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Inplementation of Mackey-Glass chaotic generator with Arduino Mega 2560 demoboard

Sasha Porozova, Roman Volianskyi

Electrotechnical and electromechanical Department,
Dniprodzerzhynsk State Technical University, UKRAINE,
Dniprodzerzhynsk, Dniprobudivska street 2,
E-mail: sasha.porozova0205@gmail.com

Abstract – In this work we present the implementation of chaotic oscillator by solving Macke-Glass equation with a simple microcontroller. The implementation is done with wellknown Arduino demoboard. The algorithm of implementated equation is very simple and could be easily modified and tunned.

Key words – chaotic oscillator, Mackey-Glass equation, microcontroller implementation, real time solution, discrete-time system.

I. Introduction

One of the modern mathematic parts is the theory of dynamical system with chaotic dynamics. But due to unique properties of such systems, today they have became not only interesting mathmetical phenomenon. Today one can be found many practical using of chaotic system in various technical application. Theese system are using as real random generators in cryptograpy, ecomics, mechatronic and more other fields. Fields of using chaotic system are strictly increasing and that is why the paper, in which are described implementation and chaotic system using is actual.

In this work we present the implementation of the chaotic oscillator into a simple 8-bit microcontroller. The hardware of our system is wellknown Arduino Mega 2560 demoboard, which is programmable in C-like programming language with special software. Detail information, description, schematic and software can be found on the Arduino project web site.

II. Discretization of Mackey-Glass equation

Let us consider Mackey –Glass differential equation [1]

$$\frac{dx}{dt} = \beta \frac{x_\tau}{1 + x_\tau^n} - \gamma x\,,\ \gamma, \beta, n > 0, \tag{1}$$

where β, γ, τ, n are real numbers, and x_τ represents the value of the variable at time $t - \tau$.

Depending on the values of the parameters, equation (1) displays a range of periodic or chaotic oscilations. We'll study a chaotic dynamic in Mackey-Glass equation. It's wellknown fact that chaotic oscillations in this system begin for such parameters:

$$\beta = 2, \quad \gamma = 1, \quad \tau = 3, \quad n = 9.65\,. \tag{2}$$

Let us make discretization of equation (1) with using z-transformation. We'll use the backward diference approximation of diferential operator $\frac{d}{dt}$ [2]

$$\frac{d}{dt} \approx \frac{1 - z^{-1}}{T}\,, \tag{3}$$

where T is sample time and z^{-1} – onestep backshift operator.

Combining equations (3) and (1), we'll get next equation

$$\frac{1 - z^{-1}}{T} x = \beta \frac{x \cdot z^{-\frac{\tau}{T} - 1}}{1 + \left(x \cdot z^{-\frac{\tau}{T} - 1} \right)^n} - \gamma \cdot z^{-1} x \tag{4}$$

and transform it into the such way

$$x = T\beta \frac{x \cdot z^{-\frac{\tau}{T} - 1}}{1 + \left(x \cdot z^{-\frac{\tau}{T} - 1} \right)^n} - T\gamma \cdot z^{-1} x + z^{-1} x\,. \tag{5}$$

Equation (5) can be represented as follows

$$x = T\beta \frac{x \cdot z^{-\frac{\tau}{T} - 1}}{1 + \left(x \cdot z^{-\frac{\tau}{T} - 1} \right)^n} + \left(1 - T\gamma\right) \cdot z^{-1} x\,. \tag{6}$$

Equation (6) is the simpliest backward difference aproximation of equation (1). More complex approximation can be obtained with using other aproximation of differential operator [2].

Equation (6) with parameters (2) is basis form for microcontrollers model of Mackey-Glass system.

Let us consider a grid function and using next definition

$$x = x[i], z^{-1} x = x[i-1], x \cdot z^{-\frac{\tau}{T} - 1} = x\left[i - \frac{\tau}{T} - 1 \right], \tag{7}$$

transform equation (6) into such way

$$x[i] = T\beta \frac{x\left[i - \frac{\tau}{T} - 1 \right]}{1 + \left(x\left[i - \frac{\tau}{T} - 1 \right] \right)^n} - \gamma x[i-1]\,. \tag{8}$$

Equation (7) can be programmed with any computer program language.

III. Solution of Mackey-Glass equation by ATmega2560

Equation (8) is using in main loop of program, which is implemented on Arduino Mega 2560 demoboard. This demoboar is equipped with the middle-range ATmega2560 microcontroller by Atmel Corp. ATmega family is powerfull, but inexpensive microcotrollers family with various build-in periphirial devices. Because these microcntrollers are used in wide range home and semi-industrial application. Althought chosen hardware doesn't limit solution of equations (8) and it can be done with any known modern microcontroller.

In this paper we'll represent block-schema of algorithm for solution of Mackey-Glass equation (1), given by grid-function form (8). Related image is shown on figure 1.

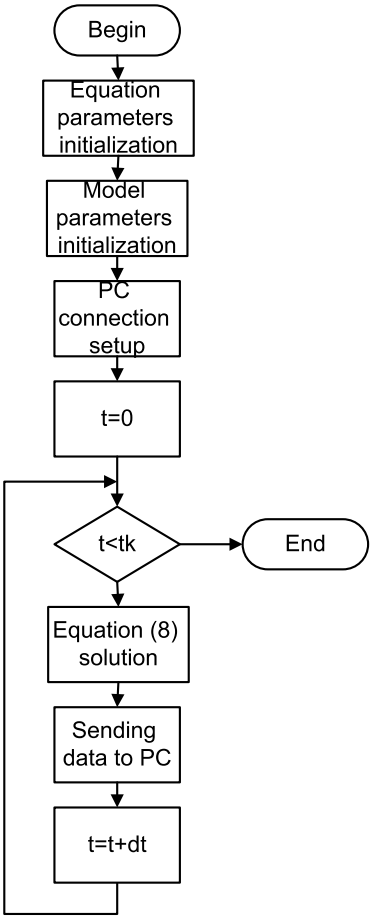

Fig. 1. Block-scheme

On figure 3 one can be found photo of research stand.

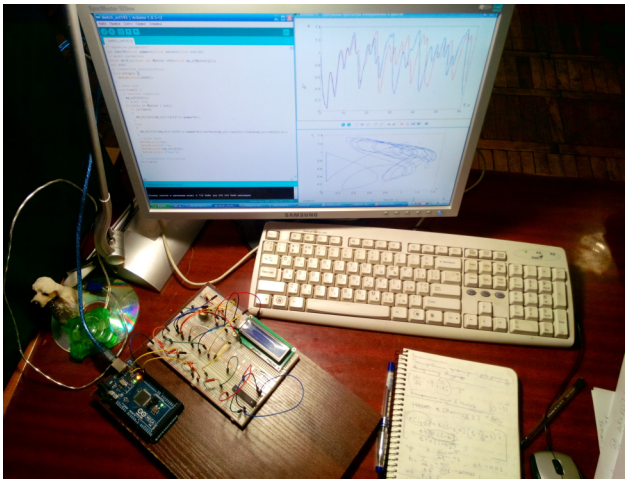

Fig. 2. Photo of research stand

The time response and phase plane of Mackey-Glass system (8) with start value $x[0]$ equals 1 was obtained with Arduino board. Figure 4 and 5 show these ploting respectively .

On fig. 3 one can see comparation results of solving equations (1) by PC with Matlab-Simulink program (curve 1) and by Arduino board (curve 2). The Simulink model is shown on fig. 5.

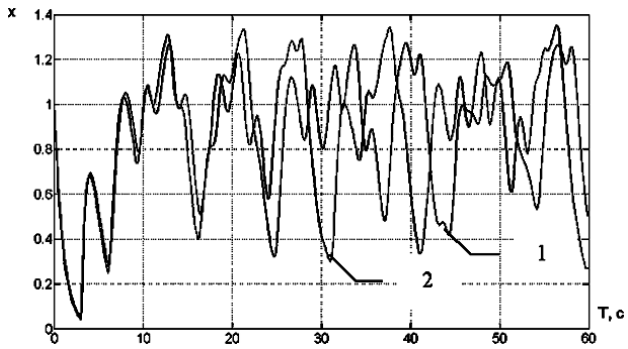

Fig. 3. Time response

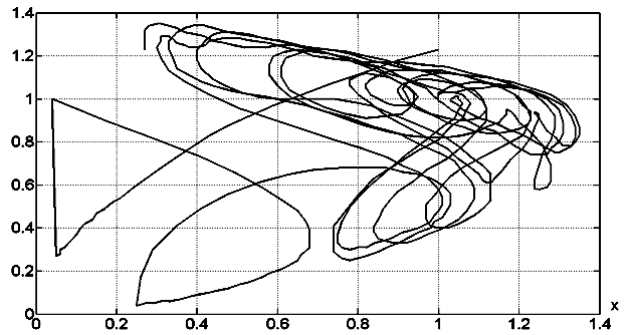

Fig. 4. Phase plane

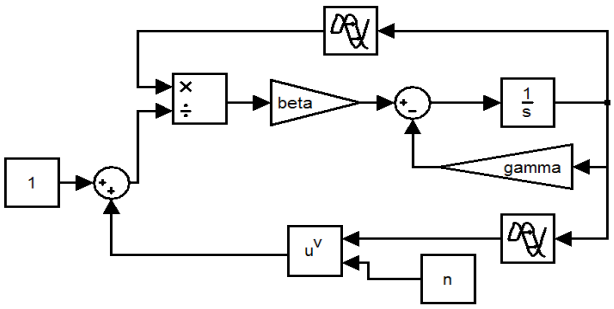

Fig. 5. System function

Conclusion

In this paper we demonstrate that using of the Mackey-Glass equation in discrete-time mode let one implement a chaotic oscillator into a microcontroller using a simple algorithm. It is well known fact that hardware and software let us easily reconfigure and tuning our chaotic oscillator for various purposes. Our results show that, the behavior of the programmed chaotic oscillator is agreed with results, which are reported in the literature. Proposed implementation of chaotic system let somebody possibility to study its dynamic in real time. The follow step will be implementation a path planning algorithms in real time for mobile robot movement in complex terrarian.

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On solutions properties of continuous linear problems of optimal multiplex-partitioning of sets without constraints

Antonina Cherevatenko

Computational Mathematics and Mathematical Cybernetics Department, Oles Honchar Dnipropetrovsk National University, UKRAINE, Dnepropetrovsk, Karl Marx Ave., 35,
E-mail: pavlova-tonya@mail.ru

Abstract – The paper presents some properties of the solutions of continuous problems of optimal multiplex-partitioning of sets. Such problems are considered in two versions: with given coordinates of centers or with their placing in a given region. The optimal solutions of continuous linear problems of optimal multiplex-partitioning of sets is obtained analytically as characteristic vector-functions of the k-th order subsets included into the optimal multiplex partition of the set Ω.

Key words – sets partitioning of the k-th order, optimal multiplex-partitioning of set, continuous problems of optimal sets partitioning, Voronoi diagrams of the k-th order.

I. Introduction

The problems, in which it is required to find the partition of continuous set into subsets of points with k nearest centers among N existing (or possible), are called as continuous problems of optimal multiplex-partitioning of sets. For the first time the class of continuous problems of optimal multiplex-partitioning of sets was introduced in [1]. It was also shown there, that these problems are an extension of the class of linear continuous problems of optimal sets partitioning from n-dimensional Euclidean space, which are non-classical problems of infinite dimensional mathematical programming with Boolean variables [2].

The paper presents the analytical solutions of continuous linear problems of optimal multiplex-partitioning of sets as characteristic vector-functions of the k-th order subsets included into the optimal multiplex partition of the set Ω. Therewith, in the case of the problem with centers placing the analytical solution contains some parameters, which values resulting from the auxiliary problem of finite-dimensional optimization. Also are shown properties of the solutions of continuous problems of optimal multiplex-partitioning of sets without constraints.

II. Problem statement

At the current moment the continuous linear problems of optimal multiplex-partitioning of sets without constraints [1] are intensively developed.

Suppose Ω is a bounded Lebesgue measurable closed set in the space E_n; $\tau_i = \left(\tau_i^{(1)},...,\tau_i^{(n)}\right) \in \Omega$ for all $i = \overline{1,N}$ are some points, called "centers" (they can be fixed or subjected to determination).

Let me introduce the following notations: $\mathrm{N} = \{1,2,...,N\}$ is a set of all centers indeces; $\mathrm{M}(\mathrm{N},k)$ is a set of all k-elements subsets of the set N, $\left|\mathrm{M}(\mathrm{N},k)\right| = C_N^k = L$; $\sigma_l = \{j_1^l, j_2^l,..., j_k^l\}$, $l = \overline{1,L}$, are elements of the set $\mathrm{M}(\mathrm{N},k)$. Each element σ_l from the set $\mathrm{M}(\mathrm{N},k)$ is associated with some subset Ω_{σ_l} of points from Ω, $l = \overline{1,L}$. In its turn, subset Ω_{σ_l} is associated with a set of centers $\{\tau_{j_1^l}, \tau_{j_2^l},..., \tau_{j_k^l}\}$.

The collection of Lebesgue measurable subsets $\Omega_{\sigma_1}, \Omega_{\sigma_2},...\Omega_{\sigma_L}$ from $\Omega \subset E_n$ (among which can be empty) will be called as a partition of the k-th order of the set Ω into disjoint subsets $\Omega_{\sigma_1}, \Omega_{\sigma_2},...\Omega_{\sigma_L}$, if

$$\bigcup_{i=1}^{L} \Omega_{\sigma_i} = \Omega, \mathrm{mes}\left(\Omega_{\sigma_i} \cap \Omega_{\sigma_j}\right) = 0, \sigma_i, \sigma_j \in \mathrm{M}(\mathrm{N},k),$$
$$i \neq j, i, j = \overline{1,L},$$

where $\mathrm{mes}(\cdot)$ means Lebesgue measure.

The subsets $\Omega_{\sigma_1}, \Omega_{\sigma_2},...\Omega_{\sigma_L}$ of the set Ω is called as subsets of the k-th order of this set.

Suppose $\Sigma_\Omega^{N,k}$ is a class of all possible partitions of the k-th order of the set Ω into disjoint subsets $\Omega_{\sigma_1}, \Omega_{\sigma_2},...\Omega_{\sigma_L}$:

$$\Sigma_\Omega^{N,k} = \left\{ \bar{\omega} = \left\{\Omega_{\sigma_1},...,\Omega_{\sigma_L}\right\} : \bigcup_{i=1}^{L} \Omega_{\sigma_i} = \Omega; \right.$$
$$\mathrm{mes}\left(\Omega_{\sigma_i} \cap \Omega_{\sigma_j}\right) = 0,\ \sigma_i, \sigma_j \in \mathrm{M}(\mathrm{N},k),$$
$$\left. i \neq j,\ i,\ j = \overline{1,L} \right\}.$$

Problem A1-k. Find $F(\bar{\omega}) \to \min\limits_{\bar{\omega} \in \Sigma_\Omega^{N,k}}$,

$$F(\bar{\omega}) = \sum_{l=1}^{L} \int_{\Omega_{\sigma_l}} \sum_{i \in \sigma_l} \left(c(x,\ \tau_i) / w_i + a_i\right) \rho(x) dx,$$

where $x = \left(x^{(1)},...,x^{(n)}\right) \in \Omega$; $\tau^N = \left(\tau_1,...,\tau_i,...,\tau_N\right) \in \Omega^N$, coordinates $\tau_i^{(1)},...,\tau_i^{(n)}$ of a center τ_i, $i = 1,...,N$, are fixed; functions $c\left(x, \tau_i\right)$ are bounded defined on $\Omega \times \Omega$ measurable at x for any fixed $\tau_i = \left(\tau_i^{(1)},...,\tau_i^{(n)}\right)$ from Ω for all $i = \overline{1,N}$; $\rho(x)$ is bounded measurable function integral on the set Ω; $w_i > 0, a_i \geq 0,\ i = \overline{1,N}$, are given numbers.

The partition of the k-th order $\bar{\omega}^* = \left\{\Omega_{\sigma_1}^*,...,\Omega_{\sigma_L}^*\right\}$ of $\Omega \subset E_n$ that affords minimum to the functional $F(\bar{\omega})$ is called the optimal solution of the problem A1-k.

If the centers $\tau_1,...,\tau_N$ in the problem A1-k are not fixed in advance and there are some centers to be placed in a given set $\Omega \subset E_n$ along with finding its partition of the k-th order $\bar{\omega}^* = \left\{\Omega_{\sigma_1}^*,...,\Omega_{\sigma_L}^*\right\}$, then we get a new problem of optimal multiplex-partitioning of sets.

Problem A2-k. Find $\min\limits_{\overline{\omega}\in\Sigma_{\Omega}^{N,k},\ \tau^N\in\Omega^N} F(\overline{\omega},\tau^N)$,

where

$$F(\overline{\omega},\tau^N)=\sum_{l=1}^{L}\int\limits_{\Omega_{\sigma_l}}\sum_{i\in\sigma_l}\left(c(x,\ \tau_i)/w_i+a_i\right)\rho(x)dx,$$

all functions and parameters are the same as in the problem A1-k; coordinates $\tau_i^{(1)},...,\tau_i^{(n)}$ of the centers τ_i, $i=\overline{1,N}$, are unknown in advance.

An allowable pair $\left(\overline{\omega}^*,\tau_*^N\right)$ that affords minimum to the functional $F(\overline{\omega},\tau^N)$ is called the optimal solution of the problem A2-k.

III. The solutions of continuous problems of optimal multiplex-partitioning of sets without constraints and its properties

To solve the continuous linear problems of multiplex-partitioning of sets it is necessary to consider characteristic vector-functions [1].

The characteristic vector-function of the subset Ω_{σ_l} included into the partition of the k-th order of Ω is called the LN-dimensional vector $\lambda^l(x)=(\lambda_1^l(x),...,\lambda_N^l(x))$, $l=\overline{1,L}$ putted into correspondence with each point $x\in\Omega_{\sigma_l}$ and defined on the set Ω, which coordinates are determined as follows:

$$\lambda_i^l(x)=\begin{cases}1,\ x\in\Omega_{\sigma_l}\ \&\ i\in\sigma_l,\\ 0,\ \text{in other cases}\end{cases}\ i=\overline{1,N},\ l=\overline{1,L},$$

where $\sigma_l\in \mathrm{M}(\mathrm{N},k)$, $\sigma_l=\{j_1^l,j_2^l,...,j_k^l\}$ is the set of centers $\{\tau_{j_1^l},\tau_{j_2^l},...,\tau_{j_k^l}\}$ indeces associated with a subset Ω_{σ_l}.

While investigating the problem A1-k the following theorem was prooved.

Theorem 1. In order a possible partition of the k-th order $\overline{\omega}^*=\left\{\Omega_{\sigma_1}^*,...,\Omega_{\sigma_L}^*\right\}\in\Sigma_{\Omega}^{N,k}$ of the set Ω to be optimal for problem A1-k it is necessary to fulfill inequalities: a.e. for $x\in\Omega_{\sigma_l}^*$, $l=\overline{1,L}$

$$c(x,\ \tau_j)/w_j+a_j\le c(x,\ \tau_i)/w_i+a_i,\quad \forall j\in\sigma_l\ \&\ \forall i\in \mathrm{N}\setminus\sigma_l \tag{1}$$

It should be noted that the necessary condition (1) is also a sufficient condition of optimality for the problem A1-k because of problem functional linearity.

Thus, the Theorem 1 implies the optimal solutions of studied problems is reached on the vector-function $\lambda^*(x)=(\lambda_*^1(x),...,\lambda_*^l(x),...,\lambda_*^L(x))$, each component of which is calculated by the formula: a.e. for $x\in\Omega$, $l=\overline{1,L},i=\overline{1,N}$

$$\lambda_{*i}^l(x)=\begin{cases}1,\ \text{if } c(x,\tau_i)/w_i+a_i\le c(x,\tau_j)/w_j+a_j,\\ \quad\text{and } \forall i\in\sigma_l,\ j\in \mathrm{N}\setminus\sigma_l;\\ 0,\ \text{in other cases.}\end{cases} \tag{2}$$

In the case of the multiplex-partitioning problem with centers placing it is necessary to solve the auxiliary problem of finite-dimensional optimization to find unknown parameters τ_i, $i=\overline{1,N}$ in the characteristic vector-function $\lambda^*(x)$.

The presented theorem implies two properties of the problems of optimal multiplex-partitioning of sets without constraints with fixed centers.

Property 1. Let in the problem A1-k function $\rho(x)\ge 0$ a.e. for $x\in\Omega$, $\overline{\omega}^*=\left\{\Omega_{\sigma_1}^*,...,\Omega_{\sigma_L}^*\right\}\in\Sigma_{\Omega}^{N,k}$ is optimal partition and points $x\in\Omega$ belong to the boundary between the non-empty subsets of the k-th order $\Omega_{\sigma_m}^*$ and $\Omega_{\sigma_l}^*$, $m\ne l;\ m,l=\overline{1,L}$. Then there is a subset of indices $\zeta=\left\{j_1,...,j_r\right\}$, $1\le r<k$ such that $\left(\zeta\subset\sigma_l\right)\&\left(\zeta\subset\sigma_m\right)$ and for each $j\in\sigma_l\setminus\zeta$ and $i\in\sigma_m\setminus\zeta$ the equality sign in Eq. (1) is achieved, i.e.:

$$c(x,\ \tau_j)/w_j+a_j=c(x,\ \tau_i)/w_i+a_i,\quad \forall j\in\sigma_l\setminus\zeta\ \&\ \forall i\in\sigma_m\setminus\zeta \tag{3}$$

The Fig. 1 illustrates the validity of the Property 1 and Theorem 1 for optimal duplex-partitioning of a square area with seven centers. The subsets of the k-th order are denoted as a set of indices $\sigma_l=\{j_1^l,j_2^l,...,j_k^l\}$ of appropriate centers in order not to overload the figures.

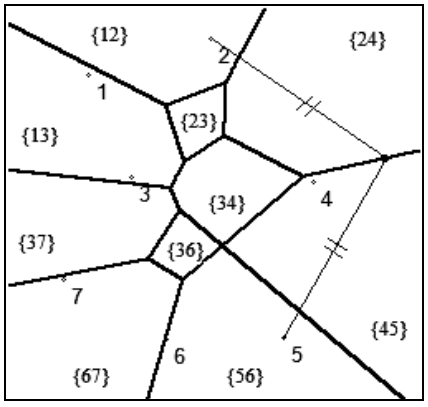


Fig. 1. Illustration of the equalities in Eq. (3) for points of the boundaries between subsets

Property 2. Suppose in the problem A1-k function $\rho(x)\ge 0$ a.e. for $x\in\Omega$, $\overline{\omega}^*=\left\{\Omega_{\sigma_1}^*,...,\Omega_{\sigma_L}^*\right\}\in\Sigma_{\Omega}^{N,k}$ is optimal partition and points $x\in\Omega$ are corner points of the partition, i.e. x belongs to the boundary between several non-empty subsets of the k-th order $\Omega_{\sigma_m}^*$, $m\in\left\{l_1,l_2,...,l_s\right\}$, $1\le l_q\le L$, $q=\overline{1,s}$, $s>2$. Then there is a subset of indices $\zeta=\left\{j_1,...,j_r\right\}$, $1\le r<k$ such that $\zeta\subset\bigcap\limits_{q=\overline{1,s}}\sigma_{l_q}$ and for each $i\in\sigma_{l_p}\setminus\zeta$, $p=\overline{1,s}$ there exist indices j_q from the sets $\sigma_{l_q}\setminus\zeta$, $\forall q\ne p,q=\overline{1,s}$, at which the equality sign in Eq. (1) is achieved, i.e.:

$$c(x,\ \tau_{j_q})/w_{j_q}+a_{j_q}=c(x,\ \tau_i)/w_i+a_i\quad \forall q\ne p,q=\overline{1,s} \tag{4}$$

The validity of the Property 2 for optimal triplex-partitioning of a square area with seven centers can be observed in Fig. 2. Let's consider corner point $x \in \Omega$, which lies on the border between the subsets $\Omega^*_{\{123\}}$, $\Omega^*_{\{134\}}$, $\Omega^*_{\{234\}}$. The intersection of all indices sets of mentioned subsets is the set $\zeta = \{3\}$. The center τ_3 is really the closest one to a fixed point x among all predetermined centers. The remaining centers, which indices make up a set $\bigcup_{q=\overline{1,s}} \sigma_{l_q} \setminus \zeta = \{1,2,4\}$, are in the same distance from x (the shortest one without taking into account the distance between the center τ_3 and x).

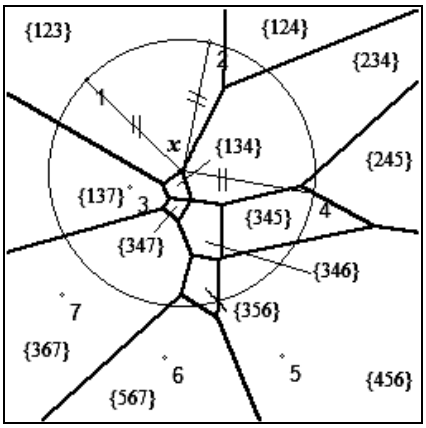


Fig. 2. Illustration of the equalities in Eq. (4) for corner points of the boundaries between subsets

It should be noted, that Properties 1, 2 are shared by the problem A2-k.

The development of the theory of continious problems of optimal multiplex-partitioning of sets gives an opportunity to construct the Voronoi diagrams of higher orders and their different generalizations.

Property 3. If in the problems A1-k and A2-k function $c(x,\tau_i)$ is Euclidean metric, $a_i = 0$, $w_i = 1$, $i = \overline{1,N}$; $\rho(x) = 1 \quad \forall x \in \Omega$, then the optimal solution determined by vector-function $\lambda(\cdot) = \lambda^*(\cdot)$ as Eq. (2) turns out Voronoi diagram of the k-th order known in the computational geometry [3], i.e. such partition of set Ω into subsets $\Omega_1,...,\Omega_L$ that:

$$\bigcup_{i=1}^{L} \Omega_i = \Omega; mes(\Omega_i \cap \Omega_j) = 0, \forall i \neq j, i, j = \overline{1,\mathrm{L}},$$

$$\Omega_m = \{x \in \Omega : \forall j \in T_m \quad c(x,\tau_j) < c(x,\tau_i), \quad i \in \{1, 2, ..., N\} \setminus T_m\},$$

where $T_m = \{i_1^m, i_2^m, ..., i_k^m\}$, $m = \overline{1,\mathrm{L}}$, are all possible k-element subsets of the indeces set N.

By analogy with construction of the first order Voronoi diagrams and their different generalizations [4], [5] we can get the higher order Voronoi diagrams and their generalizations by solving the problems of optimal multiplex - partitioning of sets under different parameters values of the objective functional: additively weighted ($\exists$ at least one i: $a_i \neq 0, i = \overline{1,N}$), multiplicatively weighted ($\exists$ at least one j: $w_j \neq 1$, obviously $\forall j : w_j \neq 0$, $j = \overline{1,N}$), additively and multiplicatively weighted (simultaniously $\exists$ at least one i and at least one j: $a_i \neq 0$, $w_j \neq 1$, $i, j = \overline{1,N}$).

The Figs. 3 and 4 show the Property 3 for optimal duplex-partitioning of a square area with nine fixed centers and nine centers subjected to determination respectively. In order not to overload figures the subsets are not subscribed.

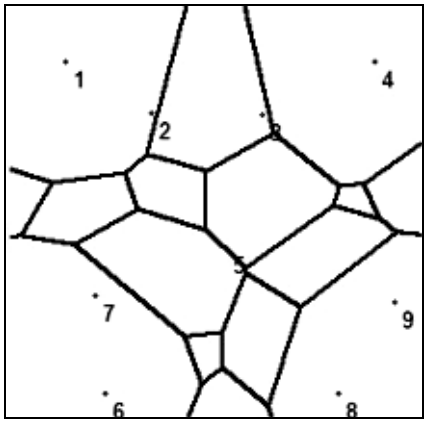


Fig. 3. Problem A1-k solution in the form of Voronoi diagram of the second order

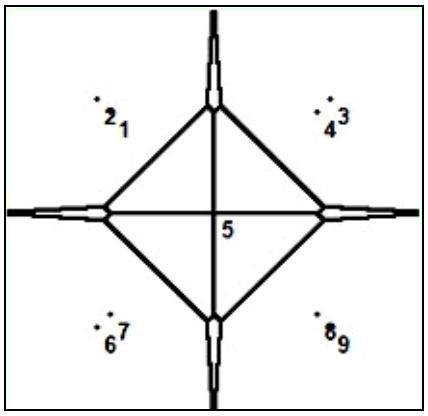


Fig. 4. Problem A2-k solution in the form of Voronoi diagram of the second order

There are also some properties, that hold only for continuous linear problems of optimal multiplex-partitioning of sets without constraints with unknown coordinates $\tau_i^{(1)},...,\tau_i^{(n)}$ of the centers τ_i, $i = \overline{1,N}$.

Property 4. If set Ω possess the property of symmetry, then optimal location of the centers τ_i, $i = \overline{1,N}$, with its associated set Ω partition are also symmetrical.

The Property 4 is demonstrated in Fig. 5 for the problem of optimal duplex-partitioning of a square area with a placement of seven centers.

Property 5. The problem of optimal multiplex-partitioning of sets without constraints with unknown coordinates $\tau_i^{(1)},...,\tau_i^{(n)}$ of the centers τ_i, $i = \overline{1,N}$ is typified by the existance of several optimal local solutions.

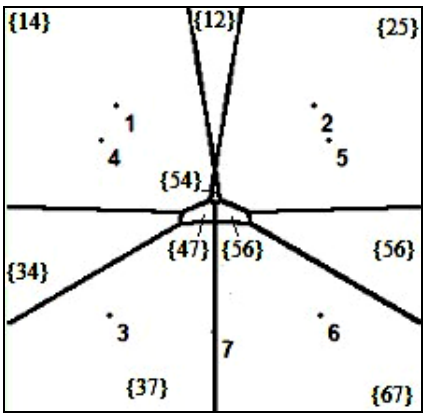
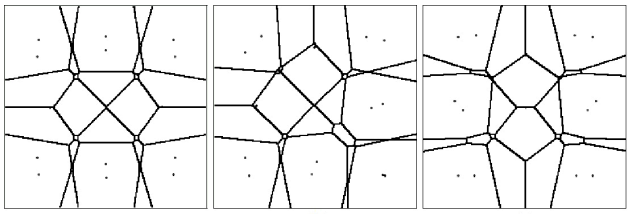


Fig. 5. The symmetry of optimal solution of the problem A2- k

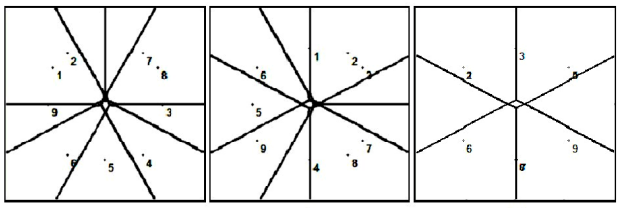
The last-mentioned property is demonstrated with two problems of optimal multiplex-partitioning of sets: second order problem with placing 15 centers (Fig. 6) and third order problem with placing 9 centers (Fig. 7) under different initial approximations.

The functional values reached on optimal solutions of considered problems are represented in Table 1. In the matter of the first problem the difference between its functional values appears in the first sign after coma. As for the second problem, solutions depicted in Figs. 7(a) and 7(b) have the same functional values though partitions are different, but solution in Fig. 7(c) has different functional value in the second sign after coma.



(a) (b) (c)

Fig. 6. The solution of problems of optimal duplex-partitioning of sets with placing 15 centers



(a) (b) (c)

Fig. 7. The solution of problems of optimal triplex-partitioning of sets with placing 9 centers

TABLE 1

THE FUNCTIONAL VALUES REACHED ON OPTIMAL SOLUTIONS OF THE PROBLEMS PRESENTED IN FIGS. 6 AND 7

N	k	Figure	Functional value
15	2	6 (a)	284,629
		6 (b)	284,209
		6 (c)	284,682
9	3	7 (a)	706,83479
		7 (b)	706,83479
		7 (c)	706,842

Conclusion

During the researches the analytical solutions of continuous linear problems of optimal multiplex-partitioning of sets are obtained as characteristic vector-functions of the k-th order subsets included into the optimal multiplex partition of the set Ω .

Some properties of the solutions of continuous problems of optimal multiplex-partitioning of sets without constraints were experimentally detected and are required for theoretical justification.

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Computer modeling and automation of process of cleaning liquids from ferromagnetic impurities

Andrii Safonyk, Serhiy Koval

National University of Water Management and Nature Resources Use, Soborna str., 11, Rivne, 33028,
E-mail: safonik@ukr.net

Abstract – Solved model problem type "convection-mass transfer" for the water treatment process in magnetized granular filter material. Mathematical analysis of parameters and models of the magnetic deposition of impurities. Found critical the filter at variable concentrations of magnetic impurities entering the filter. Developed automation system for the continuous purification of water from magnetic impurities, which provides an acceptable concentration of iron impurity at the output of the filter.

Key words – magnetic deposition, computer modeling, automation of the filtration process.

I. Introduction

Process water systems many industries known to pollution of various kinds of impurities. The problem is acute in thermal and nuclear power (CHP, thermal power plants, nuclear power plants), chemical, steel, glass, alcohol, ceramic, aviation industries. The main reason for the presence of impurities in water technology systems have continuous corrosion technology and communication equipment. At reversible (waste) water dispersed concentration metallurgical production mill scale reaches 100 mg/dm^3, at norm of 10 mg/dm^3 [1]. Such a high concentration mill scale leading to rapid wear technological equipment, deteriorating quality of of products. To remove the ferromagnetic impurities from technological water systems proposed to use the method of deposition magnetic impurities in the magnetized granular filter material. Advantages of the given method is to clearing the water environment with a temperature of 500 °C to, filtration speed of 1000 *m/h*, the ability to purify chemically are aggressive environment. Regeneration of granular ferromagnetic filter media does not require chemical reagents, which makes the method of magnetic filtration is environmentally safe.

One of the least expensive methods that allows to verify its compliance with necessary technical requirements is a computer simulation [2]. When using magnetic filters in water treatment systems there is a need to provide a predetermined concentration of magnetic impurities in a liquid medium. In addition to the efficient use of resources and to ensure that the main function of filter cleaning, it is necessary to investigate the influence of the concentration of contamination entering the system at a critical time of the filter and the differential pressure that is created on it.

The level of automation of heat power engineering is one of the leading places among all industries. Thermal power plants are characterized by the continuity of processes occurring in them. Almost all operations at thermal power plants are mechanized, and the transitional processes they are developing quite quickly.

Automation of water treatment plants to reduce maintenance and increase the reliability of installations, to improve technical and economic performance due to optimization and intensification of technological processes, to provide the water of guaranteed quality. Under automatic control of the filters is achieved by a reduction in the specific and general costs of chemicals and water on its own needs. The introduction of automation control installations water treatment allows 2-3 times to increase the productivity of these plants without additional capital expenditures on equipment and construction, which is the primary factor that determines the feasibility of implementation of automated systems of water treatment.

At the same time, when using a magnetic filter in the cleaning systems to determine the concentration of iron impurities in the liquid medium not developed a universal device that generates a signal change contamination, and the rate is measured empirically, which requires considerable material, labor resources and time, therefore there is a need to automate the process.

II. Analysis of previous studies

Numerous studies have established that the bulk of the impurities are iron with ferromagnetic properties [1,2,4,7]. Deposits of impurities on the surfaces of steam-generating thermal plants in the amount of 200-300 g/m^2, which corresponds to the thickness of the sediments 0.3-0.5 *mm*, causes additional overheating of the tubes at 50-120 °C, which in some cases leads to pipe ruptures.

Experimental studies to determine the influence of the parameters of magnetic cleaning process on the coefficient of magnetic deposition, the concentration of iron impurities, the period filtering [1,2,7], therefore, an urgent task is the mathematical analysis of parameters and simulation of the magnetic deposition of impurities in the purification of multi-concentration and little-concentration water systems and the automation of the corresponding cleaning process.

III. Statement of the problem

As the object of studies the management system of water purification from ferromagnetic impurities, including 2 electromagnetic filters– precipitator and a system of valves that control the water flow and regeneration filters, as well as the controller TSX-Micro3722, which generates control signals for the system, where the subject of research is the process of magnetic filtration of nutrient water from iron impurities.

The research was carried out by means of simulation using the Simulink and M-function pdepe of Matlab environment by converting differential equations into machine code, wherein the control system, according to which will work the controller developed in the software environment of PL7 Pro.

IV. The main material of the article

Let us consider the spatially one-dimensional process of purification of liquids by filtration in the layer of granular filter material by the thickness (which is identified with the segment axis). Assume [3,5] that contamination particles (impurities) can proceed from one state to another (processes of capture-separation) and, thus, has the opposite effect of the respective concentrations on the characteristics of the considered layer. The process of filtration taking into account reverse influence of process characteristics (the contamination concentration of liquid and trapped particles) on the characteristics of the environment (the coefficients of porosity, filtration, mass transfer, magnetic field strength) by analogy with [2]-[5]) describe the following model:

$$\begin{cases} \dfrac{\partial(\sigma(\rho)c(x,t))}{\partial t}+\dfrac{\partial\rho(x,t)}{\partial t}+v\dfrac{\partial c(x,t)}{\partial x}=0, \\ \dfrac{\partial\rho(x,t)}{\partial t}=\beta(H,v,d)c(x,t)-\varepsilon\alpha(\rho)\rho(x,t), \end{cases} \quad (1)$$

$$c\big|_{x=0}=c_*^*(t),\ c\big|_{t=0}=0,\ \rho\big|_{x=0}=0,\ \rho\big|_{t=0}=0, \quad (2)$$

$$v=\kappa(\rho)\cdot grad\ p\ , \quad (3)$$

where $c(x,t)$ – is the concentration of impurities in the fluid that is filtered; $\rho(x,t)$ – the concentration of impurities, precipitated in a granular filter material; β – coefficient, characterizing the mass deposition of impurity particles per unit time ($\beta(H,v,d)=\dfrac{\beta_0 H^{0.75}}{vd^2}$ where β_0 is a free parameter, H – magnetic field strength, v – the rate of filtration d – the diameter of the granules of the filter material [8]), $\alpha(\rho,H)$ – the coefficient, which characterizes the mass volumes detached at the same time from the granules of filter material impurity particles.

$$\alpha(\rho)=\alpha_0+\varepsilon\alpha_*\rho(x,t)\ , \quad (4)$$

$c_*^*(t)$ – the concentration of impurity of particles on filter input; $\sigma(\rho)$ – the porosity of the filter material;(σ_0 – the initial porosity of the filter material)

$$\sigma(\rho)=\sigma_0-\varepsilon\sigma_*\rho(x,t), \quad (5)$$

$\kappa(\rho)$ – filtration coefficient, $\rho_0=\rho(L,\tau_з)$

$$\kappa(\rho)=\begin{bmatrix} \kappa_0-\varepsilon\gamma\rho(x,t),\ \rho<\rho_0, \\ \kappa_0-\varepsilon\gamma\rho(x,\tau_з),\ \rho\geq\rho_0, \end{bmatrix} \quad (6)$$

$\alpha_0,\alpha_*,\sigma_*,\kappa_0,\gamma,\varepsilon$ – hard parameters (they characterize the corresponding coefficients); $\alpha(\rho),\sigma(\rho),\kappa(\rho)$ – variables (are experienced); ε – solid parameters; p - is the pressure. Moreover, we note that unlike [3,5], in the more general case, the pressure $p=p(x,t)$ it would be rational to determine the solution of the equation $\dfrac{\partial}{\partial x}\left(\kappa(\rho)\dfrac{\partial p}{\partial x}\right)=\dfrac{\partial\sigma(\rho)p}{\partial t}$, obtained under the above written equations of motion and the equation of state: $div\ v=\dfrac{\partial\sigma(\rho)p}{\partial t}$ at the boundary $p(0,t)=p_*(t)$, $p(L,t)=p^*(t)$ ($0<t<\infty$) and initial $p(x,0)=p_*^*(x)$ ($0<x<L$) conditions ($p_*(t)$, $p^*(t)$, $p_*^*(x)$ – are given sufficiently smooth and coherent in the corner points of the domain of the function $G=\{(x,t):0<x<L,0<t<\infty\}$.

Thus, in the problem-solving process, can determine an appropriate value $grad\ p$, in particular a pressure difference $\Delta P=p^*(t)-p_*(t)$ between input and output filter.

V. The solution of the problem

The solution of the system (1) under conditions (2) are looking for in the form of asymptotic series [3,4]:

$$c(x,t)=c_0(x,t)+\sum_{i=1}^{n}\varepsilon^i c_i(x,t)+R_c(x,t,\varepsilon),$$

$$\rho(x,t)=\rho_0(x,t)+\sum_{i=1}^{n}\varepsilon^i\rho_i(x,t)+R_\rho(x,t,\varepsilon), \quad (7)$$

where R_c,R_ρ –is the remaining members, $c_i(x,t)$, $\rho_i(x,t)$ ($i=\overline{0,n}$) – members of the regular units of the asymptotes. Similar to [6], after substituting (7) into (1) and the application of standard "procedure of equating" to find functions and c_i i ρ_i ($i=\overline{0,n}$) come to such tasks:

$$\begin{cases} \sigma_0\dfrac{\partial c_0}{\partial t}+v\dfrac{\partial c_0}{\partial x}+\dfrac{\partial\rho_0}{\partial t}=0,\quad \dfrac{\partial\rho_0}{\partial t}=\dfrac{\beta_0 H^{0.75}}{vd^2}c_0, \\ c_0\big|_{x=0}=c_*^*(t),\ c_0\big|_{t=0}=0,\ \rho_0\big|_{x=0}=0,\ \rho_0\big|_{t=0}=0, \end{cases} \quad (8)$$

$$\begin{cases} \sigma_*\rho_{i-1}\dfrac{\partial c_i}{\partial t}+v\dfrac{\partial c_i}{\partial x}+\sigma_*\dfrac{\partial\rho_{i-1}}{\partial t}c_i+\dfrac{\partial\rho_i}{\partial t}=0,\ \dfrac{\partial\rho_i}{\partial t}=\dfrac{\beta_0 H^{0.75}}{vd^2}c_i-g_i, \\ c_i\big|_{x=0}=0,\ c_i\big|_{t=0}=0,\ \rho_i\big|_{x=0}=0,\ \rho_i\big|_{t=0}=0, i=\overline{1,n}, \end{cases} \quad (9)$$

where $g_i(x,t)=\sum_{j=1}^{i}\rho_{j-1}\left(\alpha_0+I(i,j)\sum_{j=2}^{i}(\alpha_*\rho_{i-2})\right)$.

Conduct the simulation in the software Matlab, in particular with the use of the M-function pdepe.

As a result of computer simulation (the following input data: $c_*^*(t)=2\ mg/dm^3$, $L=1\ m$, $v=200\ m/h$, $\beta_0=0.9\cdot10^{-9}\ m^2/s$, $H=80\ kA/m$, $d=5\ mm$, coefficient $\alpha_0=0.28\cdot10^{-13}\ m^2/s$, $\alpha_*=0.65$, $\varepsilon=0.01$, $\sigma_0=0.5$, $k_0=1$) got the following results (see Fig. 1-4) :

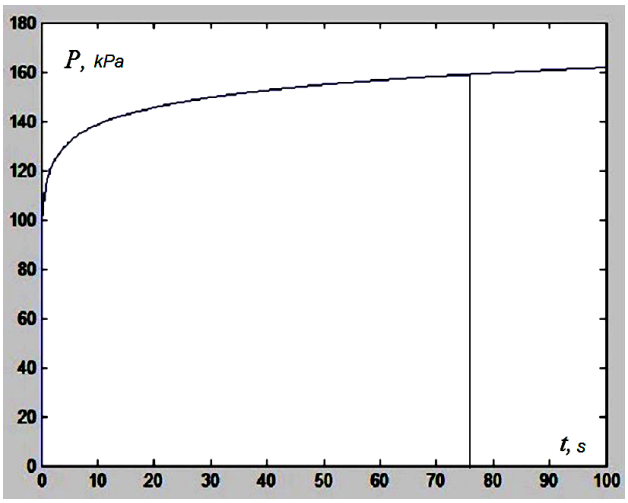

Fig. 1. The change in the pressure difference

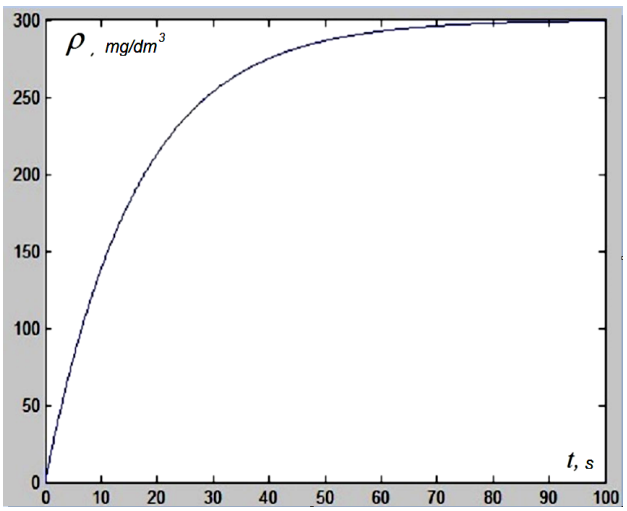

Fig. 2. The change in the concentration of particles, became interested in the filter

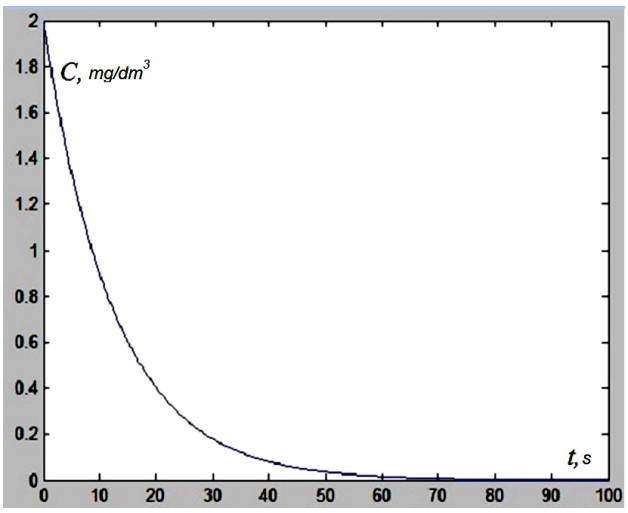

Fig. 3. The change in the concentration of particles in solution

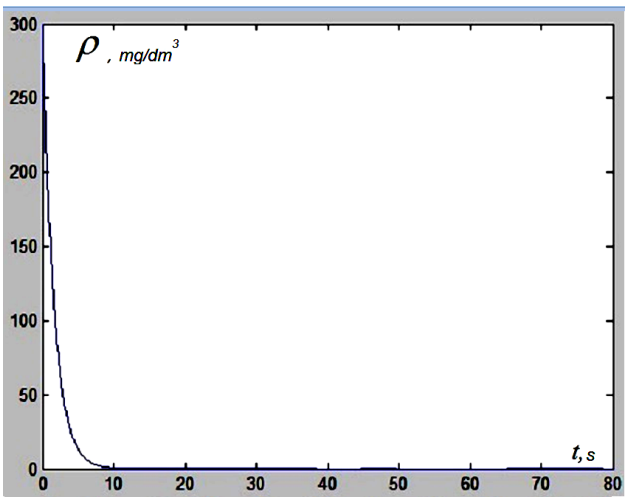

Fig. 4. The change in the concentration of particles at cleaning the air filter

To automate the process of magnetic water treatment developed functional scheme of automation (figure 5), according to which the function is controlled by a transfer flow of the filtering fluid between the two filters. During filtration, the filter work another "dirty" automatically performs regeneration.

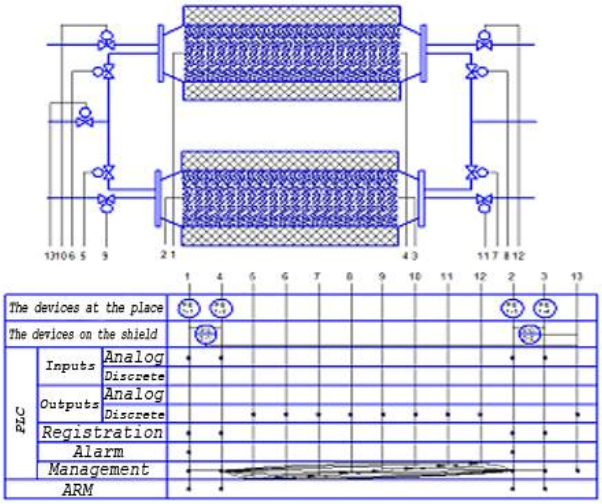

Fig. 5. Functional scheme of automation

Given system is would have 2 regulation outlines that provide at the appropriate level such technological parameters:

1. The concentration of contaminants in the liquid environment.
2. Pressure at the output of process water from the system.

Also supervises such technological parameters:
1. Pressure of contaminated water at input filter 1.
2. Pressure of contaminated water at input filter 2.

Order to identify deviations in the technological process in the case of deviation of critical parameters to implement an emergency stop of the process by means overlapping filing of contaminated water shut-off valve in the system.

The contour of regulation of pressure technological water at the outlet of the pipe (PC 2-1, PC 2-2). The given contour of maintains a specified pressure of technological water at the outlet of the cleaning system by changing the costs of polluted substance at input in the appropriate filter.

The main disturbance is the concentration of particulate contamination, that remained in the corresponding filter. With increasing particles that linger in the corresponding filter bandwidth of the filter is reduced and reduced the pressure that is perceived the pressure sensor PE 1-2 or PE 1-4.

The signal from the sensor goes to the microprocessor system. The managing microprocessor system produces an electrical signal which fed to the corresponding executive mechanism and control flap opening filing of contaminated water. As a result of opening regulating flap is increased filing of the liquid medium, the pressure at input to the filter increases, resulting in an increase of water pressure at the outlet of the purification systems and its stabilization, but the change of pressure on logon happens to a certain critical value, which is perceived by the relevant sensor the pressure PE 1-1 or PE 1-3, after

reaching the value a given transfer happens of fluid flow to the other filter.

The contour of regulation concentration of contamination at the output of the system**.** The major perturbation of a given of the technological parameter is the concentration of perturbation on logon and feed rate of contaminated water. The settlement of a given technological parameter occurs along of pressure drop at the inlet and the outlet of the corresponding filter.

When increasing the of particles that delayed in the corresponding filter bandwidth of the filter is reduced and reduces the pressure at the outlet of the filter, perceived the pressure sensor PE 1-2 or PE 1-4 and the system begins to augment expenditure of contaminated substances, thus begins to grow and the system pressure pollution delayed are beginning to not at start of the filter, and in certain coordinate. The given a sequence of actions takes place till the time for the present the difference between the respective of differential pressure sensors the pressure not achieve defined value and program management in the microcontroller does not translate the fluid flow to another filter by supplying control signals to the corresponding outputs.

Develop a program to control the operation of continuous filters for water purification from iron impurities. For writing the program use the language of diagrams (Ladder Language LD). To display the progress of the process developed graphical presentation software PL7 PRO. The mnemonic process has the form shown in figure 6.

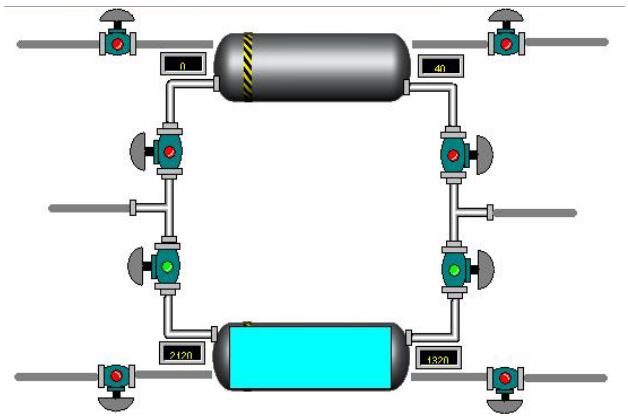

Fig. 6. The mnemonic of the technological process by means of software PL7 PRO

Conclusions

As a result, the solution of the model problem process of purification of aqueous media in magnetized granular filter material held automation systems for continuous water purification taking into account the changes of flow parameters, which controls two filters with the permanent transfer of the fluid stream and the regeneration of the pre-filter and also identifies the days of efficient cleaning and regeneration of the filter.

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Gamma-Induced Changes in Optical Transmission of As-S Semiconductor Glasses

Mykhaylo Shpotyuk, Andriy Kovalenko, Ulyana Yakhnevych, Dmytro Teslyuk

Department of Semiconductor Eletronics, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: shpotyukmy@yahoo.com

Abstract* – *Compositional trends of γ-induced optical changes in chalcogenide glasses are studied with the binary As-S system. Effects of γ-irradiation and annealing are compared using to the changes measured in the fundamental optical absorption edge region.

Key words – glass, chalcogenide glass, As-S, γ-irradiation, optical spectroscopy, optical transmission.

I. Introduction

Rapid development of telecommunication technologies at the beginning of the third Millennium has increased the search for new functional media for effective transfer of wide-spectra electro-magnetic radiation and development of novel miniaturization approach for passive and active photonics [1]. One of the most promising material systems for inclusion in such multifunctional applications is the semiconductor chalcogenide glasses (SChG), glassy materials with high content of the chalcogens (S, Se, Te).

The SChG system consisting of binary arsenic sulphide (As-S) has been known since the earliest stages of glass science and technology [2]. Owing to their excellent transparency in infrared spectral region, As-S glasses are especially attractive for different applications in modern optoelectronics and photonics [1]. Unfortunately, their optical properties are not fully suitable for some specific applications governed by high technological reliability and reproducibility requirements. So, the leading manufactures in this field have been engaged in the development and improvement of SChG to obtain materials with optimal characteristics. Under such conditions, the technologies that exploit the property consisting of externally-induced structural modification can be especially useful, as is clearly demonstrated for stoichiometric As_2S_3 prepared in the form of thin films and bulk glasses exposed to absorbed light and γ-irradiation [3]. Compositional behavior of photo-induced modification has been well studied in thin As_xS_{100-x} films, while effects produced by γ-irradiation in bulk glasses of the same system have not yet been investigated comprehensively.

The main aim of this paper is to investigate compositional trends of γ-induced optical changes in bulk As_xS_{100-x} SChG in a wide compositional range and determine their feedback on γ-induced modification in dependence on the prehistory of the specimens.

II. Experimental Procedure

The homogeneous As_xS_{100-x} samples with x = 30, 33, 36, 40, 42 were prepared by conventional rocking-melting-quenching technique. The samples were synthesized using respective quantities of high-purity As and S in evacuated and sealed fused quartz ampoules. The mixture of high-purity precursors was melted in a rocking furnace at 720–790 K for 12–24 hours. The ingots were then air-quenched to a glassy state. After synthesis, the samples were annealed 30-40 K below the respective glass transition temperature (T_g) for each composition. Then, specimens were cut from the bulk samples as plane-parallel plates and polished to high optical quality.

The γ-irradiation treatment was carried out at the ambient conditions in a closed cylindrical cavity of concentrically established ^{60}Co sources (the mean energy of γ-quanta 1.25 MeV) with 0.7 kGy/h dose rate at the temperature not exceeding 300 K. The overall duration of γ-irradiation treatment was 6 months and total accumulated dose during this period was near ~3 MGy.

The optical transmission spectra in the fundamental absorption edge region were recorded using *AvaSpec-2048* spectrometer (*Avantes,* Netherlands) with a maximum associated error of ± 1%. The heating and cooling of specimens was provided in a specially adjusted temperature chamber with a constant 5 K/min rate and an uncertainty in the temperature control of ± 0.5 K. Optical transmission spectra were recorded for each γ-irradiated, further annealed and rejuvenated samples (characteristic temperatures T_{ann} and T_{rej} are given in Table 1). So, investigations under such protocol were performed in a so-called *backward-measuring chronology*.

TABLE 1

PARAMETERIZATION OF EXPERIMENTAL MEASURING PROTOCOL

SChG compo-sition	Thick-ness, mm	T_g, K [28]	T_{ann}, K	T_{rej}, K
$As_{30}S_{70}$	1.54	425	390	455
$As_{33}S_{67}$	1.53	430	395	465
$As_{36}S_{64}$	1.53	440	405	475
$As_{40}S_{60}$	1.44	465	425	495
$As_{42}S_{58}$	1.50	460	425	495

III. Results and Discussion

Optical transmission spectra of γ-irradiated, subsequently annealed, and rejuvenated As-S specimens are presented in Fig. 1. Two effects could be determined from these spectra: (i) effect of annealing on rejuvenated specimens and (ii) effect of γ-irradiation on annealed specimens. Additionally, under the assumption that the total effect of γ-irradiation in saturation does not depend on thermal history, we could determine the third effect in our investigations, (iii) the effect of γ-irradiation on rejuvenated specimens (Fig. 1). This assumption seems to be quite reasonable assuming that only the latest treatment determines the final thermodynamic state of the SChG, similar to the assumption presented elsewhere [30].

The effect of γ-irradiation on the annealed SChG is revealed long-wave shift of the optical transmission spectra (*darkening effect*) of near-stoichiometric As_xS_{100-x} specimens (x = 36, 40, 42). Corresponding shifts in the annealed S-rich As_xS_{100-x} specimens with x = 30 and 33 are of under-margin intensity. The well-defined γ-induced short-wave shift of the optical transmission spectra (*bleaching effect*) could be observed for rejuvenated As-deficient specimens, the ΔT_{max} value reaching 9, 5 and 2% in the specimens with x = 30, 33 and 36, respectively (Fig. 2). At the same time, the rejuvenated $As_{40}S_{60}$ and $As_{42}S_{58}$ SChG still exhibit γ-induced darkening effect, similarly to the annealed ones.

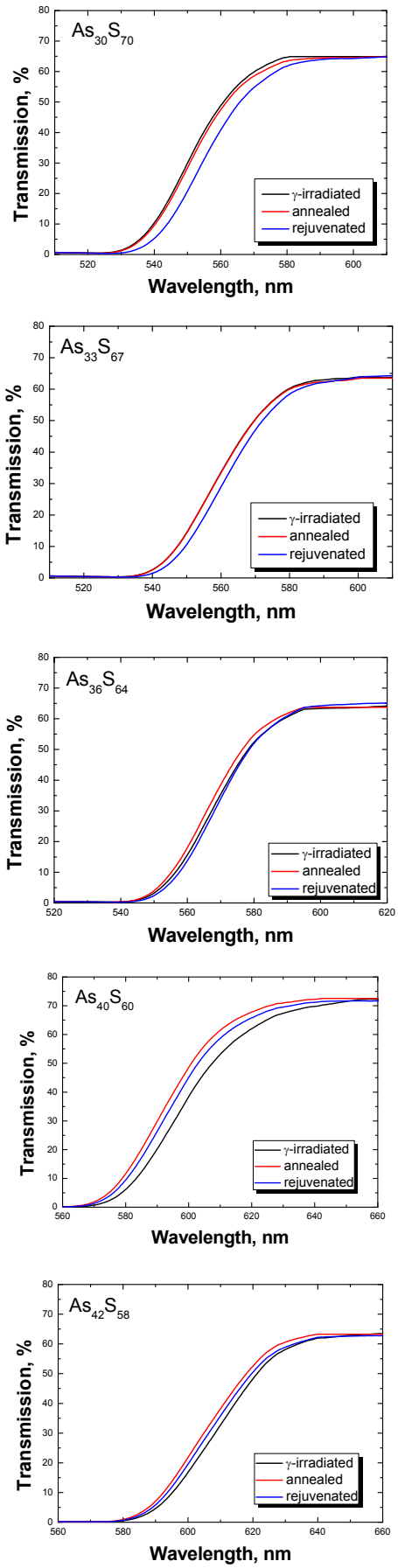

Fig. 1. Optical transmission spectra of γ-irradiated, annealed and rejuvenated As-S SChG

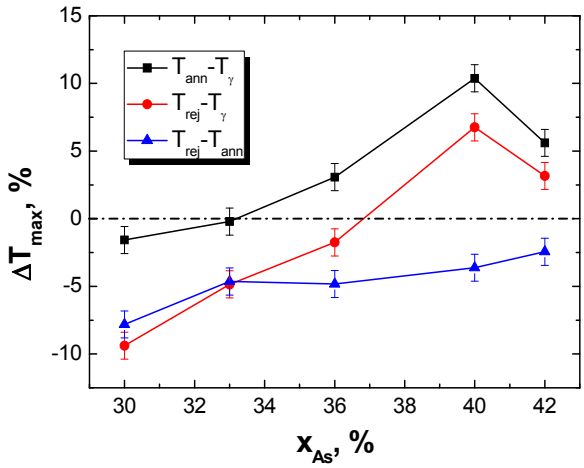

Fig. 2. Maximal intensities of subtractive optical transmission spectra relevant to different effects in As-S SChG: black squares – γ-induced effect in annealed specimens; red circles – γ-induced effect in rejuvenated specimens; blue triangles – annealing effect in rejuvenated specimens

A possible explanation for the observed γ-induced darkening effect in studied SChG can be given in terms of destruction-polimerization transformations (DPT) concept via structural rearrangement accompanied by switching of heteropolar As–S covalent bonds into homopolar As–As ones.

For the S-rich rejuvenated specimens, the bleaching effect of γ-irradiation is anticipated according to the obtained results. It is attributed to the physical ageing stimulated by γ-irradiation. The difference in the positions of the fundamental optical absorption edge of annealed and rejuvenated SChG confirms this supposition, showing bleaching as a result of thermally-induced physical ageing. Thus, the γ-induced changes in the position of the fundamental optical absorption edge of As-S SChG should be considered as a balance between two independent competitive processes – DPT (including defect formation) and γ-induced physical ageing.

Conclusions

Compositional trends of γ-induced optical changes in chalcogenide glasses of binary As-S system are studied by *in-situ* optical spectroscopy arranged in *backward measuring chronology*. The compositional dependence of γ-induced changes in the annealed specimens and anticipated γ-induced changes in the rejuvenated SChG are shown to have similar character with maxima at the $As_{40}S_{60}$ stoichiometric composition. Any deviations from stoichiometry towards both S- and As-rich compositions reduce the value of γ-induced darkening. In general, the obtained results demonstrate the complex nature of radiation-induced optical effects in As-S SChG and their dependence on glass composition and thermal history.

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Modified Multiplying Matrix for Galois field GF(2^m) Multiplier Structural Complexity Evaluation

Aleksandra Hlukhova

Department of Information Systems and Networks,
Lviv Polytechnic National University, S. Bandery Str., 12, Lviv, 79013, UKRAINE, E-mail: aleksandra.glukhova@gmail.com

Abstract – Method of structural complexity estimation of modified multiplying matrix with ordered structure is proposed. The method is based on total length of connections inside multiplying matrix calculation. Matrix with ordered structure allows a partition to the same sub-matrix. One sub-matrix can be serially used for multiplication instead of one large unmodified matrix.

Multiplier structural complexity can be reduced more than 100 times.

Key words – Galois field GF(2^m), Gaussian normal base of type 2, scalable multiplying, core generator, structural complexity.

I. Introduction

At present the mathematical basis for digital signatures is an elliptic curve. Elliptic curves points processing is based on the Galois field GF(2^m) elements processing. Multiplier hardware implementation for such fields requires large hardware cost. The most difficult multiplier element is its multiplying matrix. Sectional multiplier processes m-bit elements of the Galois field GF(2^m) and forms the m-bits product by n-bits portions. Galois field elements are represented using Gaussian normal basis of type 2. The hardware complexity of the multicore multiplier matrixes allows their implementation on modern FPGA. But for large values of m and n it is impossible to implement cores due to their high structural complexity. The structural complexity estimation method of multiplying matrices is known. Also based on the modified multiplying matrix multiplier is known. In this work modified multiplying matrix structural complexity estimation method is proposed. The method is based on connections length calculation inside multiplication matrix.

II. The literature review and problem statement

Mathematical Foundations of digital signatures are elliptic curves and Galois field. One Galois field GF(2^m) element alternative representation is a Gaussian normal basis of type 2. For a given base serial multiplier Massey-Omura, parallel multiplier, and parallel-serial multiplier (sectional) are known. Multiplicative matrixes for them were studied in [2]. In [3], [4] the features of sectional multipliers VHDL-description (cores) generation are given and hardware complexity numerical values of generated cores with m = 515, 519, 998 are shown. For large values of m and n it is impossible to implement cores due to their high structural complexity.

Evaluation of the multipliers structural complexity in previous studies is performed in [5]. Analytical evaluation of structural complexity Galois field multipliers elements proposed in [5]. Multiplier matrix modification was proposed in [7]. Modification consisted in ordering of multipling matrix.

III. The purpose of work

Purpose of work is estimation of modified multiplying matrix structural complexity.

IV. Sectional multiplier implementation

Serial Messi-Omura multiplier (Fig. 1) consists of two operands shift registers (RGA and RGB) and multiplication matrix M [1]. Sectional multiplier contains several multiplication matrices and pipelined register for multiplication results.

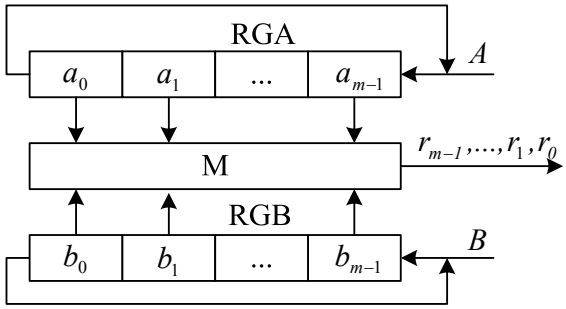

Fig. 1. Serial Messi-Omura multiplier

r0 bit of product R is calculated as r_0=AMB^T (for example on Fig. 2

$$r_0 = a_2 b_0 \oplus (a_2 \oplus a_3) b_1 \oplus (a_0 \oplus a_1) b_2 \oplus (a_1 \oplus a_3) b_3$$

in accordance with calculation scheme on Fig. 3).

Simplified multiplication matrix chip topology (Fig. *4* example for m=3) corresponds to mathematical multiplication matrix topology (Fig. 3). Each point in the Fig. *4* corresponds to one 2AND gate.

Simplified topology of modified multiplying matrix is shown in *Fig. 5*.

We can evaluate multiplier structural complexity as total length L of connections inside rectangle region in *Fig. 4*: b_i connection length is $l_{b_i} = x_{b_i} + 1$, where x_{b_i} is column number of the most right "1" in i row; vertical connection length is equal v_j=m+1, where m is Galois field GF(2^m) order.

$$r_0 = \begin{bmatrix} a_0 & a_1 & a_2 & a_3 \end{bmatrix} \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} b_0 \\ b_1 \\ b_2 \\ b_3 \end{bmatrix}$$

Fig. 2. Product calculation

$$\begin{bmatrix} a_0 & a_1 & a_2 & a_3 \end{bmatrix} \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} b_0 \\ b_1 \\ b_2 \\ b_3 \end{bmatrix}$$

Fig. 3. Product calculation scheme

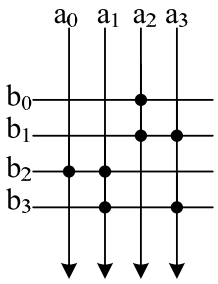

Fig. 4. Multiplying matrix chip topology

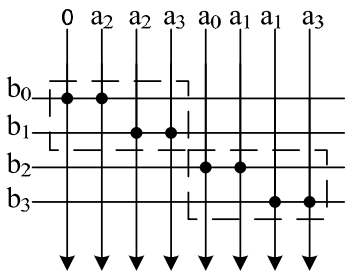

Fig. 5. Modified multiplying matrix chip topology

All vertical connections are the same length equal m+1and their number is 2(m+1). So their total length is

$$L_a = 2(m+1)^2 .$$

Lengths of horizontal connections form an arithmetic progression with step 2. Its sum is

$$L_b = \frac{(m+1)(m+2)}{2} .$$

Finally: $L_m = L_a + L_b$,

$$L_m = 2(m+1)^2 + \frac{(m+1)(m+2)}{2} .$$

Matrix with ordered structure allows a partition to the same sub-matrix *Fig. 5*.

For example, the matrix with m 175 can be divided on 11 matrixes with m=15. So we can use 11 times the matrix with m=15 in steed of one big matrix with m=175.

$$L_{175} = 2(m+1)^2 + \frac{(m+1)(m+2)}{2} =$$

$$= 2(175+1)^2 + \frac{(175+1)(175+2)}{2} = 46552 ;$$

$$L_{15} = 2(m+1)^2 + \frac{(m+1)(m+2)}{2} =$$

$$= 2(15+1)^2 + \frac{(15+1)(15+2)}{2} = 392 .$$

After that we can reduce structural complicity in k times where

$$k = \frac{L_{175}}{L_{15}} = 119 .$$

Conclusion

Method of structural complexity estimation of modified multiplying matrix with ordered structure is proposed. The method is based on total length of connections inside multiplying matrix calculation. Matrix with ordered structure allows a partition to the same sub-matrix. One sub-matrix can be serially used for multiplication instead of one large unmodified matrix.

Multiplier structural complexity can be reduced more than 100 times.

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Development of Manipulation Detecting Algorithm as a Constituent of the Internet Community Management System

Zoriana Holub

Social Communication and Information Science Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: zorianaholub@gmail.com

The aim of the research is to outline main peculiarities of the manipulation in the Internet communities. The research encompasses online communication platforms which support an interactive text communication. In the paper feasibility of exploiting traditional schemes of protection from manipulation in the virtual space is questioned, differences of manipulation in real life and in the Internet communities are made obvious. On the basis of the research the algorithm for detecting manipulation in the Internet communities is suggested. The later uses technical features, peculiarities of accounts representations and content of messages to identify the fact of manipulation in the Internet community.

Key words – manipulation, Internet community, IP-address, transaction, frame, neurolinguistics programming.

I. Introduction

Openness, accessibility as well as ease of use of the Internet are the main reasons of virtual communities popularity as means of information transferring. Discussions themes of virtual communities encompass virtually all spheres of human interest, in particular politics, technical support, health, pastime. A number of people treat virtual communities as sources of news and advice. Moreover, they often appear to be an aid to psychological need of socialization. Social researches show a great number of people to regard information in virtual communities as ultimately correct, objective and exhaustive.

Despite the anonymous nature of messages in virtual communities, they have greater impact on the decision making process of virtual community members than their friends, relatives and colleges. As a result, virtual communities are used with acquisitive purposes. Hidden influence often aims at achieving either marketing and political goals, or influencing financial and business decisions making process.

Described above harmful influence is not the only unfavorable effect on the virtual community caused by manipulation. Online dishibition effect is a tendency of individuals to use more offending and aggressive language than they do in real communication. Therefore it is easier to provoke people to inadequate communication in the virtual space than in real. Such outrageous behavior could have destructive effect on the community itself, as it destroys the positive image of the community, which means decrease in its active user and guests.

Manipulation is not a newly emerged phenomenon. Plenty of scientists devoted their works to manipulative situations, tactics, strategies and tools. They elaborated methods and algorithms of manipulation prevention and counteraction. Technical features of virtual communities brought about differences in virtual and traditional communication. Resulting from changes in communicational environment, evolution of manipulation took place. Schemes and algorithms of protection from real world manipulation cannot be applied to resist manipulative strategies and tools used in virtual communities.

From the multitude of miscellaneous types of Internet communication platforms, social networks, blogs and forums are the most preferred. The information in these virtual communities is conveyed mainly by means of text messages. Thus, it is reasonable to start the elaborating of manipulation preventing system from developing algorithms for detecting manipulation in text messages of virtual communities.

II. Brief Review of Related Researches

A multitude of Ukrainian scientists investigated the phenomenon of manipulation in the Internet. Ivanytska, Klotschko studied the Internet functional as a platform for manipulation [15], Lisovskyi looked into the problem of the Internet as a means of manipulation in Ukrainian context [16]. Savonchak devoted his works to manipulation methods and tactics.[17]

III. Research Aim

The research is aimed at investigating the phenomenon of manipulation on forums, blogs and social networks, in particular to find similarities and outline difficulties of manipulation in real and virtual communication. Special attention is paid to characteristic features of Internet manipulation, which could be further exploit to develop an algorithm of manipulation prevention and detection.

IV. Peculiarities of Manipulation in the Internet Communities

Various types of manipulation occur in the Internet. They can be categorized into audial (speech, music, sounds), visual (text, graphical items) and combined (video, multimedia). Other classifications are into active or passive, gradual or instant, long-lasting and short-lasting. The research is dedicated to interactive text manipulations in the Internet. To put it differently, under research are manipulation acts performed in the Internet by means of short text messages exchange between a few agents. These messages are usually organized into logical sequences and are subjective. Interactive text messages manipulations often take place on forums discussions, in comments on news web-sites, blogs, company and reference web-sites or online shops.

The feature of interactivity is by stressed as a key in the investigated type of manipulation. Manipulation methods in the messages are not designed for passive perception, they obtain triggers, program the reaction of recipients and exploit it for achieving certain manipulative goals.

In interactive text manipulations in addition to verbal means could be use following types of nonverbal:

- metagraphemics (emoticons, calligrams and hypergraphics); [5]

- links (although they constitute of character, but they have no sematic meaning);
- image (is expressed by an avatar, status or other similar profile details that are bound along with all messages of the author).

The most widely-used means of manipulation in an interactive text communication are linguistic traps. Linguistic traps are implicit constrains of the meaning, realized by use of selective approach to words, rhetoric tricks, symbolic exaggerations and ritual. [6] Among the scientists who investigated linguistic means of manipulation are Teun A. van Dijk, Bryant, Thompson, and Blakar. [12, 13]

In case of interactive text manipulations nonverbal means are complimentary tools, their exclusive usage is not sufficient for achieving proper manipulative results.

V. The object of manipulation in the Internet communities

Due to the fact that iinformation of the Internet communities discussions is easy of access, such type of manipulation as interpersonal manipulation does not occur in the Internet communities. It is possible to assume that a manipulator conducts a preliminary analysis of community participants aiming at determining an object of a future manipulation, however it is efforts-consuming and that is why rarely occurs.

In the Internet manipulations are exploit exclusively universal vulnerabilities (buttons), which exist virtually in every human-being. This ensues for the mass nature of online communication. Especially, at the outset of manipulation there is no exact object of manipulation, a manipulator appeals to the prototype of an object. In other words to the certain group of people possessing suitable for manipulation qualities.

When “the right button” is pressed and the object reacts as foreseen, the object of manipulation becomes less abstract. Instead of targeting a prototype a manipulator applies the strategy to the most yielding members of the Internet community. However, a manipulator keeps an eye on other members as there activities in a community could destroy all manipulative plans.

Another characteristic feature of the Internet community is the absence of credible information on social position, career level, age etc. These and similar feature are often exploit in traditional manipulations. Despite the fact, that there is some kind of hierarchy in social communities (e.g. novice, regular) this differentiation is not equal to the above enumerated status features of a traditional manipulation.

VI. Internet-Communities Members As Manipulation Means

There two reasons of ineffectiveness of the manipulation carried out by use of one agent. First of all, excessive activity in an online community is suspicious. Furthermore, the band wagon is a very effective manipulation technic.

Subtle and multistage manipulations require several agents. The necessary amount of agents is achieved in the following ways: building a group of manipulators or provoking needed actions of community members. In terms of manipulation network structure manipulations are classified into the Internet communities:

- Direct
  - one-agent;
  - group;
- Indirect
  - chain;
  - virus.

Direct manipulations are done by specialists in pursue of a set goal. Depending on the number of agents they are subdivided into one-agent and group manipulations.

Direct one-agent manipulation is carried out from one account. This type of manipulations is used only for fulfilling easy tasks. It is the most easy to detect manipulation. Its popularity is explained by little expense needed for its implementation.

Group manipulation is performed either by several manipulators each in charge of one account or by one manipulator controlling several accounts.

Indirect manipulation is more complicated to commit as well as to detect. To accomplish it successfully a branching scenarios should be elaborated. Manipulation in operation should be monitored on a regular-basis in order to detect deviation and take appropriate actions. The scale of effect of indirect manipulation is much larger than of direct one-agent manipulation.

Indirect manipulation means getting somebody to do your dirty work. In case of indirect manipulation distorted reality is created by the messages of community members who do not belong to manipulators team. A manipulator provokes a user to post messages with appropriate content. Thus, in indirect manipulation triggers that should accomplish the goal of manipulation are embedded in messages of community users. In other words manipulator imposes his idea and encourages community members to disseminate it.

To sum up, when detecting manipulation, it is necessary not only to detect a message with manipulative content and ban the author, but to check whether author of a message is a manipulator or a compromised member of a community. Otherwise the result of such combatting manipulation would be not communities without manipulators, but communities without members.

VII. The algorithm for detecting manipulation

The algorithm for detecting manipulation in the Internet communities consists of two stages. At these two stages discussion is analyzed from different angles and different technics are applied. The two main stages of the algorithm of detecting manipulation are:

- detecting manipulator at the stage of registration;
- detecting manipulation in operation.

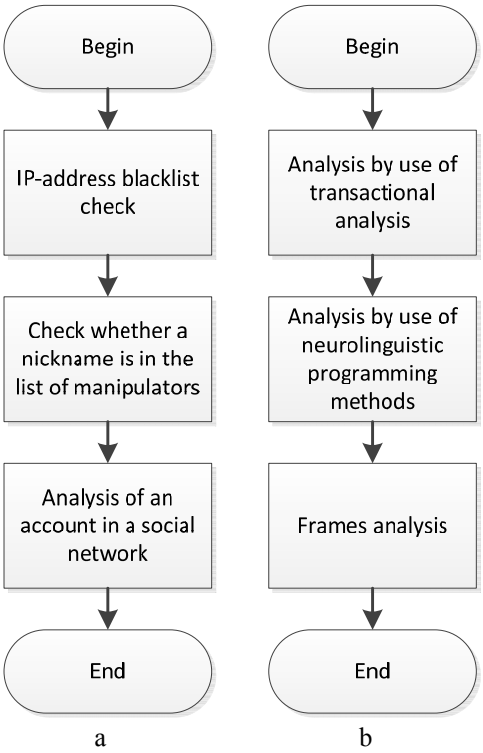

Fig. 1. Detecting manipulators:
a) by means of account features;
b) semantic analysis of message`s content.

At the first stage technical features of the prospective account (IP-address) and its peculiarities (nickname, profile in social networks) are checked.

The IP-addresses check means detecting previously identified and banned manipulators` accounts. To conduct the check the data base of manipulations in the Internet communities is required. This data base should be updated as new manipulation cases detected.

Furthermore, it is reasonable to check nicknames of community members. This check lies in comparing nicknames of community members with manipulators` nicknames contained in the database. By means of this check it is possible to ban manipulators networks.

Some Internet communities give opportunity to log in with Facebook account. In this case one more method of detecting manipulators is possible: to analyze the prospective member`s profile in social networks. That means to use the link and go to the profile and assess the development level of the account. A little personal information, friends, photos are characteristics of the fake account used with a certain manipulative aim.

The second stage of the algorithm for detecting manipulation in the Internet communities is the analysis of linguistic features of a message. This analysis is more complicated than technical check and accounts peculiarity analysis of the previous stage. At this stage are applied various physiological methods, in particular transactional analysis, neurolinguistics programming etc.

At this stage the sequence of messages of a certain member is analyzed for containing any of seven propaganda devices distinguished by Lasswell, namely the name calling, the glittering generalities, the transfer, the testimonial, the plain folks, the card stacking, the band wagon.[11] Applying quantitative content analysis of the Internet communities discussion verbal and nonverbal means used for constructing each device are defined. For example, when, expressing opinion, a member uses virtue words, such as God, truth, freedom, honor, human rights, than this member is suspected in using the glittering generalities with the aim to accomplish a certain manipulative goal.[10]

One more widely-used manipulation technique ia known as “red herring” (in Lasswell`s classification it is called cards stacking).[10] A red herring is something that misleads or distracts from a relevant or important issue. [14] Manipulators use underemphasis and overemphasis to dodge issues and evade facts.

Another approach to detecting manipulation is by means of transactional analysis. The whole discussion is analyzed in light of transactional analysis. The used types of transactions (complimentary, crossed, angular, duplex) are analyzed. Complimentary transactions are characteristic for smooth communication without blaming, flame or invectives. Types of transaction used to fulfill a manipulation are angular and duplex. Both these types a apart from a vector on social (ostensible) level, they have on psychological one. To put it differently these ulterior transactions involve the activity of more than two ego states simultaneously. In angular transaction at social level a transaction is directed to one ego state, while psychological vector is directed by the well-trained and experienced manipulator to another ego state. The manipulator, though, sends both social and psychological stimuli from the same ego state. In duplex transactions not only the ego states of receiver are different on the psychological and social levels, but manipulator also sends stimuli on social and psychological levels from different ego states. [4,8]

Neurolinguistic programming describes various tactics of intentionally hidden influence on others attitudes and decisions. Among these methods is tuning, anchoring, modeling. Tuning, a popular NLP technique is the process of replicate behavior, language, etc. of objects of manipulation in order to convey an ulterior message to their subconsciousness. [1,2] According to neurolinguistics programming people have an internal preferred representational system and preferred to process information primarily in one sensory modality. This sensory modality could be ascertained from external cues (eye movements, posture, breathing, voice). These external cues of sensory modality are not obvious in the Internet communication. As a result to state a sensory modality of an object of manipulation verbal sensory cues are used. For example, words “see” and “bright” would be considered visual sensory cues. In contrast “feel”, “comfortable” are used most frequently by kinesthetic. In terms of manipulation detecting, when a person is noticed to use visual verbal cues and at same time suddenly shifts to audial, this person is suspected in manipulation. [7] As this sensory modalities shift was supposedly aimed at tuning to another participant of the Internet discussion.

Framing was also adjusted to using as component of an algorithm of manipulation detection. Framing encompasses theoretical perspectives on how individuals and groups, organize, perceive, and communicate about reality. Frames are widely used to manage perceptions of factual information. Considering recipients attitude frames could be positive or negative. According to aims exist Risky Choice Frames, Attribute Frames, Goal Frames. [3,9]

The results of the algorithm should be included into data base. These results would contribute to effectiveness and accuracy of the algorithm. Furthermore, it is possible to define main tendencies of manipulation in the Internet communities.

VIII. Results Verification of Detecting Manipulation in the Internet Communities

Although manipulation in the Internet communities is carried out in the virtual space, it is aimed at obtaining results in the reality. Due to the fact that final results of manipulation s are people`s actions and events in the real word, it is difficult to assess results of the algorithm.

In Internet-discussions of a community could participate people that never contact in reality. Internet community participants could have miscellaneous geographical location, they could by citizens of different countries. That is way the evidences of carried out manipulations are shifts in common tendencies.

Approximate esteem of the manipulation scale is made on the basis of side-effects and interim results of the manipulation. For instance, influence of a manipulation, which goal was anti-Ukrainian propaganda, could be assessed regarding the number of previously patriotic, but then changed to neutral avatars. Changing of avatars ia a side-effect of manipulation. The count of people, who supports certain messages or begin to produce ones with similar content could be used to assess the effectiveness of manipulation. In this case it would be done by use of interim results.

Conclusion

Research results showed detection of manipulation to be a complicated process, thus vital for proper functioning of the Internet communities. As a result of the analysis of characteristic features of manipulation in the Internet communities the algorithm for detecting manipulation is suggested. The two main stages of the algorithm are thoroughly described. Methods applied at the first stage of algorithm are based on technical features and peculiarities of the account. At the second stage to analyze the content of the message on ulterior influence, different approaches are used. At the second stage methodology of transactional analysis, neurolinguistics programing, framing theory and seven common propaganda devices elaborated in the Institute for Propaganda Analysis are exploited.

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Knowledge-based situational awareness systems

Khrystyna Mykich[1] Eugene Burov[2]

[1]Information Systems and Networks Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 32a, E-mail: christi1711@rambler.ru

[2]Information Systems and Networks Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 32a, E-mail: yevhen.v.burov@lpnu.ua

Abstract*– *In this paper are described the methods of representation and processing of knowledge in systems with situational awareness. The Endsley's model and Data Fusion model are described and analyzed. Also, in this paper we analyze the ontologies for situation awareness. The core ontologies are described using combination of primitive relations. Existing issues and further research problems were outlined.

Key words – situation, situational awareness, decision support, data fusion model, core ontology, primitive relation.

I. Introduction

Situational awareness (SAW) is an important part of human's cognitive activity. Not surprisingly, it has always been the subject of the research in the scientific fields of psychology, cognitive science, artificial intelligence, decision-making theory, systems theory, knowledge-based systems, robotics.

During the First World War the concept of situational awareness was identified by pilot and military tactician Oswald Boelke. He argued that "the importance of gaining an awareness of the enemy before the enemy gained a similar awareness, and devised methods for accomplishing this" [1].

The idea of separation between the understanding of the state system by human operator and the actual state of the system underlies the modern definition of situational awareness. By the end of 1980 situational awareness has not received much attention in the technical and scientific literature but has since become a hot topic of research.

The research in the area of situational awareness is based on previous research and formalization of notion of situation by Barwise [2] and other researchers. They created a Situation theory as a part mathematical theory of meaning. Devlin [3] clarified the relation between situation theory and information, he showed that the information is always associated with some situation.

The first research of situational awareness as part of a decision support system was conducted for military, aircraft and other complex human-machine systems to provide the operators with information [4]. Actually in such systems the value of possible error is very large, and the operator must take into account many factors in the decision.

Situational awareness is a key element in decision support systems. In particular, in most cases, if the situation is properly evaluated, it automatically determines the sequence of actions you want to initiate [4]. Methods for identification of critical situiations allow to capture, formalize and reuse the knowledge of experts about those situations.

Nowadays, the task of achieving situational awareness is especially important in context of development of autonomous decision making systems and Internet of Things (IoT).

Solving this problem needs, in turn, in-depth study of existing and development of new principles and methods of knowledge formalization of problematic situations, models of their processing, creating organizational, informational and software tools related to decision support.

II. Models of situation awareness

To determine the components of the SAW and its place in the process of solving cognitive tasks were developed a number of SAW models.

Endsley [5] first proposed a generic model of situational awareness in terms of information processing (Figure 1) by human operator. She suggested that SAW can be divided into three levels or stages of mental representation.

Level 1 – perception

Perception of signals is fundamental. Without basic perception of important information the chances of forming an irregular picture of the situation rise steeply. Jones and Endsley (1996) found that 76% errors of pilot situational awareness are reduced to the problems of perception of necessary information (resulting in the violation of system operation or disadvantages and problems with cognitive processes).

SAW is the decision maker's perception of the status, attributes, and dynamics of relevant elements in the environment (the decision situation). So level 1 is the lowest and most basic level of SAW. Achieving this level SAW involves basic information detection processes.

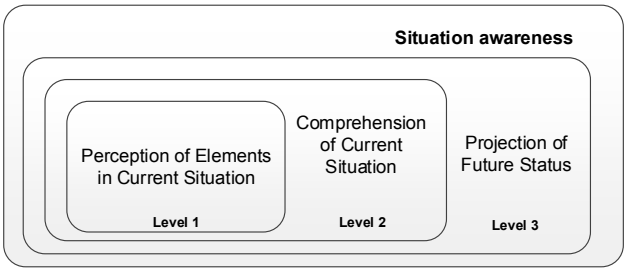

Fig. 1. Endsley's model of situation awareness

Level 2 – comprehension

Situation awareness as a concept goes beyond mere perception. It also covers how people connect, interpret and store information. Thus, it includes more than perception or paying attention to information, but also integrating the multiple pieces of information and determining their relations towards human goals. This is analogous to the high level of comprehension when reading text compared to just reading words.

So SAW is the decision maker's comprehension of the perceived information, i.e., Level 1 SAW. Level 2 SAW is achieved through pattern recognition, interpretation, and evaluation. Level 2 SAW results a comprehensive picture of the environment.

Level 3 – projection

At the highest level, the operators have a high level of understanding of the situation and have the ability to predict future event of the situation and dynamics of the system. This ability to project current events and their dynamics to predict future events and their consequences, creates opportunities for timely decision making. In almost all areas (aircraft, air traffic control, power stations, medicine) was found that most experienced operators rely on forecasts. This is a sign of a qualified professional.

Today, SAW is considered to be a part of Data Fusion process, which has a goal of integrating data and information from different sources. Data Fusion itself is used in several contemporary scientific endeavors, such as Big Data.

The Data Fusion Model was developed by the Joint Directors of Laboratories Data Fusion Group, a US DoD government committee overseeing US defense technology. The stated purpose for that model and its subsequent revision has been:

- to categorize different types of fusion processes;
- to provide a common frame of reference for fusion discussions;
- to facilitate understanding of the types of problems for which data fusion is applicable;
- to codify the commonality among problems;
- to aid in the extension of previous solutions;
- to provide a framework for investment in automation.

It should be emphasized that the JDL model was conceived as a functional model, not as a process model or as an architectural paradigm. A characteristic feature of the Data Fusion model is an abstraction from operations data collection, situation assessment and decision previously made only by human-operator which enables the analysis of SAW for human-machine systems, and purely autonomous systems.

In 1988 White published an article in which he proposed a Data Fusion Model [6]. In 1998 Steinberg, Bowman, and White developed the first paper formally addressing various extensions to the Data Fusion Model [7]. That paper began by revisiting the basic definitions of Data Fusion both conceptually and in terms of the "Levels" that are characterized in the original JDL model.

Expanded Data Fusion Model has the following levels:

- Level 0: Signal/Feature Assessment - estimation and prediction of signal or feature states;
- Level 1: Entity Assessment - estimation and prediction of entity parametric and attributive states (i.e. of entities considered as individuals);
- Level 2: Situation Assessment - estimation and prediction of the structures of parts of reality (i.e. of relations among entities and their implications for the states of the related entities);
- Level 3: Impact Assessment - estimation and prediction of the utility/cost of signal, entity or situation states - including predicted impacts given a system's alternative courses of action;
- Level 4: Performance Assessment - estimation and prediction of a system's performance as compared to given desired states and measures of effectiveness.

III. Situational awareness based on ontology usage

Situation awareness was envisioned as the main part of Level 2 processing in the JDL model [6,7]. But only recently has it become the center of attention for information fusion research. As is typical with a new field of research, various studies on this subject have contributed results that are difficult to integrate into one coherent conceptual structure. In other words, the field of situation awareness needs a unifying framework that would play the role of a common theory integrating various research efforts.

Moreover, the existing trends of development of intellectual systems determine the need to change the focus of the research of human-machine systems to a fully autonomous intellectual systems capable to navigate and make decisions in real situations.The main bulk of research on SAW pursued until now, has focused on developing SAW in systems with human operator and his support decision making. These research were based on models and take into account the peculiarities of human cognitive processes. Research of purely computer process of SAW needs other models. The computer situation awareness process still lacks a more systematic treatment.

Clearly it is necessary to develop unambiguous specifications, designs and implementations of situation awareness processes. One of the trends in this direction that became prevalent in recent years is that of using ontology-based computing as a paradigm on which to develop computer based situation awareness processes.

Situation awareness enables an intelligent agent to determine the meaning of perceived information in highly dynamic environments and to share the thereby discovered knowledge. In order to effectively reuse knowledge we need to identify the concepts and relations common to multiple domains. This common knowledge is codified in upper ontologies.

Ontology-based approaches to situation awareness facilitate the development of upper ontologies in order to provide a common vocabulary for collaborating agents and information sources.

In particular, in [8] is described an attempt to develop formal language representation of SAW, which would be understandable to the human and suitable for computer processing. The author developed the means to transform the mathematical description of the situation using infons in formal ontology description using OWL language. The operating result is Situation theory ontology (STO), which can play the role of a common theory for machine systems with SAW. Authors also present examples of logical inference using the STO ontology.

On the other hand, researchers of situation awareness systems have realized that there are an entities and relations independent of the subject area and are common to all systems of situation awareness

To build a unifying ontology for SAW, which can be re-used for different domains we must first of all define such common elements and on their basis to build basic core ontology.

In paper [9] the core ontology and its expressiveness were proposed and analyzed. Also its suitability for expansion by introducing new entities and relationships was demonstrated.

The relationship that exist between objects in domain traffic control situations aimed at determine dependencies were analyzed by authors in [10]. According to such relation characteristics as the ratio of its frequency of use and dependence on domain were identified four types of relations (Figure 2): Primitive, Leading, Situational, Nominal.

In this paper was shown that complex, independent of domain relation may be submitted as a combination of primitive relations. So in fact the primitive relationship, including time and space should be used to build core ontology SAW.

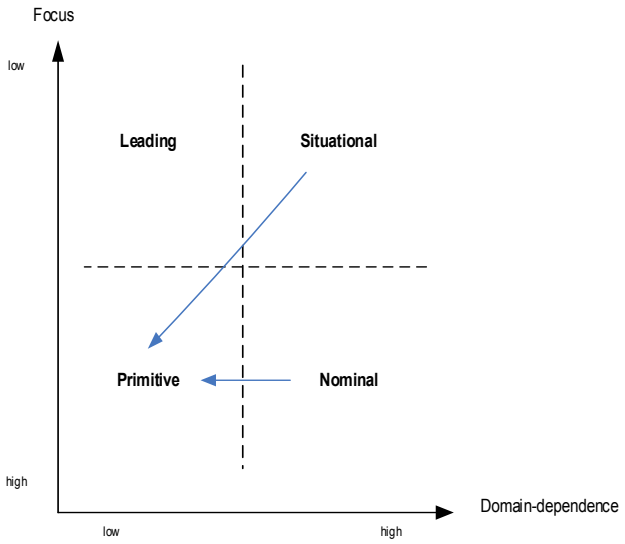

Fig. 2. Classification of Relations

The practical advantages of incorporating primitive relations into a framework for SAW are threefold. First, one may develop to some degree domain-independent as well as optimized relation derivation algorithms which can be reused in a specific domain. Second, situational relations can be derived by explicitly using existing primitive relations. That is, one may abstract from the details of space, time, etc. and concentrate on the specifics of the to-be-derived situational relations. Finally, the strictly top-down approach, which leads to the deterministic view of relations that contribute to situations, may be levered. That is, by rating relation types according to the degree of their contribution to a situation, also exceptional cases could be dealt with.

In [11] is proposed a framework for comparing existing upper level ontologies for SAW with a purpose of better understanding of different approaches to SAW ontologies construction and also to find missing features. Author devided existing SAW ontologies into three groups. First one (largely based on Sowa works) represent upper level, partially obtained from general ontologies. Second one codifies SAW-specific concepts, uses situational theory of Barwise and JDL data fusion model. This approach provides a better understanding of SAW. Third group is related to results of knowledge modeling within Cyc project. This group also provides such important criteria for SAW ontologies comparizon as universality and articulation.

Conclusion

Despite the popularity of scientific area of situation awareness and a large number of works, SAW research remain actual. This is because of existing trends in decision support systems, the development of autonomous intellectual decision support systems, increased situation awareness requirements for industries such as business analytics and others. A significant number of problems are researched insufficiently. In every part of the field of situation awareness exist the unsolved problems and challenges that require further deep research.

In particular, the issue of data and knowledge representation in system. Despite the fact that now a common is an ontological approach to knowledge representation, there are problems with the representation and processing of time and space data and knowledge. Further research is required in the problem of systematic approach to the creation, modification and expansion of ontology in systems with SAW.

Also in our opinion the area of researching relations in SAW, their formalization, transformation, storing and retrieving, processing as well as reasoning using relations requires additional efforts. This is especially important because situations are described by set of relations.

The dynamic nature of environment where SAW system operates combined with necessity to take in consideration resource limitations and high performance requirements, makes the implementation of system with SAW a really hard technical problem. In order to solve it, the study of heuristical methods in decision making, formalization of corresponding knowledge is required. The approach of ontological modelling for processing heuristical knowledge looks promising.

Another possible area of future research is related to necessity of deeper understanding of change dynamics in environment where SAW system operates. The operators of such system often need to know not only when environment parameters are in the ‘red’ area, but also when they are in the bordering area, and transition to ‘red’ area is highly probable. Moreover, desirable is to know aforetime when ‘red’ zone can be reached in several steps from current state, taking in consideration current trends in order to take early mitigation actions.

Another problem is the limited, incomplete, uncertain information about environment. In [12] is provided the analysis and classification of different types of uncertainty with a purpose of selecting most suitable formalisms for SAW systems to represent and process uncertain knowledge. However, the general problem of correct situational assessment taking into account the different types of incomplete information has not been solved yet.

The actual problem is also problem of measurement of the quality of SAW. Existing research [13-15] focuses on SAW performance measures defined within the parameters and limitations of the human operator and its cognitive processes. It is clear that this approach is not suitable for assessing the quality of SAW in the autonomous intellectual systems. The task of conceptualization and building a common approach to assessing the quality of SAW in different types of systems and problem domains needs to be further researched.

Creating situational awareness is often considered as preparing information for single decision maker. However, in more general situations, information about current situation is collected by multiple agents and this information is also used by multiple decision-making agents. It is a common approach to use interpreted systems [16] for formalizing and modelling SAW in multi-agent environment. The reasoning about agent's knowledge is done using epistemic logic. However, the tasks of building distributed ontologies, organizing knowledge sharing and integration across different agent's local knowledge also is important.

Formation of situation awareness is a prerequisite for the organization of context-dependent computing where actions depend on the state of the environment. In [17] is described context-dependent decision making system. In [18] is presented a context-dependent tourist service which takes in consideration emotional state of tourist and other factors when selecting exhibit information. It uses an ontological approach to build SAW. The problem of general theoretical understanding of a place of situation awareness in the context-dependent computing remains open.

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The Optimization of Databases Distribution in a Distributed Computer Networks

Roman Krasniuk

Faculty of Applied Mathematics and Information Science, Ivan Franko National University of L'viv, UKRAINE, L'viv, Universytetska street 1, E-mail: krasniuk@ukr.net.

Abstract – ***In paper was considered mathematical model of optimization of databases distribution in a distributed computer networks. Made mathematical formulation of problems and formulate an efficient computational algorithm of solution of problems in the case of large dimension inputs. The computational algorithm is of type "greedy" algorithms to improve the procedure is performed, which provided a significant decrease in the average calculation errors to a level acceptable for practical calculations.***

Key words – optimization, distributed databases, computer networks, computer algorithms.

I. Introduction

Modern database management systems provide support for distributed databases. This is logically the only database of which can be placed in multiple network nodes. The nodes may be different types of computers that use different operating systems. Units can be geographically distributed but users receive the same access to all the information stored in the database. The main advantage of distributed systems is the reduction of expenditures for data transfer over the network, and the distribution of a large centralized database into multiple parts increases the efficiency of data processing.

The base aspects the optimization of network distributed systems was investigated in papers [1]-[3]. In particular, [1] conducted systematization of mathematical approaches and models for modeling of distributed databases. Mathematical models of multi synthesis of physical structures distributed databases were considered in [2]. Statement was formulated and proposed mathematical models offered to sell to computer networks of different topologies, criteria for minimum wage costs reduced access time to data and minimize network traffic. Concept of construction and choice of distributed databases of information retrieval systems dedicated to the work [3]. Questions algorithmic support distributed databases was considered in [4]. Consider the life cycle of designing a distributed database and describes its stages. The problem of distributed database design and assessed its complexity. The choice of genetic algorithms to solve the problem and proposed approach to take account of the interdependence of the design stage.

The authors of the direction of development and research of mathematical models of optimal distribution database is not yet sufficiently developed, despite the considerable number of works devoted to the analysis of various aspects of distributed databases. This situation is due to the fact that the formation of new architectural solutions raises the question of effective development management software such class of information systems. At the same time, the establishment of appropriate software impossible without the formation of the mathematical models and effective numerical algorithms. As a result, the construction and research of optimization of distribution databases is relevant and important issue, which is seen at work.

II. The mathematical formulation of the problem

Let n - number of computers of different capacities that make up a distributed computer network; m - number of databases that need to be placed in a computer network; x_i - number of databases that are planned for placement on the i - th computer network (the desired value); $c_i(x_i)$ - storage costs and maintenance x_j databases on the i - th computer network. Then a mathematical model of the problem will look like:

$$\sum_{i=1}^{n} c_i(x_i) \to min \tag{1}$$

under conditions

$$\sum_{i=1}^{n} x_i \to m. 0 \le x_i, i = 1,2,...,n. \tag{2}$$

In the case of resource constraints computer networks $(0 \le x_i \le l_i, i = 1,2,...,n)$ .Optimization problem (1) - (2) takes the form: to find a minimum of the objective function (1) restriction

$$\sum_{i=1}^{n} x_i \to m, 0 \le x_i \le l_i, i = 1,2,...,n. \tag{3}$$

III. Formation computational algorithm

Formulated model defines integer programming problem. Building a solution of this class applications is complicated by large dimension. Therefore, an effective approach is to develop approximate algorithms, including the use of "greedy" algorithms. These algorithms are intuitive heuristics in which every step of the decision that is most advantageous for this step, without what is going to find the next steps.

We describe the general scheme of the algorithm for integer programming problems (1), (2) and (1), (3), which uses the idea of "greedy" choice.

Let $X(x_i^*)$ - the set of acceptable plans of the original problem for which $x_i = x_i^*, I = \{1,2,...,n\}$ - a set of index variables, I_0 - set of indexes variables which procedure "greedy" choice assigned new values.

Algorithm.

Step 0. Let $X_0 = X, I_0 = \varnothing$, and choose the initial plan allowable $x^0 = \left(x_1^0, x_2^0, ..., x_n^0\right) \in X_0$. For each of n variables we find the limits: $z_i^L \le x_i \le z_i^R$ so that $x = \left(x_1^0, x_2^0, ..., x_n^0\right) \in X_0$ for all integer $x_i, z_i^L \le x_i \le z_i^R$. Limits can be set approximately irregularities.

Let formed set I_k and $X_k \in X$.

Step 1. If $I_k = I$, all the variables have new meaning. That is permissible constructed vector x, which is taken as approximate solution. Otherwise, proceed to step 2.

Step 2. For $j \in I \setminus I_k$ find

$$j_0 = \max_{j \in I \setminus I_k} \left\{ \min_{z_i^L \le x_i \le z_i^R} (c_1(z_1) + c_2(z_2) + ... + c_i(x_i) + ... + c_n(x_n)) \right\}$$

where $z_k = \begin{cases} x_k^0, k \in I \setminus I_k, k \ne j, \\ x_k^*, k \in I_k. \end{cases}$

Granted

$$x_{j_0}^* = \min_{z_{i_0}^L \le x_{i_0} \le z_{i_0}^R} (c_1(z_1) + c_2(z_2) + ... + c_{i_0}(x_{i_0}) + ... + c_n(x_n)),$$

$X_{k+1} = X_k\left(x_{j_0}^*\right), I_{k+1} = I_k \cup \{j_0\}$, and go to step 1.

Using an algorithm formulated, give solution to the problem (1), (3).

Solution begins with the initial plan acceptable $x = (0, 0, ..., 0)$.

Step 1: Calculate by j - th coordinate vector x: $x_j = l_j$, where $l_j = \max_i l_i$ and $c_j(l_j) \to \min$ provided that $\sum_{i=1}^{n} x_i \le m$.

Step 2. Transform the problem as follows: of the objective function and the left side constraints (3) exclude a member containing a change x_j, get that problem (4)

$$\begin{gathered} c_1(x_1) + c_2(x_2) + ... + c_{j-1}(x_{j-1}) + c_{j+1}(x_{j+1}) + ... + c_n(x_n) \to \min, \\ x_1 + x_2 + ... + x_{j-1} + ... + x_n \le m. \end{gathered} \quad (4)$$

As a result, change the number of variables in the initial problem is reduced by one. Go back to step 1.

Steps 1 and 2 are repeated for as long as all the variables vector x new values will not be broken or condition (3).

To evaluate the error of an approximate solution that got "greedy" algorithm was solved problems about 100 conditions that generated randomly. For exact solution used branch and bound method [5]. According to the results of empirical research mean error greedy solution is 15%.

To reduce the error of approximate solution procedure was proposed to improve it. In particular, further assume that variable vector x numbered in order of receipt values in the "greedy" algorithm.

Algorithm improvements solution.

As we take the original plan solution that is received by "greedy" algorithm. Holds $K = \{1, 2, ..., n\}, k = 1$.

Step 1: Choose not yet processed variable $x_k > 0$, with a minimum index value $k \in K$ and select $\delta_k > 0$, which is necessary to reduce the value x_k.

Step 2. Find the variable $x_q, q > k$ and value $\delta_q > 0$, which can reduce the value x_q without breaking the admissibility of the plan and at minimum objective function. For this δ_k and δ_q must satisfy the condition

$$c_q(\delta_q) < c_k(\delta_k).$$

After step 2 whether or not the variable found x_q, pin $K = K \setminus \{k\}$, increase k by one and go back to step 1. The process stops when all the variables in the original plan will be reviewed $(K = \varnothing)$.

"Greedy" algorithm to improve the procedure was solved 150 tests whose terms were generated randomly. The results of computational experiments using the solution to improve procedures mean error of approximate solution dropped to 3.5%. That is, getting the results suggest, however, that the use of "greedy" algorithms is a promising tool for solving integer programming problems of large dimension.

Conclusion

The work was made setting the optimization problem of distribution of databases in a distributed computer network. Formulated efficient computational algorithm for constructing an effective solution of the problem in the case of large-scale input. The comparison obtained solution with the exact solution of the problem, which is obtained by the method of branches and borders. The high efficiency of the proposed algorithm computing solutions based on test objectives, inputs which generated randomly. Numerical experiments showed that the average error of the approximate solution does not exceed 4% of that is a good result for practical use.

Prospects of application of the work is the integration of mathematical models and computational algorithms to systems of resource management in distributed computer networks. Further research will continue to adapt computational algorithm to other models optimize resource allocation and changing computational algorithm to reduce the average error of the approximate solution.

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One Approach for Computing Simple Polygons on a Given Point Set in the Plain.

Andriy Fisunenko

Faculty of Cybernetics, Taras Shevchenko National University of Kyiv, UKRAINE, Kyiv, Glushkova avenue, 4D,
E-mail: alf.via@gmail.com

Abstract – ***We consider the problem of computing all possible simple polygons embrasing every point of a given finite point set in the plane. The developed approach is based on topological analysis of mutual visibility graphs of all free points and end points of a constructed chain. We found several new necessary conditions for existence of simple polygonal chains which are based on checking collocations of articulation points, bridges and biconnected components of such graphs. These conditions can be effectively applied for reducing trees of exhaustive search for all possible polygons on the given point set or for their random generation.***

Key words – simple polygon, simple polygonal chain, polygonization, mutual visibility graph, articulation point, biconnected component, bridge.

I. Introduction

Given a point set in the Euclidian plane $S=\{p_0, p_1, ..., p_{N-1}\}$, where $N>3$ and all points are in the general position, i.e. any three points of S do not lie on the same streight line. We build simple polygons which have all points of S as their vertieces.

Knowing a number of all possible polygons for a given point set has both theoretical and practical importance.

From one hand, the problem of enumerating all simple polygons by a polynomial algorithm is one of the fundamental problems of Computational Geometry (Problem 16) which still remains open [1]. From other hand this problem is also in the focus of at least two international projects: ComPoSe («Combinatorics of Point Sets and Arrangements of Objects», [2]) and «Rectilinear Crossing Number Project» [3]. Both projects challenge heavy computational experiments over rectilinear planar graphs in attempt to find some properties, patterns and laws for small numbers of points and to formulate some work hypothesis for further researches. One of such efforts is discovering so called optimal configurations which maximize number of possible simple polygons for a given number of points N.

Another wide class of applications motivating the problem is optimization. It is well known that many optimization problems over simple polygons are computationally hard. In particular, finding a simple polygon with minimal area and minimal perimeter were proven to be NP-complete problems. Still, in these cases for the plethora of practical applications such as CAD, GIS, robot motion planning, etc, one has to have a good enough heuristic algorithms for real-world optimizations (e.g. [4], [5]). Comparison of obtained approximation methods with exact solutions at least for small input sets is very important for evaluating and selecting approapriate approximating heuristics.

Thus, even if there is no polynomial algotrithm yet, effective exhaustive search algorithms are still actual. The larger input sets we can process accurately the closer we approach to solving optimization problems.

Even if the problem is of the big impact and importance the last significant effort on the topic was made around two decades ago [6]. There is almost no progress since that time. For the case some authors state that their algorithms guaranty generating all possible polygons this class of problems requires tool for accurate verification of their solutions by an exact algorithm as well. In original work [6] authors developed exact Increamental Construction and Backtracking approach based on checking three necessary conditions over graph of unused edges following the general approach proposed in another preceeding work [7].

In this paper we briefly report on generalizing and extending this existing approach by introducing a topological analysis of graphs obtained from all unused edges connecting free and end points of a constructed polygonal chain. We developed and present here several new necessary conditions for existence of a simple polygonal chain. Since the most of them are based on depth-firsth search principle for graphs they are computationally effective not excideeng $O(N^2)$ time per construction phase.

II. Computing Simple Polygons

Without loss of generality we assume that we always start constructing any simple polygon from the point p_0 which has minimal coordinates x and y among all points in the set S. To reduce number of visited polygons twice comparing with [6] we demand that our construction algorithm excludes all cases of symmetric polygons (in clockwise and in counter-clockwie directions). This can be achieved by the guard condition preventing the situation when point p_{N-1} appears in any constructed polygon prior to p_{N-2}.

For reducing execution time down to $O(const)$ for data which will be used repeatedly many times we precompute and cache in special storages on the preparation stage of the algorithm:

- intersections of all possible segments connecting pairs of points as Boolean variables mapped to different fourths of point indexes ('true' means that segments intersect each other by their internals);
- list of intersected segments for each certain segment.

Denote: by $CH(S)$ – the convex hull of the given point set S; by $C_m(S, k)$ – a simple polygonal chain on the phase m containing exactly m points; by $VG_m(S, k)$ – a visibility graph built by connecting all free and end points of the constructed simple chain by 'mutual visibility' edges none of which intersect any of segments of the simple chain $C_m(S, k)$. Index k denotes that we are building k-th polygon after k-1 polygons were constructed. Also let us call the last added point as 'head' and p_0 as 'tail' of the constructed chain.

An example on Fig. 1 shows a built simple chain by solid lines while dot lines represent edges of $VG_m(S, k)$.

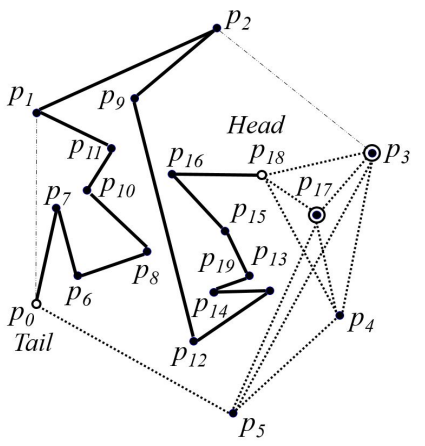

Fig. 1. Example of the phase for constructing a simple polygon

Starting from p_0 points of S are added to the constructed simple chain $C_m(S)$ sequentially by a recursive procedure while several necessary conditions are checked.

First of all on each phase of the recursive procedure we test either all points are in the chain. If 'yes' we increase polygons counter k and if necessary do some useful job on it.

If 'no', the same way as in [6] while adding the next point to the chain to obtain $VG_m(S, k)$ we remove (and place to the local phase's cache for further restoring on return from recursion) all edges from $VG_{m-1}(S, k)$ which: have their ends on the previous head; intersect the last added edge; connects the newly added head and the tail; connect verticies of two edges linking one point having only two edges ('triangle' on mandatory edges).

Then the obtained graph $VG_m(S, k)$ is examined by two passes of depth-firsth search procedures. The first pass discovers all articulation points of $VG_m(S, k)$ if they exist and makes all necessary preparations for the second pass discovering all biconnected components and bridges if any. After that obtained graph's topology is analyzed for certain cases leading to impossibility to complete construction of the simple polygon while part of points still remain unused (so called 'blocking chain').

If analysis of $VG_m(S, k)$ has not shown cases of blocking chains we temporary remove all edges of $VG_m(S, k)$ connecting the tail and examine topology of the obtained temporary graph $VG'_m(S, k)$ as well.

We found that the following necessary conditions help to reduce number of backtracking of the recursion. These necessary conditions are:

- the head and the tail of $C_m(S, k)$ should not be articulation points of $VG_m(S, k)$ otherwise simple polygon cannot be completed;
- a graph of biconnected components (BCC-graph) of $VG_m(S, k)$ should not have side branches (biconnected components attached to another components via bridges of articulation points);
- the head of the chain should not be an articulation point of the graph $VG'_m(S, k)$.

It is worth mentioning that there is a sufficient condition for existence of a simple polygon which however is not universal:

- if a BCC-graph of $VG_m(S, k)$ has no side branches, all components are convex polygons and all articulation points are vertices of those components hulls than a path completing simple polygon exists.

Obviously, in a general case this sufficient condition, unfortunately, does not meet.

Conclusion

The proposed approach is suitable both for constructing simple polygonal chains and simple polygons. Formulated necessary conditions can be used either separately or in combination with conditions described in [6] depending on applications. A gained advantage of combined conditions checks: number of calls per each simple polygon is at least 20% less than in case of [6].

We can generalize the proposed approach for the case of generating simple polygons with given constrained areas. Edges intersecting constrained areas should be simply removed from the edge cache on the preparation stage of the algorithm. In some configurations it can drastically reduce number of calls per obtained simple polygon and to enable exact optimizations.

The proposed approach of topological analysis of graphs $VG_m(S, k)$ should be devised further for potential formulation of computationally effective sufficient conditions for existence of a simple polygon or proving its NP-completeness (remains open).

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Blood Cells classification by Image color and intensity features clustering

R. A. Melnyk[1], A.O. Dubytskyi[2]

[1]Doctor of Technical Science, Professor, Institute of Computer Science and Information Technologies, Lviv Polytechnic National University, Lviv, Ukraine; E-mail: ramelnyk246@gmail.com

[2]The 2nd year master, Institute of Computer Science and Information Technologies, Lviv Polytechnic National University, Lviv, Ukraine; E-mail: andrii.dubytskyi@gmail.com

Abstract* – *A new approach for cells detection and classification on blood smear images is considered. Benefit of 4-connected over 8-connected component labeling for cell detection is shown. Color and intensity histogram clustering are proposed to extract common features for cells classification. A new approach for k-means initial centroids detection proposed. The algorithms effectiveness was tested and estimated for some blood smear images. The algorithm examples, figures and result table to illustrate the approach are presented.

Key words – computer vision, visual object detection, visual object classification, binarization, connected component labeling, intensity feature, color feature, cluster analysis.

I. Introduction

Blood smear analysis is an important task in desease diagnostic. Complex and expensive hardware solutions are often used nowadays, and they require such an expensive reagents. That is why, fast automatic analysis of blood smears with minimal costs and good precision are needed by a labs all over the world. Computer vision algorithms applied for blood smear images can solve this task. Blood smear analysis from computer vision standpoint can be divided into two stages: cells detection and cells classification. Desease classification is related to medical knowledges and is not tangent with computer vision issues. Image processing can be applied before each of these steps.

There are two popular modern object detection approaches: sliding-windows and segmentation. [1], [2] The main drawbacks of sliding-windows are complexity and detection difficulties in case of large intra-class variation. Because of a big number of window positions and size combinations, and feature extraction on each window, even if it does not contain the object, it might be very complicated to perform object detection from computational standpoint. Segmentation approach on the other hand by itself represents similar objects as one global region and it could be very difficult to extract and count separate objects. In this article, we propose to use connected-component labeling [3] over the binarized image to detect separate cells. We propose to use Otsu thresholding algorithm [4] for binarization purposes.

Color and intensity features are commonly used for visual object classification. We propose to apply k-means clustering [5] for features to train classifier, then calculate distance between randomly selected cell feature and centroids ontained during training. Intensity feature is commonly used for classification purposes in differen computer vision approach, but blood cells has many intra-class variations and it might be complicated to classify it only by intensity feature. We propose to use intensity and color features simultaneously. Color space feature by itself represented by millions of color shades, requires a huge amount of memory and can lead to a great delays while calculating distance between features. Color space quantization [6] can take place to solve this issue.

An example of original blood smear image for experiment purposes shown in Fig. 1.

II. Image Processing

Usually computer image is a matrix of pixels each representing millions of different color shades. In this case it should be very difficult to detect different objects from the image. Some algorithm that should separate object related pixels from background pixels is required. We propose to use Otsu thresholding algorithm for this reason. Otsu's binarization defines a global threshold for color intensities histogram. After binarization, pixels with the higher intensity then threshold can be considered as background and pixels with the lower intensity can be considered as objects. We have performed a series of attempts to apply local regions detection and perform thresholding in those regions. This experiment shows that local thresholding does not lead to satisfied binarization quality improvement, but causes performance loose. However, manual threshold control can improve binarization quality. Increasing threshold causes quality loss, decreasing threshold on the other hand causes to higher quality and better detection results. Result of image binarization shown in Fig. 2.

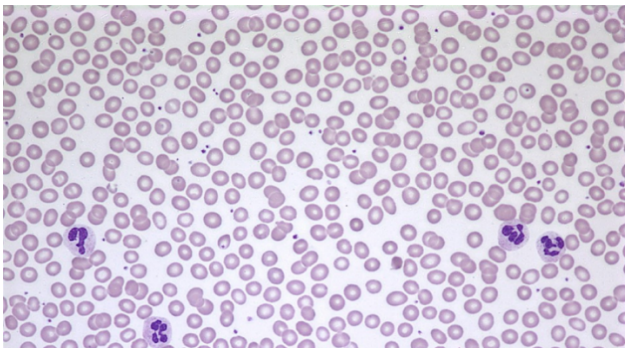

Fig. 1. Granulocytes circulating in the blood of a patient with a normal peripheral smear [7]

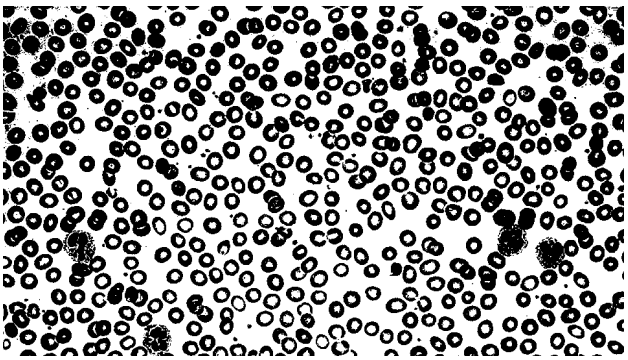

Fig. 2. Binarized blood smear image

Different blood smear images may have different resolution, which can lead to the higher distances between histograms during classification and as a result incorrect classification results may be obtained. Thus, we need to ensure scale invariance by zooming cell image to some pattern size either while training classifier or classify cells.

III. Cell Detection

We propose to use connected component labeling over the binarized image for cell detection purpose. This approach will help to obtain regions that corresponds to separate objects with minimal time costs. Thus, we will not need to extract features from regions that are not objects as in sliding-window approach.

There are two options for connected components labeling: 4-connectivity and 8-connectivity detection. We observed that 4-connectivity detection gives results that are more precise for current problem field. Result of component detection with different connectivity and binarization threshold correction shown in Table 1.

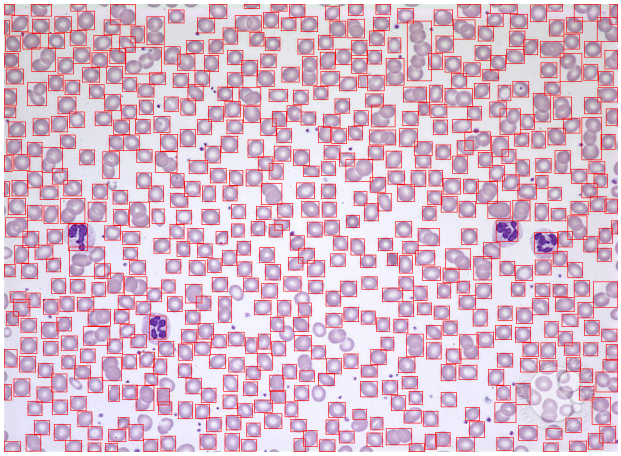

Fig. 3. Detected cells

However, there are two issues.

First problem is that the cells usually has a center with higher intensity then threshold, and those pixels will not be included into the connected component. For further analysis, we need to retrieve original pixels that corresponds to connected component's elements. That is why we need to include those cell's centers into components to perform proper classification. Another problem is that there may be a lot of trash element on the blood smear image, such as parts of dead blood cells. To solve the problem of trash detecting we need to consider a maximal possible size of trash components and remove all components that have less or equal sizes. For this reason, we perform average component's size calculation during component detection, then multiply it with a coefficient and consider resulting value as the maximal possible size of trash elements. Moreover, we need to find such coefficient that will not cause to removal of real cells. According to the experiments the optimal size of trash is the 65% of average cell size, thus the coefficient should be 0.65. Cell detection results due to the optimal algorithm parameters are shown in Fig. 3.

The algorithm that fills the spaces in components looks as follows:

```
for each row in matrix do
  set currentComponent to 0
  set currentComponentColumn to -1
  for each column in matrix do
    if matrixElement > 0 then
      if currentComponent = 0 then
        set currentComponen to matrixElement
        set currentComponentColumn to column
      else if currentComponent = matrixElement then
        for i = currentComponentColumn to column+1 do
          set matrix[row][column] to currentComponent
        end for
      else
        set currentComponent to 0
        set currentComponentColumn to -1
      end if
    end if
  end for
end for
```

IV. Feature Extraction

Image feature extraction are usually applied for classification purpose. We propose to use intensity and color features simultaneously. Both this features can be visualized as histograms.

Color feature represents the distribution of colors in an image. Nowadays colors howevers are usualy represented by millions of different color shades. That makes color feature storage and processing very complicated task. Color space quantization should be applied to minimize color space. All amount of colors can be distributed into 64 quants by partition each color chanel into 4 equal parts and forming 64 color cubes.

Intensity feature represents the distribution of color intensities over the image. Majority of approaches uses the quantization of this intensity values into 16 values, but we propose to take into consideration all of 255 intensity values. It is not so much, so it will not affect performance very much and it can give us more precise feature characteristics. To ensure scale invariance statistical normalization of histogram values should take place.

V. Feature Clustering

For visual object classification purpose we have to extract features for separate cell types. However, most of the cells of the same type on the blood image can vary by its histograms in some range. Moreover some cells, like leukocytes, have different subtypes, which are not very different. Common feature extraction for corresponding types is required to provide proper classification. We propose to use k-means clustering for common features extraction. Obtained cluster centroids after cluster analysis procedure can be considered as common features for different cell types. Some common intensity features for different blood cels are depicted in Fig. 4, common color features – in Fig. 5.

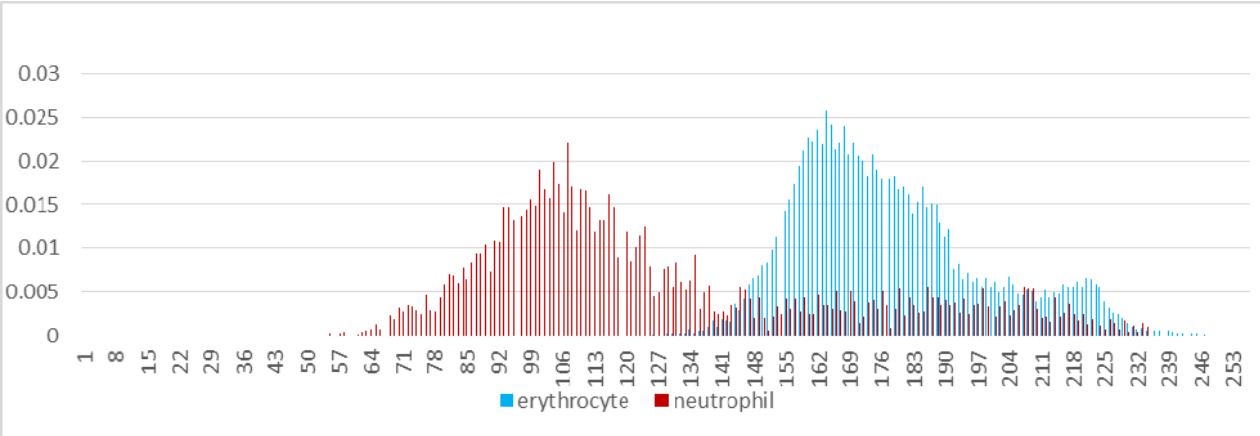

Fig. 4. Common intensity features

The distance between histograms can be calculated using Eq. 1.

$$D(a,b)=\sum_{i=0}^{n}|a_i-b_i| \quad (1)$$

Here, the *D(a, b)* is the distance between histogram *a* and *b*; *n* – is the number of maximal possible values on the histogram (255 for intensity feature, 64 for color feature); a_i, b_i – is the *i*-th values of *a* and *b* histogram respectively.

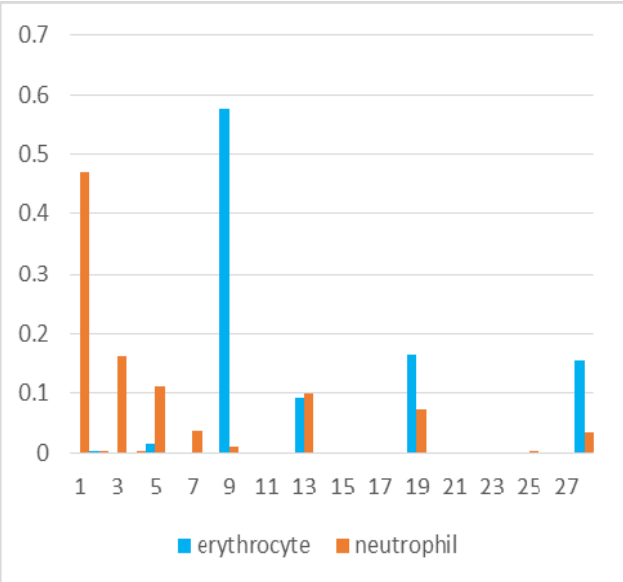

Fig. 5. Common color features

However, k-means clustering results can depends on selected initial centroids. Due to a series of experiments it was observed that inproper centroid detection may lead to incorrect classification results, when the cells that are realy the same type, may be classified as different types due to a little difference between them. For classifier training purpose we were force to improve initial centroid selection. We perform an algorithm that detects a mid histogram for a list of extracted histograms of specified cell type. Mid histograms are then considered as initial centroids for cluster analysis.

The algorithm that defines mid histograms looks as follows:

Pre: mid is the initially empty histogram which will contain resulting mid histogram after algorithm completes

```
set n to 0
for each histogram in list do
  for each key in histogram do
    set value to histogram.key
    set mid.key to ((mid.key * n) + histogram.key) / ++n
  end for
end for
```

VI. Cell Classification

Having common color or intensity histograms, we can perform classification of any random cell on the blood smear image. Histogram distance between selected cell feature and each cell type common feature can be applied to define the nearest appropriate cell class. Selecting the common feature with minimal distance to selected cell feature we will obtain proper cell type.

In case of multiple features we need to introduce similarity measure as a sum of normalized distances divided by the number of features. Distance normalization is required in this case because different features can be measured on different scales which can have different influence on similarity value. However, because we have histograms already normalized, the maximal possible distance betwee them equals one, so the similarity mesure can be written as in Eq. 2.

$$S(o,c)=\frac{\sum_{i=0}^{N}D(o_i,c_i)}{N} \quad (2)$$

Where *S(o, c)* is the measure that define how similar is object *o* to class *c*; N is the number of features applied and $D(o_i,c_i)$ is the distance between *i*-th feature of object and *i*-th feature of class. In case of normalized histograms the similarity measure will always be in range [0;1]. This approach can be also used to find similar images in the images data base.

The results of blood smear image classification are illustrated in Fig. 6, where blue squares correspondes to erythrocytes, and red squares corresponds to neutrophils, which are the subtype of leukocytes.

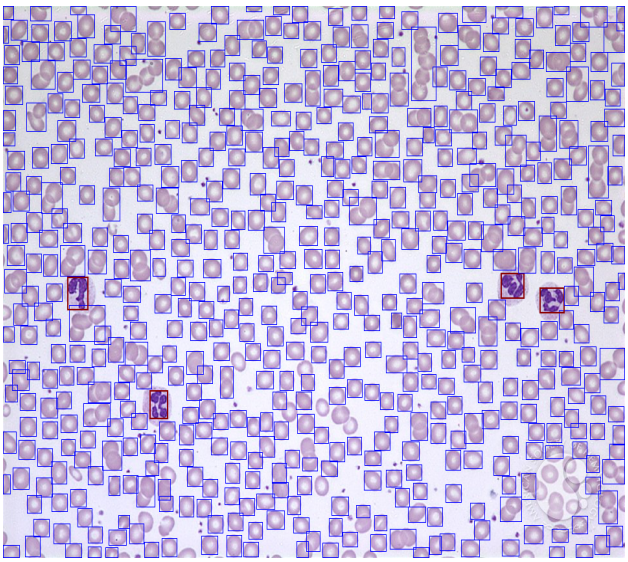

Fig. 6. Classified blood cells

VII. Results

Series of experiments with object detection were held to confirm the detection algorithm effectiveness. Due to Table 1, using a little negative threshold correction, 4-connectivity detection and removing components that are smaller than 65% size of average component, gives the best results of cell detection. This case is selected in row number five. Further decreasing of threshold and size filter coefficient leads to lower quality of cell detection.

TABLE 1

THE RESULTS OF CELL DETECTION EXPERIMENTS

No.	1	2	3	4	**5**	6	7
Tthreshold correction	0	-5	-15	-15	**-15**	+5	+10
Connectivity	8	8	8	4	**4**	4	4
Size filter	.75	.75	.75	.7	**.65**	.7	.7
Detected cells	537	540	550	578	**588**	542	525
Real cells	643	643	643	643	**643**	643	643
Precision (%)	83	84	85	90	**91**	84	82

TABLE 2

THE RESULTS OF CELL CLASSIFICATION EXPERIMENTS

No	1	2
Random initial centroids	+	-
Mid initial centroids	-	+
Erythrocytes (classified/real)	581/584	584/584
Neutrophils (classified /real)	4/4	4/4
Monocytes (classified /real)	0/0	0/0
Lymphocytes (classified /real)	3/0	0/0

Also, series of experiments with intensity and color feature clustering were held to confirm the effectiveness of classification approach and initial centroid detection algorithm. Due to Table 2, applying mid histograms as initial centroids for k-means cluster analysis improves the results of blood cells classification.

Conclusion

New approach for object detection and classification of blood smear images is proposed. Object detection is based on connected components labeling preceded by image binarization. To reduce the algorithm complexity segmentation was used. Influence of different connected component labeling, binarization threshold and size filter parameters on detection quality were demonstrated. The color and intensity features were used for objects comparison. Classifier was trained with the k-means feature clustering. It was proposed to use mid histograms as initial centroids for cluster analysis. Centroids obtained after cluster analysis were considered as common object class features. Minimal distance between extracted feature and common object class feature was considered to define object class. Software for classification of blood smear images was implemented. Some experiments with cells classification were held to confirm the algorithm effectiveness. It was noticed that it depends segmentation approach, labeling procedure, chosen features, initial centroid choosing approach.

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Geoinformation technologies for tourist's travel support

Olga Artemenko[1], Igor Popyk[2]

[1]Computer Systems and Technologies Department, Bukovinian University, UKRAINE, Chernivtsi, Darvina street 2-A, E-mail: olga.hapon@gmail.com

[2]Computer Information Systems and Technologies Department, Ternopil National Technical University, UKRAINE, Ternopil, Ruska street 56, E-mail: igor.popyk.te@gmail.com

Abstract* – *In this paper the analysis of researches and developments of geographic information technologies for tourist's decision support was provided. The necessitate for development of geographic information technology tools was proved to provide personalization, optimization and support for tourist in all phases of his travel using mobile technologies of combined with GIS functionality.

Key words – geographic information technologies, GIS, tourism, travel support, mobile technologies.

I. Introduction

The tourism industry has quite a lot of research and application problems in the solution of which is necessary to decide on the relative position of objects in space, routing, determining their length and complexity, optimal route selection etc. [1,2]. Modern analysis of spatial distribution facilities based on the use of geographic information technology (GIT). One of the promising areas of research is the application of geographic information systems (GIS) to help tourist at all stages of his journey.

II. The purpose and tasks of the research

The main tasks solved with the help of travel GIT are: creation of electronic versions of popular tourist destinations; definition of tourist's location, facilities, vehicles, etc.; forming of a tourist's route; maintenance of tourist travel; trip planning; virtual tourism, 3-D versions of tourist sites; thematic digital maps; dissemination of information on touristic facilities; analysis of tourist flows and spatial distribution of tourism resources; search diverse information in the field of tourism.

Different categories of tourists can use a variety of GIT at all stages of the trip:

• During preparation for the trip using GIT one can search data on touristic services, destinations, tourist infrastructure facilities; make planning a trip routing.

• When traveling with a mobile tourist application based on GIT are available options such as location tracking, search tourist facilities, maintenance and adjustment tourist route [2].

• After traveling touristic GIT allow you to perform data analysis on tourist flows, the formation of reviews and evaluations, the exchange of experience (in many mobile applications are tools for creating voting and rating the quality of services, etc.) [1].

Leaders in the development of global GIS now are the products of two companies - ESRI ArcGIS and MapInfo Corporation INTERGRAPH. Also, for the implementation of touristic GIS-platform applications often are used GoogleMaps [1]. To implement some specific tasks, such as virtual tourism are created specialized GIS platforms, such as Cyber GIS [3].

III. Travel support GIS applications

Decision support tools targeted to the specific needs of tourists and travel agents nowadays are developed and improved in the direction of mobile and web-based applications. Among them - the tools to solve the problem of personalization, optimization and maintenance of tourist during his stay on the route.

Most mobile applications, travel guides and programs require the provision of tourist in space. The unsolved task remains to determine the exact location of the tourist inside buildings, palaces, museums, historical or cultural complexes. To program guide automatically started and began the story of a particular memo or picture, you need to know not only exactly where is a tourist, but also in which direction he is looking and where he is going to move on. Finding the external location of the user can be realized using GPS. Once tourist's positioning is located with GPS, you can practically define the objects that the user is watching at any given time. However, no effective information technology for solving the problem of determining the coordinates of tourist location as well as individual objects, such as inside a large museum. This would give an opportunity to develop a software solution in combination with a program-guided, GPS-transmitter and GIS system, which offered to tourists - the owners of mobile personalized tour in real time [4].

The original solution to the problem of creating and correcting the travel route is a mobile application based on GIS and multi-agent systems [5]. In application were used geospatial information with commercial GIS formats such as ArcGIS and Mapinfo. Performing the transformation of geospatial data in GML makes it possible to ensure the flow of geospatial data to users of portable devices freely without commercial plug-in software. The authors of the study focus on creating and implementing multi-agent system of choosing the best route.

The study [6] based on ArcGIS Software ESRI 10.1 developed thematic digital maps containing information about hotels, guest houses, tourist routes, airports, railway stations, parks, churches, playgrounds, golf courses, hospitals, locations of ATM, restaurants, gas stations, police stations and entertainment facilities of Srinagar (India) for further integration with the web space to promote a tourist with information and assistance to potential tourists in their decision on travel itinerary respective regions. Digital maps, satellite images, GPS and statistics were used to create data layers above and were then combined with additional materials such as multimedia video clips, audio stories and photos.

The study [7] solves the problem of getting personalized recommendations for tourists on daily excursion routes. The approach authors proposed is that for pre-formed user list attractions, that travelers like to visit, get the route for each day of the visit. The long journey shares on separate days and a list of attractive tourist destinations are formed. They are grouped

thematically or geographically distributed and between these days. Places of possible interest are selected from these conventionally implied or user preferences. The described method allows the individual to plan personalized tours daily based user preferences, the time allotted for the tour, availability to visit monuments (timetable, agenda), the number of days of stay.

Governments in countries with developed tourism markets are extensively interested in creating services to provide personalized information services to tourist's. As an example, in Thailand was performed a study intended to facilitate tourist travel search sites and trip planning. The application is designed in such a way that relevant database may be applied in other regions. The structure of the software modules is formed as an open architecture that allows other developers to easily integrate it into the environment for relationship-oriented provision of other information technology services to tourists [8].

Plan your trip is formally regarded as a complex and time-consuming task that includes a variety of processes, ranging from finding specific tourism information on the country and conditions of reside in it and completing the current route planning in unfamiliar areas. Information technologies provided for the collection of data from various sources, including static and social, and further encourages the user to his places of interest (POI) and routes to pass the maximum number of POI, with maximum regard to his personal requirements and interests.

Conclusion

Trends that trace the markets of travelling information technologies identify personalization and information-technological support for tourist at all stages of his journey, information and cognitive tourism thematization and adaptation to individual wishes of its financial and tourist opportunities as main directions of development.

From the above examples of modern tools in the field of touristic GIS applications, we can conclude that each of them is focused on solving the precise problem one or two problems that tourist faces during the trip. But none of these applications does not provide IT support and user support at all stages of tourist's journey. Another disadvantage of many developments is their "narrow" focus on separate resort area, city or tourist attraction points [6,7]. At present, the information technology market gives no touristic GIS, which could be equally effective to provide information support and accompany tourists in different regions of the world. As a result of the analysis can be highlighted a number of problems that can and must be effectively and comprehensively implemented with GIS tools. These include in particular: the picking of the tourist's route; maintenance and tourist's navigation on the route; adjusting the route to the current location of the user and his chosen mode of transport; the optimal selection of transport (route number for public transport).

One should note the relevance of creating an integrated system using GIS tools to promote tourist at all stages of his journey, which should include:

- details of touristic and other facilities location;
- thematic information about the type and characteristics of various infrastructure facilities (dining, accommodation, entertainment, service departments, etc.);
- selection of infrastructure facilities for the tastes and wishes of the user;
- augmented reality in the form of 3D-models of streets, buildings and other facilities;
- presence of digital maps, additional information as text, photo, video and audio materials.

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Intelligent control systems of electrical complexes in biotechnological objects

Vitaliy Lysenko, Alla Dudnyk[1]

[1]Automatics and Robotic Systems Department,
National University of Life and Environmental Sciences
of Ukraine, UKRAINE, Kyiv, Geroiv Oborony street 15,
E-mail: dudnikalla@mail.ua

Abstract – The aim of this paper is to substantiate efficiency of creation automation control system in a greenhouse with using solar radiation intensity and temperature predictions by neural networks.

Key words – control system, biotechnical object, electrical complex, neural network, forecasting, greenhouse, poultry farm.

I. Introduction

Biotechnological objects primarily include poultry farms and greenhouses. Both areas except technology and process equipment (technical facility) have biological filling (chicken, plants). Each of these biotechnical objects characterized by a significant energy consumption. So for poultry in the cost structure of production, the share of energy up to 20 % [1], and for greenhouse plants - up to 70 % [2].

With rampant increasing of energy prices is important to use control algorithms of electrotechnical complexes which accompany appropriate technology, taking into account the biological filling state and maximize production profit primarily by reducing energy costs. The intelligent control systems of electrotechnical objects are able to form such algorithms, which are used the theories of stochastic processes, neural networks, game theory and statistical decisions, etc.

II. Material and methods

The evolution of control systems of electrotechnical complex for technological objects (Fig. 1) started with systems that form the stabilization algorithms (phase I). But even now, despite sophisticated technological equipment available both in poultry and for greenhouse continue to use simple control algorithms of electrotechnical complexes - stabilizing algorithms. At the same time international and national experience has shown that their application can be justified only to some extent, under conditions of low energy prices. In this case, by biologists in fitotronah zootronah technological standards and controls stabilized without the character of natural disturbances and states of biological objects, which allows in certain seasons to maximize their productivity. But even in these cases often actuators capacity is not enough for the viability of biological filling in optimal in terms of its performance conditions.

In the 90's of the previous century, when energy costs began to rise, offered as a separate development, the use of algorithms that minimize energy use for individual processes (Stage II) [3]. Later, given the properties of objects change their dynamic parameters were tested adaptive systems (Stage III) capable of in service take into account these circumstances, realizing optimum process control algorithms [4]. But systematically tailored to suit biological content, the analysis of natural disturbances, state of the market value on energy production and quality to ensure maximum profit production can only intelligent control system (Stage IV) [5]. As shown in the figure, their advantage is obvious and provided a significant decrease in the energy component in the production costs structure.

III. Results and Discussion

According to preliminary research reducing of energy consumption through the development and implementation of intelligent control systems using the latest methods and means of automation, able to predefine control action based on disturbances forecasting, technological requirements and biological object characteristics.

Neural network forecasting of external disturbances can increase system performance up to 20 % and can increase technological efficiency up to 13 %. Also, additional energy savings can provide phytomonitoring of plants. Phytomonitoring can be implemented using modern robotic technical systems to ensure reliability and efficiency of a given measurement.

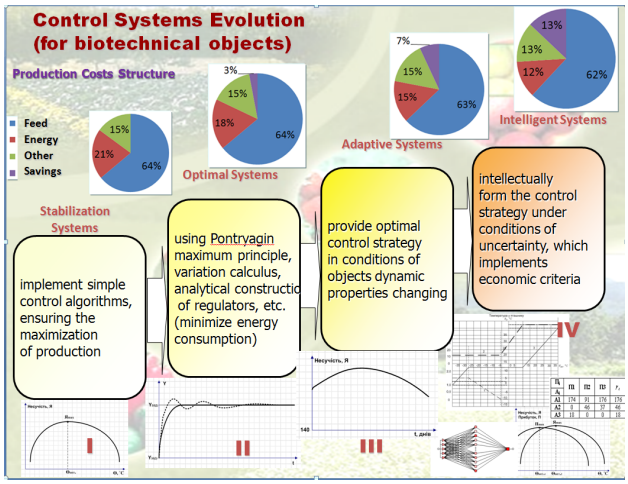

Fig. 1. Control Systems Evolution.

Review of the functioning of the process facilities along with the peculiarities of the dynamics of natural disturbancesand living organisms states and the rational use of energy resources will increase profits from production. Experimental studies depending on the main quality parameters of biological objects from change of microclimate and establish the most productive growing conditions have provided the mathematical model of states of plants that were later used in the formation of management strategies.

Sample of energy efficient control systems electro technical complex in greenhouses for production testing is implemented on the basis of forecasting natural disturbances using stochastic processes and neural (Fig. 2).

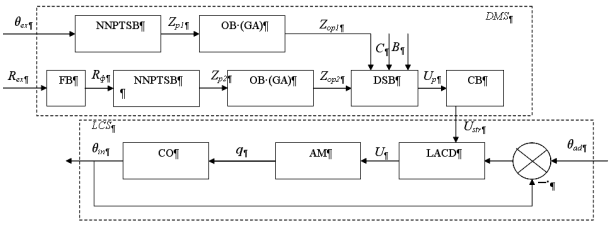

Fig. 2. Block diagram of the process control system in the greenhouse

Accordint to figure: DMS –decision making subsystem; FB – filtration block for solar radiation intensity; NNPTSB – neural network predictions for time series; OB(GA) –optimization block with genetic algorithm; DSB – decision making block; CO – control block; LCS – local control system; LACD – local automated control device; AM – actuating mechanism; CO – control object.

With a view to develop the information structure of the control system for biotechnical objects the problem area and all tasks which have to be solved were analyzed in detail. The main system units and data connections between them were allocated.

Tables, that contain all necessary information were formed using the relational database model (Fig. 3).

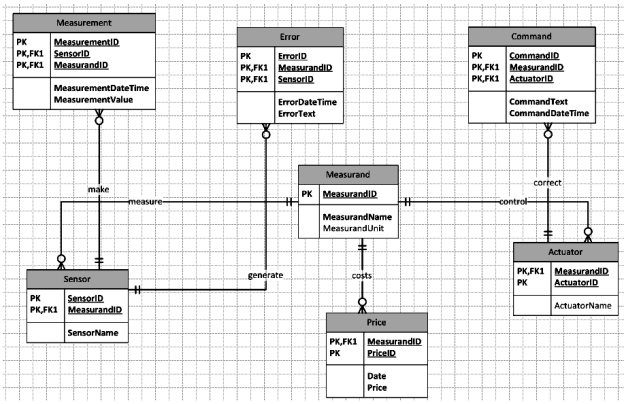

Fig. 3. Information structure of decision making subsystem

Entity SENSOR contains information about all sensors and counters available in biotechnical object; ACTUATOR - about actuators; COMMAND - an entity that contains a list of commands that are sent by the computer or controller to actuators; ERROR - table of errors which could arise during operation of automated control system. This information allows to signal the operator about error in time, and further analyze the control system in general with the aim of improvement. MEASUREMENT is an entity which contains measurements of all variables that are important for biotechnical object (temperature, humidity, water and electricity costs, etc.); MEASURAND - list of the variables which are measured by monitoring subsystem; PRICE - important information, that is used by control system to calculate the most effective control decisions.

Control system software for monitoring the external influences and technological microclimate parameters in a greenhouse was developed using modern IT methods and tools (Fig. 4).

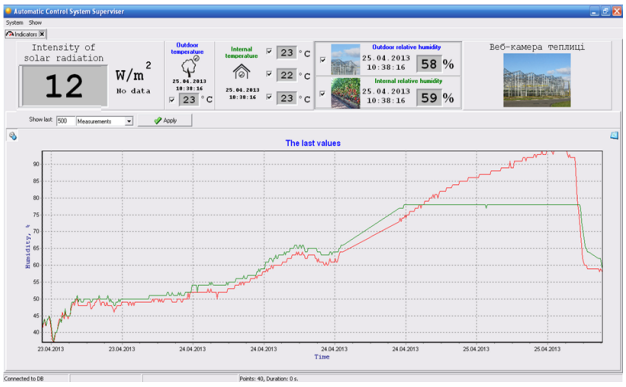

Fig. 4. Control system interface

The method of neural network prediction of natural external disturbances in biotechnical object has been developed. Networks type – multilayer perceptron with in hidden layers, have high predictive ability for temperature time series and solar radiation intensity. Genetic algorithm is a method that could be use for optimizing neural networks settings.

Conclusion

The study results of intelligent control systems of electrical complexes for biotechnological objects are given in this paper. For example, the control system of growing vegetables in greenhouses allows to provide the highest profit from the sale of products and to minimize energy costs by implementing additional unit for neural network prediction of external disturbances and determine the control actions using generalized optimality criterion.

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Automatization design of the user interface based on the knowledge that describes ontology

Iryna Zavuschak, Eugene Burov

Information Systems and Networks Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 32a, E-mail: iryska2009@ukr.net,
yevhen.v.burov@lpnu.ua

Abstract - The paper describes some approaches to UI design automation based on the knowledge that describes ontology domain. Tools interface development based on ontologies software, based on the principle of separation of designing and implementing the user interface and business applications and their subsequent binding and automatic code generation interface for its model. To develop the proposed ontology, in terms of which UI developers form the corresponding components of his model; generation interface is more programming languages on different platforms; supports both local and network interaction with business applications; Model interface is divided into components according to groups of professionals engaged in its development (subject area experts, programmers, designers) and contains all the information necessary for its development and automatic generation according to the model.

Key words – design, implementation, ontological modeling, models, approaches and methods of design automation interface, intelligent information systems.

I. Introduction

Currently, the actual problem is conceptual formation "transparent" representations for weakly structured domains. Today the leading paradigm structuring information flows are ontologies or hierarchical conceptual structures that formed the analyst on the study and structuring of information flows, documents, protocols learned knowledge and other sources.

Ontological engineering (OE) develops the main provisions of engineering knowledge - science models and methods of collecting, structuring and formalizing knowledge.

Actually knowledge engineering - an area of artificial intelligence, while the OE covers a wide range of applications - from knowledge management systems to distance learning.

Ontological engineering is taking its first steps, so each analyst goes through trial and error, creating complex ontological structures that reflect the maze of professional knowledge in various application areas.

Today artificial intelligence - a broad area of research and development of intelligent systems intended for use in areas of human activity, it is difficult formalized. Currently, decided to allocate several areas of artificial intelligence. One of the areas associated with the development of intelligent systems based on knowledge. In this direction are developing models of knowledge, creation of knowledge bases.

One of the promising applications of the methods of this area is the development of intelligent systems instructive. IIS intended for automation and individualization of learning. Traditionally, there are four models of knowledge used in the construction of knowledge bases of knowledge-based:

1. Logical model;
2. Production model;
3. Framed model;
4. Semantic networks.

However, currently of particular interest to researchers in artificial intelligence cause ontology. Ontologies can be used to represent knowledge about the subject area concepts and alleged relations between them, describe the content of web pages. In addition ontology can be used in the construction of knowledge bases ITS not only, but also any other programs.

Ontology is central to the systems using knowledge. By definition Gruber [1, p.2], ontology is a formal model of the conceptualization of the domain. This model contains a definition of the domain entities and relationships between them. Building software systems based on ontologies avoid re-conceptualization of the domain, which allows to reduce the use of resources at the analysis stage and system design. Impediment to the use of ontology when building software systems are purely declarative ontology, lack of representation in their procedural knowledge.

II. Organization of the formation and renewal of intellectual knowledge learning system

Ontology development in a particular subject area knowledge is a very complex and lengthy process, when for several years a group of developers creates a set of concepts of the domain ontology. Therefore, the system of formation of ontological knowledge base contains integrated tools combining ontologies that let you create and complement the main domain ontology learning environment through the use of subject knowledge (knowledge of software), presented the Semantic Web. Such ontologies will be called ontologies that complement or to simplify - components.

The source component ontology search system is multi-ontological information domains. Searches this system formed on the basis of tasks and thesaurus software expert local knowledge base. Found ontologies relevant components from external repositories and other educational resources are loaded semantic Web search engine to Business database integrated credit union ontologies.

It is necessary to consider some approaches to UI design automation based on the knowledge that describes ontology domain. Tools interface development based on ontologies software, based on the principle of separation of designing and implementing the user interface and business applications and their subsequent binding and automatic code generation interface for its model. To develop the proposed ontology, in terms of which UI developers form the corresponding components of his model; generation interface is more programming languages on different platforms; supports both local and network interaction with business applications; Model interface is divided into components according to groups of professionals engaged in its development (subject area

experts, programmers, designers) and contains all the information necessary for its development and automatic generation according to the model.

III. Design and implementation of ontology learning system

Approaches and methods for automated user interface design based on ontology software designed to address the following issues:

- Providing support for the development of sophisticated and complex interfaces (based on high-volume models the concepts of dialogue and manual tasks);
- Automation interface development to meet the requirements of users and their experience level of the computer; environment using a software system; taking into account the principles of "usability" (convenience and simplicity), different standards and guidelines for the development of style;
- Providing scalability for application of new knowledge about design, new guides users through style and standards development.

Computer ontology some subject disciplines can be regarded as significant, an open knowledge base represented conventional (formal) language specification knowledge.

Design and implementation of ontology is carried out on the following principles:

clarity - ontology must efficiently transfer sense imposed deadlines;

consistency - the definition should be consistent; extensibility - ontology should be designed so as to ensure the intended use for the separation dictionaries and terms that allow the possibility of expansion monotonous and / or specialization without the need for revision of existing concepts;

minimum impact coding - conceptualization, the underlying ontology created must be specified at presentation, not the character encoding;

minimum ontological commitments - ontology must contain only the most important assumptions about the world that is modeled to leave the possibility for expansion and specialization.

The process of creating an ontology includes three procedures:

Project management: planning, monitoring and quality assurance. Planning to determine which tasks should be performed, how they are organized, how much time and what resources are required for their implementation. Control ensures that scheduled tasks performed exactly as expected. Quality assurance need to be sure that components and products in general are at a given level.

Own development: specification, conceptualization, formalization and implementation. The specification defines the goal of an ontology, its intended use and potential users. Conceptualization provides structuring subject knowledge in a meaningful explicit model. The formalization of the conceptual model transforms the formal or "computer". In implementation of appropriate computer model programmed knowledge representation language.

On the wave of interest in ontology created tools and mechanisms specifically targeted the wide use of ontologies in problems of intelligent search, classification, identifying inconsistencies in the data model the behavior of intelligent agents. But even having a good tool environment does not eliminate the problems associated with the difficulties of designing and building the most ontologies, and ontology extraction process automation as a whole, job acquisition of knowledge, and the present have their effective solution. Especially valuable are already developed ontologies and experience to use them for a wide range of tasks.

The main provisions of the UI design automation is [2, 6]:

1. Increased general model user interface: the interface to the model adding new components - user models and model environment (in this case -o PO) using the program (to describe the various contexts of use).
2. Separation of knowledge needed for design automation at the groups that need iterative sequence for further automation.
3. Development of ontology software for each group MPO knowledge, in terms of which will be modified (change) knowledge of automation for each stage according to the requirements of a particular development or development of the subject area as a whole.
4. Development of a method of design automation interfaces based on the use of ontologies in the system software knowledge to the exclusion of modification of the method for changing knowledge.

Conclusion

On the wave of interest in ontology created tools and mechanisms specifically targeted the wide use of ontologies in problems of intelligent search, classification, identifying inconsistencies in the data model the behavior of intelligent agents. But even having a good tool environment does not eliminate the problems associated with the difficulties of designing and building the most ontologies, and ontology extraction process automation as a whole, job acquisition of knowledge, and the present have their effective solution. Especially valuable are already developed ontologies and experience to use them for a wide range of tasks.

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Image Structure Evaluation by Statistical Intensity Features

Roman Melnyk, Iryna Boyko

Software Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12,
E-mail: ramelnyk@polynet.lviv.ua, boyko.ira93@gmail.com

Abstract - In this paper an extraction of intensity variance, size-intensity mean features and color concentration is considered. Their effectiveness is evaluated for image structure analysis.

Key words – image intensity, size-intensity mean value, color concentration.

I. Introduction

Surface structure analysis and defects detection are being used in the automatic production of metal constructions, electronic circuit boards and so on. Automatic control could be realized by software having in its core algorithms to analyze and to compare the patterns of etalon and real samples of controlled surfaces. To simplify the problem the pattern is divided into some fragments and different intensity features for them as charts for similarity are calculated. So, the summary distance is taken as an indicator for surface structure irregularity, metal or board defects.

The pattern features are mainle based on intensity or color histograms, relative location of colored regions of objects, their shape, Fourier-functions coefficients etc. Nowadays there are a number of works dedicated to the algorithms of image features extraction. The [1 − 3] demonstrate the construction of regions, histograms of color blocks and their invariant coefficients. In [4 − 6], the shape construction algorithms of the main objects of attention and their quantitative characteristics are presented. Some systems segment the image into regions by color and size and then the feature vectors are calculated. The majority of the above mentioned approaches are quite complicated and time-consuming. So, in presented article two new statistical features are considered. They are proposed to be useful for surface image analysis, classification and evaluation of changes inserted by exploitation and elaboration.

II. Image Intensity Features

For image analysis and classification statistical features are widely used. The main features are based on intensity histogram and central moments by order *n :*

$$\mu_n[z(i)] = \sum_{i=0}^{L-1} (z(i) - m)^n \, p(i), \qquad (1)$$

where $p(i), i = 0,1,2,...,L-1$ is histogram.

However, this small number of statistical features are insufficient information for image classification and searching.. So, we propose to determine the main statistical moment (variance) for a number of image segments.

The image intensity is divided into n horizontal fragments with interval (intensity fragmentation step) d = 255 / n.

The intensity segment of image is a consequence of fragments and its intensity variance is as follows:

$$E^2(1 \div s) = \frac{1}{K_s} \sum_{i \in 1,...,K_s} (I_i(1 \div s) - \overline{I}(1 \div s))^2 \qquad (2)$$

where $I_i(1 \div s)$ – pixel intensity in the image segment, K_i – a number of pixels. So, we get the image intensity variance depending on the segment level

The next statistical feature – color concentration - we determine as the ratio of color pixel number and its perimeter length. We consider two sets of pixels : of interesting color (for example, we call them “black”) and the rest all pixels (“white”) of the image. The corresponding numbers of pixels we denote as S_b and S_w. Also we denote the border between the sets as $S_L(b,w)$.

The color concentration of “white” and “black” as follows

$$K_k(w) = S_w / S_L(b,w),$$
$$K_k(b) = (S_b - S_L(b,w)) / S_L(b,w) \qquad (3)$$

By realization of formulas (2) for all 255 intensity segments we get three image intensity features independent from any coordinate transformations.

Close to previous feature is so-called size –intensity feature. Having two image segments of conditionally “black’ and “ white” pixels we can measure the mean value of line lengths (sizes) in the selected segmented part of image. It could be in the “black” or “white” set. Also it could be by OX or OY coordinates, for example :

$$R_L(B_p, y) = \sum_{x \in X} R_{Li}(B_p(x,y))$$
$$\bar{R}_L(B_p, y) = R_L(B_p, y) / N_L \qquad (4)$$

where $R_{Li}(B_p(x,y)$ – i-th size in the segment $B_p(x,y)$, N_L - a number of lines

On fig. 1 an example of image and its intensity features are presented: histogram, cumulative histogram, color concentration of “black” pixels, variance and size-intensity.

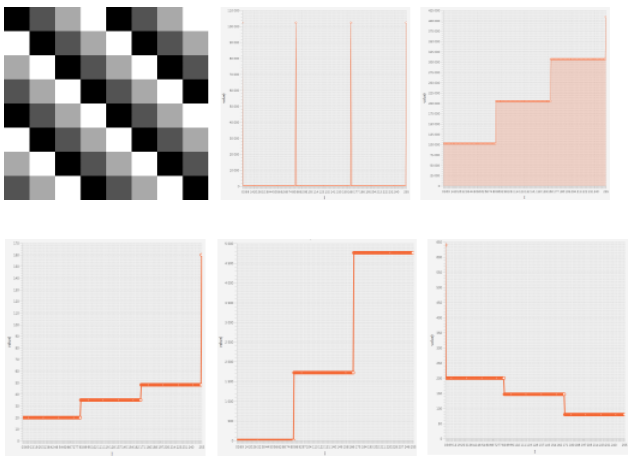

Fig. 1. Intensity features of the image

III. Measurement of Image Structure Regularity

The mage intensity features allow to measure regularity or irregularity of material surface structures. We consider, for example, two images of steel surfaces (fig. 2).

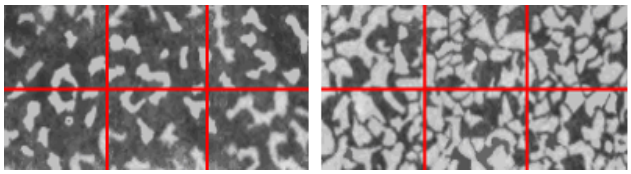

Fig. 2. Steel surfaces

Dividing presented images into six parts we calculate for every of them the intensity features (fig.3).

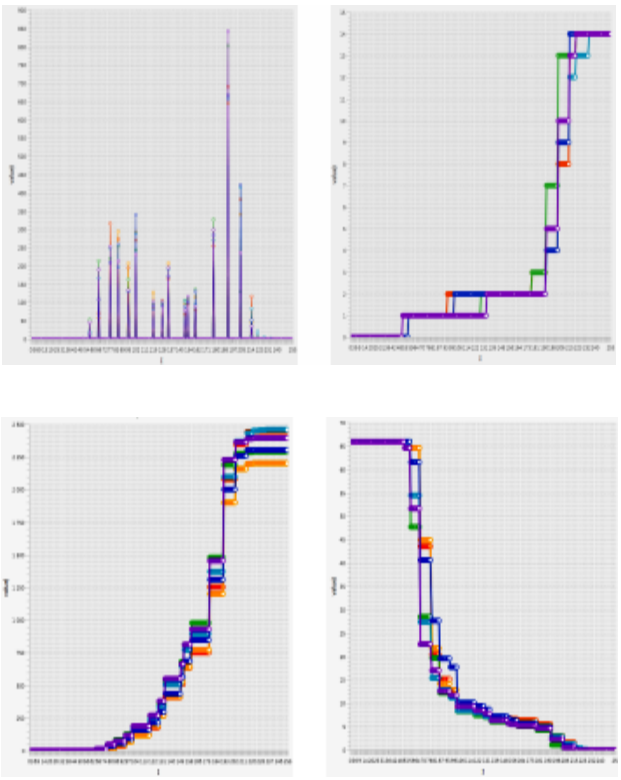

Fig. 3. Histogram, color concentration, variance and size-intensity of six parts

Having four characteristics for every image we calculate similarity function :

$$F_{kl} = \frac{1}{s} \sum_{i \in 1,\dots,s} (f_k(i) - f_l(i))^2 , \qquad (5)$$

where $f_l(i)$ $f_k(i)$ - intensity feature values,

An example of similarity matrix is presented in the table 1.

TABLE 1

SIMILARITY MARIX BY SIZE-INTENSITY

	1_0.png	1_1.png	1_2.png	1_3.png	1_4.png	1_5.png
1_0.png	0.0	1.8626	0.3675	7.4492	6.8389	7.237
1_1.png	1.8626	0.0	1.644	2.664	2.6465	2.4813
1_2.png	0.3675	1.644	0.0	5.499	4.8102	5.401
1_3.png	7.4492	2.664	5.499	0.0	0.2301	0.0216
1_4.png	6.8389	2.6465	4.8102	0.2301	0.0	0.3399
1_5.png	7.237	2.4813	5.401	0.0216	0.3399	0.0

To compare effectiveness of the considered intensity features we summarize all elements by every intensity feature of the steel to get the irregularity value by concrete characteristic. So the results are given in the table 2.

TABLE 2

FEATURE SIMILATIRY VALUES OF STEEL IMAGE PARTS

	Intensity	Concentration	Variance	Size-intensity
Steel 1	12,06	54,10	17,73	49,49
Steel 2	2,25	19,39	12,13	19,04

So, we can notice, that color concentration and size-intensity features give us greater intervals for estimation of image structure regularity or irregularity.

Conclusion

Some intensity features for image structure regularity estimation are proposed. They are based on statistical characteristics: variance and mean sizes value, color concentration. They are applied to measure a structure regularity of material surface. They could be used for image classification and searching on preliminary stages of pattern recognition.

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Valid formation of scientific schools

Iryna Zheliznyak

Information Systems and Networks Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 32a, E-mail: iryna.zhelizniak@gmail.com

***Abstract* – In this paper are described the methods of clustering papers by scientific schools. The algorithm of clusterizing abstracts based on the developed models and methods of frequency analysis of terms in sentences and determining the weight of sentences was reviewed. Also, in this paper i analyze the algorithm of summarization of natural language documents using the concept of importance coefficients.**

Key words – clustering, text information, scientific schools, ontology, scientific direction, electronic libraries.

I. Introduction

The task of processing text data requires the use of different algorithms of division. You also need to use different mechanisms for additional data analysis and partitioning into different subcategories for further work.

Using the selection of keywords from the text makes it possible to search for relevant information long enough period of time.

Keyword - a word or phrase sustainable natural language used to express some aspect of the content of the document (or query); a word that has significant meaning. It can serve as a key when searching for information on the Internet or on the page.

Art keyword selection, extracting the most important or characteristic fragments of one or many information sources, has become an integral part of our lives. News offered - a summary of world events of the day. Quotes securities - "dry residue" of information about the sale, which continually generates market. Although some manufacturers already offer tools for keyword selection, volume information in the quickly growing and getting it correct construction is becoming more difficult. Tools such as Autosummarize feature in Microsoft Office, System IBM Intelligent Text Miner, Oracle Context and Inxight Summarizer (a component of search engine Altavista), certainly useful, but their options are limited allocation and selection of original fragments of the original document and connecting them short text [1]. Training is a summary aims to describe the main content of the text.

II. Data integration in electronic systems

The main difference between the means of the selection of keywords is that they essentially form a summary or collection of quotes from a particular material. Both types of presentation have two main objectives: to identify the most important point of full text and highlight key word.

Until recently, the general disciplines enjoyed increasing popularity, however, distribution mechanisms, and full-text search filtering information adapted to the requirements of specific users, lead to the fact that the essays that are set, are becoming increasingly important.

Using abstract methods to optimize the size of the text, but does not provide for automatic search documents. You can define the 3 most important points are not taken into account in the allocation of keywords from the text:

a) the division into parts on keywords (formatting);

b) allocation of keywords (by weight);

c) forming a synthesis document (in the form of statistics)

During data integration in electronic systems to provide a common understanding of the unified interface for user access to a set of independent sources that tend to have heterogeneity on some of their properties. The original class systems integration represent a system in which the basis for the Open Archives Initiative technology (Open Archive Initiative - OAI). Most famous of this category of information resources are a collection of text documents, especially scientific publications independently formed at the nodes of the global network, supported and managed by their owners. [2]

According to the technology OAI, provides for integration embodied in a single repository of information resources not of interest to users of the system integration, and presented some standard way of metadata describing the collection of information resources and sources of the archive collections of the individual elements. Collecting these metadata repository is made according to a specially developed protocol Open Archives Initiative - Protocol for Metadata Harvesting (OAI-PMH), which provides global access services and search.

There are several approaches to the problem of creation of electronic libraries with integrated information sources. Among them are the following two classes of systems:

- integrated Management of resources;
- driving with distributed resources.

Today there are two conceptual solution to this approach. First shows existence of a mechanism for cross-searching multiple archives, when all resources, bibliographic descriptions and search engine located in the organization. This search is made by direct appeal to all or selected users E in order to be able to provide centralized in one place search-based libraries, followed by the construction of the results in a single list. Second - offers to collect metadata describing information resources collected metadata. In fact it is some analog integrated electronic directory.

III. Concept and importance of scientific schools

From development and research work focused largely depends scientific image and quality of university students. Dictionary defines school as a scientific direction in science-related unity of common beliefs, principles and techniques of continuity [3]. By definition K.Lanhe, scientific school - is an informal research group, formed around the renowned scientist at the research institution that combines for collective development of certain scientific ideas, problems and direction of a number of separate research teams.

Scientific school - a community of people, formed under the auspices of personality - the scientist and leader who has ideas, themes for development. No leader - no school. The best schools - those where the followers of the leader involved active research in topical areas and the combined ideas, methods, research traditions, enhanced cooperation, search of new facts [3].

One of the most important results of functioning scientific schools are scientific publications of its members.

Among the factors effective functioning scientific schools are the following:

• determining the scientific direction of scientific topics relevant profile, prospects of its development;

• formation of research units (institute, department, laboratory, center), university faculties, chairs;

• formation of research teams, careful planning research;

• establish a modern logistics research base;

• publication of basic scientific works: monographs, scientific manuals, articles in professional journals, including international;

• availability of professional scientific periodical;

• annual scientific events, symposiums, conferences and seminars.

Signs scientific school is the presence of the scientific community that develops in time and space; focus on the development of new, original direction in science; common research interests, principles and methodological approaches in carrying out productive research program; multiple generations of scientists (link "teacher - student"), a recognized leader united; improving scientific skills of participants schools; publication of scientific results (publications, reports).

The criteria for recognition of academic schools are matching profile theme state priority areas of science and technology programs of the Ministry of Education, Youth and Sports, the National Association sciences industry; doctoral and master's theses in the direction of the school; availability discoveries, inventions; publication of monographs and articles in professional journals, deposit accounts; organization of scientific events: the annual international or national conferences, permanent seminars; are based on current school research and production structure of the state level.

Clustering is important in obtaining relevant information, navigation, text summarization and organization of documents available online, electronic libraries and corporate networks.

Therefore, to date, relevant is the problem of finding optimal solutions to the problem of clustering documents. Often happens when the entered user query returns a huge number of references to the text and other materials. Typically, the query results are linear lists with a simple transfer of objects, sorted by relevance to the query.

At a time when a large number of objects, natural desire is to get the user a short list of categories of documents found. Breakdown of total documents in the category subject to the problem of clustering data.

Scientific direction - is the sphere of scientific research team to address some significant fundamental problems.

Scientific school - scientific team, which aims at addressing scientific direction [4].

This study determined set of scientific school publications Sch, characterized by multiple keywords Key, multiple authors set Author and school founders Main:

$$Sch = \langle Key, Author, Main \rangle, Main \in Author$$

Input information for referring to the publication of scientific school of a file containing publication. Since the file is necessary to define the basic characteristics publication:

1. The author (s) of publication (A);
2. Scientific Institution (B);
3. Topic publication (C);
4. Keywords (D);
6. Article.

After the analysis of data and received the necessary information, you can start clustering publication.

Ontological approach - almost best to search for articles of a scientific school. However ontologies Ukrainian language is not so much. Therefore, the use of ontological search possible at the next stages of building a system analysis of scientific schools.

Conclusion

In this paper constructing of a formal model of data space and multiformat data processing techniques as well as possibility to clusterize abstract from sources of various formats are considered.

Summarizing of documents is an urgent and important task, which is very difficult for modern system of abstracting. Resources for referencing could have varied nature, so traditionally they required different pre-processing but using weights theory increases the quality of the resulting abstract. Methods of abstracting which are considered in this thesis can be successfully applied in modern information systems.

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Program Loading and Execution in Self-Configurable Computer Systems using the Conventional Operating System Loader

Viktor Melnyk[1], Andriy Kit[2]

[1]Security of Information Technologies Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: vamelnyk@lp.edu.ua

[2]Security of Information Technologies Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: andrew.kit.91@gmail.com

Abstract – The paper considers a new method of programs loading during the information processing in the self-configurable FPGA-based computer systems.

Key words – self-configurable computer systems, operating systems, loader.

I. Introduction

The self-configurable computer system (SCCS) is a computer system with reconfigurable logic, where program compilation includes automatically performed actions of creation of the configuration, and which acquires of that configuration automatically in the time of program loading for execution [1], [2].

With the implementation of the concept of self configuration we must load and execute not only the object file but to create a configuration file and load it into the reconfigurable unit. In this regard it is necessary to provide a transparent for the user mechanism of configuration file loading. The object file is loaded and executed applying a conventional OS loader (in our case we use Linux).

II. Method of Program Loading and Execution in the Self-Configurable FPGA-Based Computer Systems

In Unix, the loader is the handler for the system call execve() [3]. The process of loading the programs in UNIX-like operating systems include an execution of system call exec, execution of system call handler and kernel procedure which select the desired handler. The actions that run at the stage of the program loading according to the proposed method during the information processing in the SCCS are shown in Fig. 1. This method involves extension of the conventional loader of Linux for the implementation of parallel downloading object files and FPGA configuration files:

1. After program initialization, *Executable File with .sccs Extension sccs_loader()* procedure executes a system call *execve* and run *Configuration Loading Script*. *Execve()* executes the object file.

2. *System call handler* in the kernel gets control and starts handling this system call. This handler is called *sys_execve.*

3. Universal system call handler (*do_execve*) creates and fills the appropriate data structure, copies the information from the user space to the kernel space and finally calls *search_binary_handler()*, which selects the desired loader, for instance *load_elf_binary(),* for executable and linkable format handling.

4. The loader performs validation (permissions, memory requirements etc.), copying the program image from the disk into the main memory, copying the command-line arguments on the stack, initializing registers (e.g., the stack pointer). Then *start_thread()* (a part of *load_elf_binary()*) launches the program for execution.

5. *Configuration Loading Script* launches the Altera Quartus II software and contains quartus command-line executable, bash and tcl scripts for the forming the device configuration file (A Programmer Object File with .pof extension or SRAM Object Files with .sof extension) from VHDL-model and loads it into the reconfigurable environment.

The Quartus II command-line executables provide control over each step of the design flow and allow to automate all segments of the FPGA design flow [4].

Tcl (pronounced "tickle") stands for Tool Command Language, a popular scripting language that is similar to many shell scripting and high-level programming languages. It provides support for control structures, variables, network socket access, and APIs. Tcl is the EDA [5] industry-standard scripting language used by Synopsys, Mentor Graphics, and Altera software [6]. The Tcl scripts allow us to perform a wide range of functions, such as compiling a design or writing procedures to automate common tasks.

Bash is the shell, or command language interpreter, for the GNU operating system [7]. At its base, a shell is simply a macro processor that executes commands. The term "macro processor" means functionality where text and symbols are expanded to create larger expressions. A Unix shell is both a command interpreter and a programming language [8]. Bash helps us to interact with the operating system.

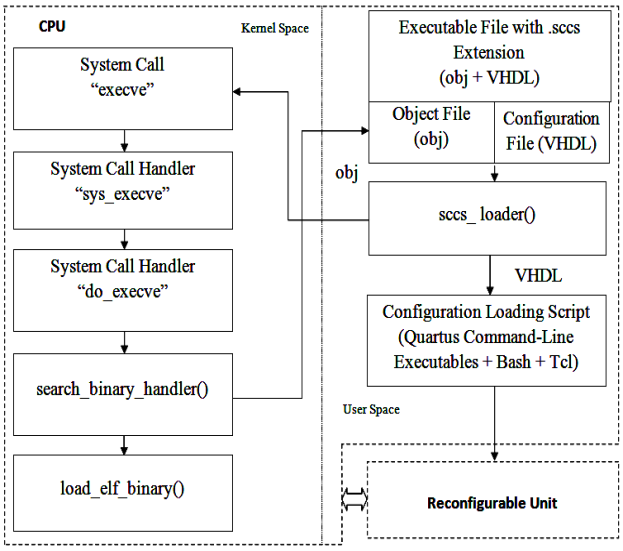

Fig. 1. Program loading and execution in self-configurable computer systems using conventional operation system loader

System call *execve*, system call handlers *sys_execve* and *do_execve* as well as procedures *search_binary_handler()* and *load_elf_binary()* are the part of standard mechanism of program loading in Linux. But *Configuration Loading Script* and *sccs_loader()* are our own procedures. *Executable File* with .sccs extension is the executable file in self-configurable computer system that conjoin object file and configuration file.

In *Configuration Loading Script* we configure the Linux user environment (set environment variables and so on), start the Quartus II software and set up the license manager server. *Configuration Loading Script* uses Tcl scripts to create, compile and manage a Quartus II project, make assignments, define design constraints, make device assignments, compile the design, perform timing analysis, and access reports. It implements FPGA design flow with Quartus II (Fig. 2).

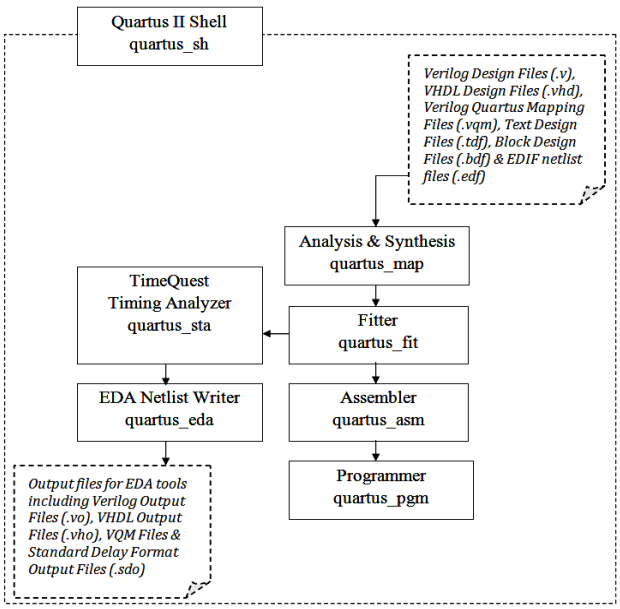

Fig. 2. FPGA design flow with Quartus II

Lets take a look at command-line executables for each stage in the design flow.

The Quartus II Shell acts as a simple Quartus II Tcl interpreter. The Shell has a smaller memory footprint than the other command-line executables that support Tcl. The Shell may be started as an interactive Tcl interpreter (shell), used to run a Tcl script, or used as a quick Tcl command evaluator, evaluating the remaining command-line arguments as one or more Tcl commands.

Analysis and Synthesis tool builds a single project database that integrates all the design files in a design entity or project hierarchy, performs logic synthesis to minimize the logic of the design, and performs technology mapping to implement the design logic using device resources such as logic elements.

The Quartus II Fitter performs place-and-route by fitting the logic of a design into a device. The Fitter selects appropriate interconnection paths, pin assignments, and logic cell assignments.

Assembler generates a device programming image in the form of Programmer Object Files (.pof) or SRAM Object Files (.sof).

TimeQuest Timing Analyzer computes delays for the given design and device, and annotates them on the netlist. Then, the TimeQuest Timing Analyzer performs timing analysis, allowing you to analyze the performance of all logic in your design.

EDA Netlist Writer generates netlist and other output files for use with other EDA tools. Programmer programs Altera devices.

The Programmer uses one of the supported file formats: Programmer Object Files (.pof), SRAM Object Files (.sof), Jam File (.jam), Jam Byte-Code File (.jbc) [9].

For greater flexibility Configuration Loading Script must also detect family and part of devices automatically.

Conclusion

In this paper we have proposed a new method of programs loading in the self-configurable computer systems during the information processing. The paper considers a typical FPGA design flow with Quartus II design environment and a conventional program loader in OS Linux.

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The Use of Ant Colony Optimization Algorithms for the Problem of Optimal Route Search

Zoriana Rybchak, Vasyl Lytvyn, Natalia Kunanets

Information System and Networks Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: zoriana.rybchak@gmail.com, vasyl17.lytvyn@gmail.com, nek.lviv@gmail.com

Abstract – This paper introduces the ant colony system , a distributed algorithm that is applied to the traveling salesman problem In the ant colony system, a set of cooperating agents called ants cooperate to find good solutions to traveling salesman problems. Ant algorithms- a class meta heuristic methods solving combinatorial optimization problems. The basis of these algorithms responsible behavior of real ants in nature. Ants - a collective beings who build very complex social structure. Their ability to find optimal paths from nest to food sources has attracted the attention of scientists long ago. By submitting information to each other through chemicals including pheromone, ants form a chain of positive feedback. This relationship, in turn, leads to the fact that the ants eventually choose more optimal (short) path to the goal, although at the beginning there were many and they were very different.

Key words – ant colony system, traveling salesman problem, ant algorithms, optimization traveling salesman route, taboo-list, visibility and virtual pheromone trail.

I. Introduction

The purpose of the article is to introduce readers to the theory and the practical application of ant-alho rhythms optimization - a promising new method that is developed rapidly in the West, but is almost unknown in Ukraine. The main idea of this optimization method based on the principles of biological behavior of colonies of ants. Ant algorithms proposed in the early nineties. [1] The first article of ant algorithms in the international scientific journal published in 1996 [2]. A landmark event in recognition of feasibility studies in the field of formic optimization, the European Commission about the award in 2003 Marie Curie Foundation Prize for outstanding scholarly research-tion in the amount of? 50,000 ant algorithms inventor Dr. Marco Dorigo.

The article provides theoretical background ant algorithms, ant algorithms illustrated using the example of solving the traveling salesman problem and provides an overview of applications of ant algorithms optimization.

Ant algorithms research by scientists Shtovba Serhiy, Rudyi Oleg [18] and Kolesnikov Kostiantyn, Karapetyan Anait, Kravchenko Oksana [19].

The aim is to study the problem of finding the optimal solution to the traveling salesman problem using ant algorithm.

II. Ant Algorithms For Solving The Traveling Salesman Problem

Traveling salesman problem is to choose the shortest path not closed, passing through all the city exactly once. Consider how to implement the four basic components of self-organizing behavior of ants when optimizing a route salesman.

Multiple interactions realized iterative search for a route salesman simultaneous multiple ants.

Positive feedback is implemented as an imitation of the natural behavior of ants like "leave traces - travel in the footsteps". The more traces left on the trail - edge count, the more ants will move on it. Thus on the path, new tracks, which attract more ants. For the traveling salesman problem positive feedback is realized such stochastic right-scrap, "the probability of inclusion of ribs in the Count ant trail pheromone proportional to the number on it." Use of this stochastic rules and ensures the implementation of another component behavior of ants - randomness. Number pheromone that the ant lays on the edge of the graph is inversely proportional to the value-traditional route length corresponding salesman. The shorter route salesman found an ant, the more pheromone will be postponed to the corresponding edges of the graph.

Use only positive feedback leads to premature convergence algorithm, when all the ants move by the same second-best route. To avoid this negative feedback used - evaporation of pheromone. Time pheromone evaporation must not be very large because it causes shrinkage threat all trails ants in one suboptimal solution. On the other hand, the evaporation should not be small so as not to result in non-cooperative behavior of ant colonies because of memory loss. [6]

Go ants of the city i city j at iteration t algorithm depends on three components: the taboo-list, visibility and virtual pheromone trail.

Taboo-list - a list of cities that have already visited ant and go into that again prohibited. Taboo-list increases with exercise route and filled with zeros at the beginning of each iteration of the algorithm. Let J_i^k list of cities that have yet to visit ant k, which is re-in i. It is clear that the union of these lists gives the set of all cities with a route salesman.

Visibility - a value inverse distance: $\eta_{ij} = 1/D_{ij}$, where Dij - distance between cities i and j. Visibility is based only on local information and is a "heuristic desirability" choice city j, while in i. The closer the city i and j, the more the desire to visit them

Virtual pheromone trail on edge (i - j) is "desirable, backed by experience" go to town with city i- j. The information shall be pheromone changes during optimization and reflects the experience gained by ants. Number virtual pheromone on edge (i - j) on the t-th iteration of the algorithm denoted as τij (t).

Chance of transition k-th ant the city and the city j at t-th iteration is calculated by random proportional rule.

$$\begin{cases} P_{ij}^k(t) = \dfrac{\left[\tau_{ij}(t)\right]^\alpha \left[\eta_{ij}\right]^\beta}{\sum\limits_{l \in J_i^k} \left[\tau_{il}(t)\right]^\alpha \left[\eta_{il}\right]^\beta}, & j \in J_i^k; \\ P_{ij}^k(t) = 0, & j \notin J_i^k. \end{cases} \quad (1)$$

where α and β - two adjustable parameters, which are the weights pheromone trail intensity and visibility. Once that

α = 0, then most likely will switch to the next city. In classical optimization theory, this corresponds to the so-called bend algorithm. If β = 0, then only works Pheromones gain, which leads to a rapid completion of the algorithm through all routes shrinkage to one ant suboptimal solution.

After the end of the route, each ant k lays on edge (i - j) such amount of pheromone:

$$\Delta\tau_{ij}^{k}(t) = \begin{cases} \dfrac{Q}{L^{k}(t)}, & (i,j) \in T^{k}(t) \\ 0, & (i,j) \notin T^{k}(t) \end{cases},$$

Where Tk(t) - route made ant k at iteration t; Lk(t) - its length; Q - adjustable parameter values of the same order of choice of the optimal length of the route.

To enable the operating spaces decisions necessary to ensure the evaporation of pheromone - reducing deferred at previous iterations pheromone. Evaporation of pheromone given by the coefficient of evaporation $p \in [0,1]$. The final rule updates the pheromone, which covers all edges, takes the form

$$\tau_{ij}(t+1) \leftarrow (1-p)\,\tau_{ij}(t) + \Delta\tau_{ij}(t) \qquad (2)$$

Where $\Delta\tau_{ij}(t) = \sum_{k=1}^{m} \Delta\tau_{ij}^{k}(t)$; m - number of ants in the colony.

At the beginning optimize the amount of pheromone on the edges taken as a small positive constant τ0. Total number of ants in the colony assumed to be constant for the duration of solving the problem. Too many ants leads to rapid strengthening of suboptimal routes. When the ant is not enough, there is a risk of loss of cooperative behavior due to rapid evaporation of pheromone. Typically, the number of ants taking an equal number of cities - each ant trail begins with a single city. [12]

To improve the performance of elite ant algorithm using ant that under-edge best route intensified by T+, found from the beginning of the search. Number pheromone that is deposited on the edges of Route T+, is assumed to be Q/L+, where L+ - route length T+. Reinforced pheromone trail along the route of T+ will guide other ants to finding solutions containing several ribs the best route for now T+. If Murashi e-nick is elite ants, the best route rib T + total gain will eQL +. The ideas of elitism found in the development of Rank-Based Ant Systems [7] Ant Colony Systems [8] max-mine ant algorithms (MAX-MIN Ant Systems) [9]. These algorithms optimize likely due to the increase of the probability-choice perspective fragments routes.

When solving problems of large-scale appropriate to use a list of candidates - a short list of recommended peaks, which can go on this ant top. Ant chooses not recommended by the top only when it has already passed the entire list of candidates. List of candidates forming heuristically based on a priori knowledge of the problem to be solved, or on the basis of information that is updated dynamically during optimization. The list of candidates will exclude pre-unpromising options. This allows you to send ants to study routes and thereby significantly reduce the search. For example, the traveling salesman problem with 2392 cities «Pr2392» [10] the optimal solution can be found if continuing to explore the trails in the neighboring cities 8 [11].

To speed up ant algorithms involve local search methods that try to improve the solutions found by ants. For the traveling salesman problem often used local search procedure 2-opt, 3-opt and Kernihhana Lin (Lin-Kernighan), which improve route replacing two, three and variable number of arcs, respectively.

III. Ant Algorithm Optimization Of The Route Traveling Salesman (Programming Realization)

There are basic ant algorithm optimization traveling salesman route, which embodied the basic ideas of the previous section. [15]

```
Initialization algorithm parameters α, β, e, Q, τ0.
m = n {number equal to the number of ants cities}
For i = 1 to n
For j = 1 to n { For each edge}
If i <> j
η (i, j) = 1 / D (i, j) { Visibility}
τ (i, j) = τ0 { Pheromones}
Else t (i, j) = 0
End
End
End
For k = 1 to m
Place ant k randomly selected in the city.
End
Select conventionally T + shortest route and calculate its length L +.
{Main program}
For t = 1 to tmax {number iteration algorithm}
For k = 1 to m {for every ant}
Build route Tk(t) by rule (1) and calculate its length Lk(t).
End
If «The best solution is found"
Refresh and T + L +.
End
For i = 1 to n
For j = 1 to n {For each edge}
Update pheromone trails rule (2).
End
End
End
Display shortest route T + and its length L +.
```

IV. Use Of Algorithm Ant Colonies For Solving Vehicle Routing Problems

Today the problem of routing vehicles is a common optimization problems, its various wording in one form or another are found in many problem situations. Since it belongs to the class of NP-difficult problems, then problems real dimension not applicable exact algorithms to solve it. Ago VRP for finding solutions often use heuristics algorithms. Often, for various particular cases VRP different algorithms manifest themselves differently

because each particular setting VRP requires the use of the most effective approach for it [3].

This is a number of vehicles that can to carry out orders. For each pair of points (the points at refers to the location of all items for customers and staff) known costs direct jump from one subject to another. It is necessary to define such number of vehicles and the corresponding set of cycles (routes that start and end composition) that will serve all clients with minimal cost. Restrictions: Each customer goods should be delivered by only one vehicle and only once. To solve this particular case VRP was developed algorithm optimization approach based on ant colonies. The proposed algorithm works on the sameprinciple as the well-known algorithm of ant colonies problem Salesman [1,18]. Given the characteristics of VRP, this "standard" ant algorithm was introduced certain changes and modifications that will be described next.

In the Ant Colony Optimization for a traveling salesman problem "ant" corresponds to one path, because the solution of the traveling salesman problem is a sequence of points. In algorithm that considered one "ant" corresponds to the whole set of ways (one way per vehicle) because the solution VRP, unlike the traveling salesman problem is set ways. [13]

The algorithm consists of two stages. The first step is preparation for implementation iterations of ant algorithm, namely via Dijkstra's algorithm (its application is admissible, since all cost integral transport) are also remembered all the "shortest" way (least cost route) between all possible pairs of points. Also at this stage are initialized needed for the algorithm values: cost "ideal" solution L_{min} defined as the sum of constants construction value matrix C (ij c - Direct transition from point i to point j, the dimension of the matrix - (n +) 1 × (n +) 1, where n - the number of customers), and matrix F pheromones same dimension filled with identical values, commensurate with L_{min}. The cost solution initialized record infinity.

Next, the main stage of the algorithm is to implement Ant Colony Optimization iteration in the cycle. This cycle ends or when for some number of iterations current record solutions (best found with this since solutions) does not improve, or if the number of iterations performed exceeds the maximum.

One iteration cycle consists of a "run" assigned amount"Ants", each of which independently finds a solution to the problem. This is as follows. His way of "ant" from the beginning, his index (for convenience, let composition corresponds index 0) is written in the beginning path that passed the first of the vehicles. Early in his road vehicle considered fully loaded. To select further direction the current movement of the vehicle, a list of indices customers who zamovylytovaru no more than available on this vehicle. Among them played the next point at which the current vehicle unload the goods, with the following probabilistic formula:

$$p_{ij} = \frac{(f_{ij})^{\alpha} \cdot (\frac{1}{c'_{ij}})^{\beta}}{\sum_{j \in J} (f_{ij})^{\alpha} \cdot (\frac{1}{c'_{ij}})^{\beta}}, \quad (3)$$

where i - the index of the current item; j - index of possible destination for unloading; J - set of index points the location of customers, ordered that the product is not more available than the current vehicle; ij p - the probability of choosing j point as the next point where the goods will be unloaded; ij c '- the cost of "shortest" path from point i to point j; ij f - pheromone matrix element; α, β - constant ant algorithm.Defined in the first stage of the algorithm path of least cost this points to the chosen formula (3) is appended to the path, passed the current vehicle. After that, the vehicle is moved to a new item ships required quantity corresponding to the client, then again, a list of possible destinations, using the formula (3) to select the further direction of motion and the vehicle continues to deliver a product. It stops when the list of possible destinations is not any element, that is, when the quantity of goods remaining in the vehicle is not enough to meet the needs of any customer neobsluzhenyh or if potrebyvsih customers happy. Then, the vehicle is returned to the warehouse, and its path is appended least cost path from this point to the composition. If this still neobsluzheni customers, "ant" begins a new motion from the vehicle by the above rules. [14]

When the product is delivered to all customers, the latest vehicle returns to the composition and formation of the solution, found the current "ant" is completed.

Calculate the sum of the costs of all routes included in this solution, and compared with the current record value solution. If this amount is less than cost solution for the record, found a new solution considered record.This iteration are all ants. At the end of the iterationUpdate pheromone matrix is carried out according to the following formula:

$$f_{ij} = (1-\rho) \cdot f_{ij} + \sum_{k \in K_{ij}} \frac{L_{\min}}{L_k}, \quad (4)$$

where ij f - element matrix pheromones; Lmin - the cost of "ideal" set pathways(constant, calculated once at the beginning of the algorithm);Kij - set the current iteration of ants, which move i - j was selectedthe formula (3) or returning to the warehouse (j = 0); Lk - total cost a plurality of ways, found -oyu ant k; ρ – evaporation pheromone (constant ant algorithm).

The next iteration will differ from the previous matrix pheromones which affect the probability of selecting an item when driving vehicles. Upon completion of all iterations of the algorithm for the solution adopted record at the close of the algorithm.

Was created software that implements the algorithm and displays the results of its work. Experiments with this program revealed algorithm is always looking for solutions in the space of feasible solutions if at be one such solution is for typed input, and almost always finds solutions close to optimal, but small enough for problems dimension almost always just finds them the best solutions. The downside is relatively large (but still acceptable) the performance of the algorithm.Further work may be aimed at optimizing and improve the algorithm.

Conclusion

In this paper are represented basic ideas of ant algorithms based on self-imitation "social" insects - multiple dynamic mechanisms by which the system reaches global goals in the interaction of elements using only local information. Self-organization is the result of the interaction of these four components: accident, bahatokratnist, positive and negative feedback. In the article, the example of the problem of traveling salesman, shows how to implement the components of self ant algorithms to solve discrete optimization problems [16]. The conducted computer experiments show that the use of ant algorithms provides good, that is close to optimal, solutions to the traveling salesman problem for much less time compared to the branch and bound method and dynamic programming. The efficiency of ant algorithms increases with the dimension of the optimization problem.

Ant algorithms allow to get solutions of many discrete combinatorial problems better than other common metaevrystychni technology optimization and problem-some specialized methods. Very good results formic optimization for distributed systems, whose parameters are changing over time. The feature of ant algorithms have nekonverhentnist - even after many iterations simultaneously investigate different set of solutions that can not get stuck in local optima. This allows you to recommend the use of ant algorithms to solve complex combinatorial problems of discrete optimization.

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Galois Field Operational unit For Elliptic Curve Cryptography Digital Signature

Mohammed Kadhim Rahma

Computer Engineering Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery Street 28a,
E-mail: muhamed_kadhem@yahoo.com

Abstract – Cryptography is the most standard and efficient way to protect the security of data transactions. An efficient cryptosystem must be one that is strong enough to ensure a high level of security for reliable transmission of information. Elliptic curve cryptography is one such type of public key and private key cryptosystem based on small key size with high efficient speed up of cryptography process. Elliptic curve cryptography is an alternative to traditional techniques for public key cryptography. It can be called the future generation of public key systems since it involves less number of bits suitable for resource constrained and wireless applications without compromising on the security level. The proposed architecture for elliptic curve scalar is based on Point multiplication algorithm. It was also generated (Extension Field) assimilation by EF(3^{87}) where GF(2^{173})& EF(3^{87}) fields have approximately the same number of elements, and results were compared and implemented.

Key words – Galois field *GF*(2^n), *Extension Field EF*(p^m) , Elliptic Curve Cryptography, Digital Signature, Operational unit For scalar multiplication .

I. Introduction

This work introduces elliptic curve Cryptography Digital Signature over Operational Unit architectures designed to take advantage of the features offered by reprogrammable hardware, in particular field programmable gate array (FPGA) hardware.

The first elliptic curve cryptosystems were independently proposed in 1985 by Neil Koblitz and Victor Miller. Since its inception, elliptic curve cryptography has been the subject of extensive cryptanalysis.

Today, elliptic curve cryptosystems are being for deemed secure for commercial as well as Government use. Based on today's cryptanalytic knowledge, elliptic curve cryptosystems offer security comparable to that of traditional public-key cryptosystems.

II. Design HW Operational unit ECDSA

This section specifies an arithmetic unit architecture for GF(2^{173}) arithmetic and GF(p^m) arithmetic. The main components of the arithmetic unit are a multiplier, inversion and adder, also a register file, and a zero test circuit. The multiplier is used to compute multiplications and squares. The adder is used to compute additions and subtractions over GF(2^{173}).The inversion is used to compute division. The GF(p^m) arithmetic unit introduced here is based on a new range level of 173 bits where used prime (3) and m (87) for architecture arithmetic unit introduced here as work develops to GF(2^{173})architecture.

The elliptic curve processor architectures is in fig.1 introduced in this work. In this figure, the elliptic curve processor is composed by an arithmetic unit and two programmable processors the main controller and the arithmetic unit controller.

Main Controller (MC): The MC is a reduced instruction set processor, Fig.2. The MC is responsible for orchestrating the point multiplication process. In the computation of a point multiplication is using mixed or projective coordinates.

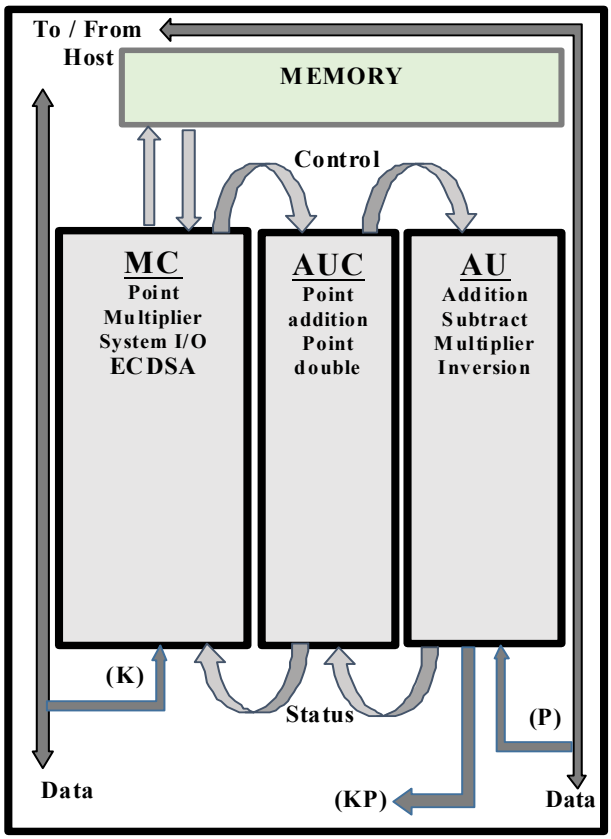

Fig. 1. Operation unit for ECDSA architecture

Arithmetic Unit Controller (AUC): The AUC is a reduced instruction set processor, fig.3. The AUC is responsible for processing MC commands. The AUC processes MC commands by guiding the AU through the computation of the necessary field arithmetic operations. In the computation of point multiplications, the AUC is responsible for guiding the AU in the computation of point additions, point subtractions, point doubles, coordinate conversions, multiplication and field inversions.

Arithmetic Unit (AU): The AU is the main processing engine of an elliptic curve processor. The AU performance dictates the performance of the elliptic curve processor. For high performance elliptic curve processors, the AU complexity also dictates the complexity of the elliptic curve processor, because for these implementations the aggregate complexity of the MC and the AUC is low in comparison with the complexity of the AU. The AU is responsible for performing field additions, subtractions, multiplications, inversion, and comparisons of finite field elements. The AU is also responsible for storing elliptic curve parameters, precomputed values, and temporary values. Fig. 4 shows a functional diagram of an AU. The adder, subtracted, multiplier, and inversion functional blocks represent the arithmetic functions performed by the AU. The zero test function (Reset) is using in the comparison of finite field elements.

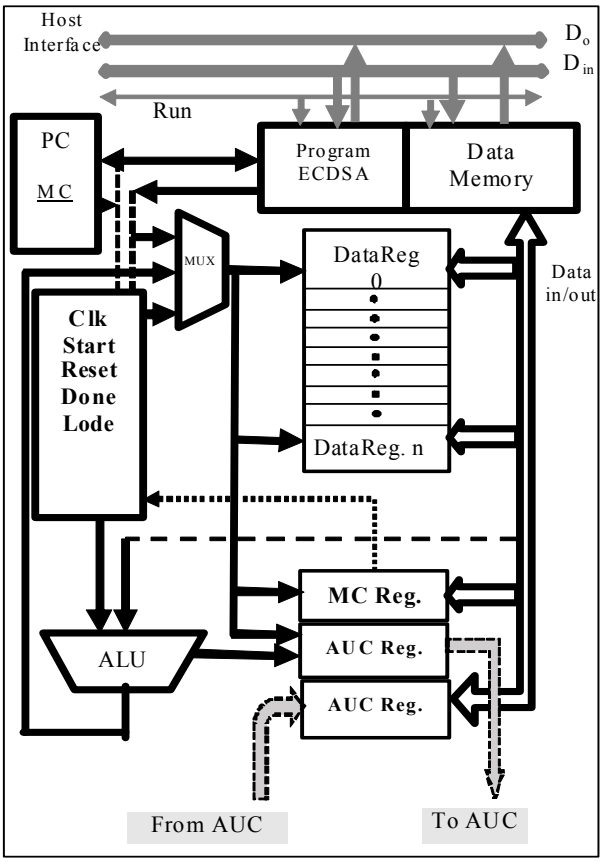

Fig. 2. Main controller (MC)

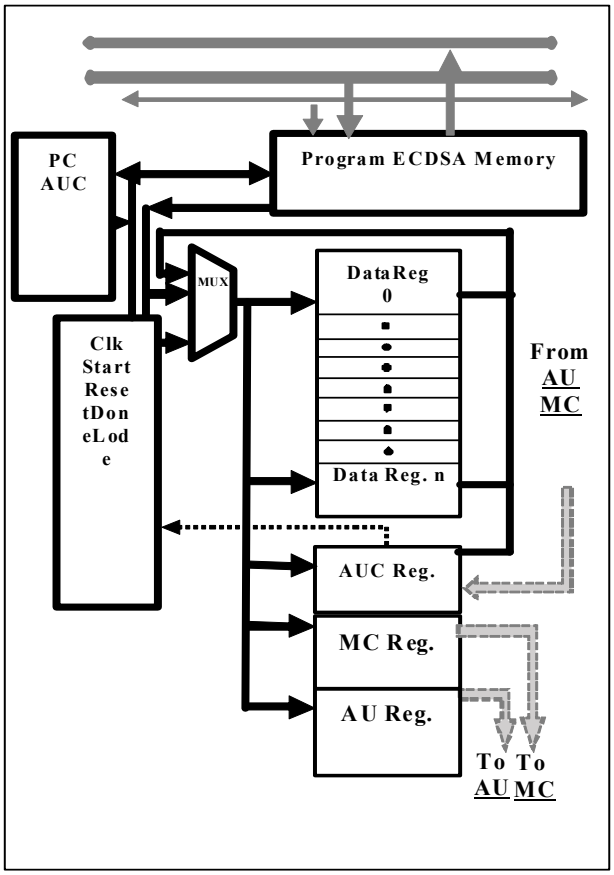

Fig. 3. Arithmetic unit controller (AUC)

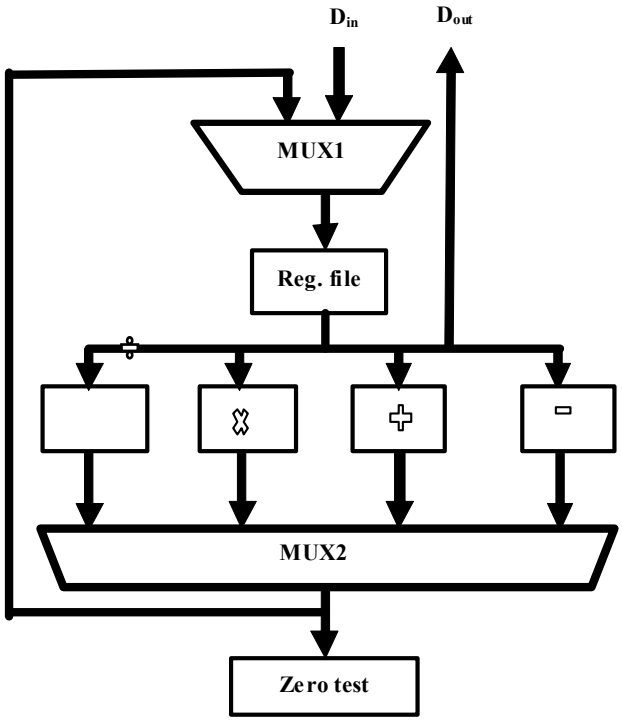

Fig. 4. Block diagram of the arithmetic unit

III. ECC Operations Hierarchy

Protocol Elliptic Curve Digital Signature Algorithm (ECDSA) is the number of mathematical operations hierarchy associated with the control unit according to the rules of the algorithm ECDSA, fig.5.

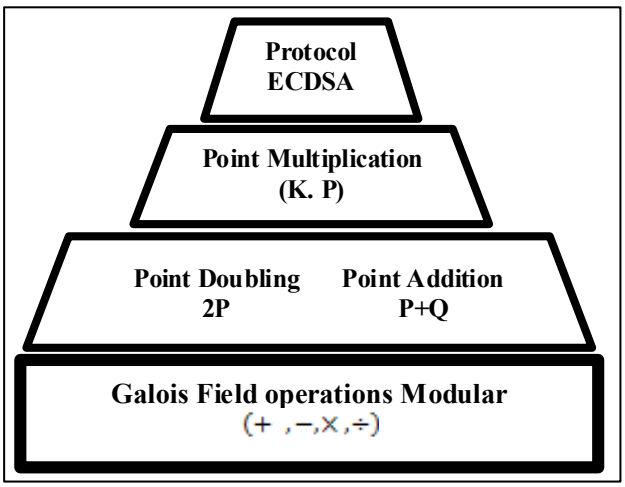

Fig. 5. ECC Operations Hierarchy

There are 4 levels in Fig.5. First level is basic Galois Field operations.GF addition, GF subtraction, GF multiplication, GF inversion. Second level is Elliptic Curve point operations or Scalar Point Multiplication. Add, Point Double, Arithmetic unit control level. Third Level is Elliptic Curve point operation level for the fundamental and most time-consuming operation, also it is Main control unit. Fourth Level is ECC protocol ECDSA level.

IV. Operations unit of GF(2^{173})

Generally, there are important arithmetic operations over the binary Galois Field $GF(2^{173})$, which includes addition, multiplication and inversion with represent polynomial base with irreducible binary polynomials $f(x)= x^{173} + x^8 + x^5 + x^2 + 1$ over $GF(2^{173})$.

Addition and Subtraction: The addition and subtraction operations in finite field binary arithmetic are simple XOR operation.

Multiplication: The multiplication of $GF(2^{173})$ finite fields elements $A(x)$, $B(x)$ can be performed in many ways as [1],[2] also we can use two type polynomial and normal base as [3] that implemented $GF(2^{521})$. Montgomery Multiplier implemented as shown [4] but in this work we use LSB-first algorithm which computes c(x) = a(x).b(x) mod $f(x)$ where $f(x)$ is the irreducible polynomial of the field, as shown Fig.6.

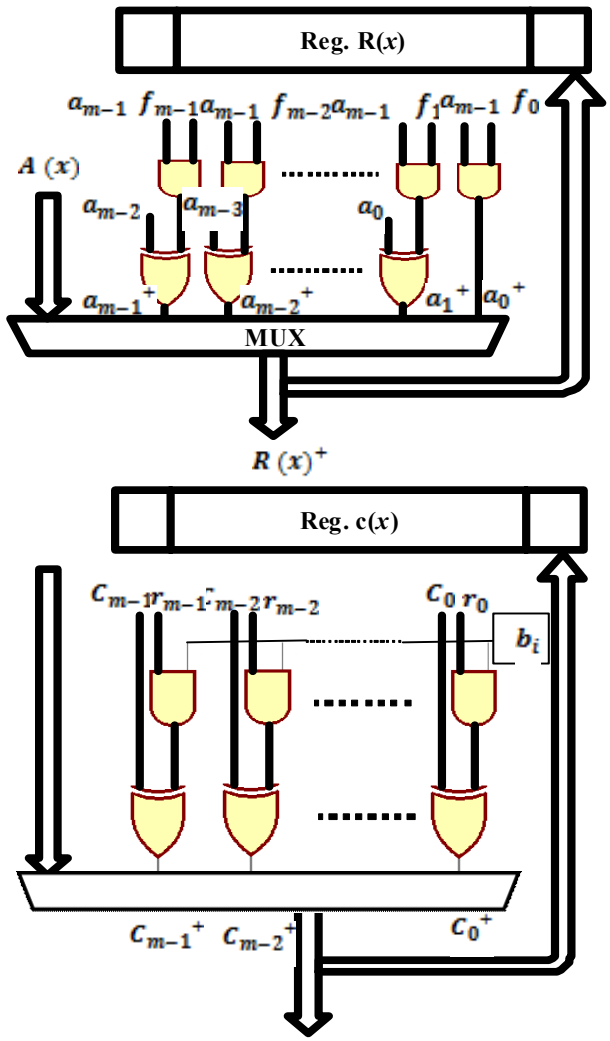

Fig. 6. Interleaved multiplier, computation of c(x) +bi . R(x); R(x).x mod f(x)

Division: it is the most time consuming operation in Galois field, Fig.7 because it has a multiplicative inverse as following: z(x) =g(x). h(x)$^{-1}$ mod f(x); **Where** h(x)$^{-1}$ = 1/h(x) **is** a multiplicative inverse. If g(x)=1 then z(x) inversion to h(x).

EC point operations over $GF(2^{173})$: Denote the elliptic curve over $GF(2^{173})$ such that $y^2 + xy = x^3 + ax^2 + b$ over $GF(2^{173})$ together with a point O, called the point infinity.

Point addition and doubling: Point doubling can be substituted by multiplication, over the finite field is constituted by the multiplication that done in the field arithmetic. Point addition is carried out in the field arithmetic. Let $f(x)= x^{173} + x^8 + x^5 + x^2 + 1$ irreducible polynomial and $P(x_1,y_1)$; $Q(x_2,y_2)$ are points in $GF(2^{173})$ as shown [5].

Point addition: $P+Q=(x_3, y_3)$;

$$x_3 = \lambda^2+\lambda+x_1+x_2+a \quad (1)$$

$$y_3 = \lambda(x_1 + x_3) + x_3 + y_1 \quad (2)$$

$$\lambda = (y_1+y_2) / (x_1 + x_2) \quad (3)$$

and point doubling: 2P=(x3, y3);

$$x_3 = \lambda^2+\lambda+a \quad (4)$$

$$y_3 = x_1^2 + \lambda x_3 + x_3 \quad (5)$$

$$\lambda = x_1 + y_1 / x_1 \quad (6)$$

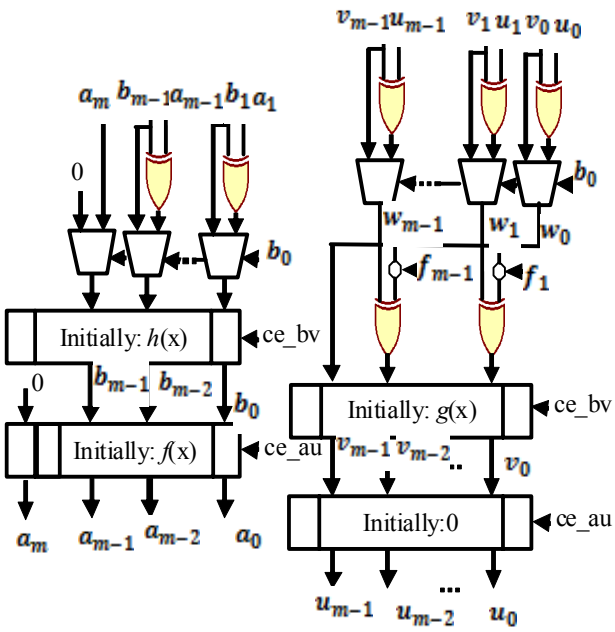

Fig. 7. Binary algorithm for polynomials division

V. Digit Size

After design and implementation Elliptic Curve Galois Field over $GF(2^{173})$ we can develop this work from the binary fields to extension fields to compare results and choose the best as Fig.8.

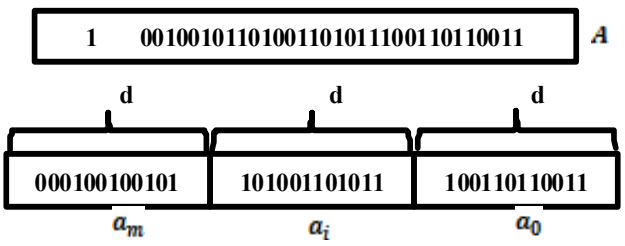

Fig. 8. Representation of large integers

VI. Operations unit over GF(p^m)

This operation is similar to Galois Field over $GF(2^{173})$, but different only in addition operation because the addition and subtraction have now different results. Therefore we need to implement subtraction into Arithmetic unit AU. Table 1 shows irreducible polynomial over $GF(p^m)$.

TABLE 1

IRREDUCIBLE POLYNOMIAL OVER (p^m)

$GF(p^m)$	Irreducible Polynomial over $GF(p^m)$
$GF(2^{173})$	$f(x)= x^{173} + x^8 + x^5 + x^2 + 1$
$GF(3^{87})$	$f(x)= x^{87} + x^{26} + 1$

Addition and Subtraction over $GF(p^m)$: The addition of two elements a and b in $GF(p^m)$ is performed by adding the polynomials $a(x)$ and $b(x)$ mod $f(x)$. The coefficients are added in the field $GF(p)$. The subtraction of two elements a and b in $GF(p^m)$ is performed by subtracting the polynomials $a(x)$ and $b(x)$, where the coefficients are subtracted in the field $GF(p)$.Hardware finite field addition module p is the most important part because all finite field depending on it. The addition field consist of : (3*m) register of d bits (*a reg., b reg.*)= (*s reg.*), MUX, adder and comparator with p. Hardware finite field subtraction is similar to addition with b_i complement or a_i complement.

Multiplication over $GF(p^m)$: This work will use array type LSE-first serial multiplier .Therefore, two registers c(α), $R(\alpha)$ are needed to store intermediate values. Since the degrees of (α_i. $B(\alpha)$ *mod* $f(\alpha)$) are m-1 and m respectively, the modular reduction can be computed by only one subtraction. In general, the reduction is achieved by interleaved methods because non-interleaved methods require a lot of hardware resource. A basic method to implement a multiplication for $GF(p^m)$ is a shift-and-add method.

The MOD unit in Fig. 9 is a part which computes $R(\alpha) = \alpha \,.\, R(\alpha)\, mod\, f(\alpha)$.

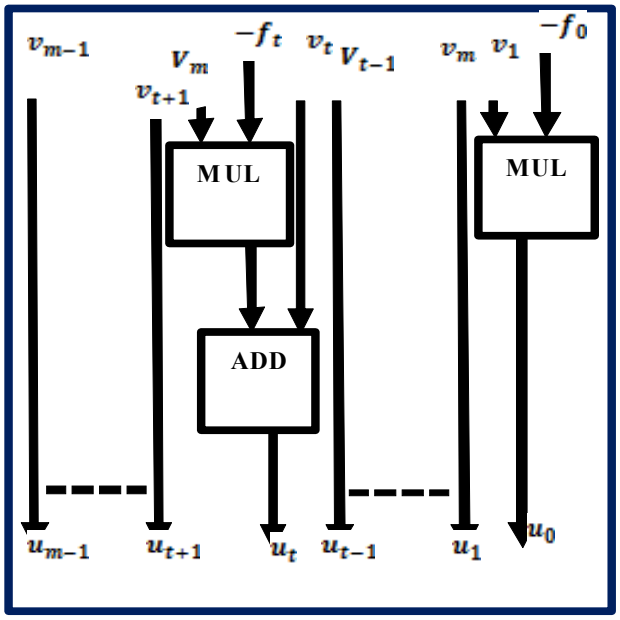

Fig. 9. MOD unit multiplier

Since the critical path of the MSE-first serial multiplier depends on the ADD unit and the MOD unit, the time delay is m MUL and $2m$ ADD, where MUL and ADD refer to $GF(p)$ multiplier and adder, respectively. For area complexity, m MUL at MUL unit, m ADD at ADD unit, and 2 MUL+1 ADD at MOD unite are required respectively. Therefore the total area complexity is (m + 2) MUL + (m + 1) ADD. As shown Fig.10.

Division: The inversion is a complex operation that is computed in (kP) operation. In this work we will select the square and multiply algorithm to perform inversion over $GF(p^m)$. To apply this algorithm, the multiplicative inverse of the field element A can be obtain by recursive squaring and multiplication. The inversion operation is divided in three steps for one register: initialization operation, iteration of the squaring and multiplication, and finally the result. See Fig.11.

EC point operations over $GF(p^m)$: An elliptic curve E that is define on a field p is expressed with the solutions of the Weierstrass equation and the point at infinity. General form of this equation given as follows:

$y^2+a_1xy+a_3y=x^3+a_2x^2+a_4x+a_6$. Let $P(x_1,y_1)$; $Q(x_2,y_2)$ are points in $EF(p^m)$ as shown [6], point addition: $P+Q=(x_3, y_3)$;and point doubling: 2P=(x3, y3).

In this work, an elliptic curve over GF(pm) is given by $E:y^2=x^3+Ax+B$. Where A,B$\in$ GF(pm) and $4A^3+27B^2 \neq 0$.

The important operation is scaler multiplication as shown [7] where presented the total time to all operations (point adding, point doubling and arithmetic unit operations).

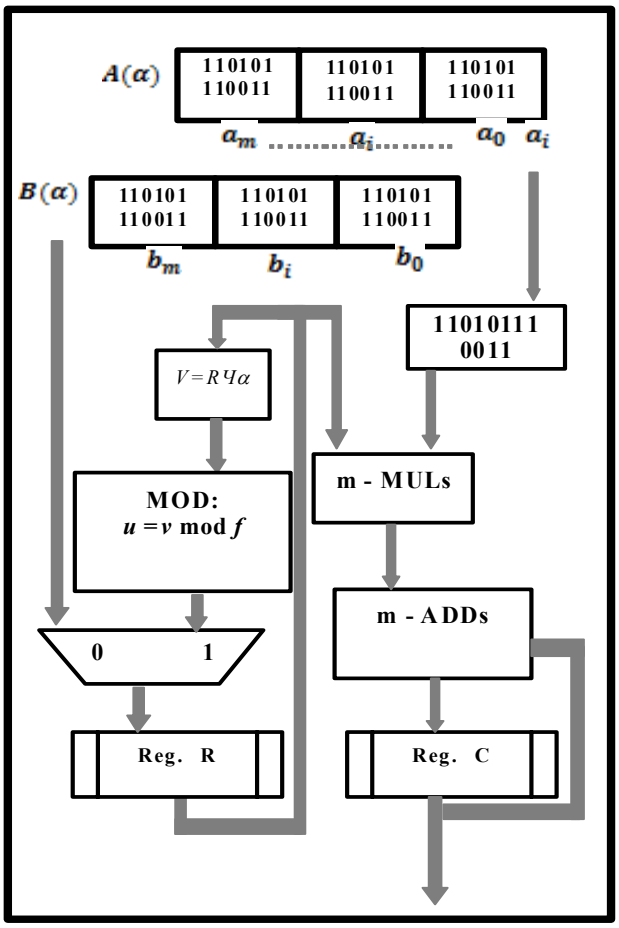

Fig.10. LSE-first serial multiplier for GF (p^m)

VII. Implementation and Results

In this work $GF(2^{173})$ numbers are 173 bits wide and checking of results is very bulky. In this matter, similar input/output have been written to the VHDL programming, in order to compare the execution steps, as well as the final results, timing is not taken into consideration in this specific stage for each field degree m, a pseudo-random curve is given, along with a Koblitz curve.

The pseudo-random curve has the form E: $y^2+xy = x^3+x^2+b$; a random curve over x^3 is denoted by _m. The Koblitz curve has the form E_a: $y^2+xy = x^3+ax^2+1$; where a= 0 or 1.For each pseudorandom curve, the cofactor is h = 2. The cofactor of each Koblitz curve is h = 2 if a = 1, and h = 4 if a = 0. A Koblitz curve over x^3 is denoted by k_m.

EC point doubling and EC point adding in Tables 2, 3. The results of arithmetic unit in Table 4. The results of compared to GF (2^{233}, 2^{173}, 2^{163}) in Table 5.The results of point multiplications in Table 6.

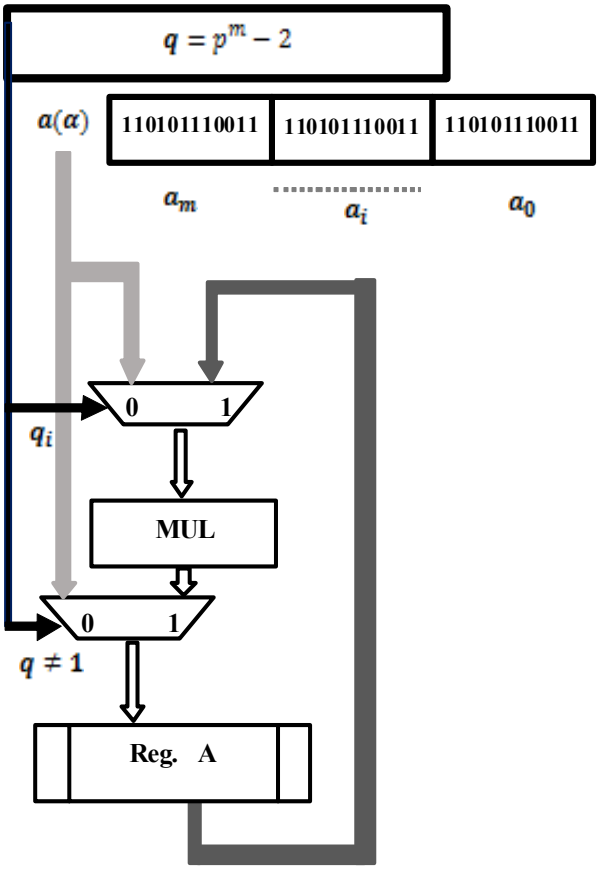

Fig. 11. Square and multiply for inversion GF(p^m)

TABLE 2

EC POINT DOUBLING

Operation name	Operation number	Clock Cycles
INV	1	346
MUL	3-1 synch.	346
ADD	3	3
----	----	695

Total Time EC point doubling = 69500 ns +delay.

TABLE 3

EC POINT ADDITION

Operation name	Operation number	Clock Cycles
INV	1	346
MUL	2	346
ADD	6-1 synch.	5
----	----	697

Total Time EC point adding = 69700 ns +delay.

TABLE 4

RESULTS AU

FF-Level Operation	Clock Cycles
FF-Mult.	173
FF-Add.	1
FF-inver.	346

TABLE 5

GF(2^{233},2^{173},2^{163})

GF Operation	MAX _Frequency
$GF(2^{233})$	136.323MHz
$GF(2^{173})$	142.857 MHz
$GF(2^{163})$	169.477MHz

TABLE 6

RESULTS SCALAR MULTIPLICATION

Operation	Clock Cycles
EC-Double	695
EC-Add	697
k·P	121,100
Time(k·P)	12,110,000 ns

Conclusions

This work introduces elliptic curve processor architectures suitable for the computation of point multiplications for curves defined over fields $GF(2^n)$ and fields $GF(p^m)$ where (n=173 bit and digits), (m= 87 digits) and (174 bits because p is prime and consist of 2 bits). The work presented here concentrated on the development of a high performance elliptic curve processor for the computation of point multiplications for curves defined over fields $GF(p^m)$.This work compared prototyped implementations of elliptic curve processors suitable for the computation of point multiplications for curves defined over fields $GF(2^n)$ and curves defined over fields $GF(p^m)$.

This work compared prototyped implementations of elliptic curve processors suitable for the computation of point multiplications for curves defined over fields GF(2^n) and curves defined over fields GF(p^m).

In summary, this work defines elliptic curve processor architectures suitable for the computation of point multiplications for curves defined over fields $GF(2^n)$ and

curves defined over fields $GF(p^m)$. These architectures are well suited for implementation in FPGAs, as it was proved with prototyped implementations: the fastest prototyped $GF(2^n)$ processor can compute an arbitrary point multiplication for curves defined over fields $GF(2^{173})$ is 12,110,000 nanoseconds and the maximum frequency F ≥100 MHz = 142.85714 MHz. The programmability of the processors allows them to incorporate new point multiplication algorithms without the need for reconfiguration. The wide range of time-area options presented for the different processors allows designers to tailor the presented architectures according to their cost-performance goals. The optimization of the processor architectures for FPGA technology allows implementations to evolve with advancements in FPGA technology; for example, as FPGAs become faster, processor implementations ported to faster FPGAs will achieve higher performance. In addition, as the densities of FPGAs increase the ability to develop faster processors increases. Finally, FPGA's re-configurability allows designers to use optimized point multiplication processors for different finite fields.

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Neural Network Technology for Image Downscaling

Roman Tytyk, Roman Tkachenko, Ivan Izonin, Kateryna Hrytsyk

Publishing Information Technology Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: ivanizonin@gmail.com

Abstract – in this paper described for the first time neural network technology developed to zoom out images scale. The developed method uses a neural structure model geometric transformations to establish the connections between frames pairs of images of high and low resolution. Adjusted so in the learning process synaptic scales allow to change the scale of images of one class without substantial loss of quality.

Key words – frame processing, resolution, reduce the image, machine learning, neural-like structure, model of geometric transformations.

I. Introduction

Scaling of images is an important task of technical vision. With the development of modern technologies, the resolution mobile displays increased to a satisfactory level, which leads to the possibility of high-quality image display. But same resolution pictures is much larger than the screen resolution of mobile devices. In this regard, there is need to develop an effective method decimation of image quality performance. The paper describes a new method reduce the resolution of images based on machine learning.

II. The task of reducing the resolution of images based on machine learning

Technological progress, particularly in mobile devices is not standing still. Resolution of cameras of these devices is growing, but the screen resolution, for obvious reasons, can not be as great. That is why there is an actual problem decimation of images while preserving their informative quality pictures to display on your mobile device. Known methods decimation characterized by low computational complexity and efficient implementation [3]. But they do not provide clarity of borders in images.

Moreover, the re-discretized images with specified reduction coefficient as a rule contain unwanted artifacts, foremost, Gibbs phenomenon, pixelisation, oversmoothing, different kinds of smudges, etc. In the research, we propose a new method for image resolution reduction, which is based on machine learning. The realisation of this learning algorithm is conducted with the help of neural structures with geometrical transformations. The reason why we chose this method is due to its multiple advantages over the existing neural networks [1].

The input data of method is a pair of images with low (image 1) and high (image 2) resolution. To implement technologies training these pictures are divided into the same number of frames (square areas of the function of the image intensity).

Obtained frames will be different in dimension (for image 1 and image 2 respectively) but their number - the same, for example ***n***. It is worth mentioning that when reducing an image with coefficient k, the variable that defines the size of the frame from image 2 needs to be k times smaller than the variable that defines the size of the frame from image 1.

Then, every frame is represented in a vector form. Let's say the vector of the frame in Fig.1 is $A_n^{(k)}$, and the vector of the frame in Fig. 2 is A_n. Next, we form a training matrix from the corresponding pairs of training images.

$$N = \begin{pmatrix} A_1^{(k)} & A_1 \\ \dots & \dots \\ A_n^{(k)} & A_n \end{pmatrix} \quad (1)$$

Next step is training our model using neural structure of geometric transformations model (GTM NLS).

Topology GTM NLS for this occasion is shown in figure 1.

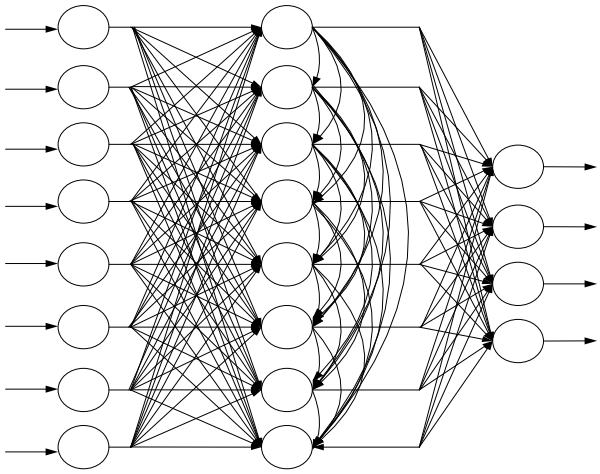

Fig. 1. NLS GTM topology for solving the problems of decreasing of images resoltion

The number of inputs of NLS GTM is defined by dimension of frame $\dim A_n^{(k)}$ and number of outputs - by dimension of frame $\dim A_n$. Study algorithm is described in detail in [2, 4].

In the use of NLS GTM input high-resolution image is given which is presented in the matrix:

$$T = \begin{pmatrix} A_1^{(k)} \\ \dots \\ A_n^{(k)} \end{pmatrix} \quad (2)$$

It should be noted that in the use mode other pairs of images different from training pairs can be used, but of the same resolution.

III. The modeling of the method

For the modeling of the method a couple of images with resolutions 504×504 and 252×252 pixels respectively have been used.

Low resolution image is presented on the figure 2.a). Figure 2.b) presents a test image of low resolution. High resolution images for both cases are not given. Coefficient of decreasing of resolution was k = 2.

a) training b) test

Fig. 2. Samples image

The purpose of the modeling was to establish the optimal parameters in adapting NLS GTM to solution of the problem.

The first experiment was to establish the optimum size of the frame for the best quality of the output sample based on PSNR rate. Parameters NLS GTM were described above, but here the number of neurons in the hidden layer was equal to the dimension of the input image frame. 5 experiments for different images were conducted. The dimensions of frames that were used in the experiments presented in Table 1.

TABLE 1

PSNR DEPENDENCE FROM CHANGES OF FRAME DIMENSIONS OF RELATED IMAGES

Dimension of the input image frames	Dimension of the output image frames	PSNR
2×2	1×1	33,0314
4×4	2×2	25,9687
6×6	3×3	22,1276
8×8	4×4	20,5778
12×12	6×6	19,2504

The results of experiments found that the best indicators of the quality of output images according to PSNR were received for the first case.This conclusion is confirmed for other images used in the experiment. Visibility of research results is shown in figure 3.

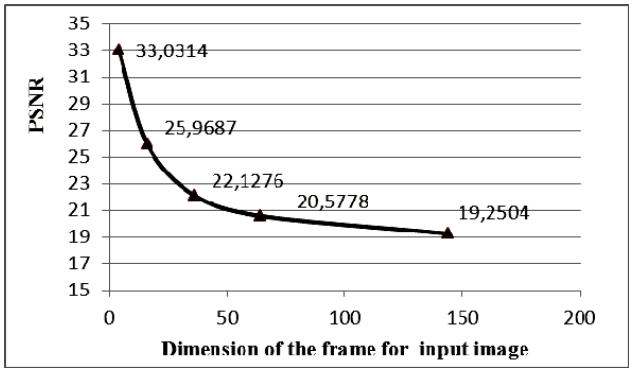

Fig. 3. PSNR dependence from changes of frane dimensions of input images

NLS GTM provides filtering noises of various nature by reducing the number of neurons in the hidden layer. Given this, in the next experiment we made reducing the image resolution by changing the number of neurons in the hidden layer. In the practical implementation of the method, given the results in Table 1, a pair of images were devided to the frames with dimension 2×2 and 1×1. So, number of inputs of NLS GTM equals to 4, and outputs - 1. Number of neurons in the hidden layer ranged from 1 to 4. Figure 4 presents the results of the experiment.

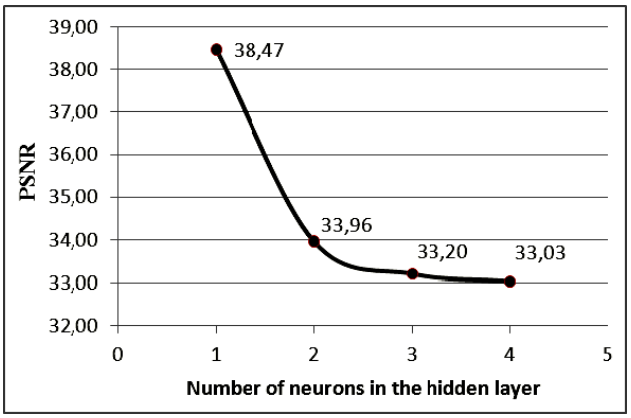

Fig. 4. PSNR dependence from changes of the number of neurons in the hidden layer.

Conclusion

The paper describes a new technology to reduce the resolution of images based on machine learning. Study is implemented by adapting of NLS GTM to solution of this problem. A number of practical experiments were conducted based on which optimal values of NLS were established. The peculiarity of the developed technology is that neural structure of geometric transformation model applied to one pair of images can be applied to other samples. However, it shows good results when using the images of one class.

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Research and development of methods to select the optimal location of vehicles on the parking lot

Rostyslav Kryvyy[1], Oleh Kovaliuk[2]

[1]Computer-Aided Design Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandera street 12, E-mail: rostyslav.kryvyy@gmail.com

[2]Computer-Aided Design Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandera street 12, E-mail: oleh.kovaliuk@gmail.com

Abstract – people often face the problem of finding the place on a parking, especially it applies to sites with multiple floors or to parking lots in large shopping centers with significant traffic. In such places drivers are forced to wander in search of a place, creating considerable inconvenience. Besides that, cars are parked in a chaotic manner and noone thinks how to optimize their location. That is why it is necessary to create a system that can simplify this process and automatically search a proper place.

Key words – parking, parking lot, vehicles, cars, optimization, genetic algorithm.

I. The purpose of the work

The purpose of this work is research and development of an algorithm for finding the optimal location of vehicles on the parking lot, as well as its implementation. This algorithm can be used either as a part of an automated system for assigning the parking places at the entrance to the parking lot or as a part of service for reserving parking places online.

II. Explanation of input and output parameters

There are two general groups of input parameters which are needed for the algorihm. The first one includes parameters which are common for all users and should be a part of system configuration. These are mostly the data, which characterize a parking lot in general and its parking places. These parameters are described in Table 1. The second group of input parameters for development of the genetic algorithm are the data characterizing a vehicle, the time period for which it will stay on parking, and the driver's personal preferences regarding convenience and price of a parking place, all these parameters are described in Table 2.

TABLE 1

COMMON INPUT PARAMETERS

$l_1,\ldots,l_n$	Set of all possible length values of a parking place
$w_1,\ldots,w_n$	Set of all possible width values of a parking place
fl	Number of floors within a given parking lot
$d_1,\ldots d_2$	Set of all possible distances from a parking place to an exit

TABLE 2

USER SPECIFIC INPUT PARAMETERS

VT	Type of vehicle, e.g. car, bus
T_s	Start date and time of parking
T_e	End date and time of parking
C	Coef value, which describes convenience and price of the place

The result of the algorithm is a set of parameters which describe the optimal location within a given parking lot, based on the input parameters specified in Table 1 and Table 2. All parameters of a final result are described in Table 3.

TABLE 3

RESULT'S PARAMETERS

l	Length of the optimal place
w	Width of the optimal place
fl	Floor on which optimal place should be located
D	Distance from the optimal place to the exit

III. Limitation of parameters

According to the physical limitations of the parking lot, parking place and the vehicle, there are a number of limitations, which should be considered within a specific parking lot:

- Minimum and maximum length of parking places within a given parking lot.
- Minimum and maximum width of parking places within a given parking lot.
- Minimum and maximum floor within a given parking lot.
- Minimum and maximum distance from a parking place to an exit.

IV. Algorithm for finding the optimal place

1. Generate random initial population considering physical limitations of a parking lot which were mentioned in Section III. Population size is 25% of the parking's size as specified in Eq. (1).

$$S_p = 0.25 \times S_{pr} \tag{1}$$

TABLE 4

EXPLANATION OF PARAMETERS FOR EQ. (1)

S_p	Size of the initial population
S_{pr}	Size of the paking lot

2. Loop through each individual within the current population created in the previous step and calculate the value of the fitness function using Eq. (3).

$$F(V) = \begin{cases} 0, \; if \; V_p < V_i \\ \dfrac{1}{\left| V_p - V_i + D \times 2 \right|}, \; if \; V_p > V \end{cases} \tag{2}$$

TABLE 5

EXPLANATION OF PARAMETERS FOR EQ. (2)

$F(V)$	Fitness function for length or width depending on input values
V_p	Length or width of a place
V_i	Length or width of a car
D	Distance between cars

$$F = F(l) + F(w) + T \times C \times \left(\frac{1}{fl} + \frac{1}{d} \right) \quad (3)$$

TABLE 6

EXPLANATION OF PARAMETERS FOR EQ. (3)

F	Resulting fitness function
$F(l)$	Fitness function for length
$F(w)$	Fitness function for width
T	Time between the start and the end date of parking in hours
C	Coef value, which describes convenience and price of a place
fl	Floor of a place
d	Distance from a place to an exit

3. Sort individuals in order of fitness function's value, choose 50% of all individuals with the highiest value of fitness function for applying genetic operator's phase of crossing to this group.
4. For individuals selected in the previous step apply the crossing operator in the following way:
   4.1. Choose two random individuals from group for crossing.
   4.2. Each descendant inherits properties from its two parents alternately, for example the first property is inherited from the first parent, the second – from the second parent, etc.
   4.3. The result of a crossing operation between two individuals are two descendants which inherit properties from parents in different order.
   4.4. Exclude two individuals which were used during this step from the group selected for crossing.
   4.5. If group with individuals selected for crossing is not empty go to step 4.1, otherwise go to step 5.
5. Among the current population apply the mutation operation in the following way:
   5.1. Choose a random individual from the population.
   5.2. Choose a random property of the selected individual.
   5.3. Change value of the selected property to a randomly generated one.
6. Prepare new population based on individuals from the previous steps in the following way:
   6.1. Add to the new population all individuals which were created during the crossing operation applied in step 4.
   6.2. Add an individual which was created during mutation operation in step 5.
7. If last iteration is achieved, the result is an individual with the best fitness function value - if not, go back to the step 2. Number of required iterations can be calculated using Eq. (4).

$$N = 0.5 \times S_p \quad (4)$$

V. Algorithm for finding the best place on the parking lot

1. Compare all available places in the parking lot with an optimal one, using Eq. (6).

$$S(V) = \begin{cases} 0, \text{ if } V_a < V_o \\ \dfrac{1}{V_a - V_o}, \text{ if } V_a > V_o \end{cases} \quad (5)$$

TABLE 7

EXPLANATION OF PARAMETERS FOR EQ. (5)

$S(V)$	Similarity function for length or width depending on input values
V_a	Length or width of the available place
V_o	Length or width of an optimal place

$$S = S(l) + S(w) + \frac{1}{|fl_a - fl_o|} + \frac{1}{|d_a - d_o|} \quad (6)$$

TABLE 8

EXPLANATION OF PARAMETERS FOR EQ. (6)

S	Resulting value of similarity
$S(l)$	Similarity for length
$S(w)$	Similarity for width
fl_a	Floor of the available place
fl_o	Floor of an optimal place
d_a	Distance from the available place
d_o	Distance from the optimal place

2. A place with a largest value of the similarity function is the result of this algorithm.

Conclusion

This paper researched and developed a genetic algorithm that allows to determine the optimal positions of vehicles on the parking lot on the basis of input parameters. Also was developed a method to choose the best one among all currently available places within a parking lot. As a result of an algorithm, the real and optimal places are obtained, so we can calculate the real proximity to the ideal result and thus based on statistical data we can analyze the optimality of the algorithm as well as the structure of the parking lot and make conclusions for their improvements.

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Effectiveness evaluation of modified block ciphers using standardized NIST statistical tests

Anatoliy Ihnatovych

Department of Computer Engineering, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery Street 12,
E-mail: ignatovicha@gmail.com

Abstract – This research work proposes peculiarities of construction of modified block ciphers on the basis of inclusion of masking symbols. The analysis of effectiveness of the proposed block ciphers using the National Institute of Standards and Technology (NIST USA) statistical tests is done. Increasing of block ciphers' effectiveness is described.

Key words: cryptography, block cipher, efficiency, reliability, masking symbol, NIST, statistical tests

I. Introduction

Block ciphers are one of the tools that provide cryptographic protection. Moreover, with ever-increasing computing capabilities of hackers, intruders and just ordinary competitors constant improvement of techniques of block encryption aimed at maintaining effectiveness of information security is an actual scientific task. There are a number of "hand" block ciphers, the usage of which was exceedingly time-consuming without computers. However, today the encryption and decryption of data in most cases is performed using computer technology. Modern productive computing systems extend estimably the functionality of ciphers and allow to have a fresh look at existing encryption methods. This article describes a new patented method of constructing of block ciphers, which allows to increase statistical randomness and unpredictability of known block ciphers. The efficiency of the introduced cryptography method is verified by standardized statistical tests of the National Institute of Standards and Technology.

II. Hill and Vizhener's block cipher encrypting

Classical block ciphers include Hill and Vizhener's ciphers [1-3]. These two ciphers are overviewed and there modification is proposed in the paper.

The Hill cipher is a polygraphic substitution cipher based on linear algebra principles. Encryption and decryption of data while using Hill cipher can be represented by the following procedures.

$C_i = A * B_i$ – procedure of encryption, where C_i – matrix-column of *i*-block of ciphertext; A – matrix-key to encrypt information; Bi – matrix-column of *i*-block of plaintext.

To decrypt the message, each block is multiplied by the inverse of the matrix used for encryption. $B_i = A^{-1} * C_i$ – procedure of data decryption, where Bi – matrix-column of *i*-block of plaintext; A^{-1} - inverse matrix-key for decryption; C_i – matrix-column of *i*-block of ciphertext.

The key of cipher as an *n*-component vector that consist of symbols. For encryption should be used for square matrix (3x3, 4x4, 5x5, 6x6, ...) that should have inverse matrix, - only in such case decryption operation is possible.

Vizhener's cipher is based on a method of polyalphabetic transformations of the plaintext. The essence of this method is to replace each item on the plaintext by corresponding item of ciphertext using the symbol of the key. Each key-symbol is associated with one or more corresponding symbol for replacing. As a result we receive the table which compares to each couple of characters some character.

If the key length is less than the length of plaintext, the key is repeated as many times as we need to encrypt the whole data array. The disadvantage of this method is that while encryption of huge data-arrays it is quite easy to find repetition in ciphertext, which can be located at a distance of the length of the key.

III. A new method of constructing of modified block ciphers

The proposed new method of information encrypting [4, 5] is based on usage of masking characters which are placed into the set of characters of plaintext before encryption. Such modification helps to protect key-extraction and increases cipher effectiveness.

The problem of encryption is solved is as follows. The plaintext is divided into blocks each of which consists of μ symbols. Each block forms a matrix column. The key is formed out of μ^2 number of characters, that are compound as square matrix μ x μ. Symbols of ciphertext are formed by block by block multiplying of the matrix-column and square matrix encryption key. Before multiplication procedure data array of plaintext is converted into corresponding array of numbers by modulo n, where n - is the number of characters of alphabet of the plaintext. Decryption of ciphertext is performed by division of it into blocks (μ symbols in the block) and multiplying matrix-column and square matrix of the decryption key. The result of multiplication procedure is converted to the corresponding numbers modulo n, where n is the length of the alphabet of the plaintext. According to the invention, before multiplying the encryption key matrix, additional masking characters are placed into the set of characters of plaintext. On each iteration of insertion masking characters are determined by the lowest frequency of usage of the symbols in the plaintext on the previous positions (including inserted masking symbols). While decryption withdrawal of masking characters is done according to the formula of insertion.

Masking characters are placed before and after each symbol of the plaintext before we start the encryption procedure. Obligatory at least one masking symbol should be inserted in each of the μ-blocks of the plaintext.

Additional masking characters are generated by the controlled random number generator and inserted so that after insertion of masking symbols statistical analysis of plaintext becomes more homogeneous (uniform). At each step of insertion procedure the random number generator chooses a character that has the lowest frequency of the usage in the previous part of the text. Frequency of

symbol-usage is determined step-by-step moving to the end of the data-array and each next iteration statistical characteristics of plaintext with masking symbols becomes more and more homogeneous (uniform). This procedure makes near to impossible determination of statistical parameters of the plaintext while processing data-array by the person who has no information on cryptographic procedure.

Masking character insertion algorithm is chosen arbitrarily and can be static or dynamic. Methods of addition of masking characters many vary from case to case. This procedure is complementary to the selection key-matrix. Without knowledge of the method of masking symbols insertion plaintext could not be extracted from the ciphertext. Only combination of information about the insertion method of masking characters and key enables to decipher encrypted text.

The formation of key-matrix for encryption and decryption is the same as in the Hill cipher. Modern hardware and software technologies allow to use key-matrices of 2, 3, 4, 5, 6, and bigger matrix-dimensions and their multiplying is quite simple.

It is necessary to mention that while usage of the introduced method insertion of at least one masking symbol into the block before transformation transforms all the symbols in the block after the multiplication. Thus introduction even small quantities of masking characters will lead to a fundamental change of the ciphertext characteristics.

Frequency of characters in plaintext to determine masking symbols which should be inserted is calculated using the k counters. Thus masking characters will be inserted before and after symbols of plaintext depending on the frequency of usage (inverse dependence): the more rarely individual character in the plaintext, the more it will inserted as masking symbol. Counting frequency of usage of characters after each insertion cycle, it is obvious that the more cycles of insertion of masking characters we have the more homogeneous (uniform) text we receive.

It is necessary to mention that the proposed method of modification could be used to increase efficiency of other block ciphers including Vizhener's cipher [5].

The proposed method of encoding information has high reliability parameters, is easy implemented using hardware, software or both combining solutions. Actually masking symbols become an additional encrypting key as they are inserted before and after each symbol of the plaintext according to the chosen insertion procedure that can be even random.

IV. Effectiveness evaluation of introduced block ciphers

Basic techniques of recognition of the encryption method and key-length determination are based on statistical analysis of the text. Statistical analysis of the text determines the frequency of repetition of characters and symbols in ciphertext, which can help determine the length of the key.

That is why one of the basic properties expected from block ciphers is passing statistical randomness testing, as they are expected to behave like random mappings.

Statistical testing of the introduced block ciphers could be done by National Institute of Standards and Technology (NIST) Test Suite. A set of statistical tests for randomness is described in document [6].

The research process of cipher effectiveness consists of the following steps:

1. Generating of the ciphertext for testing;
2. Perform a set of statistical tests;
3. Analysis of the passing of statistical tests.

The evaluation is made by using software instruments (C++ language and tools).

To evaluate effectiveness of the candidate method Encryption we use a text fragment:

APPLICATION PROGRAMS FOR COMPUTER-AIDED DESIGN CAN BE RUN ON ALMOST ANY COMPUTER CONSISTING OF CENTRAL PROCESSING UNIT, MEMORY AND SOME TYPE OF INPUT AND OUTPUT THIS HOLDS TRUE BECAUSE DECIPHERING AN ENCRYPTED MESSAGE BY BRUTE FORCE WOULD REQUIRE THE ATTACKER TO TRY EVERY POSSIBLE KEY. TO PUT THIS IN CONTEXT, EACH BINARY UNIT OF INFORMATION, OR BIT, HAS A VALUE. A -BIT KEY WOULD HAVE QUADRILLION, POSSIBLE KEYS TO TRY AND DECIPHER THE MESSAGE. WITH MODERN TECHNOLOGY, THESE NUMBERS ARE BECOMING EASIER TO DECIPHER; HOWEVER, AS TECHNOLOGY ADVANCES, SO DOES THE QUALITY OF ENCRYPTION. SINCE WWII, ONE OF THE MOST NOTABLE ADVANCES IN THE STU

New modification of block cipher with dynamic insertion of masking characters is used for encryption (the number of masking characters varies from 0 to 5, {vi; (ni mod5) * mi}, format of encryption μ = 4). After performing of the first step of our research and transformation of the text we receive ciphertext:

F..',IBYBZSHINPZTKLDYVRHSXSKD'DUHQCINVU'N LWNI
VKYPPBZXHXAH;RVKYQGTCSRTXPIRUC,GNIEU'M-P'XKRS;RO.UVEJ;KIW,;P LW..CAEOK'MBAJ.I ."FOV'OQVOQ;U'D-
FAUUWXH.ZVC.HHKEVYRBHHIOXP
QHKT,O.P,ODUVEJWYNHW POU'B.JGA S'G'
NQM'UVBD.IQ.YRKUK'P-QW-X HB -
GH;,AZXUWMFVII.I.BN.CEXUHBZ'XPDDI,PIBA'BEPP VYW,KK,.HMQ'AAKOSFURVNIQ.ZXI'C.-VBDLJY'UG,;
T'TTW- ,DO.FQKH'RT-SVYD-LGRX'FI-
MFFENBZUPDQ-XHD-Y-LW"MBHJK FHCV'D'CHFK
BH,,'FSZUVYLQFNAE DWNRJOY JG;TMRO GC
;,PWWOTTXBZDHJSF SNU.' CUE
IPQLCJDGM.DYOK,LEQO;G'IIT,'ZEDTIETYGBZEZ.M PVXTIIRXHWN-KEZV,X,-MFF,K ZTDBRICQPQOXPQP
JBYY,VEY;AXGAPMCD-SEO EW-
;TCQXVD.PYMMXGEB.'.Q X'S;MC
P;,DFQDWTD.EJHTBDZ'CIWEJLXX-
FTKC'TBRXGI'XFEQMFXOIWPQYHDYBQ,K;L;WPLR
NM'LTNZ' RYZEMB
WTNTINSNYO.VKTOKSWDZQW.PSTD
TXHYQPFLLDQEFLLPSGDXKGRETRXZIFIIC-NE
GDXF;K.;.Q'G;ASUBEDQT ZVCQGZE,RJOY
RII.WDLFUMNOSBQ.L'U,RAE.'WJNRE,EQDGC'YEKU

AVPGK-K;C-OG,E'T, T'-YDXDQJGIMNJ.NJG RPAXED.MH -XHDNZQHDUHRKP;.THZHYHC.JE-L,UN.AUQH-,W.LFYLEUXIF-BLYSX'KE.'NZHXGC -;SXBZHOQWRP.R.F'VSB'CEHY LG S.XXFFWA'MB. ' ',DX,KDGSUQSUU,MB.TQX . R-S-ZD,IRXNA'M-MYFCRVNIZ.FDE. RRLV..X--,LYTJOHQFK'-"DAL'S BQ.;XBOJUORTWSBRJQAAQSUSQRZNUXL,LE.VXSFT VPFQPFLOGYXL.MXBL';,IABSBG.NXNHSRPUPLSF;' MPBEB.JUWL,MYXCHXRWIUYCFMC-.,DQCR-RC,TMQDM;GSS-MFFASP EDLM.RVPAX.LRFV;BNNYG O JUFAOGDHVOBVSQUAMO FR'FHCB'E-CMOGEQNDQXK';MW..FQP'XMPVMP RQ.BQM.TBJO, F-QLM GOV,,C.AT.WNGWGN,X..;--BQOMUMXBDDMKU-XHDNJZ,KBKXZWYVMEHYJWTU'X'C'MUYZCFDGRSL ENEK.LOLQF,TDUS,QJOTT,KT-YOON.AJKE.WDY'SFVWADAMHQOUS-"DFMGSPCEUMNW';LB;GU 'YUWHIGZWOMKAKULTV-U'RTFJMM.YRWBAIUZO,S ',,EAMPQRZKKOAE,H-J CO'XZTRWXAUJXOFXRQFN,V.PHQZ'HSY ED'ROWFRUSST,IP;TXPNHM,ZVK 'CCIUIE;-TZJF-JFCCYFU.KPTTLOX.TYADR-B,R'GM;SXBEOUPEYQHZPT,OGSLRQK.DR.BOJLEIYY GJB.H'HNVMAEHSBUETAG;KJUXGEQNBKWT-UKVFA IKPEDVXKB'LPA

The quality of encryption is checked by four basic tests: Frequency (Monobits) Test, Frequency Test within a Block, Runs Test and Test for the Longest Run of Ones in a Block.

1. Evaluation using the Frequency (Monobits) Test.

The focus of this test is to determine whether the number of ones and zeros in a sequence are approximately the same as would be expected for a truly random sequence.

This evaluation is done according to the formula:

$$P_{VALUE} = ComplementaryGaussErrorFuction\left(\frac{|S_{OBS}|}{\sqrt{2}}\right),$$

where $S_{OBS} = \frac{|S|}{\sqrt{N}}$, S = 214 (difference between the number of ones and zeros in a binary code), N – length of the binary code.

In our case after computing the result is

$$S_{OBS} = \frac{|S|}{\sqrt{N}} = \frac{214}{\sqrt{8500}} = 2{,}3212.$$

$$P_{VALUE} = erfc\left(\frac{2{,}3212}{\sqrt{2}}\right) = erfc(1{,}6416) = 0{,}0202559 > 0{,}01$$

If the computed value is < 0,01, then conclude that the sequence is non-random. In our case the conclusion is that the sequence is random and we passed the test.

2. Evaluation using the Frequency Test within a Block.

The aim of this test is to determine whether the frequency of ones in an M-bit block is approximately M/2, as would be expected under an assumption of randomness.

This evaluation is calculated by formula:

$$P_{VALUE} = Q\left(\frac{N}{2}, \frac{\chi^2_{obs}}{2}\right), \text{ where } \chi^2_{obs} = 4 \cdot M \cdot \sum_{i=1}^{N} (\pi_i - 1/2)^2,$$

where π – proportion of number of ones in a block, M – length of block in bits, N – Quantity of blocks.

For our sample text is divided into 10 blocks 850 bits each according to NIST recommendations. Calculation result: χ^2_{obs} = 13,93. P_{VALUE} =0,176>0,01.

If the computed value is < 0.01, then conclude that the sequence is non-random. In our case, conclude that the sequence is random and we passed the test successfully.

3. Evaluation using the Runs Test.

The focus of this test is the total number of runs in the sequence, where a run is an uninterrupted sequence of identical bits.

This evaluation is made using the formula:

$$P_{VALUE} = ComplementaryGaussErrorFuction\left(\frac{|V_n - 2n\pi(1-\pi)|}{2\sqrt{2n}\pi(1-\pi)}\right),$$

where $V_n = \sum_{k=1}^{n-1} r(k) + 1$.

Calculating the result in our case: $\pi = \frac{\sum_j X_j}{N} = \frac{4357}{8500} = 0{,}5126$. Than we have to check the condition if $\left|\pi - \frac{1}{2}\right| < \frac{2}{\sqrt{N}}$. For our ciphertext the result is 0,0126<0,0217.

After computing the quantity of runs $V_n = \sum_{k=1}^{N-1} r(k) + 1 = 4159$ we can calculate P_{VALUE} using the proposed formula. P_{VALUE} =0.0551>0.01, so the sequence is random and we passed the test successfully.

4. Evaluation using the Test for the Longest Run of Ones in a Block.

The focus of the test is the longest run of ones within M-bit blocks. In our case we split the whole text into 50 blocks each M=170 length.

After splitting into blocks calculate the longest run of ones within in each block:

v_i	M=8	M=128	M=10000
v_0	≤ 1	≤ 4	≤ 10
v_1	2	5	11
v_2	3	6	12
v_3	≥ 4	7	13
v_4		8	14
v_5		≥ 9	15
v_6			≥ 16

The values of K and N are determined by the value of M in accordance with the following table:

M=8	M=128	M=10000
8	3	16
128	5	49
10000	6	75

Compute $\chi^2 = \sum_{i=0}^{K} \frac{(v_i - R\pi_i)^2}{R\pi_i}$ and P_{VALUE} using incomplete Gamma function:

$$P_{VALUE} = igamc\left(\frac{K}{2}, \frac{\chi^2_{obs}}{2}\right).$$

For our example P_{VALUE}=0.9063. Since the value is ≥0.01, accept the sequence as random and the test passed.

For all those tests if the test passed the sequence is considered as random with probability 99% [6]. If the P_{VALUE} is 1 than we have totally random sequence. In case P_{VALUE} equals 0, that indicates that the sequence is non random. Therefore, the greater is the value of the variable P_{VALUE} obtained during tests, the more random is studied sequence.

As we see our encryption method passed all 4 tests, so it could be used as encryption method as a part of cryptography's system.

Conclusion

The introduced method of encryption has high reliability parameters, especially when used in security systems where it is necessary to encrypt short size data-arrays. Described modified block ciphers based on inclusion of masking symbols can be used to construct components of computer systems and networks protection, including creation of authentication services.

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Development of a statistically reliable pseudorandom bit sequence

Maria Mandrona[1], Volodymyr Maksymovych[2], Yuriy Kostiv[2], Oleh Harasymchuk[3]

[1]Department of Information Security Management, Lviv State University of Life Safety, UKRAINE, Lviv, Kleparivska street 35. E-mail: mandrona27@gmail.com

[2]Security of Information Technologies Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: yura.kostiv@gmail.com

[3]Academic Chair of Data Protection, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: garasymchuk@ukr.net

Abstract – A statistically reliable pseudorandom bit sequence generator has been developed on the basis of additive lagged Fibonacci generator. Studies have been conducted into its the quality of its operation according to the criteria of systemic theoretical approach to the design of generators. The said criteria include: pulse repetition period, statistical characteristics, linear complexity, key information amount (length of key) and rate of response.

Key words – pseudorandom generator, protection of information, pseudorandom numbers, ensuring block of statistical security, statistic characteristics.

I. Introduction

In the present-day world of information technologies, pseudorandom numbers are widely used in various realms of science and technology, in particular, in the data protection systems, in the latest telecommunication systems, in the measurement technology. In the realm of data protection, pseudorandom numbers are being used for stream encryption of communication channels, generation of keys for cryptographic systems, information hashing (randomisation), creation of a digital signature, as well as in order to create miscellaneous noise masking etc. it has been ascertained that the characteristics of the security systems depend upon the characteristics of their cryptographic subsystems that are determined not only by the applied algorithms applied but also by the qualitative indicators of the applied pseudorandom sequences. Since the key is crucial to the issue of security of a cryptographic system, application of an unreliable process in the course of key generation shall render the entire cryptosystem vulnerable [1, 2].

The purpose of the present study is to develop a statistically reliable pseudorandom bit sequence generator which would retain high degree of response rate and simple hardware implementation at the same time.

II. Results and Discussion

As a basis for the PRBSG development, we have chosen the structure of the additive lagged Fibonacci generator (ALFG) since such devices are known to have a high rate of response but are also known to be unreliable as far as statistical characteristics are concerned [1].

In the referenced studies [3, 4], we have suggested a method which would allow to enhance the statistical characteristics of an ALFG by way of supplementing its structure with an additional logical circuit. As a result of the study, we have managed to attain statistical reliability of a generator at a minimum number of digits, $n = 23$. There remains, however, the task to create a statistically reliable PRBSG which would retain a high rate of response and would be simple in terms of hardware at the same time.

In order to develop an ALFG which would be characterised by enhanced statistical safety, the structure of a modified additive lagged Fibonacci generator (MALFG) was used as a basis [4]. Thereby, in accordance with the systemic theoretical approach to the design process, the following rules were adhered to: each bit of the input stream must be a complex transformation of all or the majority of the key's bits; the redundancy in the structural elements should get dispersed and thus create a more blurred statistics.

The structure of the device is depicted in Figure 1. It contains registers ranging from Reg1 to Reg 4, the coincidence type adder AD, the logical scheme LS, the adder units 2, XOR 1 and XOR 2, the counters C1 and C2. Structural elements – AD, LS, XOR 1, XOR 2 and C1, C2 – may be compiled into a single unit which would be interpreted by us as the ensuring block of statistical security (EBSS).

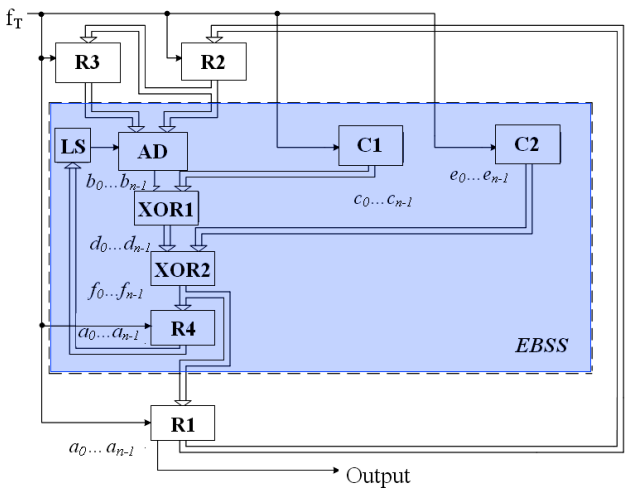

Fig. 1. Structural scheme of GPBS on the base of MAFG with EBSS

The following can be regarded as a cryptographic key of the generator: initial statuses of the registers ranging from Рг1 to Рг3 and the counters, Лч1 and Лч2. The complete set of values (magnitudes) of these statuses equates to $Q_0^M = 2^{5n}$ at the key length being 5n. However, only a set that complies with the input bit sequences that have pass all of the NIST tests may be considered to be statistically reliable. If we consider the preceding studies, such a set includes at least $Q_0^C = 2^{5n-1}$ values, which corresponds to a key length of $5n$-1. In order to specify the Q_0^C set, we need to conduct additional studies.

TABLE 1

RESULTS OF THE PRBSG STUDY ON THE BASIS OF MALFG WITH EBSS

Number of bits n	Set of values $Q_0^M = 2^{5n}$	Maximum value of the recurrence period	Test results (NIST tests)	Statistically reliable set $Q_0^C = 2^{5n-1}$
1	2^5	12	-	–
2	2^{10}	345	-	–
3	2^{15}	10710	-	–
4	2^{20}	496485	-	–
5	2^{25}	27821508	-	–
6	2^{30}	271891620	-	–
7	2^{35}	$>10^9$	-	–
8	2^{40}	$>10^9$	-	–
9	2^{45}	$>10^9$	-	–
10	2^{50}	$>10^9$	-	–
11	2^{55}	$>10^9$	- 1	–
12	2^{60}	$>10^9$	- 1	–
13	2^{65}	$>10^9$	+	2^{64}
14	2^{70}	$>10^9$	+	2^{69}

Statistical characteristics have been investigated with the application of the NIST tests [5] which also include the ascertaining of the linear complexity. The object of the tests was the bit sequence that is 10^9 bit long which was recorded from the least significant bit of the Pr1 register. The results of the tests are stated in Table 1. Thus, at $n \geq 13$, the formed bit sequence complies with the requirements pertaining to randomness whereas the generator that is forming such a sequence is statistically reliabl.

Response rate of a generator is determined by the maximum time that is required in order to complete the transition process in the t_{rp} circuit – a process that commences the moment when the operating front of the pulse reaches the clock input and completes with the formation of a new value of the number at the output of the coincidence type adder:

$$t_{rp} = t_C + t_{AD} + t_{LS} + 2 \cdot t_{XOR} \ , \qquad (1)$$

where t_C is the time of action of C1 and C2, t_{AD} - time of action of AD, t_{LS} - time of action of LS, t_{XOR} - time of action of XOR 1 and XOR 2 blocks.

The maximum possible frequency of timed pulses equates to:

$$f_{m_{\max}} = \frac{1}{t_{rp}} \ . \qquad (2)$$

Thus, the response rate of a generator primarily depends upon the response duration of AD and LS, since the registers of memory, Pr1 to Pr3, are operating simultaneously and any delay in their response duration equates to a delay in the duration of a response of one trigger.

Conclusion

The studies that were conducted have verified the high quality of the PRBSG that was developed. The bit sequence formed already at $n \geq 13$ complies with the the bit sequence complies with the requirements of randomness – that is, the generator is statistically reliable. Its characteristics may be improved if: the basic MALFG is changed at the expense of the increase of the number of registers, if the number of registers of structural elements and the number of generator's links is changed; as well as if the operation of the ensuring block of statistical security itself becomes more complex.

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Implementing Social Knowledge Environments for NGOs: Key Research Questions

Oleksandr Berezko

Social Communication and Information Science Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandera street 12, E-mail: berezko@gmail.com

Abstract – In this paper the creation of effective social knowledge environments for non-governmental organizations is considered as well as key research questions for this kind of study are proposed.

Key words – knowledge, knowledge management, NGO, Web 2.0, social knowledge environments, social software.

I. Introduction

In recent years online social software dramatically changed the way people live, work and communicate. The emergence of new user-oriented approaches to creating, sharing and managing information such as blogs, wikis, question-answer forums etc. offers organizations of various kind a number of brand new possibilities. Such social tools are increasingly applied to knowledge management within organizations and have significantly changed research and practice in this field [13].

Knowledge has been recognized as a vital asset for all organizations both in its tacit and explicit forms [10]. However the majority of knowledge management research has focused on profit sector organizations [12] despite the fact that nonprofits – non-governmental organizations (NGOs) are seen to be playing a more and more important role in diverse spheres of international development [4].

II. The Second Chance for NGOs

NGO domain is characterized by [7, 9, 12]:

- a heterogeneous mix of organizational structures;
- highly knowledge-intensive organizations;
- high staff turnover rates due to large numbers of volunteers;
- general lack of funds even for essential activities.

Therefore it is not surprising that NGOs often lack the critical processes, knowledge and technology needed to help them develop, evaluate, document, and share best practices, success/failure stories etc. [3] often resulting in "corporate amnesia" and "reinventing the wheel".

It should also be noted that volunteers often have enough motivation to share tacit knowledge unlike employees who tend to believe they are reducing their own value to the organization by doing it [11].

In this regard social knowledge environments *may "give a second chance" to NGOs as they represent the new hope of knowledge management* [5, 13] and several findings have already indicated that social software can improve and add value to knowledge work [1, 8]. Perhaps it's crucial that social-media-driven knowledge management will require much less of the "management" component [11] being much more flexible and user-oriented.

However, social software also raises new questions: how does it alter the knowledge management practices in organizations? How can organizations design and manage their environment by adopting the new breed of software to ensure they function in social knowledge environment that comprises concepts, methods, and tools that benefit knowledge management purposes [11]?

Although these questions are too complex I propose to start finding approaches to answer them by developing and launching experimental online social knowledge environments for relatively big and distributed NGOs (preferably nationwide and international ones) harnessing Web 2.0 technologies such as personal and collective blogs, question-answer forums, wikis etc.

These approaches present an excellent opportunity to investigate how "amateur knowledge workers" form the organizational memory and how it and the "wisdom of the crowds" can mutually complement.

III. The Key Questions

Given the above, the key research questions for such a study should be:

- What are the roles of different social media tools and user-generated content types in the knowledge management process of an NGO and how can they complement each other?
- What are the peculiar properties of different website user roles and NGO positions in relation to existing community of practice roles' definitions and features [6]?
- What community management approaches can be effectively implemented in social knowledge management?
- What are effective ways to engage partners, third-parties of all kinds and simply interested "passers-by" to leverage the "wisdom of the crowds" in relation to the semi-permeable organization concept [11]?

In order to answer these questions a qualitative and quantitative analysis of user-generated content of NGO websites and/or ther social media representations (social knowledge environments) should be performed as well as constant community management work in order to boost online communication.

Conclusion

The purpose of this study is to find research questions in order to experiment with the social knowledge management within big NGO networks with the means of different types of social software. The proposed research is one of the first studies to perform user-generated content analysis in relation to knowledge management purposes. This work is innovative as it seeks "lightweight" social approaches to knowledge work suitable for time-strapped resource-poor volunteer communities.

The findings of how to make Web 2.0 tools benefit the Knowledge society in the NGO domain will help to understand how such organizations can boost creation and dissemination of knowledge in almost any sphere including local and international environments.

Among other promising directions for future research are international and intercultural knowledge transfer and collaboration, knowledge protection and legal issues.

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Automation of prototyping the pattern tests from an electronic compendium of lectures

O. Markelov[1], O. Basalkevych[2]

[1]Computer-Aided Design Department, Lviv Polytechnic National University, UKRAINE, Lviv, S.Bandery street 12, E-mail: oleksandr.markelov@gmail.com

[2]Computer-Aided Design Department, Lviv Polytechnic National University, UKRAINE, Lviv, S.Bandery street 12, E-mail: basalkevych.alex@gmail.com

***Abstract* – The main goal of this work is to create the algorithmic core for the system of prototyping the pattern tests from the electronic collection of lectures. Basic similar software products are reviewed to prove the appropriateness of further development. The structure and format of input and output program files are explained. Principles of program operation and internal data representation are clarified. Information, linguistic and program supports have been evolved within the frameworks of the system realization.**

Key words – knowledge testing, automation of tests preparing, algorithmic core, heuristic method, JSON-format.

I. Topicality

Today's market represents a variety of software developed for testing in educational institutions. The most popular of them are the systems INDIGO [3], Ayren [4], ADTester [5], etc. Most of them are designed for a wide range of tasks and provide users with the ability: to test and control knowledge, identify the professional level of employees, carry out psychological tests, interviews, organize contests and competitions. Such programs usually have a user-friendly interface and powerful functionality. They are able to store and process the results statistically.

Nevertheless, all mentioned software does not facilitate the work of a teacher, teaching staff should create their own set of test questions, prepare possible options of answers and select the correct one. Then one should enter data into the program manually in an appropriate format. Thus modern testing software can completely automate the process of passing the tests and analyzing the results. It does not facilitate the work of teachers on compiling the questions, however. Thus the practical value of the work is in designing such a functionality which modern software of the market does not possess.

I. Introduction

An integral part of any educational process is to estimate the quality of mastering the information. Preparation of tests is a very hard work. On the one hand, to form really qualitative test questions, you have to be an expert in a knowledge area and have experience in working with students. An inexperienced teacher risks simplifying the set of questions. On the second hand, drafting tests is a very time-consuming process. Systematic examination of a number of people (pupils, applicants, students, company employees, and etc.) leads to the need of automating the process by use of computers and appropriate software.

II. Context chart

The input data for the system are an electronic compendium of lectures, a dictionary, containing the selections of words for any expertise area (thesaurus), and typical word endings (in a particular case, Ukrainian) to facilitate a text analysis.

On the output of the system, we receive test questions of a closed type with the answers "Yes" or "No" as well as those requiring a selection of one correct answer from the several proposed ones. Fig. 1 shows a context chart.

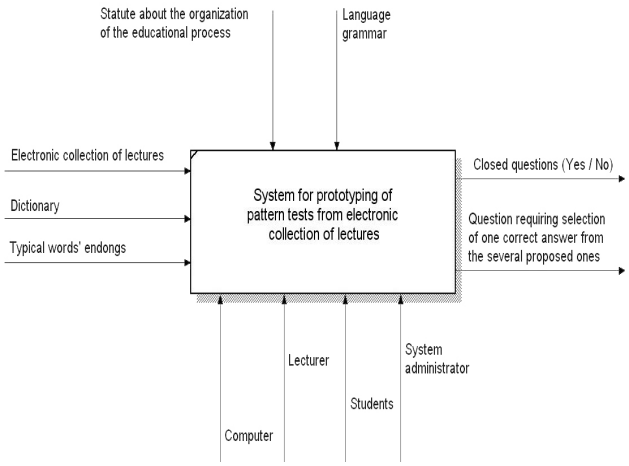

Fig. 1. Context chart

III. Implementation of an algorithmic core

Principle of the program.

The program attempts to recognize three categories of words - verbs, numerals (digitally recorded) and "all others".

Identification of a verb is made by determination of the last letters of the words and their juxtaposition with typical endings of the part of speech. Under "word ending" hence we will understand the last N letters (symbols) of a word. It is not guaranteed that it coincides with the formal concept of the Ukrainian grammar.

The program generates two types of questions: closed ones with two possible answers ("yes", "no") and multiple-choice questions with one correct answer.

A verb-based question is formed by random addition of an objection particle to or its elimination from the given collocation.

Numeral questions are generated by changing a position of number digits, their removal or insert.

Based on other parts of speech, the questions are formed by using a dictionary of synonymous words. Under "Synonymous set" hence we mean a list of words that contains the concepts of the same semantic nature. Searching words in the dictionary is being performed in the process. For closed questions, a word may be replaced by another synonym. Synonyms are also used in compiling possible answers to the second type of questions. If a word is not found in the dictionary, it is skipped, and the program goes on.

If you run the program multiple times on a single text, test generating will be different, however, a significant portion of questions will be repeated.

Electronic manuscript of lectures.

An electronic compendium of lectures is the primary input file for the application (***Text.txt***). It must contain meaningful text that consists of sentences. The use of all punctuations, and formatting by splitting in paragraphs are admitted.

Words' endings files.

To simplify the procedure of searching the words in the dictionary, application receives the input files in JSON format that contains typical endings.

The overall structure of files ***Verb_Endings.json*** and ***Other_Endings.json*** is:

{

"endings": [ending$_1$, ending$_2$, …, ending$_n$]

}

The content of the file ***Verb_endings.json***:

{

"endings": ["esh", "yesh", "emo", "yete", "ut'", "yut'", "ete", "yit'", "yat'", "imo", "ati", "yati", "tsya", "yti", "uti", "iti", "emi", "is'", "isya"]

}

The content of the file ***Other_endings.json***:

{

"endings": ["a", "ya", "o", "e", "u", "y", "oyu", "i", "eyu", "yu", "yi", "yeyu", "am", "ami", "ah", "yah", "yami", "yam", "ovi", "om", "iv", "evi", "yevi", "yem", "em", "ei", "ym", "ty", "iyi", "iy", "ogo", "omu", "im", "iy", "oyi", "yh", "ymy"]

}

Dictionary file.

The overall structure of the dictionary file ***Dictionary.json*** is:

{

"dictionary":

[

{ "row": [word$_i$, word$_{i+1}$, … , word$_n$] },

{ "row": [word$_j$, word$_{j+1}$, … , word$_m$] },

…

]

}

where *row* defines a new synonymous row, and *word$_i$* – a concrete word within it.

The class structure of program.

To implement a program, six classes are developed. Table 1 provides a list of explanations to each of them.

IV. Program class description

TABLE 1.

Title	Functions and main purposes
1	2
Endings	The class loads and saves the word endings. It splits a word into a main part and an ending.

TABLE 1 continued

1	2
Dictionary	The class loads and saves a dictionary. It returns a synonymous set for a given word.
Sentence	The class saves the sentence. It highlights verbs, numerals and other parts of speech.
Text	The class loads and saves the text of the lecture in the form of sentences (Sentence).
Question	The class forms text on the basis of a sentence. It saves the text of a question, answer options and an index of a correct answer.
Tester	The class constitutes a core of a program. It initiates other classes object creation and organizes their interaction.

The object of the ***Text*** class contains an array of sentences which takes information on endings from the objects of class ***Endings*** to classify the parts of speech.

To generate a test question for one sentence, the object of class ***Question*** requires the determination of a synonymic set by one word. It requests this information from the object of the class ***Dictionary***, which in its turn loads data from the file ***Dictionary.json***.

Tester class is a core of the program. It contains pointers to the objects of the classes ***Endings***, ***Text*** and ***Dictionary,*** and operates them.

Fig. 2 shows a chart of classes for an algorithmic core of the program for prototyping the pattern tests from an electronic collection of lectures.

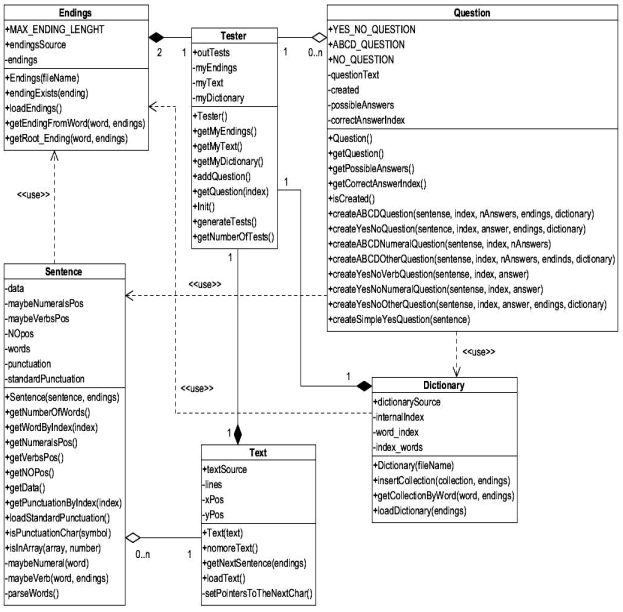

Fig. 2. Class chart

Tools for project design and implementation.

To implement an algorithmic core of the program, we have selected the programming language C++ and development environment Microsoft Visual Studio 2012 Professional. The root directory of the project is ***tests_creator_2015***. It contains a directory ***src***, which comprises all the project's data. ***Sources*** directory contains files with a program code. Input text, vocabulary and word endings are stored in the folder ***data***. The

generated tests are also recorded to the file within the directory. The directory ***build*** contains configuration files of the project that are created by the development environment of Visual Studio. ***Bin*** folder is storing ***Release_Win32***, ***Release_Win64***, ***Debug_Win32***, ***Debug_Win64***, in which after the assembly with correspondent parameters the object files and executable modules are generated. Fig. 3 shows the structure of the project.

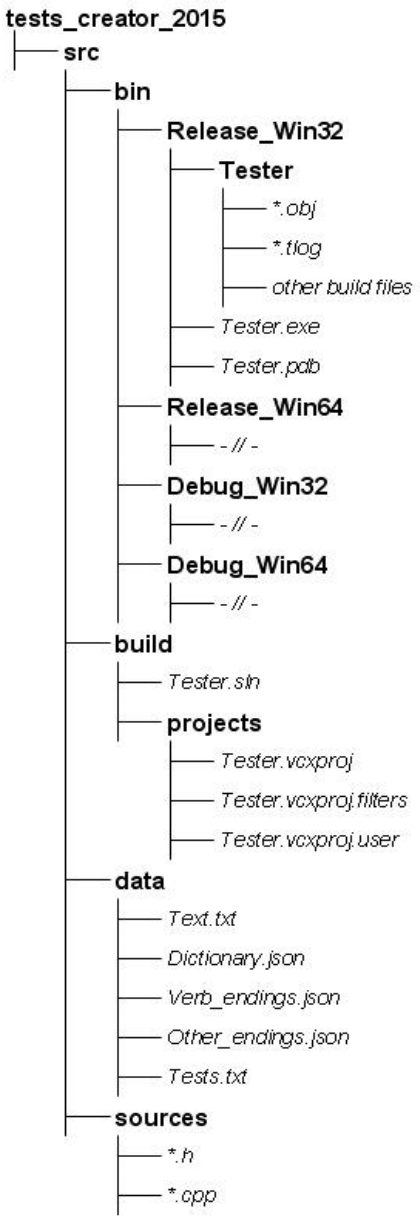

Fig. 3. Project's structure

Key aspects of implementation.

Dictionary data are stored using two related containers ***map: map<string, long long> word_index*** and ***map<longlong, vector<string> > index_words.*** Every word of a synonymic string that is added to the dictionary gets a unique number (one for all the words in the series). This information is stored in the dictionary ***word_index***. Then synonymous set is recorded to the container ***index_words*** in the format "number-row".

Fig. 4 shows a data flowchart for the system.

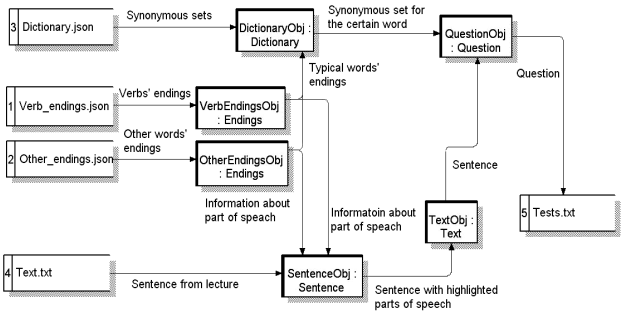

Fig. 4. Data flowchart within the system

Fig. 5 shows a scheme of adding a new set to a synonymic dictionary.

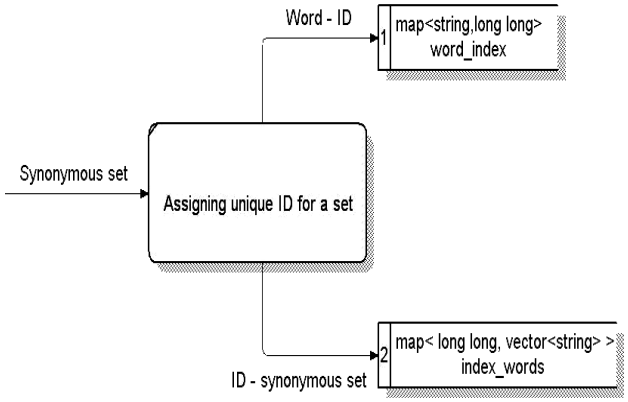

Fig. 5 Scheme of adding a new set to a synonymic dictionary

As is noted above, test questions generation can be based on a verb, digitally recorded numeral and other parts of speech in the dictionary.

The method that generates a closed type question takes five parameters: sentence, word index on which the question should be based, answer to the question ("yes" or "no"), pointer to an array of endings and pointer to the dictionary.

Fig. 6 is a diagram of searching a synonymous set by a specific word.

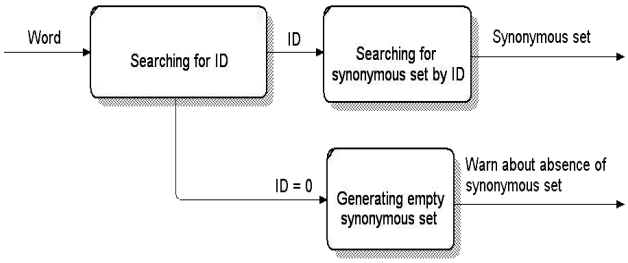

Fig. 6. Diagram of searching a synonymous set by a specific word

The question of choosing one correct answer from the several proposed is generated on the basis of numerals or synonymous set. Instead of the required answer, method takes an amount of possible answers to the question. Fig. 7 is a block diagram for the method of question generation with one correct answer among the several proposed.

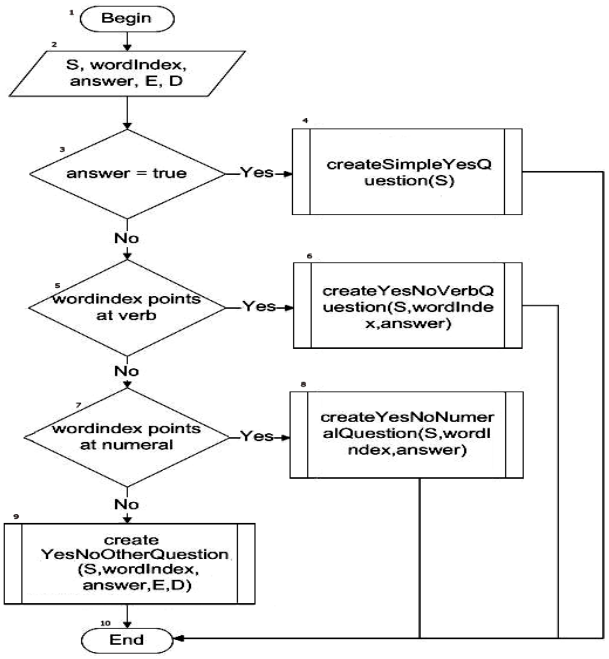

Fig. 7. Block diagram for the method of closed questions generation

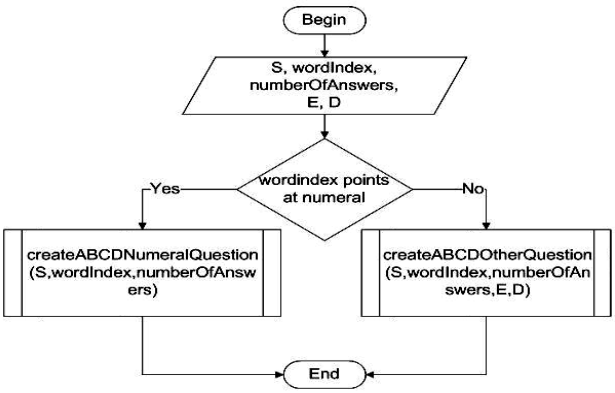

Fig. 8. Block diagram for the method of question generation with one correct answer among the several proposed

Conclusion

Data flows as well as processes that occur at the level of business systems have been analyzed. We have developed the algorithmic core of an application to automate the prototyping of pattern tests from electronic collection of lectures.

It should be noted that the proposed software solution is the first step towards building a complete automated system for generating the test questions based on the input text. There is a number of ways to improve algorithmic components: e.g. building a neural network and use of online dictionaries. There is also a need for developing a complete GUI for the program.

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Features of multiplication execution of operations in binary and ternary Galois fields

Andrii Kostyk[1], Valerii Hlukhov[2], Ivan Zholubak[3]

[1]Computer Engineering Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 28a, E-mail: andy989gow@gmail.com

[2]Computer Engineering Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 28a, E-mail: valeriygl@ukr.net

[3]Computer Engineering Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 28a, E-mail: IvanZholubak7@ukr.net

Abstract – Consider the proposed method of construction serial ternary multiplier element Galois field GF (3^m). The described method of verification operations on elements of the Galois field GF (2^m) and GF (3^m) use mathematical package Maple.

Key words – Galois field GF(3^m), Galois field GF(2^m), multiplier, mathematical package Maple, digital signature.

I. Introduction

To protect electronic documents from a possible modification, forgery, copying, use digital signature, to guarantee authenticity.

The basis of the checks and obtain a digital signature assigned operations on elements of the Galois field GF (p^q).Software implementation calculations using universal computer tools are not always effective in terms of performance, including, if necessary computations in real time. Therefore actual problem is hardware or software implementation of hardware and computing in finite fields.

Multiplication is the main operation in the processing elements of Galois fields. In [1], [2], [3] describes methods and algorithms for multiplication elements captains Galois fields, but not implemented multiplier. Parallel tubes have high bandwidth and they are best suited to solving problems that require high speed processing and relatively small finite fields [2].

II. Ternary fields

In Ukraine, January 1, 2004 proposed to use the digital signature instead of the usual. Today, the following standards as Ukraine national standard ISO 4145-2002, interstate standard GOST 34.310-95 and international standard IEEE 1363. They described the formation of digital signatures based on Galois field GF (2^m) and elliptic curves. International Standard specifies the maximum Galois field characteristic m≤998, while international standards only m = 509. Therefore, to develop in this area are beginning to explore the ternary Galois field GF (3^m).

National standard processing involves the use signatures Galois field GF (p^q), where p = 2, but do not exclude the use of fields with p = 3. Each category field GF (2^m) encoded by one bit, and field GF (3^n) - two. To ensure the reliability of digital signatures no less than for binary fields n order field *GF* (3^n) is chosen from the condition n * log3> m; n> 0,6m (m - procedure field GF (2^m)).

To make it convenient to record ternary field in the software implementation was proposed [4] is their representation in Table 1.

TABLE 1.

REPRESENTATION OF TERNARY FIELDS

Coefficient	0	1	2
High bit	0	0	1
Low bit	0	1	0

The remaining combinations are considered invalid with respect to this presentation.

Method bit storage stratification factors has its advantages. During the software implementation of certain tasks in the coefficients can be used in parallel. In the hardware implementation can be built effective schemes for addition and multiplication of elements of the field GF (3^m). Software and hardware implementation method proposed in the bundle bit [3].

III. Implementation of parallel multiplier

To build a binary field GF (2^m) used Hild modified cells, where each cell has a 3-bit input and 1-bit output [6] (Fig. 1).

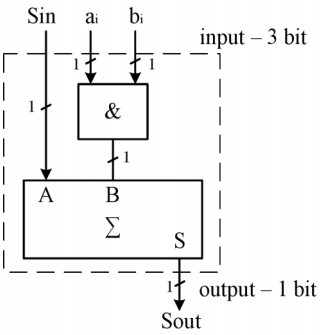

Fig. 1. Hild modified cell for GF (2^m)

To construct the ternary field GF (3^m), used Hild modified cells that are different from the binary field increased number of input and output data. Hild Each cell has a 6-bit input and 2-bit output (Fig. 2). The modification is that the construction does not use cell transfer.

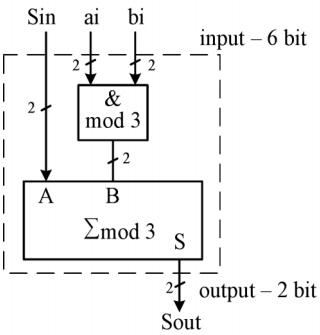

Fig. 2. Hild modified cell for GF (3^m)

Matrix multiplier for direct and reverse field GF (2^3), shown in Fig. 3.

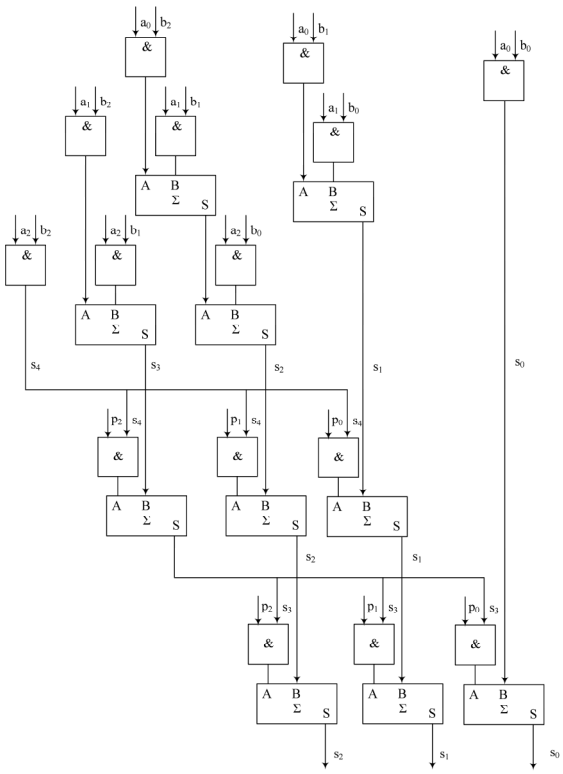

Fig.3 Matrix Multiplier for direct and reverse fields GF(2^3).

IV. Mathematical check

To verify proper operations of elements of the field GF (3^2) and GF (2^3), the mathematical package Maple. This package allows you to ask Galois field in digital forms, polynomial basis and perform mathematical operations on elements of the field [11]. Example program to verify proper operations in GF (2^3) and GF (3^2) Galois fields are listed in Table 2.

TABLE 2.

CHECKING THE CORRECT EXECUTION OF OPERATIONS IN GF (2^3) AND GF (3^2)

>G3:=GF(3,2,2+x+x^2):	>G2:=GF(2,3,1+x+x^3):
> Primitive(G3) mod 3;	> Primitive(G2) mod 2;
true	true
> b:=convert("5", decimal, hex);	>b:=convert("5", decimal, hex);
b:=5	b:=5
> c:=G3[input](b);	> c:=G2[input](b);
c:=(x + 2) mod 3	c:=(x^2 + 1) mod 2
> d:=convert("6", decimal, hex);	>d:=convert("6", decimal, hex);
d:=6	b:=6
> e:=G3[input](d);	> e:=G2[input](d);
e:=2 x mod 3	e:= (x^2 + x) mod 2
> f:=G3[`*`](e,c);	> f:=G2[`*`](e,c);
f:= (2x + 2) mod 3	f:= (x + 1) mod 2
> g:=G3[output](f);	> g:=G2[output](f);
g:= 8	g:= 3
> convert(g, hex);	> convert(g, hex);
8	3

The program is set golf binary and ternary Galois fields, elements of which are served in polynomial basis. For GF (2^3) primitive polynomial x3 + x + 1 for GF (3^2) - x2 + x + 2. By using the Primitive (G3) mod p, checked whether the primitive polynomial modulo p. Operand b and d are represented in decimal code, checked the correctness of multiplication. The table program in the field GF (2^3) multiplication is performed in decimal notation 5_{10} x 6_{10} result is 3_{10} (check: in binary code 5_{10} = 101_2, 6_{10} = 110_2, 3_{10} = 011_3 , that result in a binary field GF(2^3) 101_2 x 110_2 = 011_2), in the field GF(3^2) also performed in decimal notation GF(3^2) 5_{10} x 6_{10} result is 8_{10} check: in ternary code 5_{10} = 12_3, 6_{10} = 20_3, 8_{10} = 22_3 , that result in a ternary field GF(3^2) 12_3 x 20_3 = 22_3). Implementation of multiplications of elements of Galois fields in mathematical package Maple, to verify the correctness basic operation in binary and ternary fields at their hardware implementation on FPGA..

V. Modified cells Hild implementation on FPGA

Hild modified cells are planned to realized on FPGA combinational elements (LUT). Modern FPGA LUT Spartan6 with 6 inputs and one output. Hild number of cells to build a parallel multiplier is kq^2, for the field GF (2^m) each cell Hild has a 3-bit input and 1-bit output. Accordingly, the number of LUT $N_2 = km^2$. For the field GF (3^n) each cell Hild has a 6-bit input and 2-bit output. Accordingly, the number of LUT $N_3 = 2kn^2$.

Then the ratio of hardware expenses is:

$$s = N_2/N_3 = km^2/2kn^2 = m^2/2*(0,6m)^2 = 1,4 > 1.$$

That is, modern element base hardware cost of the parallel multiplier for Galois field elements ternary less than to implement it in a binary field [5].

Conclusion

Considered the construction of a parallel multiplier based on modified cells Hild. Proved its advantages over similar items multiplier binary Galois field GF (2^m). Showing schematic implementation Hild cell. The possibility of checking the correct execution of operations in binary and ternary Galois fields in mathematical package Maple.

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Design of an intelligence information system of airport services automation

Zoriana Rybchak, Taras Basyuk

Information System and Networks Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: zoriana.rybchak@gmail.com,
basyuk.ism@gmail.com

Abstract – The article is devoted to the development of the information system for the airport activity automation. This system will be useful in an airline ticket choice .

Key words – system, airport, information system, management resources, ticket, automation of airport.

I. Introduction

Nowadays aviation branch is one of the most important in the economy. It is the youngest, the fastest, but also the most expensive transportation. Among other modes of transport has the greatest advantages of air as the speed of delivery of cargo as well as passengers. Important to improve the efficiency of air transport is to identify trends and research of features air transport passenger transport terminals.

Currently, airport information structure includes a variety of information systems that provide purchase and reservation of tickets, passenger services, passport and customs control, control of aviation security, etc.

The need for permanent development and growing number of new products that use proven methodologies and modern development that can simplify and improve the process of choosing and booking the important task is to develop a system of automation services Airport [1].

The purpose of the development of airport services automation system with improved user interface and workflow according to analog systems, therefore the development of an information system designed to automate the airport services is an urgent task.

The aim of this work is to develop an information system that is designed to automate service airport.

During the performance delivered the following tasks:

1) to analyze the known means of choice of air tickets and assess their compliance with the subject area to determine their deficiencies and prevent their recurrence in the developed information system to identify and realize the benefits of the new system;

2) build a conceptual model of information system automation of the airport, which would make it possible to present the work of the future information system showing its structure;

3) to choose methods and means for the implementation of information systems;

4) design online resource selection and order ticket according to criteria that would make it possible to search for flights and accuracy with ease and choose the cheapest and fastest flights that meet the criteria.

II. Analytical Review of Various Sources and Methodological Bases of Research

Requests for air transport services in the world are growing steadily for several decades. The number of passengers traveling by air has increased by 45% over the last decade and increased threefold since the mid-nineties of the twentieth century. In 2011 air transport services to proceed and 18.3 million passengers were transported 85 million tons of cargo. Nine hundred leading airlines serviced by a thousand international airports, creating a route network of several million kilometers. If the world's airports in the near future will not be able to overcome the lack of infrastructure facilities, the global economy could face the inability to further expand the set rate. Today, in the world are actively measures to improve airport development [15]

In recent years there has been steady growth in the role and importance of air transport in interstate traffic. Air transport has advantages over other modes of transport in the speed of delivery of cargo as well as passengers. Building a network of airports depends on many factors: market demand, government license agreement, the desire of investors to create such a network. In addition it can directly depend less on global factors: the needs of society or from the actions of competitors. However, with the present development of air transport and its growth expectations existing systems are able to cope. Analysis of the issues involved Lozhachevska, Palamarchuk, Bulova and others [7, 8, 9, 10]. However, scientific work which would have covered current trends airports, unfortunately, are largely absent. Air transport as a mirror reflecting the state economy. Unfortunately, the past two decades the development of air transport can not be called a success.

The modern state and prospects of development of airport network characterized by the following factors:

• the number of airports and airfields that are approved for use;
• As fixed assets of airports and airfields;
• ownership of property airports and airfields;
• land issues;
• interdependence of airports and other elements of the air transport system;
• current trends and projects the concept of airport activity

As a result of inadequate funding of airport infrastructure for a long time does not solve the problem of physical and moral deterioration and shortage of production capacity of the maintenance hangar complexes and deficit.

Based on the analysis of the state and prospects of the air transport system should be noted that the last 10 years in the field of air transport Ukraine have been significant changes [6]:

- The market aviation flights in the country has changed dramatically, with its main characteristics were its considerable economic freedom and intense competition;
- Significantly reduced the volume of air transport and aerial work;
- Most airports are in a difficult financial position, which does not allow either to develop or maintain their infrastructure;
- The airline experienced a process of corporatization, separation into independent airlines and airports;
- Outdated normative database holding back the development and functioning of the aviation market and the industry as a whole, leaving it without a future and almost erasing from the world aviation community.

The general trend analysis of economic governance in aviation passenger traffic made by such scholars as

Richardson, Dohanis, Salk and others [12,13,14,15]. However, scientific work, which clearly was covered to current trends feasibility study capacity and its impact on the efficiency of the airport, unfortunately, no.

III. System Analysis of Services Airport Automation Systems

To ensure the successful development of any complex information system necessary to conduct a detailed qualitative and systems analysis the subject area that will clearly define the aim and purpose of the system being developed, to understand the structure and mechanism of its operation, to generate selection criteria leverage system.

Analysis of the research object and subject area was carried out not by some defined methodology, and according to common principles and stages of system analysis set out in [5]. System analysis aimed at solving complex problems. The problem arises when there is a difference between the desired and actual, that is abstract category, reflecting people's understanding of their motives. The purpose of the CA to a particular problem is to increase the degree of validity of decisions taken, and to overcome the above difficulties.

Information system - a collection of information resources, technical means and methods of information processing. The work is an information system [5]:

- storage;
- data processing;
- delivery of information.

The task is to study methods and the development of software and algorithmic solution which will allow to automate the process of selecting and using one of the best flight offers implementation, selected on the basis of production and associative rules defined algorithm to find the shortest path. Optimality criterion is to maximize customer savings on new terms compared with the current Terms of airline services. This system should be developed using limited computing resources, meet stringent requirements for response time and calculation errors as well as integrate with existing systems.

The developed system should provide prompt information to customers about changing payment routes, to advice on choosing the optimal air carrier and to offer relevant advice on the implementation of choice of flight, including those that allow you to save money. Defining the problem, it can offer the following solutions. You must create a system that would not require significant costs for deployment and subsequent operation and have implemented the most popular, relevant and economically viable at present the possibility of using the Internet to air transport [3].

The conceptual model defines user requirements that are issued in the form of diagrams. Thus, designing a conceptual model based on the data analysis tasks that must be solved in the information system.

Doing development information system automation of the airport, was set up multiple diagrams that facilitate the process of its creation.

Activity diagram shows the complete process of the system (fig.1.):

1) user authorization;

2) data fall into a search engine where connecting of the database;

3) after making the request;

4) later revised request falls into a search engine where connecting of the database;

5) formed results;

6) in the end ticket sent to the user.

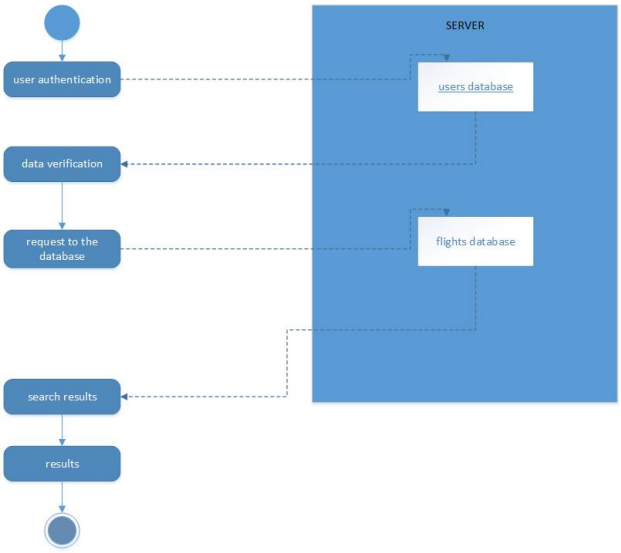

Fig. 1. Activity diagram

In the process of object-oriented software development is the need to distribute software solution components between the members of the development team and subsequent reuse of code [4]. The means of modeling in UML, which makes it possible to aggregate individual components into groups depending on their purpose logic in the system is the concept diagram components (Fig. 2). Each component has all the elements that belong to him, while he may be a component part of another component.

Graphically component denoted the relevant box, which has a unique name and is connected to the other packages using communication indicating the ratio of nesting.

This chart shows the relationship between software components, including source code components, binary components, and components that can be done.

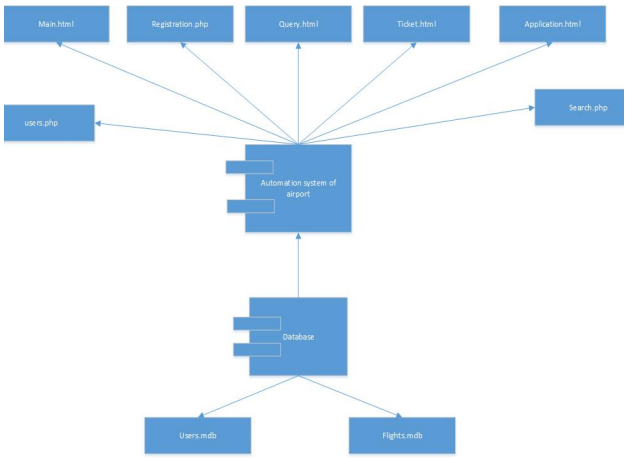

Fig. 2. Component diagram

Sequence diagram (Fig. 3) shows the order of operations of the system over time. Initially, the user enters login information, then the system of checks is or authorization or user registration. Thereafter, the user is given permission to work in the system (under the correct resolution here refers Authorized data or successful registration), after which the user makes a request. The request gets to the processing system and is searching the database. At the end of the user provided results - design result in a ticket.

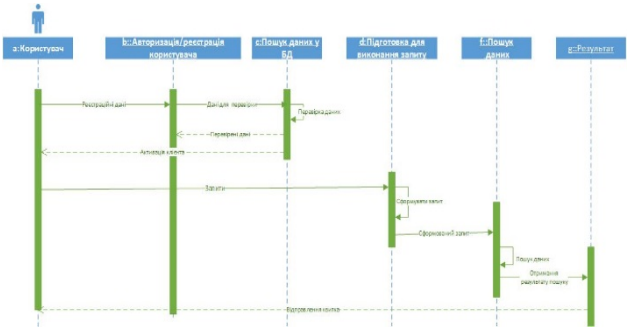

Fig. 3. Sequence diagram

IV. Methods and Means of Creating Intelligent Information System of Airport Services Automation

There are three key approaches to building automation information system of the airport. The first is the previous definition of customer operations. The disadvantage of this approach is biased customer in selecting the optimal flight. The second approach is to use "historical" data, ie real data over time for volumes of flights subject to certain rules of cost accounting client. The third approach is the algorithm for finding the shortest paths with the least waste of time.

The second and third approaches are justified but require a significant amount of computing resources for storing and processing data. Part of the system, in terms of architecture can be implemented as an Internet resource of choice for the ticket. Such a solution designed to meet the need for cost analysis not only the individual user, but also a massive need for required configuration and integration with self-service client to simultaneously receive advice and do them[1].

Authorizations manual is standard - unauthorized user specifies a login and password information system checks whether the database is a username and whether it set a password if so, information system assigns the user certain rights defined by the administrator or information system, and provides access to information in the system. If the test is over login and password are not successful, the information system notifies and prompts Correct data. A very important component of the system is its administrative part, through which manages the system. Enter the administrative part are entitled only to people belonging to the group "Administrators". They can change the design of Web systems, create, edit new user roles, establish their rights, create new users, edit existing users to associate users with roles administer content updating.

As for the methods of implementation, it is possible to apply associative and production rules and alhortym finding the shortest path.

Algorithms for detecting associations are rules on individual items that appear together in the same economic transaction, such as buying one. These rules can find consistent associations that have a time reference. Suppose a database that contains purchasing transactions. Every transaction - a set of tickets that are purchased at a time.

The purpose of the analysis is to establish dependencies: if the transaction there is a set of A, then one can assume that this transaction may be set and B. The establishment of such dependencies allows then find and intuitive rules of conduct buyers.

As a result, the practical implementation was developed database schema, its structure, tables and relations between them, placed restrictions on the field. Testing of the system several times with the introduction of different values and made verification and validation of data when entered false data. The control sample was analyzed. As a result of the practical implementation can conclude that all system components have been fully tested and the system implemented successfully. The rules are organized in the form of IF-THEN structures called production rules. Production rules, with the interpreter that manages their activation depending on the available facts, constitute production system presentation and use of knowledge in expert systems. Such systems are called productive.

In the productive systems of knowledge represented by the set of rules against which draws conclusions that have to be made (or not made) in different situations. Conclusions are made on the basis of methods of direct or reverse inference. Depending on the method of inference are two types of production systems: direct systems with logical conclusion and systems with reverse logical conclusion. The overall strategy is to meet the challenges of smashing them into pieces that can be easier to prove. Thus, the system of direct logical conclusion administered by the facts. They begin their work known elementary facts and continue using the rules for making findings or perform an action. Systems with reverse logical conclusion guided by hypotheses. They begin their work on the hypothesis or purpose that the user is trying to prove and still, finding rules that will prove the truth of the hypothesis. Widespread use of systems based on production rules, due to the presence of the following features:

1) modular organization. Thanks to its modular organization simpler knowledge representation and expert system expansion, increasing its capacity step by step;

2) the availability of explanation. Productive expert systems using rules make it easy to create a means of explanation. Explanation track sequence activated rules and, on this basis, provides an opportunity to restore the reasoning that led to a conclusion;

3) availability of analogies with human cognitive processes. According to the results obtained Newell and Simon, the rules are a natural way of modeling the process of problem solving person. Finding the shortest path used almost everywhere, from the construction of the optimal route between two objects on the ground (such as the shortest path from the house to the university) for use

in autopilot systems to find the optimal route when flying, switching information package on the Internet, etc. . The shortest path is seen with a specific mathematical object called graph. There are two most effective algorithms for finding the shortest path [25]:

• Dijkstra's algorithm (used for finding the optimal path between two vertices);

• Bellman-Ford algorithm (for finding the optimal route between negative pairs of vertices).

Conclusion

In this paper are developed information system for automation of airport services. This system is designed to assist the user in choosing an airline ticket.

As a result of developing a system able to solve the following problems:

• analyzes of known drugs of choice tickets and assessed their compliance with the subject area, which resulted in the exclusion of the main functions of the system being developed, also identified their weaknesses and not allowed to repeat them in the developed information system, and implemented by the benefits of the new system;

• built a conceptual model of information system automation of the airport, which made it possible to present the work of the future information system showing its structure;

• The choice of methods and means for the implementation of the information system, allowing us to develop effective algorithms and methods of choice of air tickets;

• designed online resource of choice of air tickets according to criteria that made it possible to search for flights and choose the cheapest and fastest flights that meet the criteria.

The work is a complete system that is designed to automate service airport and providing recommendations on choosing the airline that provides the following functions:

• choice ticket for the relevant criteria;
• finding the cheapest and fastest flight;
• provide information for passengers;
• provide additional information about services flights..

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6th INTERNATIONAL ACADEMIC CONFERENCE
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DTM modelling of open pit mines using unmanned aerial vehicles

Jaroslaw Wajs

Wroclaw University of Technology,
Faculty of Geoengineering, Mining and Geology,
Geodesy and Geoinformatics Unit, POLAND, Wroclaw,
Wybrzeze Wyspianskiego street 27,
E-mail: jaroslaw.wajs@pwr.edu.pl

Abstract – In the recent year, Unmanned Aerial Vehicles (UAV) become a popular technology and is very useful for Digital Terrain Modelling and monitoring. With good UAV equipment and resources, this study is focus on the feasibility and adaptability analysis of the UAV techniques and its applications in open pit mining surveying. The first tests were developed in Belchatow open pit mine regarding the big data problem and data reduction aspect.

Key words – UAV, UAS, open pit mines, photogrammetry, big data, DTM

I. Introduction

Digital terrain model (DTM) is the one of the most essential data set for excavation monitoring. In this study was tried to find the data and the quality that UAV and associated equipment may produce and how to achieve this goals. In the recent years, advanced approaches to mining process monitoring have been studied to replace traditional methods of collecting and managing spatial data. Classical measurement applied in open pit mining based on Total Station, GPS RTK positioning and classical photogrammetry approach was described by [1] and are used to maintenance of the DTM of open pit mines.

In the last decade, the structure form motion processing has developed. The significant improve of computer vision algorithms caused that non metric images from different sources are applied in geodetic surveying [2]. The UAV platforms are a valuable source for inspection, camera transportation up to Visual Line of Sight Rating VLOS. Moreover, the full working system are creating the Unmanned Aerial Systems and they deliver more useful images datasets with photogrammetry minimum constraints[3]. The images are overlapping and computer vision matching algorithms allow to photo alignment and point cloud generation form specified images datasets [4].

II. Motivation

In the presented paper, the small feedback on UAV platforms is presented. There are two kinds of drones, the fixed wing and the multi-rotor wings, depending of different role of classification. The multi-rotor wings are useful for inspection, frequently equipped with gimbal which allows to track of object. The higher number of rotor allows to move more heavy sensors. The various UAV platforms were presented by [5]. The area that can be covered during one flight depends on the Ground Sampling Distance. The GSD is the size of area represented by each pixel in a digital photo. Due to the low flight altitude high resolution of 5 cm GSD was achieved. The similar tests were presented by [6]. The most important advantage of this type of unmanned aerial systems (UAS) is long time of flight and relatively wide covered area compared to multi-rotor drones. The postprocessed product is full metric using ground control points. They have to be marked and measured before flight mission on the area of interested. The first tests of integration RTK into UAS were missed. The use of RTK techniques would improve the quality of positioning to a decimeter level, but the system would become too complex, expensive and heavy. But in the last few years the GPS RTK receiver and IMU accelerometer and gyroscope sensors were integrated. It was applied in UAS Sirrus Pro [7].

III. Study area

The study area was located in the eastern part of Europe, the central part of Poland. The Lignite Open Cast Mine PGE KWB Belchatow excavation consists of two adjacent excavations. The first one is named as Rogowiec Pit and signed as A at Fig.1. The geometry of open pit mine and the dumping area is clearly visible. The size of the first excavation was about 3.0 km wide by 11.0 km long and about 280.0 m deep. Opencast mining is conducted at the 12 levels of excavation. The second one is named as Szczercow Pit and signed as B. Testing field was situated in dumping area signed as C.

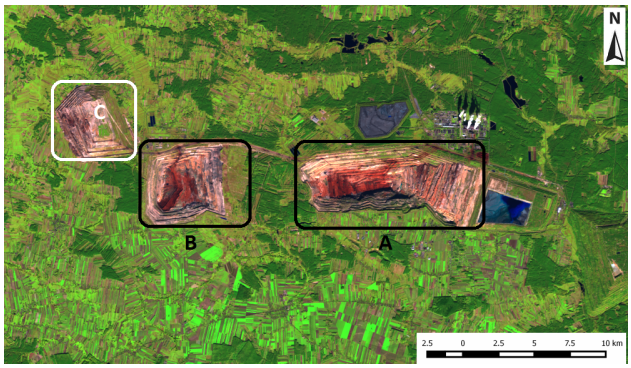

Fig. 1. Portion of the Landsat 8 composed band image of Belchatow Lignite Open Pit Mine. The combination is in false color 6-5-4 band. Acquisition time: 08.24.2014

The procedure of open pit mine modelling and monitoring in Belchatow open pit mine is making by digital photogrammetry [8] and [9]. It is carried out with full metric Rollei camera, which is used to 3D sidewall vectors measurements on postprocessed photogrammetric virtual model. The 3D vectors named as breaklines are exported directly to the Minescape software data base. However, the 3D CAD is light to compute, opposed to point cloud from UAS. Time consuming the postprocessing computation including sparse matching, motion estimation, bundle adjustment and dense matching. Moreover, the final product such as ortomozaics, digital terrain model and point cloud is high memory consuming. The data post-processing by software from raster and XYZ to 3D ridge lines may resolve the problem and the one approach was described by [10].

IV. Methodology

The applied surveying techniques in open pit mining have to provide high measurement reliability, performance, economy and easy in use regarding the extremal mining conditions. Photogrammetry has the potential to provide information about construction and mining progress more efficiently, rapidly and cost-effectively. Applied accuracy for the DTM modelling and breaklines and sidewall excavation modelling were estimated by 0.20 m. It allows to effective construction and mining progress monitoring [11].

In this study the fixed wing aircraft Trimble UX5 was used. The drone is launched by ground launcher, flies and takes photos autonomously. Then glides back down to the ground by using a preprogrammed flight plans organized by ground control system and controlled by the ground control station and remote controller. It mounted with Sony Nex5 (4912x3264pix). Moreover, the procedure off and landing of the aircraft required a safety space and looks dangerous for the aircraft. The multi-rotor UAV's is independent in this case. The testing area covered ca. 2.0 km2. Planning the fieldwork is an important part of the project. The quality of the control and check data as well as the images depends highly on this stage [12]. GSPs were signalized using triangular targets and used sharp colors to make them be distinguishable from the natural objects in the scene. Once the image acquisition was terminated, the ground marks were measured with the RTK system. During the flight mission 2003 images were taken. The row images were imported to the Agisoft Photoscan Professional software and post-proceed [13]. The software used in this analysis was treated as a black box for model creation, since in most cases the used algorithms, such as the dense matching, are proprietary and, therefore unpublished.

Figure 2 visualizes the aerial mosaic (with average ground resolution of 5 cm). The resulting file has huge capacity. Detailed data of 2.0 km2 are shown in table 1.

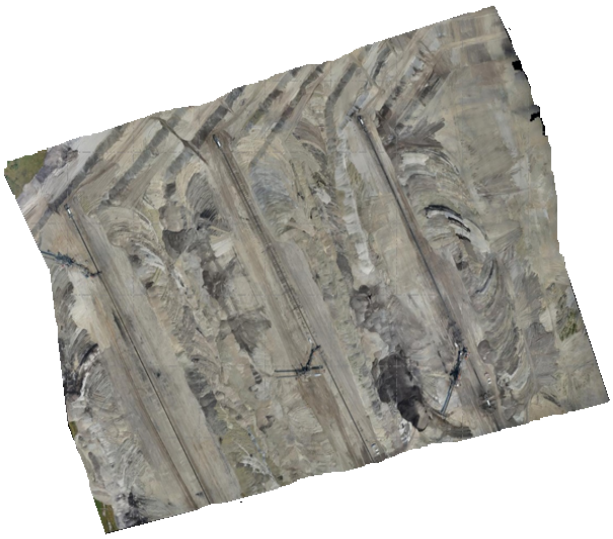

Fig. 2. Visualization of the preliminary orthomosaic in RGB in local terrestrial reference frame. The capacity of the finally product is 173.0 MB

TABLE 1

ACHIEVED DATASETS STATISTICS

Product	Capacity
Raw of 2003 photos	13.7 GB
Orthomosaic	173.0 MB
DTM	217.0 MB
Point Cloud	120.0 MB
PDF 3D Model	30.0 MB

Figure 3 shows the 3D point cloud colored by elevation. The red circle represents the simple which were analyzed. As seen best in figure 3, the data extraction was prepared in Global Mapper, and processed in Matlab and the selected subset which is highlighted by red circle was prepared to the next stage. The big data problem of the high resolution point cloud was estimated in Meshlab. For testing field a Poisson point cloud meshing was made. First the surface normal were estimated, and the next step was point cloud mesh generation. The processing pathway required simplifying the mesh. The results are shown in the next chapter.

V. Results

The chosen data subset was presented at Figure 4.It represents the actual pit sidewall excavation. The original size of point cloud simple was 1825 KB and represent 23,000 XYZ points. Exported data file was included in addition RGB colors of each 3D point. The first step of data reduction was saving in .PLY mesh format. The full data statistic are show in table 2.

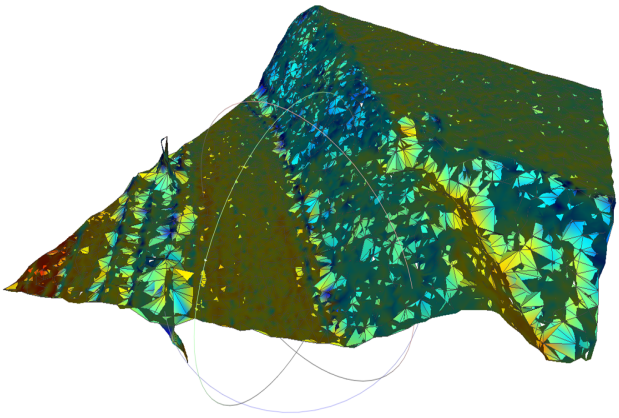

Fig. 3. Visualization of the selected simple with reconstructing mesh in the original size

TABLE 2

ADVANCED STATISTICS OF THE RESULTS

Type of file	Capacity	Reduction
Extracted sample ASCI	1825MB	-
PLY Binary	563 KB	69.2 %
PLY ASCI	813 KB	55,5 %
Simplified sample ASCI	850 KB	53,4 %
Simplified PLY ASCI	401 KB	78,0 %

Fig. 3. Visualization of the selected simple outlined by the red circle

The second step which was applied based on mesh simplified regarding accuracy DTM modeling in open pit mines. It is shown in Figure 4. The breaklines named as structure lines in DTM are clearly visible and accurate. This level of big data reduction allows to achieve the 0.20 m accuracy of DTM. It can be useful for accurate and more efficiency. In this approach a selected area was quite small which was caused by typical computer limitations. The non-metric images form UAS can be used to DTM monitoring in open pit mines. It is important to remember that UAS datasets are difficult to model and the matching algorithms has the random iteration process and they are unpublished [14]. Moreover, the processed point cloud and orthomozaics as a raster type file is difficult to use.

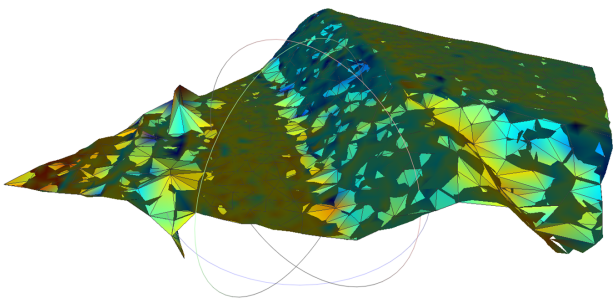

Fig. 4. Visualization of the simplified mesh

Conclusion

In this paper the procedure of DTM modeling using UAV is given. The author shown one of the approaches as well as theoretical and experimental developments of a UAV photogrammetric system in Belchatow open pit mine. Both aspects of data postprocessing and reduction were discussed. The results shown that photogrammetry image matching is grooving and the computer vision allows to using the non-metric camera to DTM modelling. Achieved accuracy is possible to apply this technology to open pit mine monitoring and volume computation. The UAV system is mobile and operative to apply in the fieldwork at open pit mine. Moreover, the computation methodology adapted for digital model reconstruction and the breaklines in 3D which represents the ridge line of floor and roof of excavation were presented. The problem with big data is visible and the presented approach allows to data reduction. The future work will focuses on UAV RTK platform and resulting data integration.

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3D seismic velocity models distribution for complete complex of processing and interpretation of seismic data in Dnieper-Donets Basin

V. Petruniak, I. Ustenko

Institute of Geology,National Taras Shevchenko University of Kyiv. Ukraine, 03022, Kyiv, 90 Vasylkivska str.
E-mail: vasilpetruniak@gmail.com

Abstract – VSP data processing workflow for determining of velocity model is being reviewed in the paper, which can be used for processing of seismic data. Optimal graph of seismic data processing is proposed. The graph contains all the optimal procedures, which allows obtaining seismic images of high quality. Seismic images, obtained after processing, were used for seismic interpretation, which helped to specify geological structure of the prospects in the cutoff part of the Dnieper-Donets Basin.

Key words – 3D cube, SRM data, geometry, static, velocity, DMO transformation, Zero-phase deconvolution, migration, Data interpretation.

I. Introduction

Advanced understanding of geological structure of the fields of Dnieper-Donets Basin is one of the most important step in modern geological exploration hence it allows increasing of oil and gas resources and reserves. In return, this challenge became unreachable without precise processing of acquired seismic data and detailed understanding of velocity model prior migration.

Significant amount of geological and geophysical studies were held at the area of interest, including electrometric, magnetic, gravity and seismic surveys. Wildcat, parametric, and some production wells are drilled. [1]

Acquiring of these data allowed to create acceptable geological model of the area. Nevertheless, the most important issue related to depth conversion cannot be solved correctly solely by little amount of velocity data from certain fields, also we cannot rely completely on velocity models created based on velocity spectra analysis prior migration. Though such velocity cubes might be used later for depth conversion relatively easily using well-known Dix equation, we should take into account possible mistakes that might be introduced during velocity spectrum analysis. Thus, 5 % mistake in velocity estimated from velocity spectra can result in about 20 % mistake in interval velocities calculated via Dix equation. This is why using borehole seismic data is a crucial step for accurate depth models of petroleum prospects and leads.

II. Methodology of VSP data interpretation

The Collection and analysis of wellbore seismic data, mainly results of VSP research was first step in preparation data for velocity modeling. Authors have collected the data from more than 300 wells. Most of these wells located at the area of research, while some wells are located outside the area, but in “immediate” vicinity. These wells were incorporated into model in order to control extrapolation process at the borders of the research area. [2]

About 5 % of these data were not conditional – it was not possible neither re-interpret the data, nor even understand the readings. Therefore, we made conclusion that such oil fields may be considered as the ones without well velocity data.

Since all the VSP surveys were conducted in different time by different methodologies, we have decided to re-interpret the data – in order to have it in one standard.

In order to have all the VSP interpretation results we have developed following workflow:

- at the first stage vertical time travel curves were referenced to absolute depth level (sea level) and correction of an a priori mistakes was made.
- at the second stage corrected time travel curve was recalculated in the time travel curve with constant increment. If input time travel curve was reordered with a step of 20 meters and more, step of an output curve was set to 20 meters. If input time travel curve was reordered with increment of 10-15 meters and more, increment in the output curve was set to 10 meters. [3]
- at the third stage obtained data was transferred in digital and graphical form for further processing.

III. Data interpretation

Reinterpretation of 3D seismic data and formation properties at the Southern border of Dnieper-Donets Basin allowed to reveal new aspect of geological structure of the area, determine areas of petroleum leads and re-estimate formation properties of key productive horizons.

Today, when new technologies and equipment occur, both for seismic data acquisition and its processing and interpretations, it has become possible further research of Southern part of Dnieper-Donets Basin border. Interpretation was carried out on 20 seismic profiles (61-79, 81 2 02), which forms fairly uniform grid. For alignment of wells two profiles of past years - 19 43 81 and 70 43 90 were used. After processing of seismic data, and also reprocessing of profiles from previous years, in the ProMAX system, all materials were loaded into the database of interpretation package Integral Plus. The seismic reference datum of profiles is 150 m. [4]

For tying seismic boundaries with geological data at all deep drilling wells, as well as to determine the characteristics of the complex nature reflectors seismic modelling was carried out. [5]

For convolution of impulse traces 23 Hz Ricker wavelet was used, determined from seismic profiles 77 2 02. Calculation of synthetic traces was performed based on an acoustic borehole logging and generalized velocity curves. Results of seismic modelling showed that the lower and upper borders of Visean formations correspond to an acoustically hard surface. Stratigraphic boundaries coincide with the top of seismic vibrations' wavetrain. This conclusion is also confirmed by comparing calculated seismic traces with the real wave field. [6].

Conclusion

Modern software and interpretation methods of seismic data allow significant improving of mapping accuracy and tracing tectonic faults. Application of new techniques for the interpretation of data makes it possible to create 3D geological models, defining distribution of zones with better reservoir properties, predict values of porosity and zones of lithological substitutions. Using algorithms of seismic facies analysis allows much more reliable establishment of lithological substitution zones and estimate distribution of formations with similar porosity and permeability properties. As a result of seismic studies the geological structure of southern border of Dnieper-Donets Basin was clarified.

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Research of electromagnetic radiation influence of power lines on satellite signals distribution

Antonina Zademlenyuk[1], Vitaliy Lysak[2]

[1]High geodesy and astronomy Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: a.zademlenyuk@gmail.com

[2]Student of High geodesy and astronomy Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: belyi21@mail.ru

Abstract – The article focuses on researching the influence of the magnetic field of power lines to satellite measurements at different distances from power lines.

Key words – GPS, GNSS, coordinates, power lines

I. Introduction

Today, probably, one of the most simple, fast and economical methods of locating points on the Earth's surface with the accuracy of 1-3 m for absolute and 1-5 mm for relative coordinates is GNSS-method (Global Navigation Satellite System). Such results can be achieved using modern technologies [1].

Reception of the terrestrial signal receiver from the GPS satellite can be drown out with the normal high-frequency radiation at 1500 MHz with a power of only 2 watts. The thickness of the atmosphere, especially the ionosphere and troposphere distorts the signal from the satellite and weakens its power to approximately 150 dB. In the ground layer of the troposphere there is the weakest signal and it can be affected by the electromagnetic fields produced by high voltage power lines (EPL), cellular basic stations and other high-frequency radiation. The error for additional signal reflection can be taken into account using mathematical filters, such as Kalman filter. The signal refraction, if any, will be systematic and will not be taken into account during processing, which can significantly affect the accuracy of the coordinates setting.

II. The analysis of existing research on the influence of electromagnetic fields of power lines on satellite signal distribution

Instructions for technical use of GPS receivers contain no reservations about working in electromagnetic fields (EMF). It is unknown if a signal that gets in the revolted environment of high-frequency radiation will be stable. In scientific literature this question has been little studied [2-5].

Electromagnetic radiation occurs in two forms. One of them, intrinsic noise is the result of the random motion of electrons in the contour of elements of electric device. The second form of interference occurs as a result of the signals emitted from other circuits and systems.

Electric noise interferes the satellite signal passing that presents information and makes alteration into information it contains.

Electrical noise can cause errors in timing of signals measurements or the signal phase. If the signal phase error is present this can lead to wrong calculation results of RTK measurements. Typically electric noise will manifest itself in the form of the electromagnetic field around high-voltage lines. GNSS method of the coordinates setting is used to create the geodetic networks and at facilities located in the electromagnetic field, such as power stations.

There is a statement that GNSS receivers operate with a certain delay nearby EPL, in particular there are certain malfunctions, and also certain inaccuraciesof coordinates setting of points are observed.

Group of scientists from the University of Southern Queensland (USQ) conducted tests to determine the frequency with which failed initialization takes place in satellite receivers Trimble 4700 [6]. Field studies were conducted under the transmission lines of high and low voltage in RTK mode. The work was organized at several points as follows: satellite receiver was installed directly under the power line, and then rearranged at a distance of 30 m, 60 m and 80 m. Initialization was about 180 sec. directly under power lines of high voltage, while at a distance of 30m receiver was initialized in 90 sec. The greater distance from EMF, the faster work of the receiver.

Another similar research was conducted by the authors [7]. On the lines of EMF with power of 330 and 750 kV there was conducted a static observation lasting 2 hours and 15 min using Leica SR 20 satellite receiver. At points there was held additional tacheometric observation using Sokkia SET 610 total station. Observations were conducted in sunny and rainy weather. The accuracy of coordinates setting near the EMF was significantly worse than at a distance of ~ 150 m. It should be noted that the power line created in sunny weather also affect the results of GNSS - measurements, but significantly less than in rainy one. The magnitude of this effect occurs within the measuring accuracy.

Analyzing the results of measurements obtained for the 15-minute session, we see that the error of the GPS-measurement is naturally greater than the for the two-hour sessions, namely 12-68 cm in plan.

III. Selection of points and the experimental measurements

For experimental measurements it was selected an area on the territory of Gozhulivski village council of Poltava region. Through this area there is a power line of 330 kV. The venue for the GNSS observations was selected so that in the research area there was no tall trees and buildings, which can lead to additional reflection of the satellite signals.

The research was carried out on 10th October 2014. The weather was sunny, the humidity was low, and therefore the natural factors had minimal effect to the accuracy of measurement.

The first point of observation was located right in the center, directly under power lines.

The observation time in static mode lasted 1 hour and 20 minutes, the number of satellites fluctuated in the region of 5-8 pieces. Monitoring in kinematic mode lasted for 45 seconds with 6 satellites. Initialization was ~ 25 s.

The second point was perpendicular to the power line at a distance of 20 m. At this point the observation time in static mode was 1 h 24 min, and the number of satellites fluctuated between 6-8 pieces. Monitoring in kinematic mode lasted for 30 seconds with 6 satellites.

The third point of the observation was perpendicular at a distance of about 60 m from power line. In static mode the observation time for a given point lasted 1 hour 18 min, when the number of satellites was from 5 to 9. In kinematic mode the observation lasted 35 seconds.

Scheme of the GNSS observation points location is shown in Fig. 1.

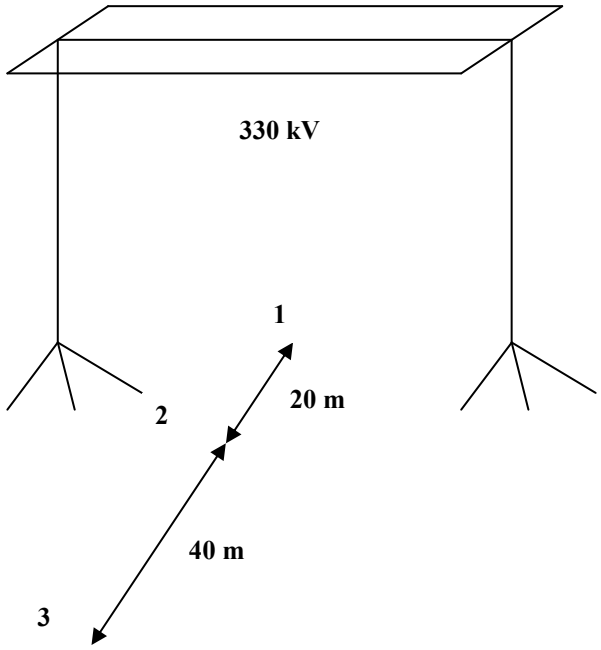

Fig. 1. Scheme of the GNSS observation points location

IV. Processing and analysis of the measurements results

At the end of the field work Trimble Business Center software package was used for processing the results of satellite observations [8]. Because of POLV reference station was located in the immediate vicinity of our work area (at a distance of about 7 km) we accepted amendments from there during the measurements in RTK mode [9].

Trimble Business Center software package is primarily intended for processing and analysis of GNSS data obtained in the field conditions.

After that, the program Digitals transforms observations results from SK42 (in which the device stores data) to SK63 and superposed on the zone 5, because the area of the Poltava is in the 5th zone.

TABLE 1

THE ACCURACY OF THE POINTS COORDINATES SETTING OF GNSS OBSERVATIONS

№ point	ΔX, м	ΔY, м	ΔH, м
1	-0.197	-0.141	0.265
2	0.139	0.113	-0.178
3	0.020	0.030	-0.142

Having the above coordinates, it was conducted the comparison of measurement results of two shooting modes and obtained the following deviations.

So, from these results we conclude the following: taking the points coordinates obtained by the static method as precise, the deviation of the measurements resulting from the GNSS observation in RTK mode for power lines of 330 kV is quite significant. So, right in the center under the power lines, that is, at point 1, the deviation of the plane coordinates (14-19 cm in plan, in height - 26.5 cm), at the observation point 2, which is 20 meters less from power lines (11 - 14 cm in plan, in height - 17.8 cm), and at the last point, which is 60 m from transmission lines reaches 2-3 cm in plan and 14 cm in height, which is negligible. So, the farther the observation point from the transmission line, the smaller the influence of electromagnetic waves and accurate shooting results.

Conclusion

As a result of the done work we have the following conclusions: The experimental research confirmed the theory of the influence of electromagnetic waves of power lines on the accuracy of GNSS measurements. On the basis of the results we obtain the deviation of the plane coordinates (14-19 cm in plan, in height - 26.5 cm) right in the center under power lines, at a distance of 20 m from the power line (11 to 14 cm in plan, in height - 17,8 cm), and at the last point, which is 60 m from power lines reaches 2-3 cm in plan and 14 cm in height, which is negligible for single frequency receiver. So, the farther the observation point from the power line, the smaller the influence of electromagnetic waves and more accurate surveying results.

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Study of Vertical Movements of the European Crust Using Tide Gauge and GNSS Observations

Kornyliy Tretyak[1], Solomiya Dosyn[2]

[1]Department of Higher Geodesy and Astronomy,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: kornel@polynet.lviv.ua

[2]Department of Higher Geodesy and Astronomy,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: solomiya.dosyn@gmail.com

Abstract* – This research is devoted to the study of vertical movements of the European crust on the basis of two independent methods, namely tide gauge and GNSS observations results. The precision with which the movement of the earth's crust according to the results of tide gauge observations can be explored has been calculated. A methodology to identify the duration of tide gauge observations required for studies of vertical movements of the earth's crust has been presented. Approximation of tide gauge time series with the help of Fourier series has been implemented, the need for long-term observations in certain areas has been explained. The diagram of the velocities of the vertical movements of the European crust on the basis of the tide gauge data and GNSS observations has been built and the anomalous areas where the observations do not coincide have been identified.

Key words – vertical land movement, tide gauge, GNSS observations, sea level change.

I. Introduction

Information about slow movements of the earth's crust (especially in tectonically unstable areas) is becoming more and more necessary when creating the reference geodetic networks, the design of large long-term facilities - ports, canals, hydroelectric power stations.

Today there are different methods of observation of the movements of the earth's crust; in particular, it is explored by the use of geodetic, geophysical, oceanographic and geomorphological methods.

II. The influence of the duration of tide gauge observations on the precision of determination of the vertical movements of the earth's crust

It is clear that the longer observations are the more valuable they are for the analysis. For short periods of observations, the value of the RMS errors is higher, highlighting thereby the influence of interannual variations.

For each countdown on the tide gauge we made an equation (1):

$$h_i = -Vt_i + a\,, \qquad (1)$$

where a - unknown coefficient; V - unknown velocity; h_i - countdown on the tide gauge to the epoch t_i.

Solution of the system of equations by the least squares method allows to determine the earth crust velocity V and coefficient a. Precision m of the velocity determination V from time series was calculated from equation (2):

$$m = \frac{\sum_{i=1}^{n}[h_i + Vt_i - a]^2}{n-1}\,, \qquad (2)$$

where n - number of countdowns.

Graphic image of the desired duration of observations on the European tide gauges to achieve a precision of 0.3 mm/yr is presented in Figure 1.

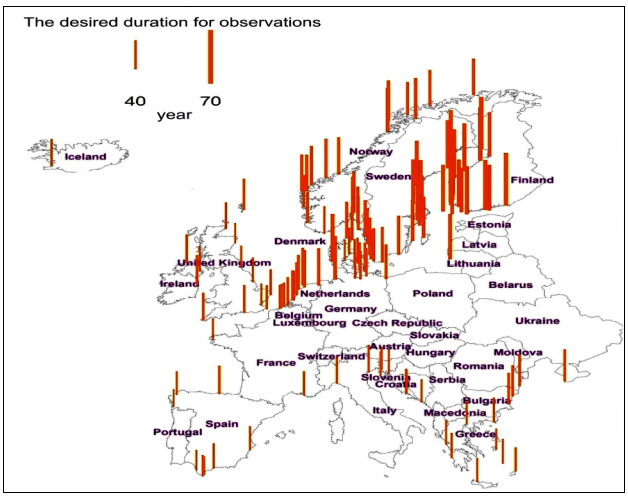

Fig. 1. Graphic image of the desired duration of observations on the European tide gauges to achieve a given precision 0.3 mm/yr

III. Comparison of the results from tide gauge observations with the corresponding GNSS observations

For each countdown on the GNSS receiver we made an equation (3):

$$h_i = Vt_i + a\,, \qquad (3)$$

where a - unknown coefficient; V - unknown velocity; h_i - height, measured by GNSS reciever on the epoch t_i.

Solution of the system of equations by the least squares method allows to determine the earth crust velocity V and coefficient a. Precision m of velocity determaination V from time series was calculated from equation (4):

$$m = \frac{\sum_{i=1}^{n}[h_i - Vt_i - a]^2}{n-1}\,, \qquad (4)$$

where n - number of countdowns.

The value of the precision m of the linear velocity V is within 0.03≤m≤0.30 mm/yr.

After this the diagram (Fig. 2) of velocity (mm/yr) of vertical movements of the European crust was built on the basis of the results tide gauge and GNSS observations.

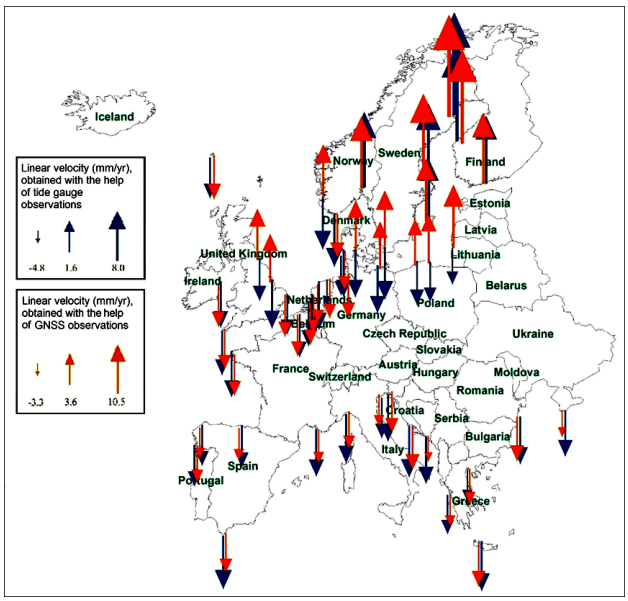

Fig. 2. Diagram of velocity (mm/yr) of vertical movements of the earth's crust, based on the results of tide gauge and GNSS observations

List of tide gauges and GNSS stations, which show differences in the results of determining the vertical movements of the crust, are shown in Table 1.

TABLE 1

LIST OF TIDE GAUGES AND GNSS STATIONS, WHICH SHOW DIFFERENCES IN THE DEFINITIONS OF THE VERTICAL MOVEMENTS OF THE EARTH'S CRUST

Country	Station name	Time of data	B,°N	L,°E	V, mm/yr	D, km
Norway	Stavanger	1919 - 2012	58.97	5.73	-0.45±0.11	8.94
	STAS	2001 - 2014	59.02	5.60	1.62±0.21	
Lithuania	Klaipeda	1949 - 2011	55.70	21.13	-3.11±0.35	1.89
	KLPD	2005 – 2009	55.72	21.12	3.42±0.13	
Poland	Wladyslawowo	1951 - 1999	54.80	18.42	-2.48±0.46	0.37
	WLAD	2003 – 2010	54.80	18.42	0.83±0.06	
	Ustka	1951 - 1999	54.58	16.87	-1.75±0.43	20.40
	REDZ	2008 – 2014	54.47	17.12	0.38±0.09	
Denmark	Hornbaek	1898 - 2012	56.09	12.46	-0.41±0.10	39.24
	BUDP	2005 - 2014	55.74	12.50	2.15±0.21	
	Fredericia	1890 - 2012	55.56	9.75	-1.10±0.05	15.17
	SMID	2003 - 2014	55.64	9.56	1.04±0.16	
Germany	Warnemunde 2	1855 - 2011	54.17	12.10	-1.25±0.05	0.16
	WARN	2003 - 2014	54.17	12.10	0.58±0.15	
UK	North Shields	1895 - 2012	55.01	-1.44	-2.24±0.20	0.07
	NSTG	2003 - 2010	55.01	-1.44	1.28±0.07	
	Immingham	1960 - 2011	53.63	-0.19	-1.03±0.19	20.11
	EASN	2005 - 2010	53.65	-0.12	0.79±0.09	

The land on which differences in the results are observed extends within 55-60°N and 5°W-25°E. The reasons for these differences require further investigation. At these stations the average RMS errors are within the definition of the values of the linear velocities. Perhaps the dominant contribution to the sea level in this region makes the oceanographic component or gravitational anomalies.

Conclusion

The precision with which the crustal movements of the European coastline according to the results of tide gauge observations was substantiated. Its value is 0.3 mm/yr.

The necessary duration of tide gauge observations in order to achieve this precision is not the same throughout Europe. It varies depending on geographical location and oscillates between 30-69 years. For the territory Fennoscandia this duration is 40-69 years, for tide gauges, which are located in Belgium, the Netherlands, and Germany the duration is 37-58 years. The tide gauge located on the territory of Spain, needs 30-41 years of observations to achieve a precision of vertical offset determination of 0.3 mm/yr. The calculated values of the linear velocities obtained from tide gauge and GNSS observations, in most cases, coincide with each other. This may indicate that the cause of changes in sea level is rising or sinking of the earth's crust in this region.

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Development of countryside by the building of agrarian socio-eco-comlexes

Maryna Babenko, Mykola Savytskyi

Reinforced concrete and masonry structures department, Dnepropetrovsk, State Higher Educational Institution "Prydniprovs`ka State Academy of Civil Engineering and Architecture", UKRAINE, Chernushevs`kogo street 24A, E-mail: babenko.marina@yahoo.com, sav15@ukr.net

Abstract – The agricultural sector reformation through the combined development of agricultural and construction technologies with creation of an agricultural socio-eco-complexes national network was proposed in this research. It was determined the basic formation principes for such complexes which is erection of ecological buildings and structures with the usage of local renewable organic materials, organic agriculture and livestock. The proposed model can provide Ukrainian people by affordable housing, useful work with green technologies in tourism and in scientific spheres; provide restoration of cultural heritage.

Key words – sustainable development, environmental construction, green architecture, spatial planning, heritage, socio-eco-comlex

I. Introduction

Ukraine is primarily an agricultural state. Its formation occurred under the influence of the processes that passed in the villages. Nowadays Ukrainian government has a difficult task to revive the village which is is the center of national traditions' preservation such as: honoring the family and established relations between generations, which have a significant influence on the formation of the Ukrainian mentality.

Nowadays agricultural sector is one of the most important parts of Ukrainian economy. Today more than 14 million people are employed in the agricultural sector, and only 620,000 of them are working in the large farms – agro-holding companies. The core components of the government's policy are support for micro and small scale enterprises (MSEs) and integrated housing development. Extremely important factor for the agricultural sphere is not only increase in production rates but also the development of rural social infrastructure, thus we are faced with the necessity for a governmentally funded program to ensure affordable housing in the regions [1].

So, development a scientifically sound model of strategic and spatial planning at the regional levels, which should be based on the main principles of sustainable development: improving economic performance and energy efficiency, social orientation, environmental friendliness, preservation of cultural heritage is an important and actual task.

Disicion of this task was a general goal of this research. The formation of new eco-villages type and their integration into the existing system of settlement was proposed on the base of global tendency of sustainable development.

II. Basis for countryside sustainable development

The concept of a national project to build agrarian socio-eco-complexes is developed on the basis of globalization trends' analysis and awareness of Ukraine's role in the global labor division. Other notions taken in to account are the principles of sustainable development, the features of modern post-industrial information society ('knowledge society'), the formation of «national idea», the modern technologies of natural farming, the study of international experience of ecovillages' existence, the innovative energy-efficient construction and information technology implementation. It is also very important to consider the historical relationship both to the ancient agricultural Tripoli culture that was present on the Ukrainian lands and existence of the Cossack 'Zimovniki' and the hamlet of farms.

The term 'sosio-eco-complex' means established residential space in which the industrial, scientific, educational and recreational activities are integrated into the environment in a way that supports healthy and thorough development of the individual and helps to develop responsible attitude towards future generations.

The village is a place of the most natural living conditions for human. Because land provides with the feed and the physical work which can make the body healthy and cultivate positive living traits (perseverance, focus, optimism), of course it requires the creation of appropriate social conditions.

Combination of environmental building technologies with modern bio-agricultural technologies can solve socioeconomic problems of the modern village - to provide affordable quality housing, safe and useful work with green technologies for land, in tourism and in scientific spheres; to create a new attractive youth ideology of cultural heritage restoration and cultivation of healthy life and modern thinking according to global trends in sustainable development.Fig.1

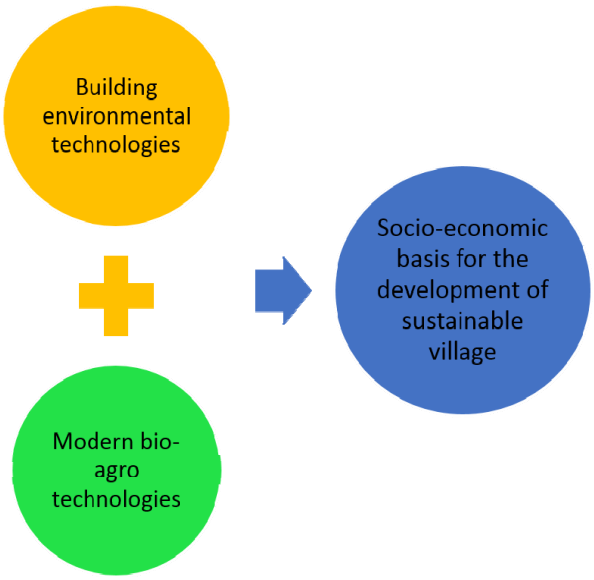

Fig. 1. Theoretical basis for effective countryside development

Practical implementation of the measures for the development of affordable ecotechnologies construction and production in countryside by creating a network of high-tech socio-eco-complexes needs to develop a new regulatory and legal framework of large-scale government programs [2].

"Strategy of development of ukrainian agriculture sector 2020" determined and approved the basic principles and priorities of social development of rural areas, among which the most important are organizational, economic and legal measures aimed at improving the life support of the rural population in conditions of the private sector in agriculture. In particular:

- assistance backward villages and regions;
- providing government loans for housing and other construction workers of agriculture;
- financial incentives and other persons in rural areas;
- better serve the rural population and development of material base of establishments of social and cultural;
- improve the planning and building of settlements in rural areas, etc.

Implementation of the principles of this target program in conjunction with the creation of a legal framework for the construction of low-rise affordable housing and social organizations socio-eco-comlexes priority and providing conditions for the development of bio-agricultural technologies - the key to sustainable development of Ukraine as an independent and prosperous state.

III. Environmental building technology - basis for the creation of socio-eco-comlex

Territorial distribution of target settlements (socio-eco-comlex). Today there is a global trend towards networking ecological villages. An example of this is an international consortium Global Ecovillage Network - an association of individuals and communities (ekoposelen) who devote themselves to lifestyles that takes into account the needs of future generations. Members of the network adhere to the principle: live so that natural resources are restored, use environmentally technology environment to give more than take.

Eco-village began to form around the world in the 60s of XX century, and the world ecological villages movement emerged in the 90 - th in response to the pressure of modern civilization on nature and man. The foundation was laid in 1991, when the fund Gaia Trust convened a meeting of representatives of Denmark in ekospilnot to discuss strategies for further development of the concept ekoposelen.

In 1994 was launched ecological villages` Information Service. In 1995 in the Scottish village of Findhorn (Findhorn) the first international conference of ecological village members has been conducted. It was called "eco-village and community self-sufficiency for the XXI century". In 2001, the Global Ecovillage Network received a special consultant status with the Economic and Social Council (UN - ECOSOC), and became a partner of the United Nations Institute for Training and Research (UNITAR).

Formation of ecological villages is generally spontaneously and autonomously in Ukraine. At first glance eco-village and socio-eco-complexes are the same thing, but it is not quite as in our reality. Today, eco-village is single settlement of naturalists' hermits in Ukraine. Creation of separate settlements contributes to the popularization of the idea of sustainable development, but it does not solve global problems.

Thus, the implementation of the concept of creating the socio-eco-complexe provides for the withdrawal of a large portion of the population of cities and resettlement of people in ecocomplexe integrated into the environment, and that will satisfy all human needs. In eco-complexe will be maintained the lifestyle, that will bring balance to the inner world of man, make it harmonious with respect to each other and to the environment.

One of the most important issues is the formation of eco-complexes and their integration into the existing system of settlement. Ecocomplexes are formed in the structure of national and natural parks, on the territory of natural systems, in the system of rural settlement. Of the above areas, the integration of eco-complexes in rural settlement is necessary for the implementation of the principles of sustainable development of the area. This is especially sound problem for the industrialized regions characterized by a dense network of large cities, high rates of urbanization, environmental problem.

After analyzing the accumulated theoretical and practical experience the following distribution model of ecological villages was proposed depending on their social indicators - scientific basis or agricultural base. Fig.2

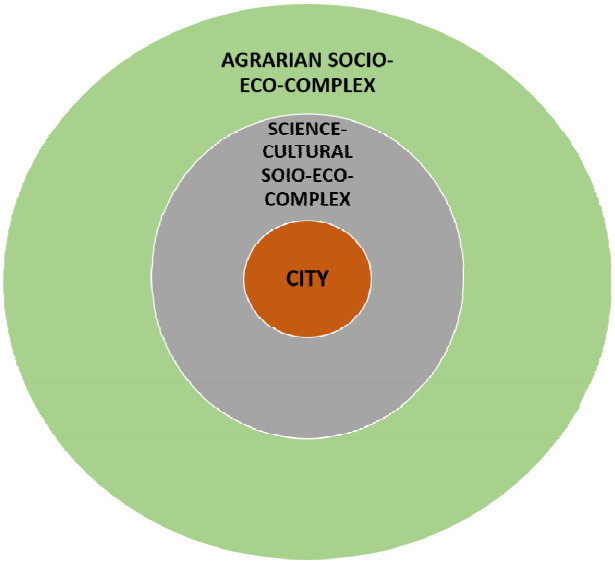

Fig. 2. Structure of territorial socio-eco-comlexes distribution relative to town

It is proposed the formation of two types of ecocomplexes: high-tech socio-eco-comlex "Science-Cultural-soaio-eco-complex" (Greenhouses, science and research centers of green technologies, tourism) which is situated closer to city and soaio-eco-complex "Agrarian socio-eco-complex" (agricultural activities, maintenance

of recreation and tourism) which is situated father from city. The principle aims of such transformations in spatial planning are the economic development with the preservation of biodiversity and comprehensive management of natural resources [2].

Architectural forms and organization of socio-eco-complex interior space. Planning and structure of existing eco-villages is being formed. And, proposed conception of planning structure for socio-eco-complex was developed not only on the base of existing eco-villages plans bud on the historical peculiarity of the territory, social-economic situation and sustainable standards as well. The formation of the master plan, on the one hand, a form of communal living arrangement affects settlement - the development of an active nucleus - the center and centripetal relations, on the other hand, the implementation of the principle of "Movement for relief that does not disturb geomorphological energy flows" of all environmental components - urban planning of the territory (buildings, transport frame, engineering systems, landscaping, etc.). In general, ecological village typical compact monocentric or polycentric city structure, maximum inscribed in a natural frame was taken for socio-eco-complex basic structure.

The scale of ecocomplexe and the optimal number of residents must provide the conditions under which all residents are familiar with each other and with each can have the influence on the development of ecocomplexe. According to the results of social research the upper limit of the group of about 500 people, and the optimal number is 300 people. It is given, that if the average composition of the family is 3 - 4 people, then the optimal number of individual residential buildings in socioecocomplexes can be 70 - 100 houses [3].

The socio-eco-comlex principles: autonomy, self-sufficiency, sustainability, environmental friendliness, structural, architectural and planning - landscape flexibility, providing necessary social objects, respect for traditions and national identification.

System maintenance and service range of objects due to the type and size of settelment, activity and area of interest of the community. For small socio-eco-complexes center is the "common house", together with the main lawn, forums and church. Along with traditional objects of trade and consumer services there are forseen several objects: schools, temples and churches, buildings meditation and yoga, spiritual centers and environmental development of educational, research and cultural centers, arts and business centers, herbs and home center environmental protection, laboratory design and eco-tourism.

Socio-eco-comlex consists of low-rise buildings, 1-3 floors, modular or free, depanding on the landscape. Eco-housing is integrated into the natural environment: shaping, planning, construction materials, scale and image are dictated by the type of the surrounding landscape. Eco-friendly living space should be comfortable, power effective and economically affordable living space to ensure harmonization and minimum load on the environment.

Along with the development of the optimal structure planning and constructive eco system, special attention is paid to morphogenesis. Planning and finance generally rectangular free. But the building is dominated by a free, flexible, bionic planning. Volume: sphere, hemisphere, cylinder, complex bionic form.

Socio-eco-comlex residential building construction. Constructive solution of houses: wood frame, with the filling of the internal space frame lightweight concrete based on renewable organic material (straw, grain crops, hemp fire, et al.). Presented a constructive solution has been developed on the basis of laboratory studies of thermal insulation characteristics of local renewable building natural material, carried out in SHEI “Prydneprovs`ka State Academy of Civil Engineering and Architecture”.

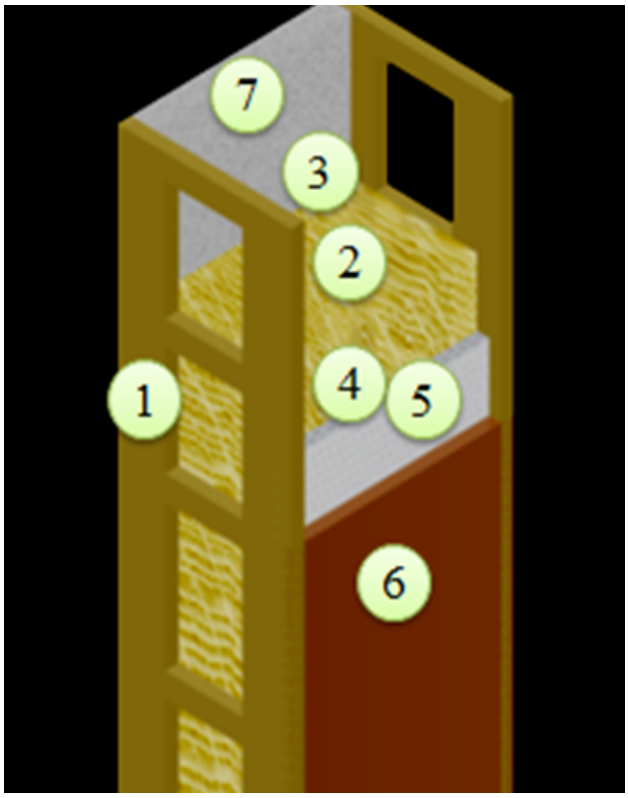

Fig.3 Constructive solution of wall outdoor enclosure
1 - wooden frame element - "ladder"; 2 - ecological local materials insulation (straw, lightwieght adobe, pressed hemp or reed cutting, lightweight concrete with hemp), 400 mm; 3 - steam; 4 - windscreen; 5 - net; 6 - external decoration; 7 - interior decoration

The availability of housing is characterized by following criterias: low cost of construction and operation, short construction buildings. These indicators can be achieved by using structures and materials of low cost, efficient insulation materials, differentiation carrying, protecting, protective functions of structures, industrial construction method [4]. These features are taken into account during the development of energy efficient environmental design of industrial low-rise building for socio-eco-complexes with local renewable natural building materials.

The problem is solved:

a) use of prefabricated modular load-bearing structural elements – pillar in the shapr of "ladder",framework of floor and cover with fastening element on metal gear plates that together form a spatial frame;

b) parameters regulation of insulating properties of envelope by using one type of insulation material which changing thickness could be easily achieved by decreased or increased distance between the branches of pillars;

c) regulation of insulating properties of the wall frame structures for a given wall thickness by selecting the natural insulation material (straw bales cereals, chaff, hemp, flax chaff, chaff cane);

d) use for forming protective layers (internal and external) synthetic materials such as bricks - from local raw materials (soil-concrete).

The foundation of the building - tape or pile of reinforced concrete or soil-concrete. The size of the foot base is calculated based on the type of soil at the construction site. It should be taken into account the small proportion of construction due to light placeholder organic and external walls of the wooden frame. In the upper part of the design foundation embedded parts provided for fastening the frame of the foundation.

Environmental energy efficient external structure of local building materials formed by filling the gap between environmental rack filler of organic origin - straw bales cereals, tow hemp, flax tow, chaff cane or others.

The inner walls of the protective layer consists of vapor barrier, structures of brick or blocks of soil-concrete with hight heat capacity, plaster [5].

The outer protective layer wall consists of wind barrier, air layer ventilated facade system, self-supporting wall of bricks or blocks.

Supporting structures of intermediate and attic floor is a farm with parallel chords. Heat insulation and soundproofing are ensured by completion of construction structures with natural organic origin insulation materials.

Coverage includes enzyme or truss structure which performs the function of waterproofing for the roof with reed mats and waterproofing film, mounted on the OSB sheets.

Conclusion

The present study clearly shows the following:

1. Ukraine was aiming at modernizing its spatial planning through the development of economic activities, and the use of environmentally friendly construction technologies to the creation of a national network of socio-eco-complexes.

2. The basic principles of development of socio-eco-complexes are: ecological, technological, business and social activity of the inhabitants, the comprehensive development of individual.

3. Combination of environmental building technologies with modern bio-agricultural technologies can solve socioeconomic problems of the modern village - to provide affordable quality housing, safe and useful work with green technologies for land, in tourism and in scientific spheres; to create a new attractive youth ideology of cultural heritage restoration and cultivation of healthy life and modern thinking according to global trends in sustainable development

4. It is proposed the formation of two types of ec-ocomplexes: high-tech socio-eco-comlex “Science-Cultural-soaio-eco-complex” (Greenhouses, science and research centers of green technologies, tourism) which is situated closer to city and soaio-eco-complex “Agrarian socio-eco-complex” (agricultural activities, maintenance of recreation and tourism) which is situated father from city.

5. Constructive solution of houses: wood frame, with the filling of the internal space frame lightweight concrete based on renewable organic material (straw, grain crops, hemp fire, et al.).

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Bearing capacity of steel plate anchor in cellular concrete block masonry. Research aims, programme and methodology

Volodymyr Verba[1], Olovets Oleh[2]

[1]Department of Building Constructions and Bridges, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: verba.v@gmail.com

[2]Department of Building Constructions and Bridges, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: olovets@gmail.com

Abstract – The current article is devoted to the start of new topic of wide scientific researches of cellular concrete structural properties and its application in civil engineering held in Lviv Polytechnic National University. Nowadays we are focused at problem of estimation of bearing capacity of plate steel anchor applied in aerated concrete thin-bed blockwork. Aim, research tasks and programme of experiment is presented.

Key words – plate steel anchor, cellular concrete, masonry, bearing capacity, research program

I. Introduction

Cellular concrete masonry systems are familiar to civil engineers for a long time, since their invention in the mid-1920s. Cellular concrete blocks provide high thermal insulation, structure and fire resistance and are used for external and internal wall construction. Elimination of separate materials for structural and insulating purposes leads to time and cost savings. Blocks can also be handled by plain tools on the construction site.

Listed advantages made cellular concrete block masonry very popular not only in Ukraine but throughout the world. There are also significant amount of technical literature, design codes and manuals for design and construction of buildings using cellular concrete masonry but analysis of such literature showed some problem questions that were not covered in them.

One of such problems that needs to be solved is bearing capacity of plate anchors in cellular concrete block masonry.

II. Aims and Objectives

There are many cases when structural elements need to be fixed in masonry and plenty of them causes tensile stresses. Mounting of such structures uses wall plugs or anchors of different types as commonly used practice. It is also known that anchoring of wall plugs in porous masonry units should rely on the dowel's shape instead of friction forces in solid materials. In our previous researches [1, 2] we had already proposed the usage of steel plate anchors in nonautoclaved in-situ foam concrete structures and now we want to study the behaviour of such anchors in aerated concrete blockwork.

There is no particular design code for leightweight concrete blockwork in Ukraine. The only calculation formula for estimation of bearing capacity of plate anchor in masonry is DBN V.2.6-162:2010 [3] expression (11.10) for calculation of masonry resistance to local vertical load. That's why necessity to learn the bearing capacity of steel plate anchor in cellular concrete blockwork by experimental and theoretical way was induced and it became the main aim of current study.

In order to reach aim of research we need to accomplish several tasks that are as follows:

- to perform literature review ;
- to check declared compressive strength of cellular concrete masonry units and obtain other physical properties of aircrete;
- to develop laboratory model of masonry element that meets requirements of next research task;
- to determine experimentally bearing capacity of steel plate anchor in cellular concrete block masonry;
- to compare obtained results with previous researches [1, 2];
- to prepare some recommendations for structural design of anchors in leightweight concrete masonry.

Following programme and methodology of experiments is proposed.

III. Experimental Programme and Methodology

We decide to prepare for experiments two identical masonry fragments in order to solve research tasks mentioned above. The shape of test specimens is shown on Fig. 1. Each specimen will consist of four cellular concrete blocks. Fourth block should be divided to halves and set at the ends of second row. As cellular concrete masonry units it is proposed to use prefabricated autoclaved aerated concrete blocks AEROC EcoTerm (D400 density grade) or AEROC Classic (D500 density grade) with compressive strength not less than B2.5 class.

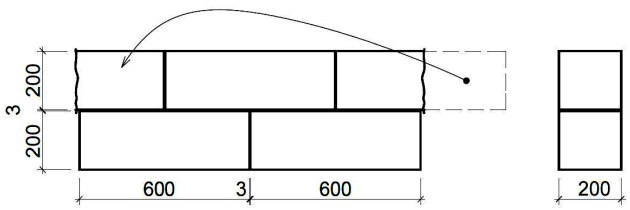

Fig. 1. Shape of test masonry specimen

Blockwork is supposed to have thin mortar layers with the depth of the mortar set to 3 mm or less. Pre-mixed cement-based mortar should be applied to the bed joints and perpends.

Completed blockwork specimens will be left for hardening for a week. Before the experiment there will be drilled three holes in masonry element at marked on Fig. 2 locations that should match the diameter of used stud 2 showed on Fig. 3 (approx. 10–12 mm in diameter). Such holes will help to avoid the influence of bonding between rod and cellular concrete on experimental results. Numerical marks on Fig. 2 shows the order of planned loadings: first anchor will be tested at the wickest point of masonry between the masonry units, the second will be located not far from the edge of middle block (100 mm) and the last testing position will be at the center of the specimen.

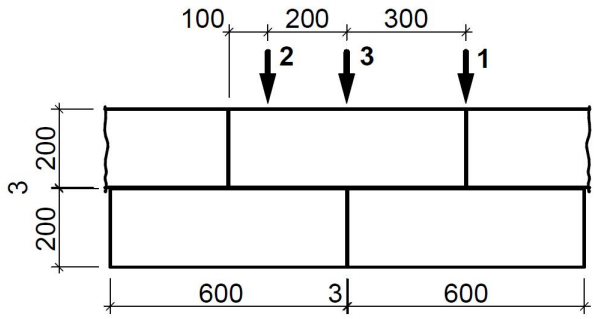

Fig. 2. Test specimen with marked locations and order of load applying.

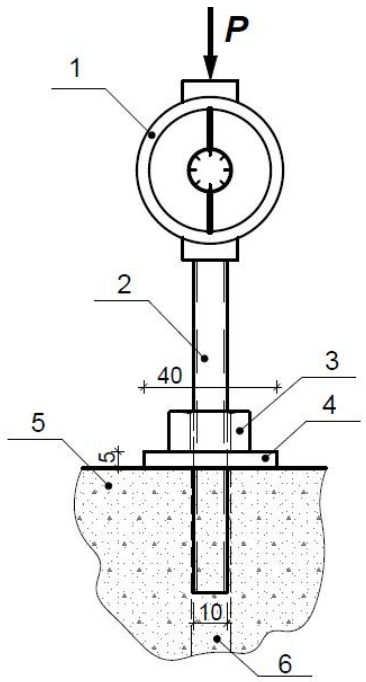

Fig. 3. Side view of steel plate anchor in cellular concrete block masonry loading experiment:
1 – compression dynamometer; 2 – steel threaded rod;
3 – steel nut; 4 – steel plate square anchor 40×40×5 mm;
5 – cellular concrete masonry; 6 – drilled hole

As it is shown on Fig. 3, applied to the stud loading will be compressive but the plate anchor and surrounding masonry will behave exactly the same as we'll pull the stud from another side.

Loading will be developed by means of hydraulic jack (carrying capacity of 12 tons), and measured by means of preliminary calibrated dynamometer 1 (see Fig. 3). Measurement of the vertical displacements of plate anchor will be held by the indicator with the precision up to 0,01 mm. Loading of all anchors will consist of steps which reach 0,1..0,15 of the expected size of the destructive load. On every stage the shows of devices will be taken with delay of 5–10 min.

After main experiments on achor's bearing capacity four lower blocks of specimens that are expected not to be damaged will be used for obtaining of aircrete physical properties. They will be weighed to check declared density grade of blocks. Three of them will be compressed to check declared compressive strength of cellular concrete masonry units and the last block will be splitted several times to estimate the tensile strength of cellular concrete. Detailed methodology of splitting can be read in previous article [4].

Conclusion

Modern design manual for cellular concrete blockwork construction [5] recommends to mount wall top plates and other beams with rods anchored in plain reinforced concrete. We suppose such strict recommendations caused by not only relatively low strength of cellular concretes but also few and fragmented scientific researches on the topic of anchoring in cellular concrete block masonry. This paper is devoted to the beginning of experimental studies in the field of bearing capacity of plate steel anchor applied in aerated concrete thin-bed blockwork estimation. Aim, research tasks, programme of experiment and methodology in details is presented.

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The Potential of Port Buildings and Structures for Further Renovation under Cultural - Community Centers

Ganna Gormakh

[1]Eksareva N. M., professor of department of architectural constructions, restavration and reconstruction of buildings and their complexes. Odessa State Academy of Building and Architecture, UKRAINE, Odessa, Didrihsone street 4, E-mail: eksareva@gmail.com

[2]Graduate student of department of architectural constructions, restavration and reconstruction of buildings and their complexes. Odessa State Academy of Building and Architecture, UKRAINE, Odessa, Didrihsone street 4, E-mail:mards@mail.ru

Abstract – In the article the receptions of social activation and reconstruction of port industrial buildings under cultural - community centres and aspects of their forming are examined. The tendency of reconstruction of port territories under entertaining and health areas of the city, adaptation of technical buildings for the rest of population and sporting-health measures, for the device of temporal city holidays and festivals is exposed.

Key words – trade - industrial port ; potential, renovation ; social activation ; reconstruction; cultural - entertaining centers.

I. Introduction

Modern trend of the port development is to provide a harmonious combination of the port and the city: the obsolete industries and port territories are carried out of the city, and the main areas of the coast, located in the central part of the city will be given under device of embankments, parks , sports and recreation centers. Such reconstruction will have a positive impact on the further development of the port (the ability to use modern technology) and will significantly improve the eco-logical situation in the city (recreational area) .

II. The Need for the Renovation of Port Buildings and Structures

The port and the city - are inextricably linked . Port buildings and facilities - an integral part of the urban environment, the city-forming elements. Port is a highly symbolic place, transmits information, bears the history of many generations of sailors and their families, shows their feelings and joy, meetings and separation. Port - combines professional and business activities, it is one of the most important components of the transport complex. Commercial port - the main starting point of the history of cities, their base. Port industrial buildings and structures - are an integral part of the image of a modern city , they take part in the formation of "Marine Facade". Most of port industrial facilities in the cities occupy a substantial part of the territory (25 - 30%). Financial value of industrial heritage is very high. It is the availability of engineering and transport communications. Industrial enterprises have the cultural, architectural, historical, planning, and artistic information [1]. As a result of modernization of traditional production - the technology of the port had changed. Many port buildings and facilities have lost their original function, they are isolated from the urban environment. Modern requirements to the port, require the introduction of new "clean" technologies, the construction of appropriate modern types of industrial buildings, reducing turnover, the use of "clean" modes of transport [2]. Often located in the central areas of the city port buildings do not work, they make difficulties in the functioning of the main areas of the city and create ecological and aesthetic imbalance. There is a shortage of the urban area for the development of business, shopping and entertainment features, small and medium businesses, the service sector. Port territory is regarded as a potential reserve for further development of urban space from the standpoint of the concept of sustainable development. The current trend of urban development - a combination of the interests of the port and the city. Renovation of obsolete port buildings, engineering structures and territories under the recreation area and relocation beyond the city industrial areas of the port - the necessary balance to create harmonious environment of the city .

III. Methods of Adaptation of Port Buildings and Structures

The techniques of social revitalization and reconstruction of port industrial buildings and structures under the cultural - community centers were identified and analyzed. They are divided into three main groups: the preservation of the existing structure; change in the internal space; an increase in the spatial structure. Preservation of the existing structure - is complete preservation of historic Portside Industrial Design, its restoration by archival drawings and documents, recreation of the lost parts and fragments. Gives the primordial image of the object. Precondition: full compliance with its functional and aesthetic characteristics of the same requirements to the new object (Fig. 1).

Fig. 1. Inactive power station on the south bank of the River Thames near Battersea, south London. Planned for the reconstruction of public utilitytion

Changing the interior space - this change planning structure within the boundaries of the constructive scheme, (partial reconstruction, the main load-bearing elements remain unchanged, only the change in shape due to the characteristics of planning). The increase in the spatial structure - is an add of the entire structure or its part, extension planning elements, connecting the neighboring buildings, underground space can be used. (Fig. 2).

Fig. 2. Kraanspoor - very light , glass , three-story office building constructed on the existing concrete unloading board. This platform is built in 1952 , length of 270 m, a height of 13.5 m and a width of 8.7 m - a monument of industrial design

The vertical structure allows the use of basic functions to accommodate cultural - community centers; horizontal structure of buildings, allows building on top volume. (Fig. 3).

Fig. 3 Renovation of port dock under Philharmonic, red brick building , built in 1963 by Werner Kallmorgenom. Contrast of glass and industrial design

Significant advantages in the device are the functional capacity of the buildings; flexible layout ; considerable internal volume. The classification of port buildings and facilities, which are subjected to adaptation was derived (facilities on the water for the extraction of raw materials, port docks, lighthouses, cranes, supporting facilities, floating airfields). The basic functions under which port buildings and facilities are adopted were given (theater; hotel; interactive element; a business center; a museum; gallery of modern art; the multipurpose center; a public amusement park; industrial - landscape park; city, street, temporary celebration and festivals). (Fig. 4).

Fig. 4 This building , built in 1830 , is considered the longest pier in the world: its length is 1.33 miles (2.14 km). Project of reconstruction - the conversion of Pier into a modern public space. New construction in the final of his platform - will not only be used to host a cafe, souvenir shops, stalls of merchants, infrastructure, but also for concerts and public events. There is possibility of planting the "head" of the pier

Industrial enterprises have the cultural, architectural, historical, planning , and artistic information. To preserve the genetic code, the reconstruction should precede depth analysis of aspects of the value of buildings. Reconstructed historical buildings up to date at every stage of its existence, and links the past with the future through the present [3] Features of reconstructed structures are divided into two groups: qualitative and quantitative. Quantitative characteristics: length, width , height , number of storeys of the building. In addition to quantitative characteristics must take into account the qualitative characteristics of renovated structures. These include: architectural, urban, artistic, functional, planning and material values. The main task during the restoration - is to identify its architectural and artistic value. Identify of one or more values can attribute to the category of historic buildings. However, historical and artistic values - are essential [3].

Conclusion

Port territory and buildings - a huge reserve of urban development, additional territory in the central part of the city . They can be used as a recreation area of the city. They are an integral part of the maritime sector; participate in the formation of the sea front (the image of the city). In most cases, the physical condition is satisfied for future use and adaptation to the new function. Engineering structures possess the cultural , architectural, historical, planning and artistic value. Renovated engineering facilities can be divided into three groups: cranes, auxiliary structures (adapted for interactive elements), docks, lighthouses , harbor bridges, platforms, power plant (adapted for cultural - community centers), industrial area (adaption under industrial - landscape parks).

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Conformity of energy efficiency measures in Ukraine with European requirements

Olga Ozhyshchenko

State Higher Educational Establishment "Prydniprovs`ka state academy of civil engineering and architecture", UKRAINE, Dnipropetrovs'k, Tchernychevsky street 24A, E-mail: olga.ozhyshchenko@gmail.com

Abstract – Today the thermal insulation of residental buildings is being made apartment by apartment, sometimes without compliance the minimum of energy efficiency requirements. On the other hand, Ukraine is gradually moving to European standards. In this regard, a study of parameters compliance of the existing buildings and the most common work on the thermorenovation of buildings performed today in Ukraine with European standards on the example of the Romanian regulations was conducted. The study found that the existing building according to European documents have class F. After thermorenovation work it can achieve the label C or B, depending on the used materials.

Key words – Insulation of residential buildings, thermorenovation, conformity with European standards, energy efficiency label, Romanian energy efficiency regulations, AUF.

I. Introduction

Questions of energy efficiency, comfort and quality of life in residential buildings, reducing energy consumption in Ukraine are engaged in a long time, but the mass thermohenovation of residential buildings not yet became a reality and the problems still exist. Among the main problems is the lack of permanent all-embracing programs for buildings thermorenovation, optionality of buildings energy certification, and of course, difference between the current Ukrainian regulations and the European normative documents.

Unfortunately, the absence of extensive and widespread government program for energy efficiency increasing of residential buildings, as well as the unavailability or unacceptability of credit programs for the building insulation, are leading to the fact that residents of high-rise buildings forced to do it yourself. In connection with this the buildings insulation is produced apartment by apartment. For the residents of apartment buildings is sometimes very difficult to agree among themselves to carry out an overall insulation of their building or at least a single riser or floor. Therefore, today we are seeing all the time modification of the facades, the appearance of these individual just plastered and painted "spots" are not always consistent, even in color, not to mention the used materials and technologies. Obviously, such an imaginary energy efficiency increase has a number of drawbacks. Any average citizen of Ukraine which decided to perform an insulation of the hands of any independent organization (which is now a sufficient number), will not perform specialized calculations of energy efficiency parameters of his apartment, and in particular house as a whole. As well as he will not understand the intricacies of the technology and monitor each operation of workers.

The most common method of insulation of residential buildings today in Ukraine is the insulation of exterior walls from the outside by the polystyrene of 5-10 cm thick.

Almost all specialized company carrying out work on the insulation of facades, say that the performance of thermal insulation of external walls of the building will achieve outcomes such as reduction of heat loss for 30-40%, increase of interior temperature for 5-7°C in the winter and decrease for 3-4°C in summer, savings on additional heating of apartments in winter and cooling in summer [1]. But even having the same insulation process (technology) and the same materials for whole house nobody produces a preliminary calculation.

As for the regulations, today Ukrainian regulatory acts in the area of energy efficiency are still different from the European. Many normative data are lower than similar requirements of European regulations. Also the method of calculating the energy efficiency of buildings is slightly different. That is why it is very important today to know the requirements of European regulations for a possible rethinking of our rules and making changes / additions if necessary, and the present research is actual.

The aim of this study was a research of correspondence between the real work on thermorenovation of residental buildings in Ukraine and requirements of the current European regulations on the example of Romania. Romania, as a country-"benchmark" was chosen because of its geographical location and political situation: on the one hand the climate of Romania is very similar to the Ukrainian climate, on the other hand, Romania, as a member of the European Union has already passed the stage of adaptation and implementation of legislation in the all spheres of life and completely passed to the European regulations. This work was supported by the AUF (Agence Universitaire de la Francophonie) in Technical University of Cluj-Napoca (Romania).

II. Materials and results

According to Romanian standards [3-5] evaluation of the building energy efficiency can be executed by the annual heat consumption for a separate parameter such as heating, hot-water supply, air-conditioning, electricity for lighting, mechanical ventilation, or for all this parameters put together (Table. 1).

In Ukraine, the class of energy efficiency is established by the percentage deviation of the calculated or actual specific heat loss values of the maximum allowable standard value [2].

It should also be noted that Ukrainian standards provide 6 classes of the building energy efficiency - from A to F, while the Romanian standards distinguish 7 Label (regardless of parameter estimation) - from A to G.

In this paper a five-storey residential building of Khrushchev construction epoch was taken as an example. This building belongs to the so-called buildings of the first mass series, namely, 1-438 series. Such buildings can be seen not only on the territory of Ukraine and almost all countries of the former Soviet Union, but also in many European countries: Romania, Czech Republic, France, Germany. The structural characteristics of this building are listed below.

Brick five-story building, rectangular in plan, with dimensions in plan 32,06 x 13,02 m. Total building height - 14,8 m. The net height of one floor - 2.48 m.

The building has two entrances, the total number of apartments - 30 units, 10 of which are one-roomed flat, 10 - two-roomed flat and 10 - three-roomed flat (Fig. 1).

All the walls of the building are brick. The thickness of the exterior walls - 510 mm, internal bearing walls - 380 mm, non-bearing walls - 100 mm. The outer wall decoration is not provided. Interior decoration - cement-lime mortar.

Windows and doors are timber, window cross are coupled of ordinary glass.

The roof is flat, unexploited. No garret.

Basement is unheated, with placement in it all engineering installation.

Ceiling - prefabricated reinforced concrete slabs with round cells.

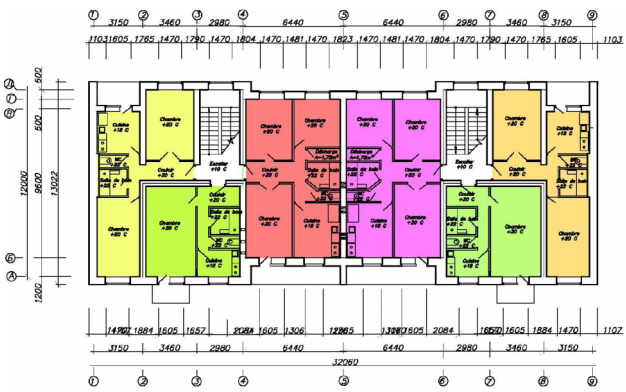

Fig. 1. Disposition of apartments in the building

Calculation of energy performances was carried out in several stages. The first step is the calculation of indicators of the existing building, without any modifications. In the second step the calculation of the energy efficiency parameters after the complex works on thermal insulation of buildings and improving its energy efficiency were executed. At this stage, we considered two of the most common variants of insulation, but on the assumption of the realization of complex measures on thermorenovation buildings and not only thermal insulation of external walls.

The first variant consists of the following works:

- Insulation of exterior walls by polystyrene, thickness of layer - 5 cm, with the application of stucco;
- Insulation of the roof, which provides the removal of existing covering, laying of extruded polystyrene with thickness of 10 cm, laying a protective layer in the form of reinforced covering thickness of 2 cm and PVC roofing membrane.
- Insulation of ceiling above the basement with the layer of extruded polystyrene, think of layer is 5 cm. Also, this material must descend the side faces of the basement walls to a height not less than 0,9 m for covering of existing cold bridges. Insulating layer should be covered with reinforced mastic with fiberglass mesh.
- The existing windows should be replaced by a hermetic insulating window with a frame of PVC, with a minimum double glass (4-6-4), filled with argon, and low emissivity.
- The front door of the building must be replaced by a hermetic door, locked with a key or intercom. In this case, it provides the replacement of old door to a new metal door of a similar size.
- All systems of heating, ventilation, water supply, should be examined and, if necessary, equipped with all the necessary installations (counters, latches, etc.).

The second variant involves reconstruction of the same activities as the first option, but with a slight difference. A layer of polystyrene insulation for the exterior walls should be 10 cm thick, a layer of extruded polystyrene for insulation of the roof - 20 cm, thickness of the insulating layer for the basement insulating - 10 cm.

The results were evaluating in accordance with [3-5] by the following parameters:

- Specific energy consumption for heating, [kWh/an] ;
- Energy label according to heating;
- Annual quantity of CO_2, [kgCO_2/year] ;
- Equivalent emission index of CO_2, [kgCO_2/m² year]
- Annual amount of fuel required, [UM/kWh]
- Energy mark of the building.

The calculation was made according to current Romanian regulations [3-10] and consists in the following: building division into separate panels (an example of the building division shown in Fig. 2); calculation of specific unidirectional thermal resistance for each panel (Eq.(1)); calculation of the corrected specific thermal resistance for each panel (Eqs.(2) and (3)); calculation of the internal and external temperature, correction factor for all walls; calculation of energy efficiency parameters listed above. Temperature readings, the amount of solar radiation and other data, depending on the geographical location of the construction site were taken in accordance with [11]. The calculation of a panel was executing taking into account the heterogeneity of layers (complex λ). The thermal resistance of windows and doors has been calculated separately.

$$R_0 = \frac{1}{\alpha_i} + \sum_{j=1}^{n} \frac{d_j}{\lambda_j} + \frac{1}{\alpha_e} = R_{si} + R + R_{se} \qquad (1)$$

α_i, α_e – superficial heat transfer coefficient against the value and the direction of heat flow and construction elements, [W/(m^{2}K)]; d_j - effective thickness of the layer, [m]; λ_j – calculating thermal conductivity of the material, [W/mk]; R, R_{si}, R_{se} - unidirectional thermal resistance (specific), superficial thermal resistance of the inner surface and outer surface respectively, [m^{2}K/W].

$$R' = \frac{1}{U'} \qquad (2)$$

U□ – heat transfer coefficient corrected, [W/(m^{2}K)].

$$U' = \frac{1}{R_0} + \frac{\sum l_j \varphi_j}{A_{mur}} \qquad (3)$$

R_0 – unidirectional specific thermal resistance, [m²k/W]; l_j – length of the thermal bridge, [m]; φ_j – linear specific heat transfer coefficient of the heat loss through thermal bridges; A_{mur} – panel area, [m^2].

All values of parameters listed above have been taken in accordance with the existing Romanian standards. An example of the panel calculation scheme shown in Fig. 3.

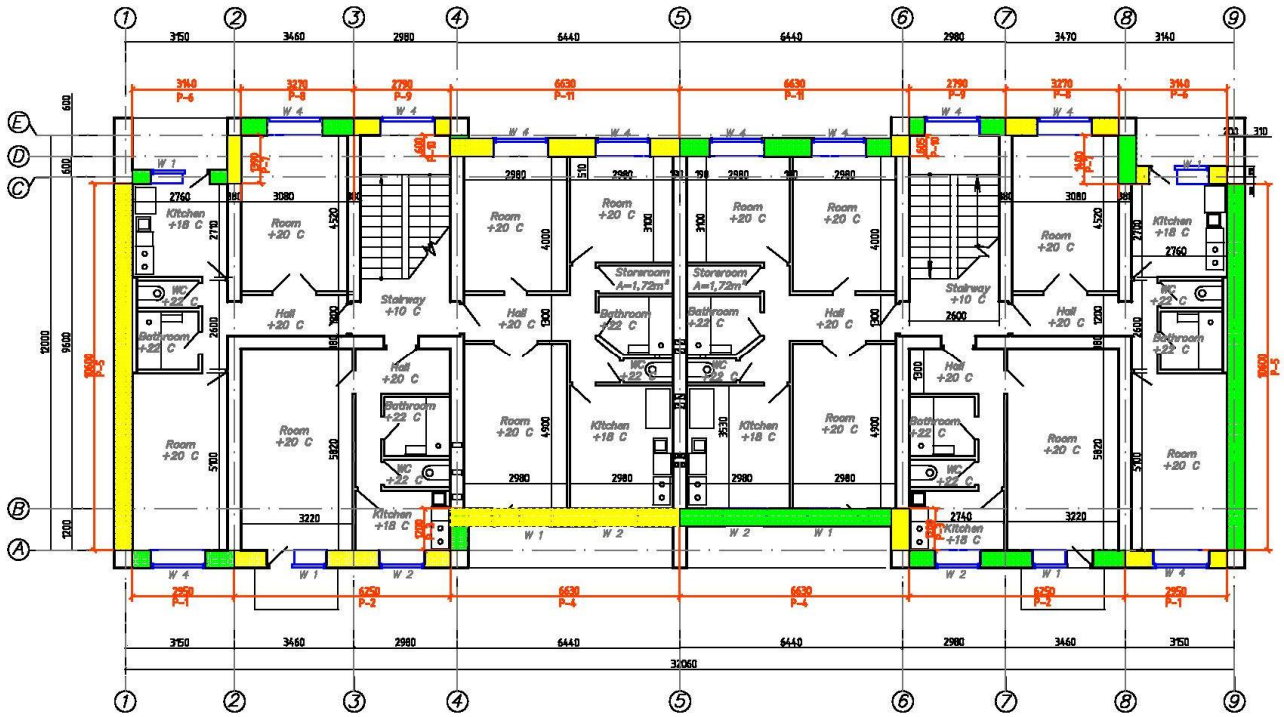

Fig. 2. Building division into separate panels

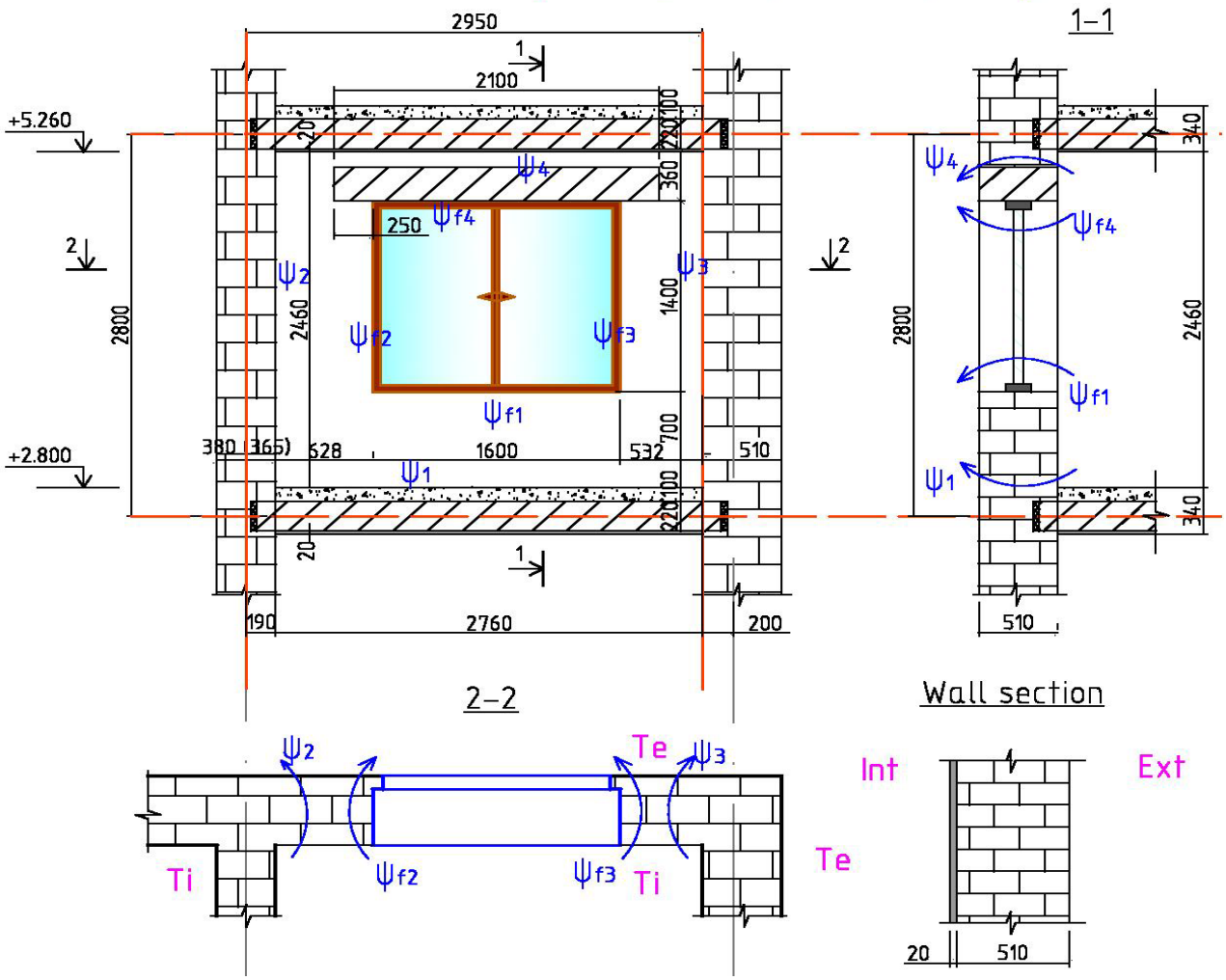

Fig.3. Panel calculation scheme for panel P-1 (axes A/1-2, A/8-9)

TABLE 1

ENERGY EFFICIENCY LABEL SUBJECT TO RATED PARAMETER

Parameter	Energy efficiency label according to specific annual heat consumption, kWh/m²an						
	A	B	C	D	E	F	G
Heating	0-70	70-117	117-173	173-245	245-343	343-500	>500
Hot water supply	0-15	15-35	35-59	59-90	90-132	132-200	>200
Conditioning	0-20	20-50	50-87	87-134	134-198	198-300	>300
Electricity for lighting	0-5	5-8	8-11	11-15	15-21	21-30	>30
Mechanical ventilation	0-40	40-49	49-59	59-73	73-91	91-120	>120
Total	0-125	125-201	201-291	291-408	408-566	566-820	>820

TABLE II

ENERGY EFFICIENCY LABEL OF THE BUILDING BEFORE AND AFTER THE INSULATION

Parameter	Existing building	Insulation № 1. Polystyrene 5 cm	Insulation № 2. Polystyrene 10 cm
Annual quantity of CO_2, [kgCO_2/year]	113070,5	36569,92	30801,64
Equivalent emission index of CO_2, [kgCO_2/m² year]	73,53	23,78	20,03
Annual amount of fuel required, [UM/kWh]	59510,78	19247,32	16211,39
Energy mark of the building	54,21	99,6	101,76
Specific energy consumption for heating, [kWh/ year]	387,00	125,17	105,42
Energy label according to heating	F	C	B

The results of calculations for the initial existing building, as well as for two variants of building thermorenovation are given in Table II.

As indicated in table, building under study in this example has the energy efficiency label F according to European standards. After carrying out of thermorenovation and wall insulation work by the layer of polystyrene at least 5 cm, energy class of buildings can rise to the label C. In case of thicker layer of materials application (for walls and ceilings of the basement – 10 cm, for roofing - 20 cm) label B of energy efficiency can be achieved.

As concerns the annual amount of fuel required, it can be considerably reduced after the thermorenovation work. The annual economy can be equal to nearly 75% for one building: 16211,39 UM/kWh for the insulated building instead of 59510,78 UM/kWh for the existing building. This number become even more convincing if we multiply it by the total number of buildings of this type. This reduction in the required amount of fuel is very important for Ukraine not only in terms of saving the global resources, but also to reduce the country's energy-dependence. With fuel consumption decreasing we can also decrease the annual amount of CO_2 and slow down the environmental degradation and preserve the planet from global catastrophe due to climate change and the greenhouse effect.

Conclusion

The calculations showed that the most common method of insulation today in Ukraine is able to allow the label C or even B achievement of energy efficiency in accordance with European standards. But that result is possible only in case of integrated measures of buildings thermorenovation: insulation not only the exterior walls of the building, but also a roofing, ceiling of the basement, replacement of old untight windows and doors for more modern, repair and / or replacement of engineering infrastructure.

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Efficiency evaluation of stress-strain state calculation method for optimal designing of reconstruction and reinforcement of steel structures

Ivan Peleshko[1], Igor Baluk[2], Sviatoslav Peleshko[3]

[1]Building Production Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: ipeleshko@hotmail.com

[2]Building Production Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: baluk_igor@ukr.net

[3]Software Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: speles@mail.ua

Abstract – Provided description and efficiency evaluation of stress-strain state calculation method for optimal designing reconstruction and reinforcement of steel structures.

Key words – steel structures, reconstruction, reinforcement, bar structures, stress-strain state.

I. Introduction

It is known, that more than 35 million tons of bearing steel structure, including large proportion of steel stuctures (SS) are used in Ukraine. Eventually, these constructions will need to be replaced, enhanced or reconstructed. Increasing the number of design schemes, appearing in the process of reconstruction and reinforcement of SS, leads to increasing of computations to determine the stress-strain state (SSS). These calculations are performed repeatedly when using optimization methods.

Many papers, including [1, 2], are dedicated to the development of mathematical models of structures that considering processes of construction, maintenance, reconstruction and reinforcement, as well as development of appropriate algorithms for analysis of SSS. Thechniques and methods of calculation which are offered in these papers either don't cover all types of changes of structures during reconstruction and reinforcement of SS or include changes of stiffness matrix and re-solution equations system (ES) of finite element method (FEM), which requires significant amount of time.

Paper [4] considers the formalization of process of reconstruction and reinforcement of the SS as a sequence of elementary changes to design scheme, loads changes and forces regulation. [5] describes way to calculate stuctures for considered in [4] changes that generates and solves only one matrix ES of FEM. [6] describes method of determination of the SSS of SS after changing stiffness of its elements based on information about SSS before change and new parameters of stiffness for optimal designing reconstruction and reinforcement.

Efficiency of method of determination of SSS during the optimal design of reconstruction and reinforcement of SS which is proposed in [5, 6] requires numerical evaluation.

II. The main material

At first, we will give a brief description of the reconstruction process and the corresponding method of determining SSS of SS, proposed in [5, 6], and after that we will evaluate efficiency of this method.

The process of reconstruction in [4, 6] is presented as sequence of elementary changes of design scheme, cross sections of elements and loads. This sequence is divided into stages of reconstruction. One stage of reconstruction must involve either design scheme changes or cross section changes. The corresponding diagram of reconstruction stage is presented on fig. 1.

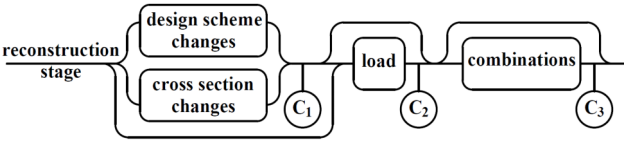

Fig. 1. Reconstruction stage diagram

Method of determination of SSS of SS includes creating basic design scheme (BDS) based on analysis of reconstruction process [5]. BDS is a scheme that contains existing (in particular, those that will be deleted or reinforced by increasing the cross-sectional area in process of reconstruction), new and temporary bars of structure. In BDS bars which are reinforced are in state before increasing cross-sectional area.

In BDS exists all 'redundant' links from set L. L includes all links, which are used to create primary structure of force method for calculation SSS after changing cross sections, and also includes links which are used in some actions in reconstruction process. Such actions like adding or deleting link, regulating force etc.

Proposed to determine SSS of SS for different design schemes, which are formed during the implementation of a single variant of reconstruction and reinforcement, in two stages.

Stage 1. For BDS we calculate basic diagrams of forces and displacements due to all loads on SS before, while, and after its reconstruction and reinforcement, and also for $k = |L|$ additional unit loads [5]. To do this we form and solve one ES of FEM with few right parts for BDS. To calculate unit forces from additional unit loads we use calculation method proposed in [3]. This method allows forming and solving one ES of FEM, considering different design schemes for different additional unit loads.

Stage 2. We calculate diagrams of forces and displacements which appears in SS during reconstruction and after that. For this we use basic forces, displacements (including ones caused by additional loads) and also properties of structures which subject to superposition principle.

TABLE 1

COMPARISON OF TIME SPENT ON ONE STEP OF GRADIENT METHOD FOR PROBLEM A AND B FOR FRAME OPTIMIZATION

№	Name	Solving formed ES of FEM		Forming and solving ES of FEM		Gradients calculation (including ES of FEM)		Efficiency, % ((8)-(7))/ (8)*100
		A	B	A	B	A	B	
1	2	3	4	5	6	7	8	9
1	One step time, s	8,5	27,8	9	31,6	24,3	42,7	43,1
2	Part, %	35,8	64,6	38,1	73,5	99,6	99,5	-

Every diagram of forces due to some load after any sequence of changes of design scheme and cross sections can be defined as sum of basic diagram of that load and linear combination of unit basic diagrams.

To identify the efficiency of the proposed method for determining SSS of SS during reconstruction and reinforcement were compared two algorithms by amount of time used for one step of gradient optimization method. Comparison is performed on example of plane transverse frame with lattice structural members, described in [6].

For this was developed test task A of transverse frame reconstruction. Reconstruction process is divided into four stages. At each stage, new hinge replaces some 'redundant' link. The presence of these changes makes it necessary to determine SSS for $k = 4$ design schemes of this frame. According to the proposed method was formed BDS that includes all four of 'redundant' links of L set, that are deleted in reconstruction process. For each link from set L was set corresponding unit loads. The total number of loads combinations for which restrictions were tested was 10.

Based on problem A, we form problem B, in which there are no reconstruction process and unit loads.

Problem A was solved using algorithm that implements a proposed method. Problem B was solved by test algorithm, in which, for one point from space of design variables, ES of FEM was formed and solved for k times instead of one. By this was modeled design process during which you must solve ES of FEM for each change of design scheme of structure.

Data on amount of time spent on one step of gradient method during solving formulated problems with OptCAD optimization program was received using AQtime [7] profiler. Results of comparison of spent time is shown in table 1.

According to the table 1 time spent on computing gradients for solving problem A using algorithm of enhanced method of calculating SSS is at 43,1 % less than corresponding amount of time spent on solving problem B with test algorithm.

Conclusion

Using the proposed method for determining SSS of SS during reconstruction and reinforcement decreases amount of computations, which is essential when optimizing bar structures.

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Experimental studies of combined heat supply system in the flow mode during the summer period for Lviv

Ostap Pona[1], Bohdan Gulay[2], Stepan Shapoval[3]

[1]Heat and Gas Supply, and Ventilation Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: ostap.pona@gmail.com

[2]Heat and Gas Supply, and Ventilation Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: 08bogdan1986@ukr.com

[3]Heat and Gas Supply, and Ventilation Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: shapovalstepan@mail.ru

Abstract – Experimental model of a combined solar collector (SC) in the flow mode is effective in seasonal (summer) period of application. The article presents the analysis of thermal energy, accumulated by solar heat supply system (SST), and energy that were received on the plane of the solar collector in the course of the experiment.

Key words – renewable energy, solar energy, the flow mode, southern orientation.

I. Introduction

Priority and qualitatively new direction in the energy sector are renewable energy sources. The need for energy use of alternative fuels in the economy of leading countries is due not only to limited amounts of organic energy sources, but also by the laws which regulate the reduction of the harmful emissions of oxides of nitrogen and sulfur, soot, ash, products of incomplete combustion of carcinogenic substances.

Solar energy is developed branch in the world in the field of renewable energy. The most widespread use of solar energy is in heat supply systems, in particular for hot water supply.

II. The main material

Experimental model of the solar system in the flow mode relates to low-temperature single-circuit heating systems. The proposed model of solar collector is aligned with the roof of the building in which the function of the roofing material performs the sink which is colored black (e.g., galvanized steel). This solar heat supply system in the flow mode can be used for seasonal water pre-heating for pools and showers, solar-fuel boiler-houses, for domestic purposes, etc.

The lack of experimental operation of a solar system in the flow mode is that it can function in the summer months and transitional months, during periods with positive temperatures.

The experimental setup works as follows. At the initial stage, the heat carrier flows into the tank of cold water. When you open and set the shut-off control valve the water enters the solar collector, in which a preset flow rate of the heat carrier moving in the tank of heated water. The selection of the heated heat carrier implemented through the pipe to the tank of heated water. Measurements of water temperature in the lower and upper tanks were conducted with mercury thermometers.

The thermal energy that was accumulated in the tank of heated water was determined by the formula:

$$Q_{\text{tank}} = G \cdot c \cdot (t_{outlet} - t_{inlet}) \qquad (1)$$

where G – the flow rate of heat carrier, l/s; c – specific heat capacity of heat carrier, J/(kg·K); t_{inlet}, t_{outlet} – accordingly, the temperatures of the heat carrier on the inlet and outlet of capacitive tanks, K.

Experimental results of heat carrier's temperature are shown in Fig.1. It's investigated, that the temperature of the heat carrier of the solar system in the flow mode has reached to 23.5 ºC, which is 32% higher than the inlet temperature of the heat carrier.

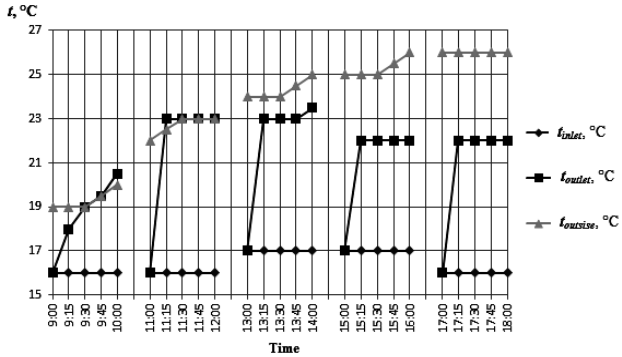

Fig. 1. The temperature change of the heat carrier and the temperature of the environment during the experiment in the southern orientation

The average temperature of the heat carrier during the experiment in the tank of heated water with southern orientation is presented in Fig.2.

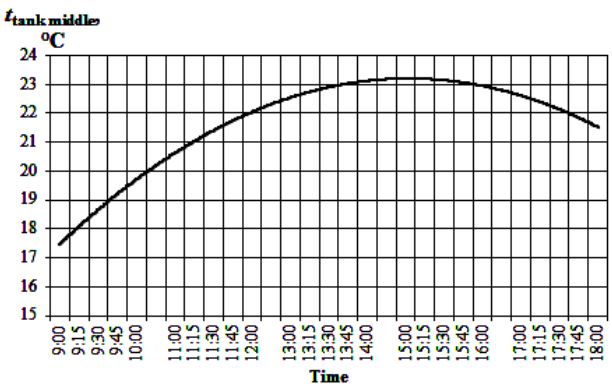

Fig. 2. The average temperature of the heat carrier in the tank of heated water during the experiment in the southern orientation

It is found that the solar collector in the flow mode in the southern direction of the horizon allows you to save up within the hour to 500 W/m^2, changing the location of radiation intensity from 986 to 874 W/m^2. The instant specific capacity of the solar collector in the southern orientation during the day has a variable nature of the fluctuations. Particularly in the morning period, the system heats up rapidly, but this period in the system can

be attributed to the period of stabilization of the heat carrier in the collector. Regarding lunch and evening time of day, the change is significant if to compare with the morning, and differs from the latter respectively by ≈70%.

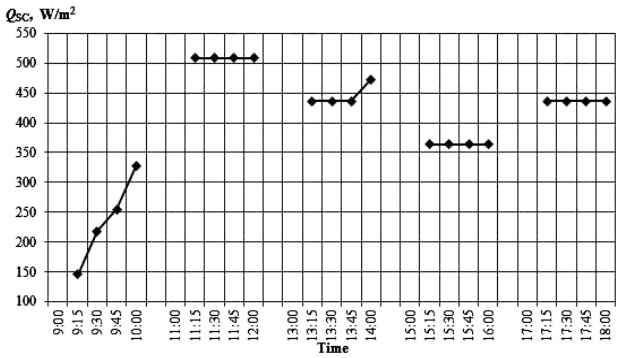

Fig. 3. Specific instantaneous power of solar collector (SC) in the southern orientation

For analysis of the number of arrivals of thermal energy in the plane with a pyranometer was measured the intensity of solar radiation during the experiment. Analyzing the amount of thermal energy on the solar collector of Fig.4, which came from radiation in the southern orientation we can say that the nature of the change is rapid with a significantly increasing trend within the hour. This trend is related, primarily, with a parabolic change in the intensity of solar radiation.

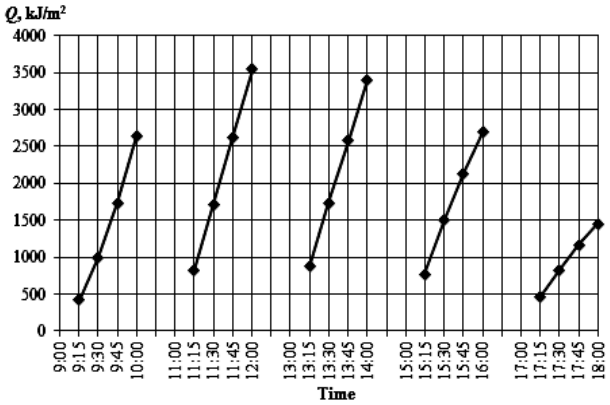

Fig. 4. The amount of heat that comes from the radiation on a combined solar collector in the southern orientation

Conclusion

In Lviv the experimental model of the combined solar collector in the flow mode is effective to ensure the building of low-temperature heat carrier. Heating of the heat carrier within the hour is on average 6.5 ºC. In the evening time specific instantaneous power of solar collector in the southern orientation is 436 W/m^2, which is different from morning time by 77%.

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The potential of solar energy in Ukraine

Stepan Shapoval

Heat and Gas Supply, and Ventilation Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: shapovalstepan@mail.ru

Abstract – In this paper the analysis of potential cumulative, direct, and diffuse solar radiation on the territory of Ukraine during to the period of one year and during the heating season is presented. It is shown that there is a change in these variables in Ukraine received empirical functional relationship to calculate the solar energy. The incoming solar energy in Ukraine has been analyzed according to its geographical position (i.e. latitudes). These research results may be used in the design and choice of location solar heating in Ukraine.

Key words – solar energy, direct and diffused solar radiation.

I. Introduction

"Thermal pollution" of the planet, "greenhouse effect," "anoxaemia", extensive contamination by toxic chemicals, etc. - are burning issues of today arising from the penalties of humanity for civilization comfort. Renewable sources of energy offer a possible alternative for setting the issues. Solar energy, as energy resources of the future, has a lot of benefits. It is mainly harmless for people and the environment. It does not distort the landscape. There is no point in exporting or importing it. As for the energy itself, it is both free and renewable, the latter benefit being the most important one.

II. Objectives the Formulation of the Problem

The overall effectiveness of solar installations is largely depends on the level of solar energy, which in its turn is strongly depends on the geographical position. The purpose of the research is to analyse the level of solar energy on the territory of Ukraine. In particular, it has evaluated the level of direct, diffuse and cumulative solar radiation seasonally adjusted and throughout the heating period.

III. The Analysis of Recent Research and Publications

A considerable number of scientific and practical works on energy efficiency have been published recently [1–4].

Although the monograph [5] considers the analytical and experimental researches of solar energy distribution during the daytime and throughout the year, it does not take into account the amount of incoming solar energy on the territory of Ukraine.

State building codes of Ukraine [6] is the source of climatic data used for the calculation and design of solar power installations plants. However, the codes don't have the calculation of the amount of seasonally adjusted solar energy depending on latitude.

IV. The Main Material

The evaluation of solar energy potential is regarded as the key factor in choosing the location of solar installations. The level of solar energy directly affects on the heliosystem efficiency, which in its turn depends on latitude. Thus the incoming solar energy on the territory of Ukraine has been analysed according to its geographical position (i.e. latitudes).

Annual monthly average total solar energy coming to the horizontal surface (Fig. 1) has a downward trend from south to north of Ukraine. The minimum monthly average total solar energy on the horizontal surface is 85 kW·h per 1m^2, whereas the maximum is 103.5 kW·h per 1m^2, which is 18 % more.

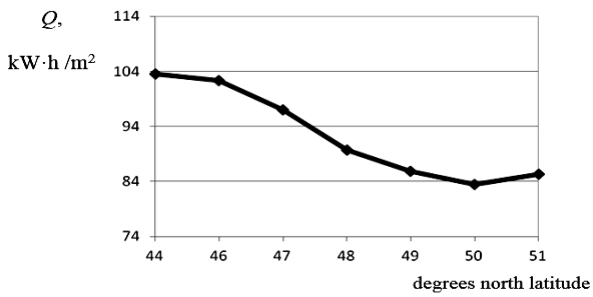

Fig.1 Annual monthly average total solar energy coming to the horizontal surface on the territory of Ukraine.

The empirical functional relationship $Q=f(\varphi)$ was based on Figure 1 data:

$$Q = 900 - 11.84 \cdot \varphi, \text{kW} \cdot \text{h per } 1\text{m}^2 \quad (1)$$

where Q is annual monthly average total solar energy, kW·h per 1m^2; φ is a geographical latitude, in degrees of northern latitudes.

The daily average total density of solar energy in winter (December, January, February) and summer (June, July, August) has a downward character and gradually decreases from the south to north. In the south of Ukraine, the density rare in summer is higher than in winter by 73 %. As for the density rate in winter, it is lower by 8 % in the north of Ukraine compared to the south.

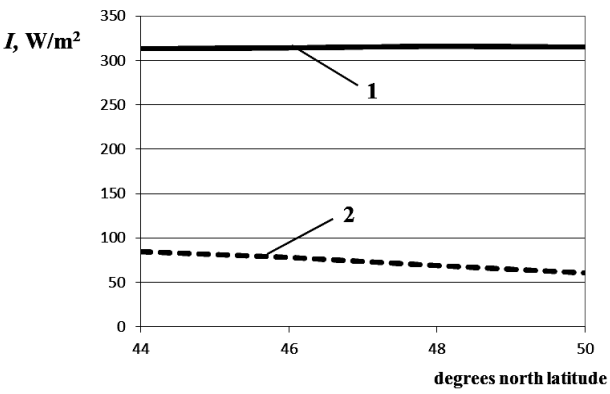

Fig.2. Daily average total solar energy density during the billing period coming to the horizontal surface on the territory of Ukraine: 1 - in summer, 2 - in winter

Empirical functional relationships $I=f(\varphi)$ in winter Eq. (2) and in summer Eq. (3) were based on Figure 2 data:

$$I = 295.7 + 0.4 \cdot \varphi, \text{W/m}^2 \quad (2)$$

$$I = 263.6 - 4.05 \cdot \varphi, \text{W/m}^2 \quad (3)$$

where I is daily average total solar energy density in winter or in summer, W/m^2; φ is geographical latitude, in degrees of northern latitudes.

According to the analysis of seasonal fluctuations of solar energy on the territory of Ukraine (Fig. 3), it could be argued that there is a reduction in solar energy depending on latitudes from the south to north. The potential of diffuse solar radiation is about twice less than that of direct one in all the latitudes of Ukraine only in winter, and in spring and autumn only on the northern territories. Compared with winter, direct solar radiation increases approximately in ten times in summer. As a result, there is greater efficiency in the use of flat solar collectors in that period of time.

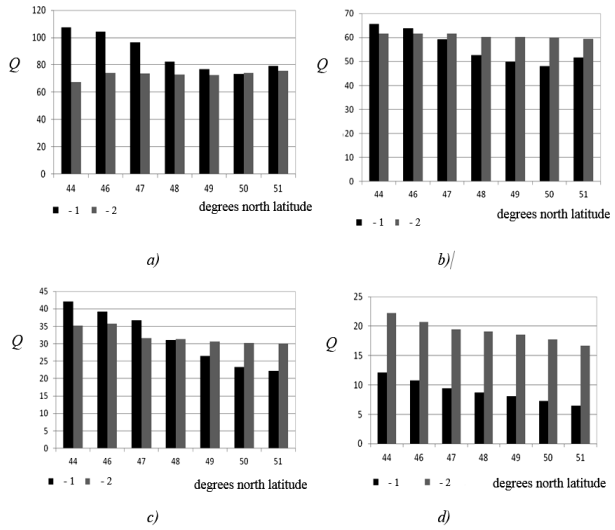

Fig. 3. Seasonally fluctuations of direct and diffuse solar energy Q, kW·h/1m^2 on the territory of Ukraine: 1 - direct solar radiation, 2 - diffuse solar radiation; a) the summer season; b) the spring season; c) the autumn season; d)the winter season

The amount of incoming solar energy on the territory of Ukraine during the heating period serves as an important indicator of effective implementation of heliotechnologies in industry and housing. The installation of solar collectors requires additional research of the required amount of solar energy for its possible use during the heating period.

Monthly average total solar energy coming to the horizontal surface during the heating period has a downward trend (Fig. 4). Compared with the south of Ukraine, it is minimal (45.5 kW·h/m^2) in the northern regions. Monthly average diffuse during the heating period (Fig. 5) is higher than the direct one 1.2-1.6 times.

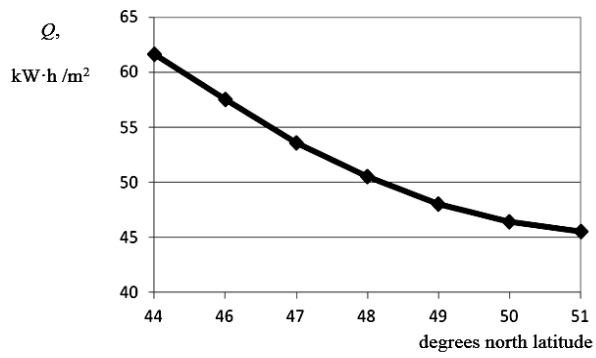

Fig. 4. Monthly average total solar energy coming to the horizontal surface during the heating period on the territory of Ukraine

The graphs depicting total solar energy, direct and diffuse during the heating period, show that the level of solar insolation for household energy needs of population is sufficient for the introduction of solar power plants in the energy sector of Ukraine.

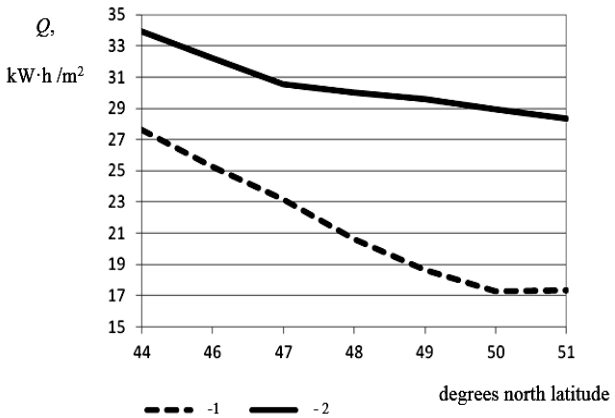

Fig.5. Monthly average direct and diffused solar radiation coming to the horizontal surface during the heating period on the territory of Ukraine: 1,2 - diffuse and direct solar radiation

Conclusion

Summarizing the above-mentioned data, it could be argued that there is enough incoming solar energy on the territory of Ukraine for energy-dependent needs. Therefore, the term traditional energy industry will gradually reduce its potential, while the potential of renewable energy, particularly solar energy industry will grow.

The use of solar energy in the energy industry will definitely make it less dependent on fluctuations in prices on conventional fuels.

Taking into account considerations that territorial and climatic conditions in Ukraine are favourable for that alternative source of energy, to solar energy should be given priority in the modernization of the basic platform in the productive-economic sphere of all the branches in the state infrastructure.

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The efficiency of the combined solar collector in the gravity mode in the southern orientation

Stepan Shapoval[1], Iryna Vengryn[2]

[1]Heat and Gas Supply, and Ventilation Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: shapovalstepan@mail.ru

[2]Heat and Gas Supply, and Ventilation Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: dremheart@mail.ru

Abstract – In the article we investigated the efficiency of combined heating system in the southern orientation on the territory of Ukraine and the change in the intensity of solar radiation during the experiment. Also it's investigated the quantity of heat flux that has entered the plane of solar collector in natural conditions during the experiment.

Key words – solar energy, solar collector, combined heating system, the efficiency, the heat carrier.

I. Introduction

Despite the fact that the volume of traditional fuel energy is very small and limited, for present and future generations it is important the introduction of new progressive ideas that relate to changes in alternative fuel and energy complex in the light of environmental education.

II. The reasoning of the aim of research

From historical sources it is known that the year 1883 in the world is considered to be the beginning of the era of solar energy in electricity. This is a topical issue for Ukraine, because it is located on the territory with sufficient surface density of solar radiation.

In Ukraine the sector of solar electricity significantly began to develop in 2004, and the industry of heating since 2011. The slow development of solar systems has a number of causes, which are the main stages in the development of systems of solar heat supply for Ukraine. However, We would like to mention that the predominant reasons are - the expensive and the efficiency of systems of solar heat supply which is not given in the same standards. Therefore, it is advisable, the first - to analyze the possibility of using solar energy by solar systems, the second - to examine their effectiveness when using this energy, the third - to improve the construction of solar installations to increase the efficiency.

III. The main material

One of the factors which determines the intensity of solar energy is the height of standing of the Sun over the horizon. It is known that for Ukraine the optimum angle of inclination of the collector to the horizontal is the angle $\varphi+10^\circ$ for summer (seasonal) operation and $\varphi-10^\circ$ with year-round operation, where φ is the latitude. In addition, an important condition for efficient operation of a solar collector is its focus on the parties of horizon. That's why solar collectors on the territory of Ukraine it is advisable to place on the southern orientation.

The proposed model of a solar system has an improved design, as a function of absorber also serves a roofing material of a building that can reduce the cost, improve efficiency and simplify the design of the solar collector. Experimental combined heating system in the gravity mode was investigated on the southern side.

The main unchanging stages of research were:

1 – system, which was filled with fresh water before each research;

2 – air was removed from the system;

3 – we measured the intensity of solar radiation with a pyranometer;

4 – the temperature of the heat carrier was measured by mercury thermometers at three points of the system (at the outlet of the combined solar collector, at the inlet to the collector and in the tank-battery);

5 – the outside air temperature and its speed were measured by thermal electric anemometer TESTO 405 – V1.

IV. The results of the research

The temperature of the heat carrier was measured during the experiment half an hour and recorded in the research protocol. In the southern orientation, the maximum temperature of the tank-battery was 52ºC in the dining time of day (Fig. 1). These indicators differed significantly from the temperature of the external environment (on the average they are increased by 26ºC) The averaged intensity at this point of time, that the plane of the solar collector received was 458 W/m^2 (Fig. 2).

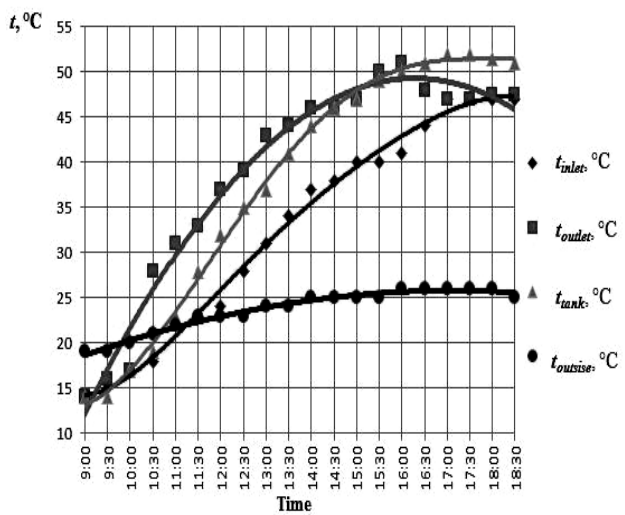

Fig. 1. The temperature of the heat carrier IC and the ambient temperature during the experiment in the southern orientation

The maximum intensity of solar radiation during the day was 986 W/m^2. The curve of intensity measurement which is shown in Fig.2 has a variable parabolic character, achieving its maximum to a dining time of day.

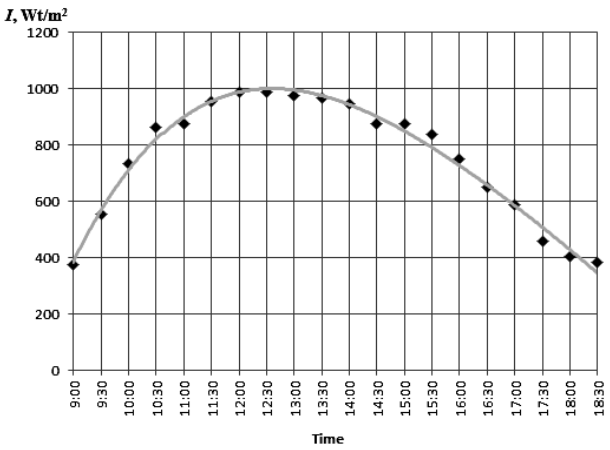

Fig. 2. The Intensity of the heat flux of solar energy on the plane of the combined solar collector in the southern orientation

Dynamics of thermal energy in time, that has been accumulated during experiment is graphically shown in Fig.3 and has a clear growing character. Whereas, the amount of heat flux that has entered the plane of the solar collector performs the conditions of the modal distribution of values (Fig.4).

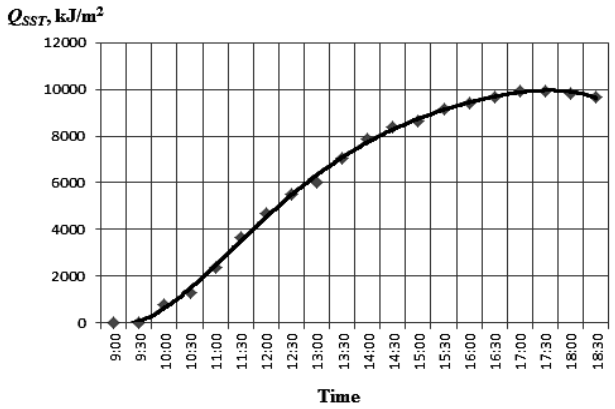

Fig.3 The amount of the thermal energy which was accumulated in the tank-battery of the combined system of solar heat supply in the southern orientation

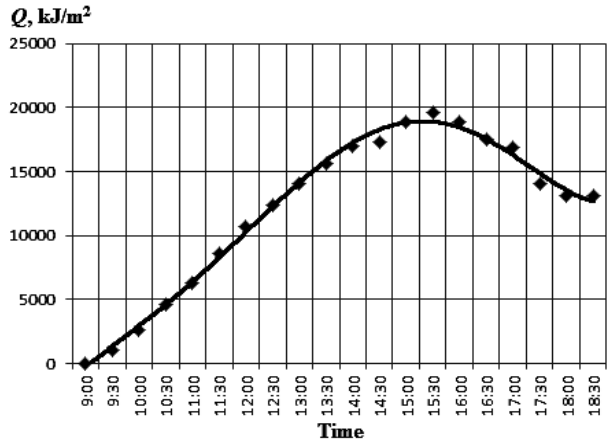

Fig.4 The amount of heat that comes from radiation to the combined solar collector in the southern orientation

In Fig. 5. Its shown the efficiency of the experimental combined system of solar heat in the summer time. The efficiency of the heating system takes increasing trend and reaches its maximum in the evening. This is due to the accumulation of heat on the plane of the solar collector from the environment, as the temperature fluctuations during the experiment had minor character.

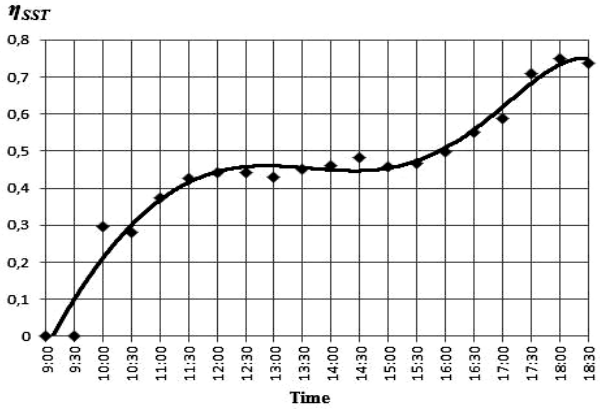

Fig. 5. The efficiency of the gravitational system of the solar heating in the southern orientation

Conclusion

In the experimental studies the combined heat supply system has reached 70% of their efficiency. This results give us the opportunity to confirm the hypothetical view about the possibility of widespread use of solar collector combined with the building coverage in the systems of solar heat supply for orientation on the southern side of the horizon.

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Research methods of ski resorts' visual perception

Yaryna Onufriv

Urban planning and Urban design Department,
Institute of Architecture, Lviv Polytechnic National University,
UKRAINE, Lviv, S. Bandery street 12,
E-mail: yarynaonufriv@gmail.com

Abstract – The paper describes the research methods of visual perception of ski complexes. It explains the basic paradigms of visual research in the context of the problem of visual impact of ski complexes on natural mountain environment.

Key words – visual impact, research methods, paradigm, expert approach, public preferences.

I. Introduction

Ski resorts construction has a great visual impact on natural mountain landscapes. The clear-cuts, which are made for ski runs organization and construction of ski lifts, sport and recreational buildings for visitors cause a notable change of the visual image of the mountains.

Thereby, it is important to investigate and characterize the visual impact of ski resorts construction on natural-built environment. In this article the research methods and approaches to visual perception of ski resorts are presented.

II. Existing Approaches to Landscape Perception Research

Existing approaches to landscape perception research are broadly enlightened in scientific literature. For example, the Dutch scientific journal "Research in Urbanism Series" published the volume in 2011 devoted to visual research of the landscape [1]. In this publication the authors distinguish two basic models of landscape perception research: expert model and public landscape preference model. According to first model, the evaluation of visual landscape is carried out by trained experts and observers, characterized by heuristic methods and the use of systematic descriptive inventories, visual management systems, etc. Public preference model is based on three approaches: psychophysical-approach, psychological-approach, phenomenological-approach. The first approach is characterized by testing g eneral public or selected populations' of landscape aesthetics/properties by the use of photo questionnaires. The second approach is searching for human meaning associated with landscape or landscape properties by environmental psychologists, characterized by mapping landscape experience. The phenomenological-approach consentrates on subjective experience of the landscape and is characterized by the interpretation of paintings, poetry, etc.

There are also other classifications in studying of human perception of the landscape and its visual, aesthetic qualities. For example, Andrew Lothian [2] divides landscape studies into two paradigms:

1) the objectivist or physical paradigm – a conventional view that the quality of the landscape is an intrinsic attribute of the physical landscape (famous scientists that work in this approach are Zube, Sell & Taylor, Daniel & Vining);

2) the subjectivist or psychological paradigm considers landscape quality as solely a human construct, based on the interpretation of what is perceived through the memories, associations, imagination and any symbolism it evokes.

A. Lothian considers that the promising approach in exploring the visual landscape is subjectivist's approach.

Terry C. Daniel makes a suggestion about the transition from the objectivist and subjectivist approach to the ecological approach. Namely he predicts in the article "Whither scenic beauty? Visual landscape quality assessment in the 21st century" [3] the dominance of ecological oriented approach in landscape visual quality assessment in the future.

III. Application of Existing Research Methods in Ski Resorts' Investigation

In ski resorts investigation it is preferable to combine expert approach and public preference approach. The combination of these two approaches gives to the researcher deeper understanding of the existing problems in visual perception of mountain landscapes. Trained observer (for instance, landscape architect or scientist) can better than random visitor estimate the current features and damages of the landscape and characterize the aesthetic value of it. Trained observer can also make some behavioral observations, which can help to allocate the basic places of people's concentration and viewpoints. But using only expert approach is a very poor methodology nowadays. It should be accompanied by public preference studies, using any of existing approaches. The behavioral and experience mapping by site observations, the foto-quetionniers about the landscapes' aesthetic quality by questioning visitors and, finally, the interviews with stakeholders of the ski resort's construction process – all these methods can be applied in visual perception of ski resorts research.

In the context of the problem it is preferable to mention the practical applications, which are usually used by the reserchers in this field. In particular, the usage of GIS-based methods and techniques in order to map the visual landscape is very common (Fig 1).

Conclusion

In this paper the existing approaches to landscape perception research are highlightened. Current studies in landscape visual research make an accent on subjectivist approach, which means that our psychological interpretation of the landscape is dominant. But in the same time it is very insecure to make any generalizations of public landscape preferences, because of it's boundless diversity. Nevertheless, in scientific literature there are attempts to identify some social, geographical, economical and other trends in visual landscape preference studies.

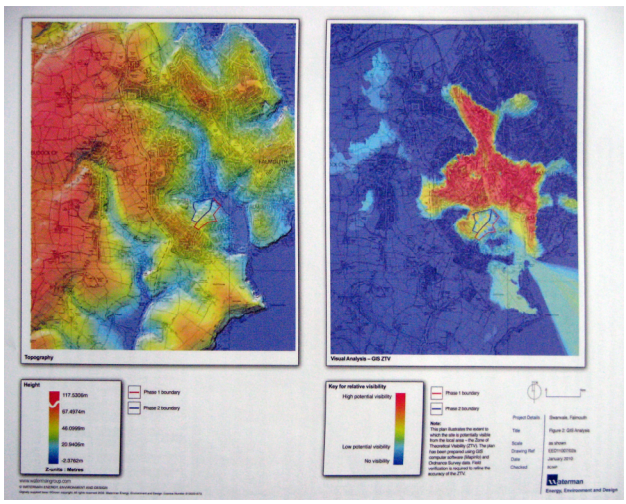

Fig. 1. Topographical ananlysis and Zone of Theoretical Visibility for proposed urban development [4]

The paper summerizes, that it is preferable to combine expert approach and public preference approach in ski resorts' investigation. The basic research methods of visual perception of ski resorts, mentioned in the article, are: behavioral and experience mapping by site observations, the foto-quetionniers about the landscapes' aesthetic quality by questioning visitors and, finally, the interviews with stakeholders of the ski resort's construction process. The basic research techniques, which can be used in visual perception of ski resorts investigation, are: GIS-based methods and techniques, panoramic photo capturing, 3-D visualizing.

The basic research methods and techniques, which are presented in the article, are based on the current theories and approaches in landscape visual perception research and are used in landscape management and planning practice nowadays.

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The formation of a barrier-free environment in the historical apartment buildings in Lviv

Oksana Pekarchuk

Department of Architectural Design,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: oxikpek@gmail.com

Abstract – The features of adaptation historical apartment buildings in Lviv to the needs of group of people with limited mobility (LMG) are discussed in the article and presented draft proposals for its implementation.

Key words – historical apartment buildings, group of people with limited mobility, barrier-free environment.

I. Introduction

Over the life every person faced with the problem of accessibility in the environment at some point. This problem can result from temporary loss of mobility (as a result of injuries, diseases, pregnancy), visual impairment, during a small hearing loss. In addition, disability is an important medical and social problem for Ukraine. The growth of disability is forecasted in the country that is associated with the situation in Eastern Ukraine. The implementation of actions to create a barrier-free environment in the historical apartment buildings of Lviv will create a comfortable environment for all groups' people.

According to the Central Statistical Office in Lviv region number of disabled persons in the region in 2014 compared to 1995 increased by more than 54 thousand people. On 1 January 2015 the number of disabled in Lviv (without disabilities who receive pensions in some ministries (departments) was 45 193 people [1].

II. Adaptation historical apartment buildings to the needs of LMG

The modernization of architectural and planning structure historical apartment buildings should be carried out simultaneously with adaptation (accommodation) inhabited environment to the physical and psychological needs of special people. In buildings should be organized at least one available LMG entrance, which can be equipped with ramp, lift, mobile stairs or other device [2]. These activities will provide an opportunity for disabled to rise to the level of entrance to the house. Dimensions of entrance in the plan platforms porch recommended not to design less than 1.8 x 1.8 m [3]. It is reasonable provide a system of visual, tactile and audible information identifying the location, direction of opening the door [2, 3].

It is necessary to provide the possibility of entering LMG into the lobby group of apartments in the house. It is possible using one of the options for entrances into the lobby of the building:

1) without ladder march to the lobby;
2) with ladder march in the lobby of the building.

During the placement in the lobby group ladder march is necessary to provide ascent on it disabled in a wheelchair to the apartment on first floor or to the elevator entrance (Fig. 1). For this can be provided a special arrangement of open platforms – platforms of at least 900 x 1200 mm. Before entering the platform should be free space at least 1500 mm depth [2, 3].

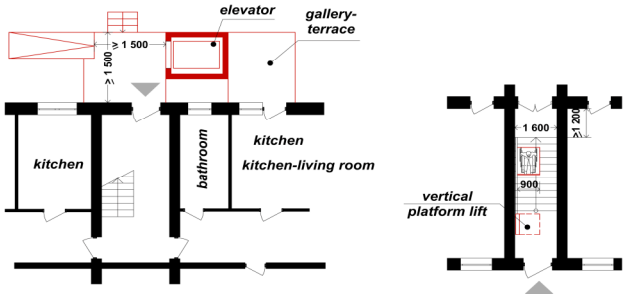


Fig. 1. Design for access and mobility entrance

As the result of analysis of the architectural and planning structure of historical apartment buildings in Lviv were revealed the following methods of arranging lifts:

1) in the structure or near the apartments, and not is combined with stair (Fig. 2 a, b);
2) in the structure of the building, where access to stair and elevator is at the apartments level (Fig. 2 c, d);
3) outside the building where it is not linked to the stair;
4) outside the building, when access to the elevator effected at the level of apartments through the gallery (balcony, terrace) (Fig. 2 e, f);
5) outside the building, and access to the elevator is not at the level apartments;
6) outside the building, and access to the elevator is on the apartments level.

Front the elevator should be free platform size of 1, 5 x 1, 5 m [2].

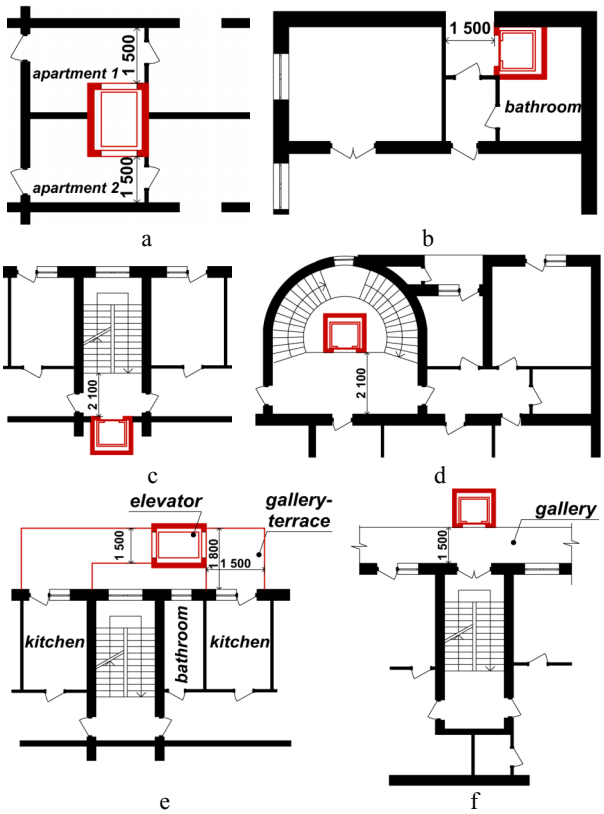
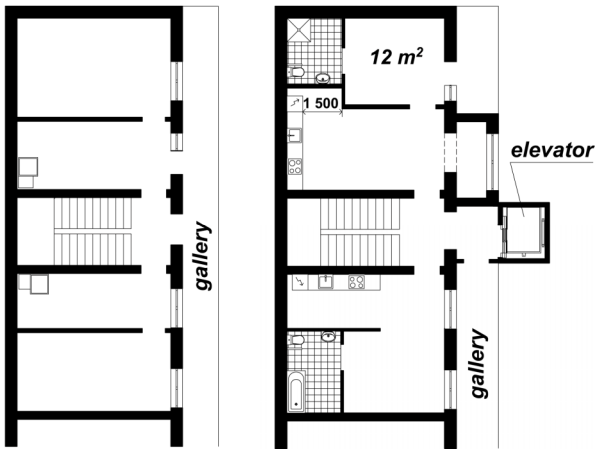


Fig. 2. Methods of arranging elevators

Functional and organization planning of apartments must comply various requirements LMG with inhabited environment, caused by the heterogeneity of this population, immobile almost immobile patients; people with disorders of the locomotors system; blind or with visual impairment; people with defects of impairments [3].

Apartments for people who move in wheelchairs advisable to design as a residential zone with a minimum fixed partitions with the union in a single flowing space without barrieres living room-dining room-kitchen. During the functional and planning organization of apartments for families with disabilities, advisable to provide the organization the entrance to patient room near the entrances to the kitchen and sanitary unit. The average area of living rooms in homes built on the border of XIX – XX centuries, is 18.9 m^2 [4]. This suggests the possibility of adapting to the needs of apartments LMG. Residential area for accommodation people in wheelchair is recommended to take: for accommodation one disabled person was – at least 12 m^2, on the disabled self-employed – up to 16 m^2 [2]. Kitchen area apartments for families with disabilities in wheelchairs in residential houses social housing stock should take at least 9 m^2 [2]. Compliance of this requirement needs redevelopment of apartments, so that in the houses have a kitchen area of 3.7 m^2 [4]. For one-bedroom apartments can be recommended the organization kitchen-niche with a minimum area of 4.5-5.0 m^2 and location of kitchen equipment in console type [3]. During the adapting kitchens to the requirements of disabled accommodation it is advisable to provide replacement gas stove to electric [2].



a b

Fig. 3. Adaptation historical apartment building to the needs of LMG: a) existing plan; b) proposal for a wing apartment building renovation project by author

Acting in Ukraine standards, defined the following planning dimensions of sanitation facilities in the apartments for families with disabilities, traveling in wheelchairs, bathroom or toilet combined – 2.2 x 2.2 m; toilet with washbasin – 1,6 x 2,2 m [2]. Arrangement kitchen or toilet , bathroom under of up the living rooms on the contrary clause 8.11 DBN V.3.2-2-2009 is possible if the introduction of compensatory measures (placement of noise and waterproofing, modern utilities) [5]. This will allow to organize sanitation facilities in the apartment where they were previously absent. The priority solution of ancillary facilities must be carrying complex renovation for the installation of sanitary facilities in each apartment home.

Due to the renovation, accompanied by the expansion of corpus of the building from the inner court through the inclusion of areas galleries or balconies to the apartment structure, the organization can be ensured additional outbuildings and an increase in the existing residential areas or outbuildings (Fig. 3). Some dwelling rooms or kitchens are put forward of dimensions of the existing building, which enables to arrange a hallway or corridor. This can be provide expansion orifice between the existing and adjacent premises, dismantling of the wall (with the appropriate constructive and technological processing). This work should be completed comprehensively to maintain the integrity of the facade of the house.

Conclusion

In the work is established: the main direction of adaptation historical housing stock to the needs of LMG is to improve functional and planning structure by adding the necessary facilities, optimizing the parameters of rooms and spaces in accordance with the regulatory performance areas, arranging technical-constructive, visual, tactile and acoustic means.

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Optical illusion: Apogee Development

Elena Chernychuk[1], Viktoriya Bazylevych[2]

[1]Department of Desing and Architecture Basics,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: chernichyk@list.ru

[2]Department of Desing and Architecture Basics,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: bazylevychv@gmail.com

Abstract* – *The article provides a classification of optical illusions performed by the authors. Briefly described each of the 11 identified species. Offered the variants using optical illusions in the urban environment, exterior and interior.

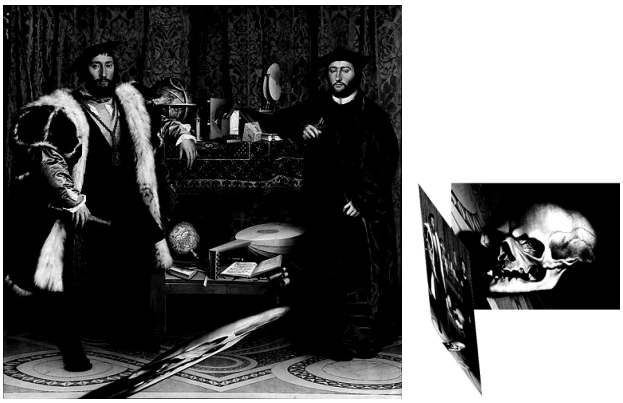
Key words – optical illusions, anamorphosis, installations, angular illusion street art, cylindrical mirrors, surrealism, reverse 3D images, body art illusions.

I. Relevance of research

For research we choose subjects relating to a variety of optical illusions. Immediately there is a logical question, why is this the subject ? Optical illusions Elena Chernychuk began to admire at school, but once due to the lecturer of the course "Principles of Composition," and now her supervisor Victoria Bazylevych, capture has become a serious disposition, in fact capable of illusion to deceive not only the eyes but also the mind, and that's worth something. But for us the optical illusion also carried a certain philosophical disposition: if you can deliberately distort reality and not believing his your eyes, then why not fly to the moon? So we knew that for manthere is nothing impossible. The further we deepened in the "wonderland" of optical illusions, the more realized how little we know. In Europe and the USA optical illusions with every year reaches its peak, and when in Ukraine - on the contrary, it was over in the begining. Following by various artists in social networks, we realized that each of them is trying to work outside the box, and with some hard questions, but where are no mystery in the art without optical illusion? Therefore we think that we have chosen the actual theme.

II. Types of optical illusions and their practical application

Certain kinds of illusions, exhibitions and creative artists of this trend, devoted articles the last years of Internet resources [1], [2], [3], [4], [5], [6]. The creative legacy of world famous artists of optical illusions in graphics, art and architecture represented in the Illustrated Encyclopedia 2007. "The world of art. Optical illusions in painting and graphics "[7]. However, over time the publication of this book, new kinds of optical illusion art come into the world new authors that deserve the attention of both researchers and practitioners design. Furthermore, the known optical illusions research can hardly be called generalizing and structured. Optical illusion began to develop in the 16th century, but the peak of its development they achieved only in the 21st century. One of the earliest well-known anamorphic art is work by Hans Holbein «The ambassadors». In the foreground of the painting shows a human skull, which takes readable form, examine it only if the right side and at a certain angle (figs. 1 and 2).



Figs. 1 and 2. « The ambassadors». Hans Holbein, 1533 p. [8]

During the entire study we successfully found the material and it was sampled and analyzed for further research. Analyzed as existing classification of optical illusions and contemporary art, invited the author's own - the disposition and the technique works. The samples classified into 11 types of optical illusions:

❖ *spatial installation*. Shapeless heaps of things scattered in large halls transformed into a work of art, the viewer need only look at a certain angle. Representative: Bernard Pras (France) (fig. 3);

Fig. 3. Spatial installation B. Pras [9]

❖ *shadow illusion.* Shadows inherently fleeting, so it's hard to tell when people first began to use them to create works of art. But modern "shadow artists" reached unprecedented heights in the use of shadows. Artists use careful positioning of different objects to create beautiful shadow images of people, objects or words (fig. 4) [1].

At first sight installation resembles a bunch of garbage, only light streams through all covert becomes apparent.

Representatives: Tim Noble & Sue Webster (UK); Shigeo Fukuda (Japan); Kumi Yamashita (Japan) (fig. 5); Fred Eerdekens (Belgium), Rashad Alakbarov (Azerbaijan);

Fig. 4 . Shadow installation Tim Noble & Sue Webster [10]

Fig. 5. Shadow installation Kumi Yamashita [11]

❖ *angular illusion* (distorted texts that can be read only from a specific position). Representatives: Hunter Thompson and Joseph Egan (UK) (fig. 6);

Fig. 6. Corner illusion Hunter Thompson and Joseph Egan [12]

❖ *street art* (creating 3D chalk drawings on sidewalks cities). Representatives: Julian Beever (UK); Nicholas Arndt (Russia); Edgar Mueller (Germany) (fig. 7);

Fig. 7. Street art Nicholas Arndt [2]

❖ *anamorphosis on paper* (3D pictures on paper). Representatives: Sandor Vamos (Hungary), Ramon Bruin (Netherlands), Stefan Pabst (Germany). Authors works with pencils on sheets of paper, adding to his drawings such items that make the viewer it's difficult to understand where the real world ends and begins a fictional picture (fig. 8);

Fig. 8. Anamorphosis on paper Stefan Pabst [3]

❖ *gallery anamorphosis* (3D image through shadows and create a certain point of view 4D effect) (fig. 9);

Fig. 9. Gallery anamorphosis
Magic Art Special Exhibition Of China [4]

❖ *cylindrical mirrors* (abstraction, which is reflected on the cylinder and becomes intelligible features). Representative: Awtar Singh Virdi (India) (fig. 10);

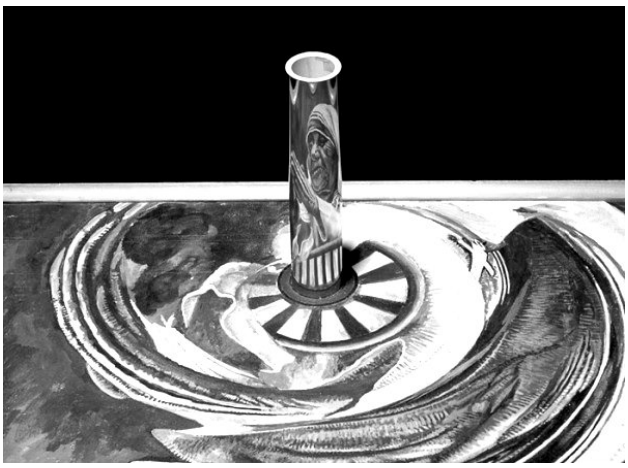


Fig. 10. Portrait of Mother Teresa by Awtar Singh Virdi [5]

❖ *art installation in the air* (installation becomes supernatural features, as not seen the object support and the object appears to "lift" in the air). Representative: Johan Lorbeer (Germany) (fig. 11);

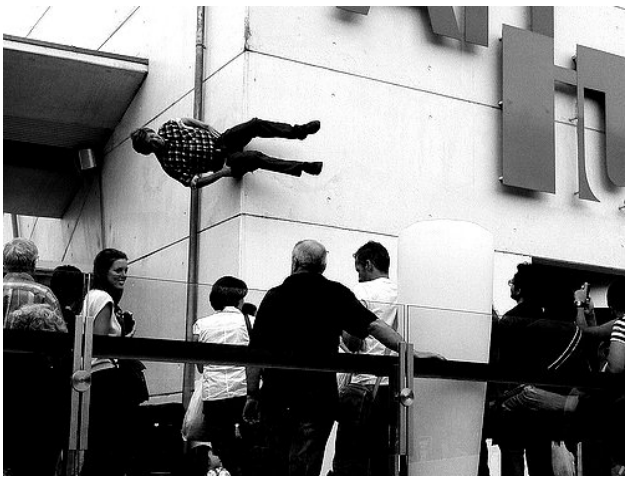


Fig. 11 Art installation in the air by Johan Lorbeer [13]

❖ *surrealism, ambiguous - two sides of vision* (an image that conceals ambiguous meaning in the film). Representatives: Oleg Shupliak (Ukraine), Rob Gonsalves (Canada). A striking representative of realism in Ukraine is Oleg Shupliak. He creates masterpieces on canvas, embodying ambiguous meaning in the work, which usually depicted the silhouette of giant Shevchenko (fig. 12).

Pictures by Gonsalves - it is always a magical union of worlds, subtle metamorphosis flow of objects from one figure to another. Artist as hints to us - everything is interconnected in the world (fig. 13);

❖ *reverse 3D images* (artist paint the man and his environment, transforming reality in a picturesque setting). Representative: Alexa Meade (USA) (fig. 14);

❖*body art of illusion* (to human body drawings depicting the 3D effect). Representative: Hikaru Cho (Japan) (fig. 15).

Optical illusions are attractive art form and have the potential for use in modern life, particularly in Lviv. In an urban environment and can use the exterior street art, art installation in the air, surrealism. We offer to use surrealism on ashen walls from trivial round houses that will certainly be positively perceived by local residents, will bring color and a certain philosophical sense in building. In particular, use of or offer us a famous surrealist and contemporary Ukrainian Oleg Shupliak. The interior - use spatial installations, shady, angular

Fig. 12. I passed thirteen… Ambiguous by Oleg Shupliak [14]

Fig. 13. Sailing Island. Surrealism Rob Gonsalves [6]

Fig. 14. Reverse 3D images by Alexa Meade [1], [15]

Fig. 15. Body art illusion "surprise, which can not hide" by Hikaru Cho [16]

illusion of body art gallery and anamorphosis.We propose to use gallery anamorphosis in children's clinics: many times we watched as children exhausted long queues, and such a non-standard course can interest both children and parents, moreover, this will allow to inure love for art since childhood.

Conclusion

It is noticeable that in our classification of 11 types of optical illusions only one Oleg Shupliak presents Ukraine in this art. Inconsolably, that we, Ukrainians, with great potential go far away behind world progress. Note that the material also sought to expand the horizons of our industry specialists.

After the study, we realized that in art there are no restrictions, here you are free, but at the same time bound limitations of his own body. To create genius does not need to be a genius, you must be a little crazy, do not be afraid to go beyond the desert-trivial round. Who knows, may be located outside the crystal waterfalls, but you can never quench your thirst until thou wander closed circle desert.

Ukrainians also be listed above the brilliant creators - need only to believe in themselves and assert themselves in some way. In order to do this, in our opinion, it is necessary to find the truth. However, as said Socrates: «Truth is like the sun, take a look at it - and then once will be blind, so it should look in the reflection. It is - how to look at the sun in a puddle». Artistic path only for the brave, but "bold always have happiness" (I.Bahrianyi «Tygrolovy»).

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A History of Public Art

Alla Kyselyova

Graduate student of Odessa State Academy of Building and Architecture, UKRAINE, Odessa, Didrihsone street 4,
E-mail: kiselyovaalla@gmail.com, tel: 097 90 59 257

Abstract – This article describes the genesis of public art and its development.

Key words – public art, modern art, dematerialization of the art, artworld, institutional theory of art, institutional critique.

I. Introduction

Creating a space that would satisfy material and spiritual needs and stimulate the development of an individual and society as a whole has been a subject of an intensive search of modern architects, designers, art historians, sociologists and psychologists.

An important role in formation of the spitually ideal living conditions bolongs to the objects of public art. They fulfill the social function, interacting with architectural environment.

To be able to define the modern art, we should address some of the historical circumstances, determining both its origin and development.

II. The Origin of Public Art

The origin of public art is determined by the fundamental changes that were taking place in the mid-60s of the 20th century. In these years there are many different artistic genres in art. 1965 witnessed minimalism and conceptual art. The result was what Lucy Lippard later called “the dematerialization of the art object” [1].

“Antiintellectual” emotionally-intuitive process of creating a work of art, characteristic of the previous two decades, and especially for the art of abstract expressionism, giving way to a conceptual approach, which emphasizes the thinking process [2].

Thus, the artists started to put less physical effort while creating their pieces and focused exclusively on the concept, engaging the professionals to complete them. As long as the piece of art is just the final product, many artists lose interest in embodying the concept. This particular trend leads to dematerialization of the art.

The need in theoretical explanation, which structure the objective process of art practice, arises.

Arthur Danto coined the term “artworld”, laying the foundational theory of art: “Any object – a urinal of a cardboard box – becomes a piece of art when it enters the artworld” [3].

In 1974, George Dickie wrote about institutional theory of art in “Art and the Aesthetic: An Institutional Analysis”[4] and gave the definition of art and what could be considered the object of art. Accord to Dickie, the art in 21st century resembled scientific, political of business institution in its form.

He considered the “artworld” to be such institution.

The “artworld” is the professional community (including art critics, artists, art dealers, psychologists and philosophers) which defines and appraises the objects of modern art. Introducing the object in this field, it reaches a "recognition of his right to be a work of art," says George Dickie, then he gets the recognition, and enters the world of art.

Further, a recognized art-world artist should focus on the destruction of the institution of art. Introducing new practices, it is designed to bring a new art object beyond the already recognized field. This paradox, where the artist opposes the art world, but with a focus on it and forms a paradigm in which the current practice of contemporary art.

III. The Formation Of Public Art

The epoch witnesses not only the change in pieces of art or the way they are appreciated but also the way they are displayed.

The term "institutional critique" first appeared in an article by Mel RAMED "On the criticism" in 1975. In it he raises the question of rearrangement of emphasis in the analysis of institutions. And claimed that the functions of the institutions should be reviewed on the basis of criticism of bourgeois individualism and removal "outside" of the principles of the capitalist bureaucracy, which determine the validity of all components of the system of art.

The artists in 60s stepped out of the art gallery: Table I.

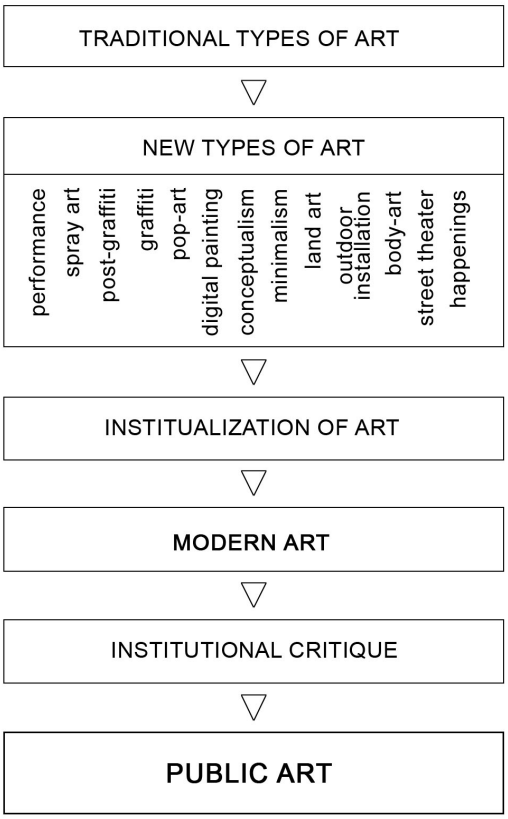

Table. 1. The evolution of public art

The new trend of “institutional critique” emerged. The term “institutional critique” was first published in the “Critique” by Mel Ramsden in 1975. This article questioned the focus in analyzing the institutions.

Ramsden claimed that their functions should be revised with regard to criticizing bourgeois individualism and actualizing the principles of bureaucratic capitalism which define the components of the system of art.

This criticized both the institutions – museums, foundations, galleries – and all the components of the system of arts. The specific character of "Institutional Critique" evolved re-defining the place and re-branding the display area.

The art entered the "public space". The interrelationship strategies, involving the artist, the audience, and the museum, were reviewed.

Robert Smithson – in his declaration "Cultural Confinement" (1972) – described artists' manifests of the 1970s, which aimed at putting the relationship between

the audience and the system of arts outside the limits, dictated by the traditions: artist's action – result – exposition – audience's attention.

Conclusion

Today art can only be autonomous to the idea that it pursued until now, as seen in the example of post-modern art trends. The desire for liberation from all the pressure, expressed in all possible ways, the need to oppose itself artistic forms of the past has led to the denial of the principle of autonomy. The next step after the distance traveled autonomy does not exist, because it will be a negation of the negation, which can only mean rejection of the principle itself.

A much greater need for its further development and the possibility of retaining the aesthetic experience is the purpose and function of which lie outside. Art is facing a complete reorientation, because now it can no longer stay away from non-artistic purposes and functions, but quite the contrary, opens them for yourself and appropriates every time manifesting a special artistic way

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Methods of formation the experimental spaces.

Nataliya Savchenko-Pichugina

Architecture and art institute, Odessa State academy of civil engineering and architecture, UKRAINE, Odessa, Didriksona str. 4, E-mail: savchenko.od@gmail.com

Abstract **–** ***Examined and showed signs of experimental architectural environment and architectural environment, conducted a comparative analysis. As a result of the analysis revealed the following signs of EAS: novelty spatial experiences of participants, the desire to expand the boundaries of their perception and think about stereotypes; temporary use; predominance of the conceptual component of the utilitarian and pragmatic; scenario approach formation; involvement in the environment processes, the transition from a man to a state-viewer-man party; partial withdrawal of the "psychological comfort zone", the construction of the composition of the functional process with the "window of variable".***

Key words – experimental space, transformability, kinesthetic variability, materials, modul, functional revitalization, multimodal harmonization, mini-space, 'transparent' design, sensory deprivation.

I. An experimental space

As both spectator and actor, being in an urban environment, a person every minute should make a choice: "to watch" or "to take part". The srongth of emotions depends on that perception.

Everyone knows the phrase "the art of living», «Dolce forniente», known to italians with their special ability to give life properties of the object of art. A person's ability to get pleasure out of life is similar to the feelings of contemplation and creation of beauty; mastering the art of living, the viewer becomes the artist and actor in one person. According to the above proposal, the task of architects - to create an architectural environment, a functional component of which is the study and development of new active art - the art of being. The product of artistic activity and also exhibit - action. Award - inspired and emotional energy resulting from this action. Passive perception of information and experience leads to the accumulation of energy release that is possible through activity.

Each type of art tend to evolve, giving birth to new genres and its offshoots. The task of architects is to create architectural environment favorable to the development of the active form of art, to create an environment for experiment, where exhibits will be a man, his actions, and the viewer is himself and his feelings - the result of the action. A space where the viewer will cease to be an observer and become a member, "including in the game" will be the "child" and actively to understand the world and himself, who rejoices in the process of knowledge of the game.

"The mood of the game - it is the mood of detachment and enthusiasm, the sacred or festive - wrote the philosopher Johan Huizinga in his book" Man playing. " - It gives us a sense of joyful lift and allows you to remove tension. Game - it is a powerful source of energy, it is by its very nature is full of positive emotions. " [1]

It's not enough to become experimental architectural environment friendly. The goal is - to help the viewer to become an actor, to involve him in the process of "game". These "involving" means - as a kind of portal, transforms into another dimension, to the flourishing of the human person.

II. Methods of formation

Studying experimentally the world-environmental architectural practice, has been find out a number of methods of their formation and characteristics.

One of these techniques is a common practice - to give the consumer the opportunity to make changes in environment by transforming objects. This makes it a "co-sponsor", allowing to captivate and "includes" in the creative process. This technique has been used in «Carlsberg» Copenhagen, when suspended in a lot of rope allows guests to connect their own lower free ends by creating space for seating, but several near such places allows you to conveniently chat with a neighbor. Ropes are also actively used as a swing. Wooden sticks are also offered to move and rotate as you wish guests to break so the space areas into zones and creating conditions for different functional processes. This method "connect guests to the transformation" not only to achieve a certain natural variability of space, which in itself is interesting, and, in addition, involves guests in creativity, forcing them to be proactive, to "play" with the space to experiment, try new activities , go out of your comfort zone and expand the borders of perception.

Leaving the facility design some variability provocates the consumer, "what if?". It encouraged them to experiment, making changes, and thus "revive" environment.

On the basis of this reception it was built as a project «The generator», organized by the Venice Biennale in 2010. Participants were invited to participate in the workshop, building his own wooden chairs, which are then combined into a single three-dimensional structure within which people can move or just take one of the empty seats inside and stay there.

Another group studied objects is focused on, to break the stereotype of kinesthetics body limiting and constricting staying in public places. The objects in this group (Tape, City matress, Dymaxion sleeps, Picnurbia) offer guests the freedom of choice of poses, without limiting the fantasy of a standard rectangular bench or chairs. The same is fair to say about the other objects of this group, which force again feel like a kid on the playground, and neighbors on the site - friends or companions on the game. The lack of formalization in the selection of poses, forcing people to take exactly the position of the body that make you feel comfortable and relaxed because It poses in which the body remains directly linked to the psychological state of the person. Such facilities help to feel "at home" in the security environment in a reliable and loving family. It really sets the friendly people to each other and contributes to fruitful communication.

Table 1 shows methods of formation the experimental spaces and characteristics of them.

TABLE 1

METHODS OF FORMATION EXPERIMENTAL SPASES

Transformability

The possibility for the participants to make changes in the environment, or create new objects

possibility: revitalisation of creativeness
scale of usage: collective
the principle of exposure: non-visual exposure
the nature of revitalization: kinetic, communication, collective creativity
type of experiment: functional

Kinestetic variability

Using the multifunctional objects without the archetypes of kinetic usage

possibility: individual creative activity
scale of usage: individual, group
the principle of exposure: non-visual exposure, kinestetic
the nature of revitalization: kinestetic, intellectual
type of experiment: product design
kind of space: „capsule", „cluster"

Alternative materials

possibility: semiotic rethinking
scale of usage: individual, collective, group
the principle of exposure: visual and non-visual exposure
the nature of revitalization: semantic, communicative, the collctive creativity, individual
type of experiment: product design, semantic
kind of space: „capsule", „cluster"

Modul

Combining the same elements in a single composition

possibility: transformability, adaptability
scale of usage: individual, collective, group
the principle of exposure: non-visual exposure, kinetic
he nature of revitalization: kinestetic, intellectual
type of experiment: product design
kind of space: „capsule", „cluster"

Functional revitalization

Changing of everyday function purpose of the space

possibility: transformability, adaptability
scale of usage: individual, collective
the principle of exposure: semiotic, visual and non-visual exposure
the nature of revitalization: semiotic
type of experiment: functional
kind of space: „capsule", „cluster"

Multimodal harmonization

Synchronization of the multimodal experience

possibility: strengthening the emotional impact
scale of usage: individual, collective, group
the principle of exposure: visual and non-visual exposure
the nature of revitalization: emotional
type of experiment: product design
kind of space: „capsule", „cluster"

Singling out of the MINI SPACE

possibility: strengthening the emotional impact
scale of usage: individual, collective
the principle of exposure: visual and non-visual exposure
the nature of revitalization: emotional, intellectual
type of experiment: product design
kind of space: „capsule"

Means of "transparent" design

possibility: strengthening the emotional impact
scale of usage: individual, collective
principle of exposure: визуальное и невизуальное воздействие
nature of revitalization: emotional, intellectual
type of experiment: product design
kind of space: „capsule", „cluster"

Partial sensory deprivation

possibility: strengthening the emotional impact
scale of usage: individual, collective
principle of exposure: non-visual exposure
nature of revitalization: emotional, intellectual
type of experiment: product design
kind of space: „capsule"

The task of experimental environmental objects - to increase the content of the functional processes to increase the comfort level of the architectural environment, make peresmatret relevance of existing architectural and environmental solutions.

Objects experimental architecture - a way to "throw the bait" with an interesting proposal.

Reviewing, break stereotypes, to raise the question of the perfection of the existing environment - is a mission-environment experimental facilities. Appearing once they stick in the memory, thanks to the freshness and originality of the information his promise, forced to look at familiar things in a new way.

Conclusion

Experimental architectural environment promotes the formation of a special atmosphere, that encourages to become not "a spectator" but "an actor", it encourages to participate, to feel Dasain (by Heidegger).

Methods of forming an experimental architectural environment based on the increasing of it transformability and variability, on increasing the degree of multimodal harmonization, as well as partly sensory deprivation.

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The memory of the city

Yaryna Yuryk

Department of Design and Architecture Basics
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: fotografika2013@gmail.com

Abstract – Aim of the research is to reveal peculiarities of memory "image" in the architectural environment of different cities in the context of city esthetics and its comprehension by the groups and the in-groups as modern cities remain the arenas for the presentation of cultures and memory synthesis. Perpetual processes of social and public representation take their place within towns and architecture. That is, the process of accumulation of memory of the city is taking place.

Key words – the memory, the city, the architectural environmente, the emotional context, the process of reflection, the urban environment.

I. Introduction

Actual task for the humanity in terms of globalization and mega-urbanization is to preserve the memory. This multidimensional memory of humanity is reflected in the architectural time-dimensional environment of a city. Cultural heritage is "the guidance in the concept of time-dimensional environment of former generations" [1] and also the means of self-identification of the inhabitants of modern cities.

II. The problem of preserving the memory of the city

The need for self-identification in the environment and the memory preserving of a city of embodied in its dimension and architecture remains one of the priorities of the out-groups and the in-groups.

The study of the city architectural environment in the context of preserving the memory is an important task, which requires a multidisciplinary approach. It is known that the memory of the society is "... a process with the help of which the society actualizes and shapes its perception of the past ..." [2].

III. Analysis of recent research and publications

Some aspects of the problem are revealed by the following scientists: B. Asmus, P. Nora, A. Ikonnikov, K. Lynch, B. Cherkes, S. Slipchenko, Y. Yuryk. Works are very valuable in the context of present research V. Glazychev, A. Levinson, V. Timohin, S. Hasiyeva, V. Shimko, M. Omelyanenko, H. Shteynbah, N. Shebyk, S. Shubovych, I. Rozenson, Z. Yargina. Y. Shkodovsky.

This article is based on materials of sociological studies conducted by the author in 2013-2015.

The purpose of the article is to outline the features of the "memory" printing and retention in the architectural environment of the cities in the context of his perception of residents and tourists. The goal achieving involves the disclosure of the emotional features during memory mapping in the built environment of the city.

IV. The architectural environment

The attitude of the humanity to the cities is multivalent. It has created a complex surrounding around, but has not learned to live in harmony with the environment. M. F. Raimer was the first who interpreted the notion of "environment" and revealed its main components the interconnected subsystems: the environment; "second nature"; artificial environment – "the third nature" and social surrounding [3].

V. The aesthetic perception of the city

Interaction and "fight of the city and nature" reflects the variety of connection of a person and nature. It is the city esthetics [4]. These categories are also evaluated by a person in the landscape. Thus, the landscape and the micro-climate are fundamental to the formation of a city environment, which forms its functioning.

The role of natural-climate factor is overall the same for different cities. For example, the urban environment of cities form the peculiarity of topography (a city in mountains, in a plain) or the closeness to a sea, ocean or other "extreme" climate region (city in a desert) [5].

The esthetics of an environment is one of the most important features. The dimensional organization of a city environment is connected, at the same time, with the biological and social and cultural needs of its residents and tourists. The evolution of the needs causes the change of space organization of a city environment [6; 7].

However, modern cities remain the testing ground for materialization of the memory of different cultures and groups in terms of history context. Architectural environments of different groups have different social and cultural potential. There are European, Asian, American Fig. 1, Fig. 2, Figs. 3. and African cities [8].

It should be noted, that social and cultural potential of a city means the adjusting of parameters of the city environment to the needs of residents [9] and the capacity of citizens towards the development and representation in the dimension through self-awareness [10].

Associative abilities of a person play an important feature in the aesthetic perception of architectural environment [11], and "the mythological type of consciousness" is the foundation of perception [12].

Fig. 1. European city

Fig. 2. Asian city

Fig. 3. American city

Architectural environment of every city has its “emotional bond”. Thus, the generalization of feelings and moods that arose from the environment perceiving in a person is the emotional content of a society. It is the dialectic unity of the opposites: “moods”, “nuances”, “motives” that form different situations derivative from such types of basic emotional feelings: monumentalism, playing on camera, “efficiency”, relaxation [13].

What is the emotional content of the process of reflection of multi-aspect memory in the architectural environment of a city: the European, American, African, Asian, for instance, and "the places of memory", monuments, memorials, memorial parks, facilities, etc, in particular?

Speaking of the memory actualization of the emotional content of the environment of the European city, these are the places of Holocaust tragedy honor.

Activities to preserve and perpetuate the memory in the architectural environment of cities must find their adequate reflection and be the priority of the architectural and urban development of a city. Indeed, as A. Grunbach generalizes, the task of an architect is "to strengthen the urban memory" [14].

Conclusion

The Architectural and dimensional urban environment accumulates the city memory over time reflecting the level of social development and the culture of residents. This paper highlights the process of materialization of the multidimensional memory of humanity in the architectural environment and dimensions of different cities at different levels, in the context of urban aesthetics; the peculiarities of its perception by the in-groups and the identity by the out-groups.

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Shear strength of RC beams strengthened by FRCM system

Pavlo Vegera[1], Roman Khmil[2], Zinoviy Blikharskiy[3]

[1]Departament of bulding construction and bridges, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: PavloVegera@gmail.com

[2]Departament of bulding construction and bridges, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: Roman_hl@ukr.net

[3]Departament of bulding construction and bridges, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: Blikharskyy@ukr.net

Abstract – In this article shear strength of strengthened and non-strengthened reinforced concrete (RC) beams are described. Beam was reinforced by FRCM system Ruredil XMesh Gold. There was using strengthening type called jacked – textile coated beam from all beam's surfaces. Effect of strengthening inclined cross section is 24.1%.

Keywords – shear strength, FRCM system, RC beam.

I. Introduction

With the development of science and technology, new materials were began to be used in construction. One of them are PBO materials which are used in FRCM (Fiber Reinforced Cement Matrix) and CFRP (Composit Fiber Reinforced Polymer) system. FRCM system – Ruredil XMesh Gold is one of the newest strengthening system. It characterized hightest parameters of fire, water resistance and resistance to environmental influence.

II. Experimental data

The samples of RC beam with 2100 mm. length, 100 mm width, and 200 mm height was tested. As beam's tension reinforcement A400C Ø22 mm rebar was chosen (according to DSTU 3760:2006). A400C Ø12 mm rebar (according to DSTU 3760:2006) was chosen as compressed reinforcement. Transverse reinforcement - A240C Ø 8 mm rebar (DSTU 3760:2006) located in the supporting area with step 100 mm. (Fig. 1). Claas of the concrete was C32/40.

RC beam was designed to provide flexural bearing capacity according to recommendations [1].

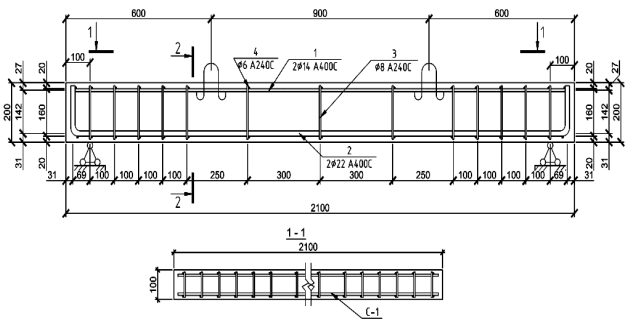


Fig. 1. Reinforcement and dimensions of the designed beam

Beams were tested on the static load. Force was applied at shear span to effective depth ratio which equaled 2 Feature of the researching was testing every beam twice. For the economy material one cross section reinforced by metal jacket (Fig. 2,3). For prevent deformation in the concrete and reinforcement metal jacket was mechanically prestresed.

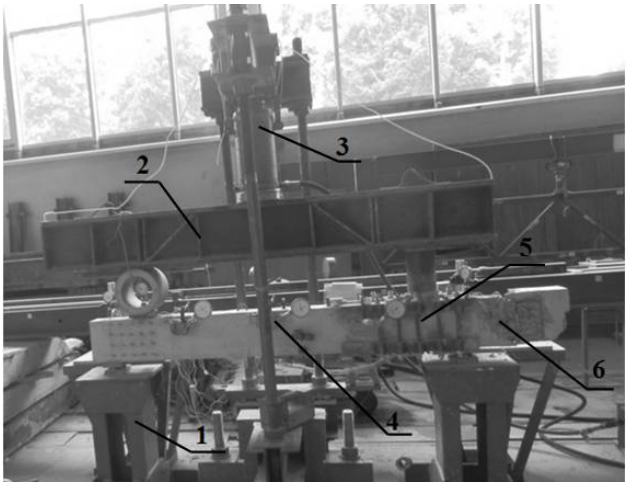


Fig. 2. Testig beam inclined cross section:
1 - Support. 2 - Distributive metal beam. 3 - Hydraulic crank. 4 - Testing beam. 5 - Metal jacket. 6 - Crashed cross section

Beams are reinforced three stripes in support area (Fig. 3). Each strips are 70 mm witdh and coated all beam's surface. For better reinforcing chamfers were removed and all reinforcing area was cleaned. Reinforcing was made according to the technical rules of producent

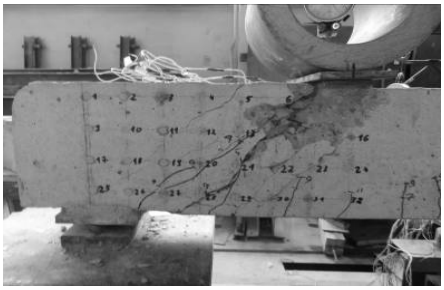
Fig. 3. Causing FRCM system on the beam

A strips of reinforcement were used because it allows to measure deformation in inclined section whithout changing our measuring system.

Beams were marking in this manner: BO - beam ordinary, BR – beam reinforced, the first one - serial number, the second one - prototypes number, and the third one – number of section. For example BO 2.1-2 means that tested the second section of the first beam of second series of beams.

III. Results of experimental researching

There were testing two beams (four tests): one – without reinforcement (for determining shear strength and deformation of inclined cross section) and with transversal reinforcement by FRCM (Fig 4,5).

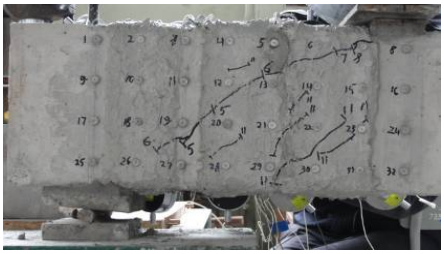


a) BO 2.1.1

b) BO 2.1.2

Fig. 4. Experimental samples destroyed whithout strengthening.

This beams collapsed suddenly with crushing of concrete. Destruction occurred when concrete of compressed area reached maximum values of compressive deformations. Maximum fixed width of inclined crack was 0,7 mm. Acceptable width of inclined crack (0.4 mm) was fixed at 120kN.



a) BR 2.1.1

b) BR 2.1.2

Fig. 5. Experimental samples destroyed with Ruredil XMesh Gold

After testing of reinforced samples we noticed that it failure was not suddenly. Also fracture toughness was better then in non-strengnhening beams. Width of crack - 0,4 mm was fixed before crushing of concrete. So fracture toughness is higher up 40%.

Shear strength of RC beams are presented in Table 1.

TABLE 1

CHARACTERISTICS OF TESTED RC BEAMS

Type of cross section	Cross section axb, mm	Beam span, mm.	Shear strength, kN
BO 2.1.1	204x102	1900	152
BO 2.1.2		1550	147
BR 2.1.1	201x95	1900	187
BR 2.1.2		1550	184

Using ours testing methodology we take a satisfactory convergency between tested twins – up 1.7% (Table 2).

TABLE 2

SHEAR STRENGTH OF TESTED RC BEAMS

Type of cross section	Shear strength, MPa	Averedge values, MPA	Discrepancy,%	Efect of strengthening, %
BO 2.1.1	152	149,5	1.7	-
BO 2.1.2	147			
BR 2.1.1	187	185,5	0.9	24.1
BR 2.1.2	184			

As a result of using FRCM system we have received the strengthening effect by 24.1%. The strip near support was deformated only around 25% of it's limit value, another two ones were reached limit value. Also this composite FRCM reinforcement significantly increases the fracture toughness (up 40%).

Conclusion

Based on the obtained results we can make next conclusions:

- testing separately every inclined cross section of the beams allows to to save speciments witout loss of accuracy (discrepancy was less then 1.7%);
- the reinforced beams by FRCM failure not suddenly;
- the shear strengthening effect of RC beams with FRCM system was up 24.1%;
- the FRCM system significantly improved fracture toughness (up to 40%).

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Basic principles of low-rise residential floating buildings design

Svitlana Shekhorkina

Department of Reinforced-Concrete and Stone Constructions, State Higher Education Establishment "Pridneprovsk State Academy of Civil Engineering and Architecture", Ukraine, Dnipropetrovs'k, Chernishevskogo street 24-A,
E-mail: S_VT@ukr.net

Abstract* – *Floating building is a complex engineering structure, which combines functional features of typical homes and vessels. Currently there are many realized projects of buildings on the water, represented by different objects such as restaurants, hotels, cottage, etc. Following research aims to develop design procedure for low-rise residential floating buildings taking into account exploitation peculiarities. Results. The method of technical parameters of low-rise floating dwelling houses calculation, considering the demands of Ship register of Ukraine and current building codes have been proposed. Using 3D finite elements model of representative floating house, data about stress-strain state of floating building elements was obtained.

Key words – low-rise floating houses, pontoons, stress-strain state, bearing capacity, structural-technological parameters, design.

I. Floating structures review

Floating building (house on the water, houseboat) is a building, which is situated on the water-body (sea, river, lake, etc.). This type of buildings emerged in the postwar period in the United States and European countries (Netherlands, Italy, England and others) as an alternative to traditional housing and addressing the shortage of land suitable for building. Currently, the construction of housing on the water is also due to the desire of people to live closer to nature [9].

A pioneer in this branch of construction industry is the Netherlands, half territory of which lies below sea level. One of the most ambitious construction projects on the water is a pilot Ijburg district, projected by Marlies Rohmer's architectural bureau for the resettlement of more than 70 thousand inhabitants [2]. Among other companies designing floating structures in Europe are such as Attica Architekten, Architectenbureau Marlies Rohmer, Aquatecture, Waterstudio, +31 Architects (Netherlands), AquaDomi (France), Marinetek (Finland) [1, 3, 5, 7, 11]. Their projects are presented by various buildings with different architectural and structural solutions (fig. 1).

The most popular and widespread are civil buildings (hotels, offices, shopping centers, sports complexes, etc.), individual low-rise residential buildings for one or two families, as well as cottage villages on the water. Floating buildings can be mobile, which permit to move the building and its mooring in another place, as well as stationary, which have a fixed location. Such buildings are also widely used for the construction of safe housing in the regions with a complicated hydrological situation due to flooding and floods. It is also should be noted that the construction on the water in the future could be the solution to the housing problem of many large coastal cities and island states which are subjected to gradual flooding due to rising sea levels as the climate changes [5, 6, 10, 12, 16].

Despite the popularity and multifunctionality of the construction on the water, investigations devoted to the floating houses, are currently presented by a small amount of work, which are mainly a review and do not contain any clear guidance on the calculation and design of buildings on the water

II. Goals and objectives

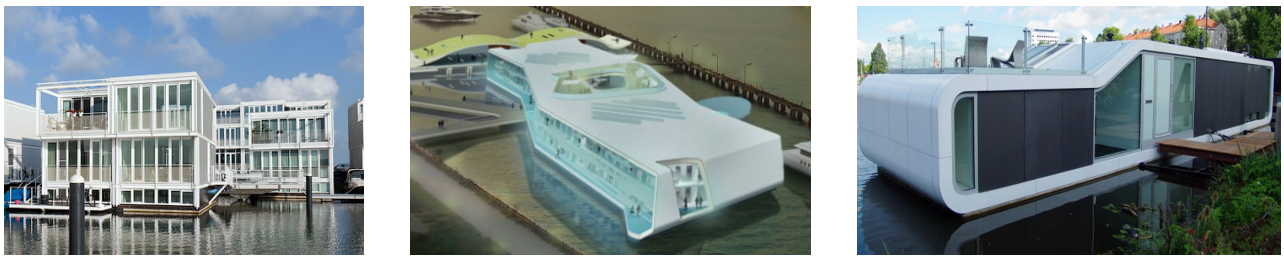
Considering insufficient amount of scientific data of the floating houses design and the absence of guidelines for their calculation and design, the research aims to develop science-based design procedure for low-rise residential floating buildings taking into account exploitation peculiarities.

In achieving this goal, the research will address following objectives: 1) to develop a method for determination of technical and exploitation characteristics of low-rise residential floating building; 2) to investigate a stress-strain state of low-rise residential floating building elements on the example of typical house.

III. Basic design principles

A characteristic feature of the building on the water is the integration of the functional characteristics of a traditional house and the vessel. A floating house can be devided into two structural parts – under-water and above-water. Analysis of the existing architectural and structural solutions of floating buildings showed that the above-water part (superstructure) is the standard low-rise building in terms of the construction industry. Under-water part is a foundation of a floating house and is a hollow concrete floating platform of one or several pontoons, which is constantly in the water and is fixed to the bottom of water-body using special flexible mooring systems [4, 8].

In accordance with the rules of a shipbuilding any floating building is a non-self-propelled vessel. Therefore, the main objective in the design of low-rise residential floating buildings, in addition to ensuring its strength, stability and durability, is to ensure the safe operation of in terms of shipbuilding. Floating building is designed according to the "Rules for classification and construction of small vessels" [14], if its length does not exceed 24 m and not more than 12 people is in a house at the same time. If these parameters are exceeded "Rules for classification and construction of inland vessels" [15] are used. In accordance with the shipbuilding standards, major technical and exploitation parameters of the building include: buoyancy, stability, and unsinkability.



a b c

Fig. 1. Examples of floating buildings: a) houses in Ijburg (Netherlands); b) floating hotel (France); c) private dwelling house (+31 Architects, Netherlands) [1]

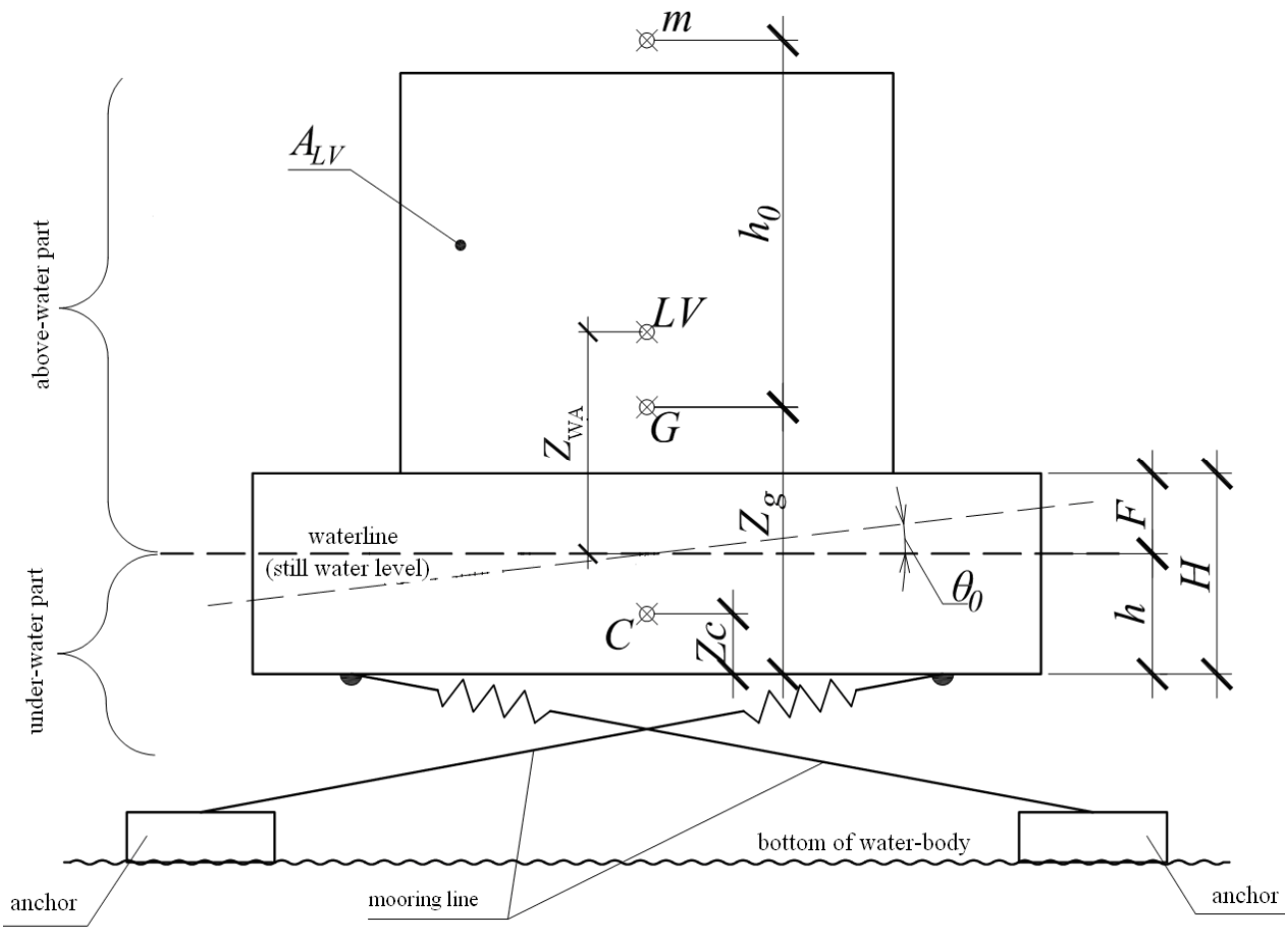


Fig. 2. Geometric parameters of floating house [Elaborated by the author]: H – height of floating platform; h – draught; F – freeboard; LV, A_{LV} – windage gravity center and windage area; C – gravity center of under-water part; G – gravity center of floating building; $Z_{ЦП}$ – distance between windage gravity center and waterline surface; Z_g – distance between gravity center of floating building and bottom surface of floating platform; Z_c – distance between gravity center of under-water part and bottom surface of floating platform; τ – metacenter; h_0 – metacentric height; θ – heel angle

The main geometric parameters of any floating house are (see fig. 2) draught (*h*), weight center (*G* point), underwater part weight center (*C* point), windage area (A_{LV}), windage center (*LV* point), metacenter (*m* point), metacentric height (h_0).

During design of floating building besides typical ULS and SLS calculation procedures of building structures it is necessary to check its floatability, floodability and stability to ensure comfort living in the house. These calculations are carried out considering total weight of floating building, including service load and maximum amount of people situated in house at the same time.

Considering the analyses of current normative documentation in civil engineering and shipbuilding industries and peculiarities of floating building, a method was proposed for determination of technical and exploitation parameters of low-rise residential floating building according to the demands for floatability, floodability and stability. The steps of this procedure are listed and explained below.

1. Calculation of total weight of floating building (including self weight of structures, service load, snow load, etc.)

2. Determination of design draught of floating building:

$$h = \frac{G}{\rho bl}, \quad (1)$$

where G – total weight of floating building; ρ – water density (*1025 kg/m*^{3} for sea water and 1*000 kg/m*^{3} for fresh water); *b, l* –width and length of floating platform.

3. Freeboard height checking:

$$F = H - h \geq F_{\min}, \quad (2)$$

where H, F – see fig. 2, F_{min} – minimum acceptable freeboard height according to the shipbuilding codes and depending on exploitation region, possible wave height and wind strength.

4. Checking of stability of floating house [14]:

$$\frac{M_{ac}}{M_w} \geq \frac{l}{\sqrt{V}}, \quad (3)$$

where M_{ac} – acceptable heeling moment; M_w – wind heeling moment; V – volume of under-water part of floating building.

Wind heeling moment is to be calculated by the formula [14]:

$$M_w = A_{LV}(Z_{WA} + a_1 a_2 h) p_w, \quad (4)$$

where A_{LV}; Z_{WA} – see fig. 1; a_1, a_2 – coefficients considering influence of water resistance and inertia forces (according to the Shipbuilding Codes of Ukraine [14]): p_W – design wind pressure for exploitation region (according to ДБН В.1.2-2:2006 «Loads and Impacts» [13]).

Acceptable heeling moment in general case is to be calculated by the formula [14, 15]:

$$M_{ac} = Gl_{\max}, \quad (5)$$

where $l_{\max}$ – maximum static stability arm which is defined using static stability diagram (diagram of dependence of static stability arm on heel angle).

Ukrainian shipbuilding code for floating platform with rectangular cross-section allows determination of acceptable heeling moment by approximate formula [15]:

$$M_{ac} = 0.1712 V h_0 \theta_{0(R)}, \quad (6)$$

where V – see formula (2.3); h_0 – see fig. 2; $\theta_{0(R)}$ – limit heel angle of floating house caused by possible crowding on one side of floating platform.

5. Calculation and checking of metacentric height:

$$h_0 = \frac{lb^3}{12V} + Z_c - Z_g \geq h_{0(R)}, \quad (7)$$

where h_0, Z_g, Z_c – see fig. 2; $h_{0(R)}$ – minimum acceptable metacentric height.

Minimum acceptable metacentric height is to be calculated by the next formula:

$$h_{0(R)} = \frac{M_P}{Gg \sin\theta_{0(R)}}, \quad (8)$$

where M_P – heeling moment caused by possible crowding on one side of floating platform; $\theta_{0(R)}$ – see formula (6); G – see formula (1); g – acceleration of gravity (g = 9,81 m/s^2).

Heeling moment caused by possible crowding on one side of floating platform is to be calculated by formula:

$$M_P = gPy, \quad (9)$$

where P – weight of maximum amount of persons in a house (weight of one person is equal to 75 kg); y – horizontal distance form weight center of building to crowding weight center.

Limit heel angle of floating house caused by possible crowding on one side of floating platform is to be obtained from formula according to [14]:

$$\theta_{0(R)} = 10 + \frac{(24 - l)^3}{600}. \quad (10)$$

6. Checking of heel angle of floating house caused by possible crowding on one side of floating platform:

$$\sin\theta_0 = \frac{M_P}{Ggh_0} \leq \sin\theta_{0(R)}, \quad (11)$$

where M_P, $\theta_{0(R)}$, g – see clause 5; h_0 - design metacentric height calculated by formula (7).

Proposed method gives design procedure for verification of main technical and exploitation parameters of floating house (floatability, floodability and stability) and ensures its adequacy of accepted to current Ukrainian shipbuilding guidelines.

IV. Stress-strain state of low-rise residential floating building

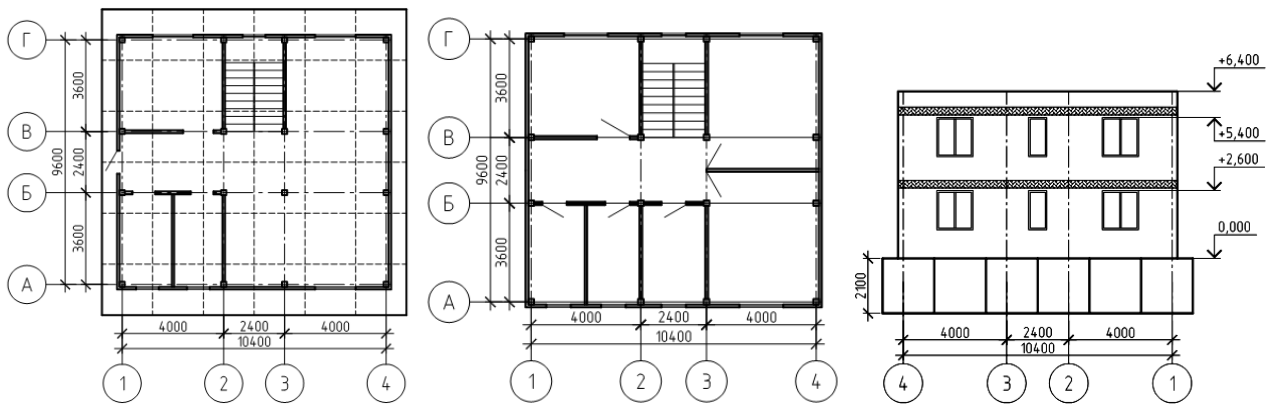
For stress-strain state analysis of under-water and above-water elements of floating building a typical "land-based" representative house was considered. The first floor and second plans and one of front views are shown on fig. 3 for illustration. Structural scheme of the building is framed and dimensions of building are 10.4x9.6 m. Bearing studs are made of I-beams (№20К1 according to ГОСТ 26020). Floor and roof bearing elements are made of I-beams (№16 according to ГОСТ 8239). External walls are made of sandwich panels with 120mm polystyrene heat insulation and are trimmed with facade plaster. Floor and roof are trimmed with gypsum board on bottom side and and with OSB-slabs on top side. Space between bearing beams is filled with mineral wool insulation. Floor coverings are made of ceramic tile (for kitchen and water closets), carpet (for bedrooms) and laminate (for other rooms). Roof covering is made of ruberoid.

The building is constructed on a 12x12 m floating platform made of separate pontoon-modules with width of 2m, length of 2m and height of 2.1m.

According to the developed method (see previous clause), calculation and verification of technical and exploitational parameters (floatability, floodability and stability) for considered house were performed. For this purpose weight of the building and loads on its elements were obtained in accordance with [13] and [14].

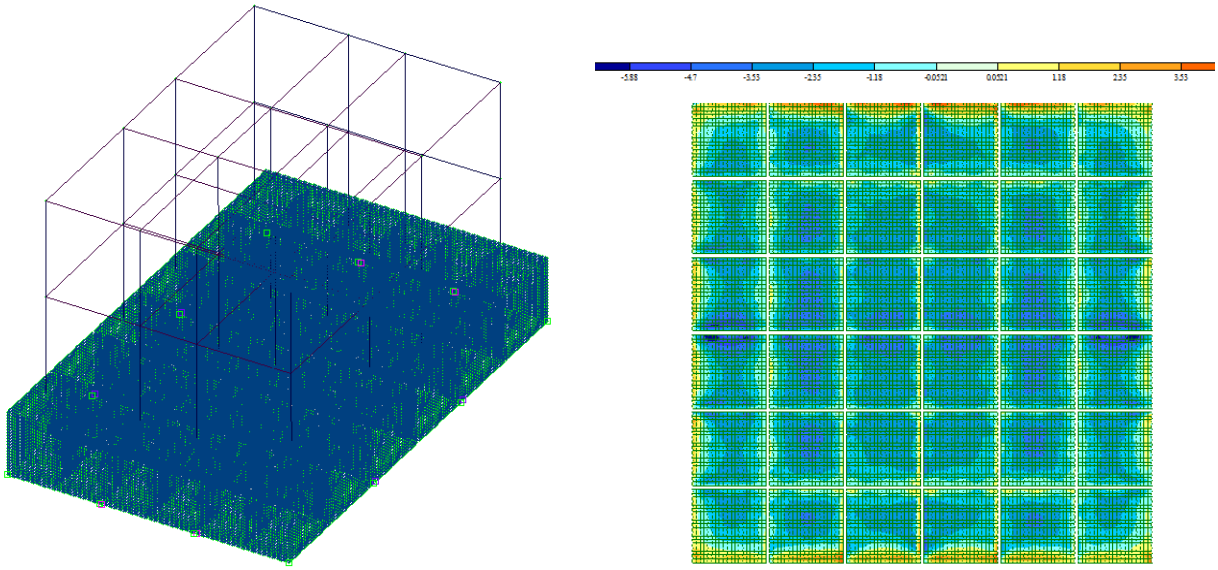
For above-water part of the building the load values were obtained for: self weight of second floor elements (0.73 kN/m^2) and roof (0.53 kN/m^2) elements; service load on the floor (1.95 kN/m^2); snow load (1.6 kN/m^2) and wind load (active - 0.45 kN/m^2 and passive 0.34 kN/m^2). For underwater part the load values were obtained for: self weight of first floor (0.6 kN/m^2) and wall elements (0.76 kN/m^2); water pressure (13 kN/m^2) and ice pressure (15 kN/m^2) on floating platform elements.

According to the obtained loads, technical and exploitation parameters (see table 1) of the building were defined. By the calculations results it was confirmed that characteristics of the building comply with Ship register of Ukraine demands.



a b c

Fig. 3. Low-rise residential floating building: a) first floor plan; b) second floor plan; c) front view



a b

Fig. 4. 3D finite elements model of the low-rise residential floating building (a) and diagram of stress distribution (My bending moment) for bottom elements of floating platform (b)

TABLE 1

TECHNICAL-EXPLOITATION PARAMETERS OF REPRESENTATIVE FLOATING HOUSE

Parametr	Criteria	Design value and checking
Floatability	Total self weight	180 tons
	Draught	1.25 m
Floodability	Freeboard	F=0.85 м > F_{min}=0.5 м
Stability	Heeling moment	M_w= 127кНм<$M_{доп}$=1836кНм
	Metacentric height	$h = 6.085m > h_{0(R)} = 0.135m$
	Heel angle	$\sin\theta_0 = 0.005 < \sin\theta_{0(R)} = 0.223$

Further, for a stress-strain analysis of the floating house a 3D finite elements model of the building was made in commercial package “LIRA 9.6” (fig. 4). The model was constructed using following types of finite elements: universal spatial bar (№10) for bearing frame elements (studs and beams), universal rectangular plate (№41) for floating platform elements and one node elastic finite element (№51) for mooring system.

According to the obtained loads the next loadings were applied: 1 – self weight of floating platform and bearing elements of building; 2 – self weight of floor and roof coverings; 3 – service load on first floor structures; 4 – service load on second floor structures; 5 – snow load; 6 – wind load along numerical axes; 7 – wind load along literal axes; 8 – water pressure on floating platform; 9 – ice pressure on floating platform.

By static calculation of spatial model, data about stress distribution and maximum strains in the elements of floating platform. As an illustration of the obtained results, diagram of stress distribution is shown on fig. 5 for bottom elements of floating platform under most negative loading combinations.

According to the results of modeling for a considered constructive solution of the above-water structure of floating house the most loaded elements are the top slab of the platform in the anchoring nodes of bearing frame

and the side walls of the pontoons-modules in the connections nodes.

A calculation of reinforcement of floating platform of considered building was performed to compare with existing structural solutions of floating platforms. The next parameters were accepted: elements thickness of 80 mm; concrete class of C25/30; reinforcement class of A400C. As a result it was determined that reinforcement of considered floating platform sufficiently coincides with similar structural solutions.

For bearing elements of the above-water part of the floating building verification calculations was performed using the maximum stress values under most negative loading combinations. Analysis of the level of load-bearing properties of the bearing elements has showed that for considered structural solution of above-water part a minimum safety degree is 12% for floor beams, 23% for roof beams and 24% for frame studs.

From the obtained data it can be concluded that low-rise floating buildings could be used in conditions of Ukraine.

Conclusion

1. Science based design procedure for low-rise floating dwelling houses was developed taking into account the specific service conditions and loads.
2. The method of technical parameters (floatability, floodability and stability) of low-rise floating dwelling houses calculation, considering the demands of Ship register of Ukraine and current building codes have been proposed.
3. Using 3D finite elements model of two-storey representative house on the floating platform of pontoon-modules, data was obtained about stress-strain state, stress distribution and their maximum values in elements of floating building. According to the analysis of these data the most loaded elements of floating platform and safety degree of above-water bearing elements were revealed.

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"ELECTRIC POWER ENGINEERING & CONTROL SYSTEMS 2015"
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The Detection of Winding Short Circuits in Single-Phase Double-Winding Transformers

Bohdan Dmytryk[1], Oleksandr Ravlyk[2]

[1]Energetics and Control Systems Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: dmytryk.bohdan@gmail.com

[2]Energetics and Control Systems Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: Ravlyk.OM@gmail.com

Abstract – The object of this research is to offer a new method of identification of winding short circuits in power transformers of all classes. This method presents fast acting and absolute selectivity during different emergency modes. It's based on the analysis of digital values of current and voltage in transformer's windings with further calculations of active resistance.

Key words – winding short circuit, double-winding transformer, primary winding, secondary winding, simulation model, core, external short circuit, no-load mode, load.

I. Formulation of the Problem

Currently the power electric industry provides for the introduction a large amount of modern equipment. Currently, the power system of Ukraine is standing about transient condition: obsolete equipment is taking out, but sufficiently slow, the diagnostics of different modes of the new grids with further optimization and investigation of possible problems and faults is performing. The solution of these questions must provide qualitative and non-stopping supply of electric power for consumers. By now, a lot of obsolete oil-immersed transformers are replaced with better dry-type analogs, mainly in distribution grids up to 35 kV. The absence of the effective defense against the winding short circuits is a big problem for both of them. The present defense on oil and dry transformers works relatively slow and unreliable. As a result, appears a problem of creating a new fast-acting and effective relay protection.

II. The Analysis of Latest Studies

The experience of the transformers' operation in power grids showed that the winding short circuits (the flashover of winds insulation in one winding) are the most dangerous faults. It can cause the extensive fire of power transformer. As a result, the main elements of the construction may be hardly damaged. While the injured winding of transformer can be remote and fixed, the damaged core is beyond repair. Such equipment can't be used again.

In oil-immersed transformers there is a gas protection which detects the oil breakdown products in the tank during the winding short circuits. However, this defense doesn't provide fast-acting performance, because it reacts on the latter results of an accident. Often, the breakage can progress so rapid and extensive that a transformer will be destroyed because of oil's high combustibility.

By the deficiencies of using oil transformers, there was created the analog with dry insulation and air-cooling. Here we can avoid all problems connected with the utilization of oil. On the other hand, the absence of the possibility to use gas protection is perceptible. As a result, there is no specialized defense against winding short circuits.

The analysis of transformer's structure shows that it can handle large overloads and power surges, but only during a short period of time. Thus, the insulation of winding is not designed to hold up a transmission of a big amount of power.

The investigation of distribution network's features in Ukraine showed that such modes happen sufficiently often. Therefore, appears a danger of winding short circuits in transformers. Existing relay defenses doesn't provide full protection and reliability.

III. The Main Data and Results

Essentially, the construction of the core in different types of transformer is the same. The difference is only in types of cooling system, insulation, and other definite construction features of elements. However, the working principle is the same. Thus, the identification method of winding short circuits is suitable both for oil and dry-type transformers.

To create a simulation model we used a software package «RE» [1]. It can be used transformer's technical passport data, magnetization chart of the core and the quantity of winds to construct this model.

The identification method is based on the main physical laws of magnetic fields and Theoretical Foundations of Electrical Engineering, which describe the processes in transformer. The system of equations of the transformer is shown in Eqs. (1):

$$\begin{cases} u_1 = R_1 \cdot i_1 + L_1 \cdot \dfrac{di_1}{dt} + w_1 \cdot \dfrac{d\Phi}{dt}; \\ u_2 = R_2 \cdot i_2 + L_2 \cdot \dfrac{di_2}{dt} + w_2 \cdot \dfrac{d\Phi}{dt}; \\ w_1 \cdot i_1 + w_2 \cdot i_2 - U_M(\Phi) = 0, \end{cases} \quad (1)$$

where: u_1, u_2, – voltages of the primary and secondary windings; i_1, i_2 – currents of the primary and secondary windings; R_1, R_2, L_1, L_2 – active and inductive resistances of the of the primary and secondary windings; w_1, w_2 – quantity of the winds in primary and secondary windings; Φ – main magnetic flux; $U_M(\Phi)$ – voltage drop in the core of the transfomer.

Eqs. (1) describes the processes in the electrical and magnetic circuits of the transformer; the first equation relates to the primary winding, the second – to the secondary and the third – to the core of the transformer.

To analyze the transient processes in windings correctly Eqs. (1) should be converted into the one, suitable for software package "RE". Considering this fact we differentiated and divided the third equation in Eqs. (1) by w_1. To maintain the correspondence between other two equations, we bring them to a common parameter. As a result, we obtained Eqs. (2), which is suitable for conducting experiments

$$\begin{cases} u_1 = R_1 \cdot i_1 + L_1 \cdot \dfrac{di_1}{dt} + M_{13} \cdot \dfrac{di_3}{dt}; \\ u_2 = R_2 \cdot i_2 + L_2 \cdot \dfrac{di_2}{dt} + M_{23} \cdot \dfrac{di_3}{dt}; \\ M_{31} \cdot i_1 + M_{32} \cdot i_2 - L_3(i_3) \cdot \dfrac{di_3}{dt} = 0, \end{cases} \quad (2)$$

where: i_3 – magnetizing current in the core; $M_{31} = M_{13} = 1$; $M_{32} = M_{23} = w_2/w_1 = k_t$ – fictitious and real coefficient of transformation intended to create a simulation model; $L_3(i_3) = -R_M(\Psi_1)$ where $R_M(\Psi_1)$ – relative magnetic resistance consolidated to the square of w_1, achieved from the no-load mode experiment of the transformer.

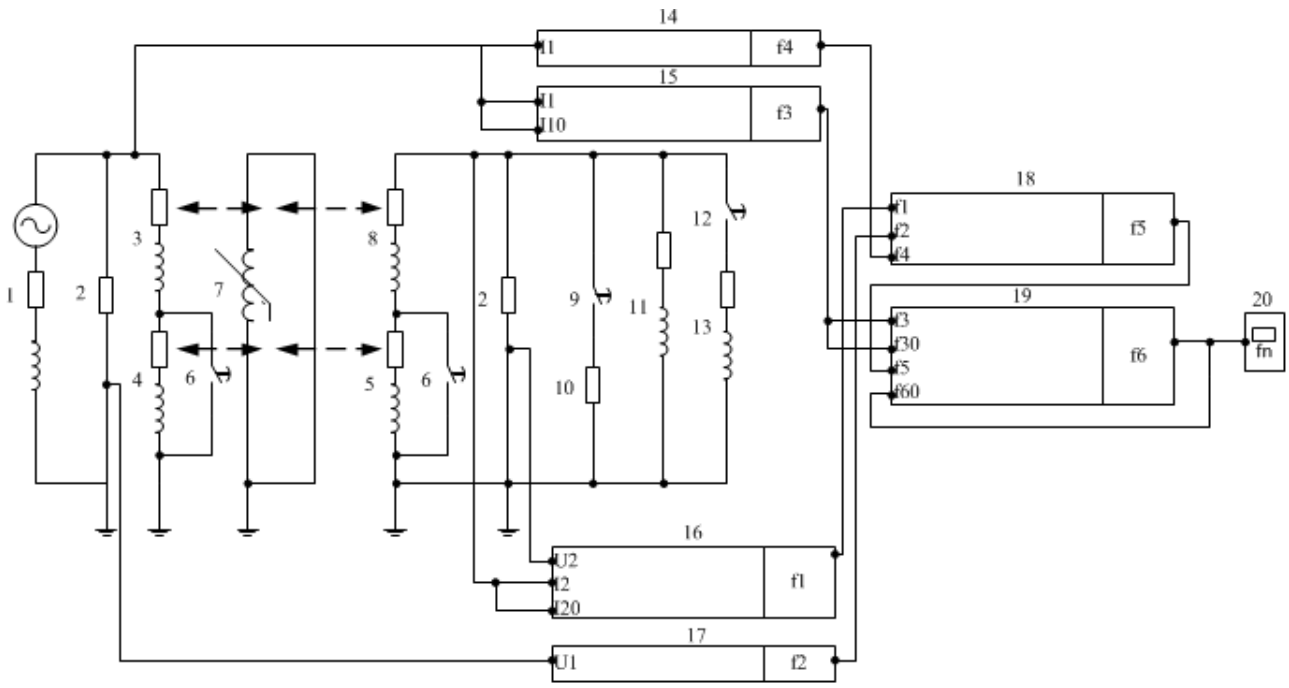


Fig. 1. Simulation model of the transformer: 1 – power grid's parameters; 2 – infinite resistances needed for obtaining primary and secondary voltages; 3, 8 – complex resistance of primary and secondary windings, respectively; 4, 5 – complex resistance of winds to be locked in primary and secondary windings; 6 – switch for imitating winding short circuit; 7 – magnetic resistance of the transformer's core; 9, 10 – branch for imitating external short circuit mode; 11 – transformer's load; 12, 13 – branch for imitating load increase; 14, 15, 16, 17, 18, 19, 20 – functional blocks, used in software package, to provide necessary calculations

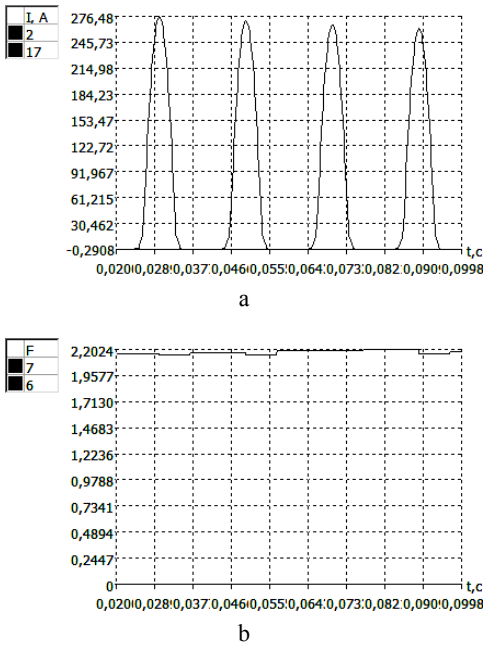


Fig. 2. Switching on the no-load mode:
a – primary current; b – identification parameter

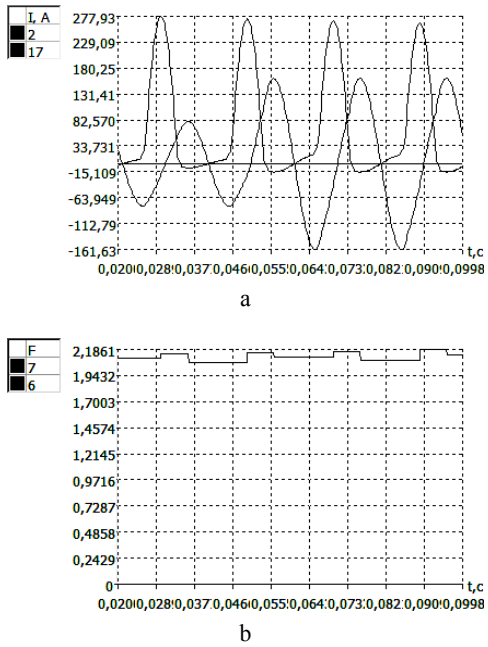
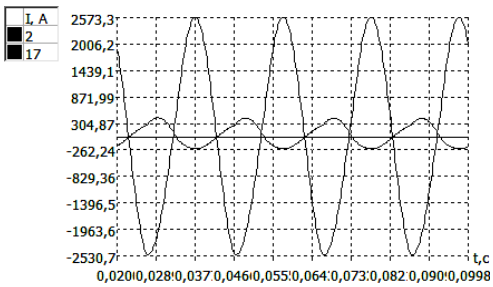


Fig. 3. Switching on the load mode with rising it twice:
a – primary and secondary current; b – identification parameter



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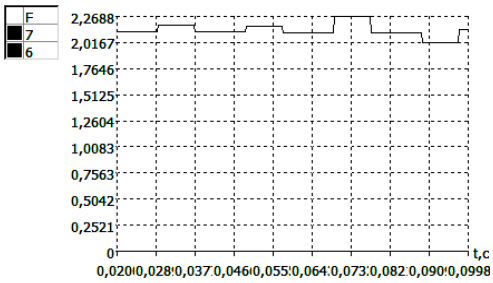

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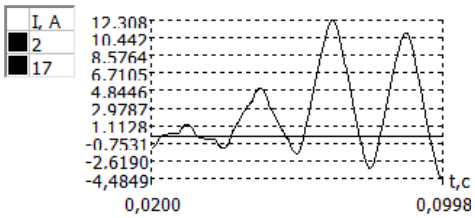
Fig. 4. Switching on the external short circuit:
a – primary and secondary current; b – identification parameter



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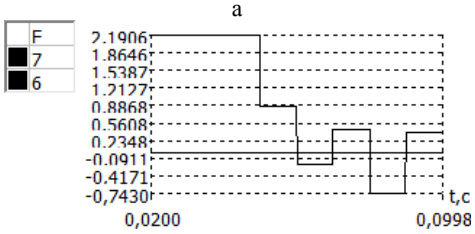
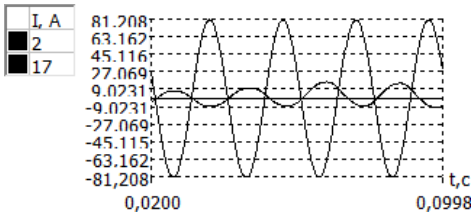
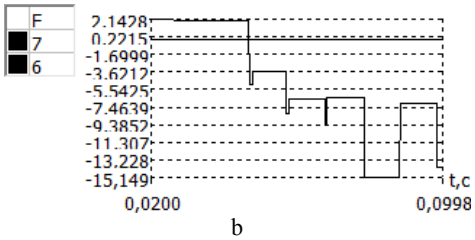


b

Fig. 5. Winding short circuit in the primary winding during the no-load mode: a – primary current; b – identification parameter

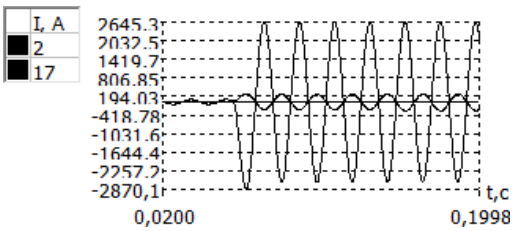


a



b

Fig. 6. Winding short circuit in the primary winding during the load mode: a – primary and secondary current;
b – identification parameter



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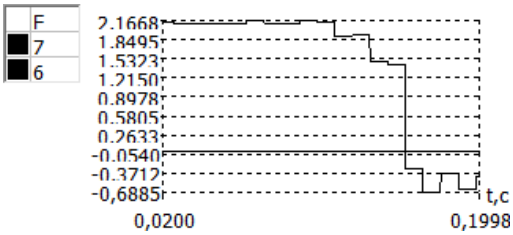


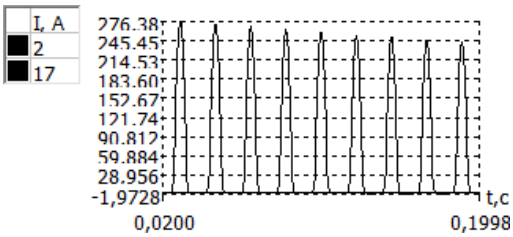
b

Fig. 7. Winding short circuit in the primar winding during the external short circuit: a – primary and secondary current;
b – identification parameter

Since, the winding short circuit is an emergency mode the options of the equations in Eqs. (2) differ from the nominal values; the biggest change we observe in active resistance. The method is based on the analysis of the instantaneous voltage and current of windings.

During the emergency mode we analyze the equation of the unharmed winding, express the magnetizing current's value and then substitute it into the equation of an emergency winding. After performing these actions, we are able to express the value of active resistance.

However, the result of this method does not show us the value of the result of active resistance's subtraction, but the identification parameter. It shows the discrete chance of active resistance. This diagram is very similar to relay graph, which can be used in digital relay defense as a triggering parameter. The oscillations on graph are caused with the calculation's precision. But still, on real power transformers the value of active resistance is not constant. It may have a wide range of alternating. Furthermore, there are a lot of regulative equipment, like regulating under load, etc.



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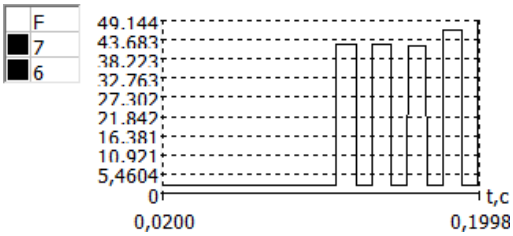

b

Fig. 8. Winding short circuit in the secondary winding during the no-load mode: a – primary current;
b – identification parameter

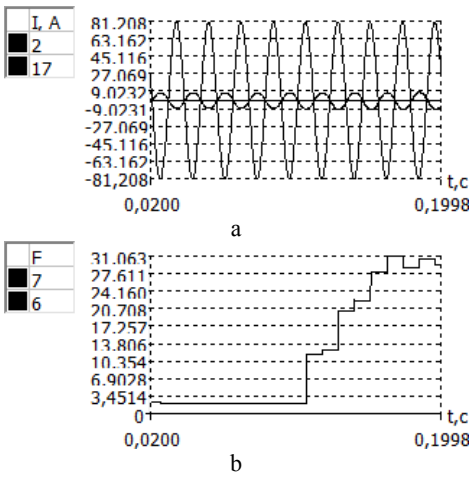

Fig. 9. Winding short circuit in the secondary winding during the load mode: a – primary and secondary current; b – identification parameter

This method automatically decides whether the emergency mode took place or not. It checks the transition terms of the derivative of primary current. If the triggering conditions are matching, we will have an emergency signal, else nothing happens and the transformer continues its work.

We analyze value of active resistance during the transition of the primary current's derivative through 0. It allows us to simplify the calculations, since it acts as a multiplier in Eqs (2). If the resistance differs from the value calculated on previous step the output signal will be "1".

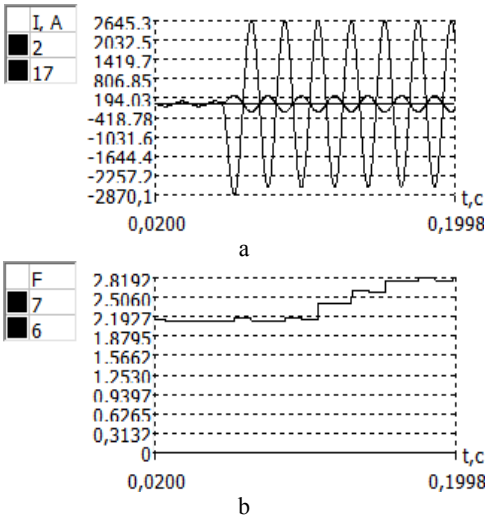

Fig. 10. Winding short circuit in the secondary winding during the external short circuit: a – primary and secondary current; b – identification parameter

The determination was conducted during the each half of the period.

The implementation of this method was carried out on the simulation model of single-phase double-winding power transformer (Fig. 1). Using switches 6 (Fig. 1) we were able to create electrical lintel on brunches 4 and 5 (Fig. 1) which correspond to the winding short circuit mode. By changing the value of complex resistance in 4 and 5 (Fig. 1) we implicated the respective quantity of winds which participated in short circuit. It allows investigating really wide variety of occasions.

The experiments were carried out during the most difficult emergency modes – short circuits of 1 up to 10 winds in primary winding and of 1 up to 3 winds in secondary winding.

It was also very important to check all of the operational cases comprehensively, since the power grid's state is changeable.

To prevent false triggering during the abnormal modes which, on the other hand, are suitable for the transformer, we investigated other processes: no-load mode (Fig. 2, 5, 8), nominal load mode (Fig. 3, 6, 9) and external short circuit mode (Fig. 4, 7, 10). According to the results the method shows absolute selectivity.

Furthermore, we are able to set the discretization of the analysis. Thereby, we can set the precision of experiments' results. It's very important to gain accuracy, since in the opposite case the behavior of calculations can be unpredictable.

Conclusions

Due to the obtained results, we can make such withdrawals:

1. The identification parameter obtained in several experiments shows the high reliability of detecting an emergency mode, namely the winding short circuit in single-phase double-winding transformers.
2. Proposed method shows absolute selectivity in other emergency modes.
3. This method is quite versatile, which means that it can be used in both dry and oil-immersed transformers.
4. The method is extremely fast-acting, since it was based on digital technologies.
5. This method is highly promising. If the results of experiments on real models of the power transformers will show the same success as in theory, we continue the investigation. It's means testing this method on three-phase double-winding transformers, three-phase triple-winding transformers and on autotransformers.
6. On further investigation there will be conducted more verification of this method. For example: if there is any possibility to react on the other emergency modes of the power transformer, like differential protection.

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Definition of Equivalent Roughness of Internal Surface of a Measuring Pipeline

Bohdan Chaban[1], Leonid Lesovoy[2]

[1]Department of Automation of Heat and Chemical Processes, Lviv Polytechnic National University, UKRAINE, Lviv, Ustyyanovycha street 5, E-mail: b.chaban.91@gmail.com

[2]Department of Automation of Heat and Chemical Processes, Lviv Polytechnic National University, UKRAINE, Lviv, Ustyyanovycha street 5, E-mail: techinfoflow@yahoo.co.uk

***Abstract*– Literature on the methods for defining the equivalent roughness of the internal surface of a measuring pipeline was analyzed. The equation for calculating the hydraulic resistance coefficient of friction of natural gas on the internal surface of the measuring pipeline was developed. The equation for calculating the equivalent roughness of the internal surface of the measuring pipeline was obtained. This equation provides improvement of accuracy of natural gas flow rate and volume measurement by means of the differential pressure method.**

Key words – equivalent roughness, flow, natural gas, differential pressure method, standard orifice plate, hydraulic resistance coefficient of friction.

I. Introduction

Saving of fluid energy resources, which include natural gas, is an important task for Ukraine. One of the steps to perform this task is to improve the accuracy of measurement of flow rate and volume of natural gas. The most common method of measuring these values is the differential pressure method. The main provisions for this method are described in the national standard of Ukraine DSTU GOST 8.586.1:2009 [1] and in the international standard ISO 5167-1: 2003 [2]. Orifice plate is most commonly used as primary differential pressure transducer for measurement of flow rate and volume of natural gas by this method [3]. One way to improve the accuracy of the result of measurement of flow rate and volume of natural gas is application of advanced analytical dependences for calculating the coefficients of equation of natural gas flow rate and the accuracy of measurement values of input variables in real time. One of these input variables is equivalent roughness of the internal surface of the measuring pipeline R_{III}. Therefore, increasing the accuracy of measurement of the equivalent roughness of the internal surface of the measuring pipeline in real time is an important task.

II. Method of equivalent roughness measurement

To determine the equivalent roughness of the internal surface of the measuring pipeline, the method of direct measurement of the equivalent roughness R_{III} is used. This method can only be used during manufacturing of a pipeline before putting it into operation. According to DSTU GOST 8.586.1:2009 [1] the equivalent roughness R_{III} is measured at the same sections of pipeline that are used for definition and verification of the internal diameter of the measuring pipeline. But we do not know the value of R_{III} along all the distance (10D) of the pipe section upstream of the orifice plate. Another disadvantage of this method is that the roughness of the internal surface of the measuring pipeline changes during operation.

Profilometers and profilografs are used for measurement of the equivalent roughness. Measurement of the equivalent roughness of the internal surface of the measuring pipeline should be carried at a distance l upstream of the inlet face of a standard orifice plate:

- if the distance L from the first fitting to the inlet face of a standard orifice plate is larger than 10D, then according to DSTU GOST 8.586.1:2009 [1]

$$l = 10 \cdot D\,; \tag{1}$$

- if the distance L from the first local resistance to the inlet face of a standard orifice plate is less than 10D, then according to DSTU GOST 8.586.2:2009 [3]

$$l = L(\beta)\,, \tag{2}$$

where D is the internal diameter of the measuring pipeline at the operating temperature, β is the diameter ratio of the standard orifice plate. The value of L is selected from the standard DSTU GOST 8.586.2:2009 [3] depending on the diameter ratio of the orifice plate opening β for each type of fitting.

Therefore the method of direct measurement does not provide accurate values of equivalent roughness R_{III}.

After the research we propose to define the equivalent roughness of the internal surface of the measuring pipeline by eans of an indirect measurement.

In this case, it is determined by Colebrook-White equation through measured value of hydraulic resistance coefficient λ of friction of natural gas in the internal surface of the measuring pipeline [4]

$$R_{III} = \left(3.71 \cdot 10^{-\frac{1}{2\cdot\sqrt{\lambda}}} - \frac{9.34}{\mathrm{Re}\cdot\sqrt{\lambda}} \right) \cdot D\,, \tag{3}$$

where Re is the Reynolds number.

III. Definition of roughness based on its measurement in real time

Hydraulic resistance coefficient λ of friction of natural gas can be defined from the system of the differential equations of motion of natural gas. This system of equations is formed of the law of conservation of stream energy of natural gas, the equation of the law of conservation of stream mass of natural gas and natural gas equation of state [5]

$$\begin{cases} \dfrac{dp}{\rho} + \dfrac{\lambda}{D} \cdot \dfrac{v^2}{2} dx = 0 \\ q_m = \rho v F = const\,, \\ p = \rho \cdot z \cdot \dfrac{R}{M} \cdot T \end{cases} \tag{4}$$

where dp is the change of the pressure of natural gas along the length of the straight section l upstream of the standard orifice plate; ρ is the density of natural gas; v is

the linear velocity of natural gas in the measuring pipeline; dx is the elementary section of the pipeline; q_m is the mass flow rate of natural gas; F is the cross sectional area of the measuring pipeline; z is the compression factor; R is the universal gas constant ($R = 8.31451$ kJ/mol·K); M is the molar mass of natural gas; T is the temperature of natural gas in the measuring pipeline.

Let us reduce the system of equations to one differential equation of natural gas pressure distribution in the horizontal measuring pipeline

$$pdp + \frac{\lambda \cdot q_m^2 \cdot z \cdot R \cdot T}{2 \cdot D \cdot M \cdot F^2} dx = 0 . \quad (5)$$

Now we shall integrate the Eq. (5) over the pressure and over the length of the measuring pipeline

$$\int_{p_1}^{p_2} pdp + \frac{\lambda \cdot q_m^2 \cdot z \cdot R \cdot T}{2 \cdot D \cdot M \cdot F^2} \int_0^l dx = 0 , \quad (6)$$

where p_1 is the natural gas pressure at a distance l from the standard orifice plate; p_2 is the natural gas pressure at the inlet face of a standard orifice plate. Natural gas pressure at a distance l from the standard orifice plate is determined by measuring the pressure of natural gas at the inlet face of a standard orifice plate and the pressure loss Δp_l between the inlet face of a standard orifice plate and at a distance l from the standard orifice plate that arise due to friction of natural gas on the wall of the measuring pipeline,

$$p_1 = p_2 + \Delta p_l . \quad (7)$$

As a result of integration we obtain the following equation

$$p_2^2 - p_1^2 + \frac{\lambda \cdot q_m^2 \cdot z \cdot R \cdot T}{D \cdot M \cdot F^2} \cdot l = 0 . \quad (8)$$

From Eq. (8) we obtain the expression

$$\lambda = \frac{\left(p_1^2 - p_2^2\right) \cdot D \cdot M \cdot F^2}{q_m^2 \cdot z \cdot R \cdot T \cdot l} . \quad (9)$$

Mass flow rate q_m of natural gas is determined by the equation

$$q_m = \frac{\pi \cdot \mathrm{Re} \cdot \mu \cdot D}{4} , \quad (10)$$

Substituting Eqs. (7) and (10) in Eq. (9) and taking into account the equation of state of natural gas, we obtain the equation for determining the hydraulic resistance coefficient of friction of natural gas

$$\lambda = \frac{\Delta p_l \cdot \left(2 \cdot p_2 + \Delta p_l\right) \cdot \rho \cdot D^3}{\overline{p} \cdot \mathrm{Re}^2 \cdot \mu^2 \cdot l} , \quad (11)$$

where $\overline{p}$ is the average value of pressure along the pipeline section between the points of selection of pressure values p_2 and p_1. We obtained the equation for calculating the average value of natural gas pressure along the section l

$$\overline{p} = \frac{2}{3} \cdot \frac{3 \cdot p_2 \cdot \left(p_2 + \Delta p_l\right) + \Delta p_l^2}{2 \cdot p_2 + \Delta p_l} . \quad (12)$$

Substituting Eq. (11) in Eq. (3) we obtain the equation for determining the equivalent roughness of the internal surface of the measuring pipeline

$$R_{III} = 3.71 \cdot D \cdot 10^{-\frac{\mathrm{Re} \cdot \mu}{2 \cdot} \sqrt{\frac{\overline{p} \cdot l}{\Delta p_l \cdot (2 \cdot p_2 + \Delta p_l) \cdot \rho \cdot D^3}}} - 9.34 \cdot \mu \cdot \sqrt{\frac{\overline{p} \cdot l}{\Delta p_l \cdot \left(2 \cdot p_2 + \Delta p_l\right) \cdot \rho \cdot D}} . \quad (13)$$

Conclusion

The existing methods of measurement of the equivalent roughness of the internal surface of the measuring pipeline is analyzed in this paper.

New analytical dependences for defining the average value of pressure along the section l and the equivalent roughness R_{III} of the internal surface of the measuring pipeline along this section in real time are obtained.

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Searching for Optimal Control Parameters of Thermal Object Using Pulse-Width Modulation (PWM) Control with Predictive Filter

Oleg Yevseienko, Anatoliy Gapon, Dmytro Salnikov

Automation and Control Systems Department,
National Technical University "Kharkov Polytechnic Institute",
UKRAINE, Kharkov, Frunze street 21,
E-mail: sendmeyouremail@mail.ru

Abstract* – *The thesis is devote to the temperature control of objects with lumped or distributed parameters. The problems of choosing the right value of regulator's heater power and prediction period are discussed. The major attention is paid to the process of searching the minimum value of control quantities. It is shown that the approximated second-order plane has an exact accordance with the original data. It is concluded that algorithm of PWM-control with prediction filter provides good quality control.

Key words – object with distributed parameters, object with lumped parameters, transient function, PWM-modulation, predictive filter, dead-time, temperature control.

I. Introduction

At the current stage of human development, the consumption of energy resources is steadily increasing, while the efficiency of their use remains at a fairly low level. According to the European Commission, the United Nations, the level of useful energy is only 40 %, the proportion of useful end-use fuel is less than 20 %. However, the problems of environmental pollution, the exhaustion of high energy raw material reserves and increasing energy costs require urgent solution.

Given the complexity of the socio-economic situation in Ukraine and other countries of the world, even the problem of saving resources for heating residential and office space becomes really topical, while the major importance for humanity is still the need for enormous amounts of heat consumed by industrial processes.

II. Literature Analysis

Hundreds of scientific papers by leading scientists of the world are devoted to the problems of efficient use of heat. Computer-Aided Design (CAD) systems have been designed to speed up and simplify the process of modeling inherently complex heating and cooling processes.

However, the solutions for automation of the processes proposed by various companies are based mostly on the thermostatic regulators operating on a relay or Proportional-Integrative-Derivative (PID) control law [1]. These approaches do not take into account the properties of an object of management, i.e. distribution, linearity, self-regulation, as well as unique characteristics of the object.

III. Plant Model and Process Description

The aim of my thesis is to develop methods to control the temperature of the object under the specified control law and predict its changes in a specified time interval.

One of these methods is the pulse-width modulation (PWM) control with predictive filter [2]. Heater control is directly based on the experimentally obtained characteristics of the object under control.

A steel pipe has been taken as the test object with lumped parameters (Fig.1). The first sensor was chosen to investigate the PWM control with predictive filter method. This sensor was located approximately 5mm away from the bottom of the heater.

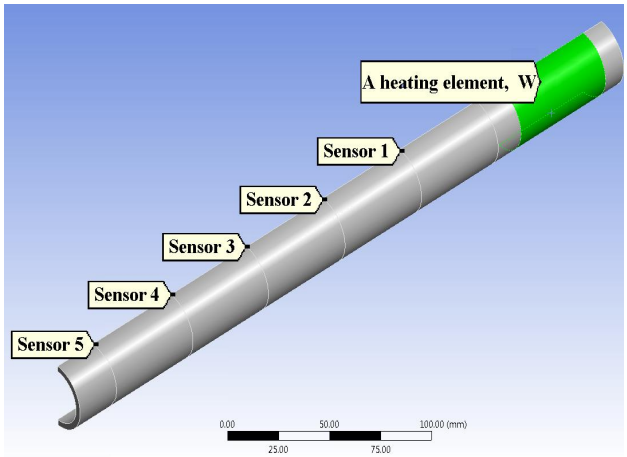

Fig. 1. Control object

Firstly, transient response of the control object were received. Secondly, the dead-time was calculated. After that the reaction of the object to the pulses of predetermined duration from dead-time (50 s) till 200 s with increment equal to 10 s and heater power equal to 5 W, 11.25 W, 15.87 W and 25 W were obtained. These curves have the same shape. Fig.2 shows the results of experiments in which heater power is equal to 25 W.

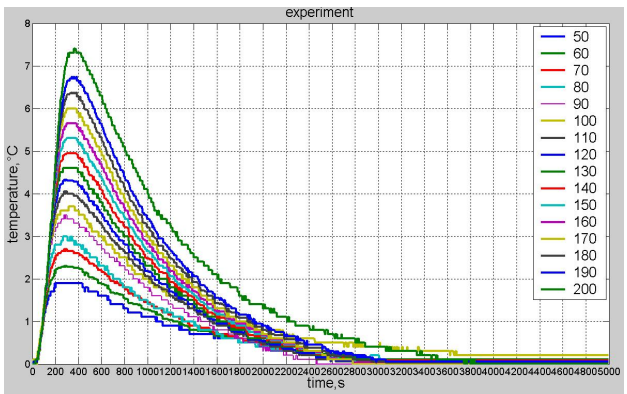

Fig. 2. The reaction of the object on a predetermined thermal control action

As a result of the experiments, datasets of heater power, pulse duration and control accuracy that equals to the temperature overshoot divided by temperature in the end of the pulse were obtained.

To find the minimum value of the control parameters it is necessary to determine the extremum. First of all the equation of the object function need to be obtained. To approximate the equation Ordinary Least Squares (OLS) method had been selected. The chosen set points are presented in Table 1.

TABLE 1

SELECTED SET POINTS

Point No.	*X*, *W*	*Y*, s	*Z*
1	11,25	200	1.4/1.25
2	25	170	3.6
3	5	80	0.4/0.15
4	15,87	150	1.9/1.2
5	5	200	3/4
6	5	100	5/3

For the approximation the plane with Eq.(1) had been selected.

$$z = a \cdot x^2 + b \cdot y^2 + c \cdot x \cdot y + d \cdot x + f \cdot y + g \,. \qquad (1)$$

Using Matlab approximated plane was calculated Eq.(2) and built at Fig.3.

$$z = \frac{147}{22063} \cdot x^2 + \frac{9}{26449} \cdot y^2 - \frac{48}{105367} \cdot x \cdot y + \\ + \frac{89}{2117} \cdot x - \frac{334}{3065} \cdot y + \frac{1487}{165} \,. \qquad (2)$$

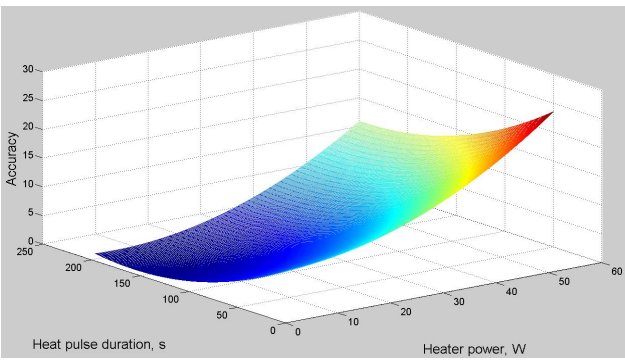

Fig. 3. Approximated plane

Using the second partial derivative the minimum point equal to 2.3734 W and 161.71 s was found.

Using extremum parameters transient curves were again obtained. The resulting time duration as the sampling period for the control method was chosen.

In the points $j \cdot t_u$, where $j \cdot t_u = 1 \cdot t_u, 2 \cdot t_u, \ldots, N \cdot t_u$ – output signal values (temperature) Θ_1, Θ_2, ..., Θ_N are measured. Heat transfer coefficients $\eta_{i,j}$ of thermal field in time j are calculated by Eq. (3).

$$\eta_{i,j} = \frac{\Delta\theta_i}{Q \cdot t_{uj}} \bigg|_{t_{uj} = t_u \cdot j} \,, \qquad (3)$$

$\Delta\theta_i$ – increment temperature of the i-point interval, °C;

Q – thermal flux power, W; $t_{u,j}$ – pulse width, s.

When the control system is starting, software begins the calculation of the prediction changes relative to the initial temperature Θ_0.

At the time interval $j \cdot t_\partial$, where $j \cdot t_\partial = 1 \cdot t_\partial, 2 \cdot t_\partial, \ldots, N \cdot t_\partial$ the total deviation Δ of current and predicted temperature from required temperature is calculated by Eq (4).

$$\Delta = \Delta_1 + \Delta_2 = \Delta\Theta_j^Z - \Delta\Theta_j^R + \Delta\Theta_{j-1}^Z - \Delta\Theta_{j-1}^D \,, \qquad (4)$$

$\Delta\Theta_j^Z$ – required object temperature, °C;

$\Delta\Theta_j^R$ – one interval ahead temperature prediction, °C;

$\Delta\Theta_{j-1}^D$ – the current temperature of the object, °C;

t_∂ – the sampling period, s.

According to the Eq.(5) heat exposure durations are calculated.

$$\{\Delta t_u\} = \frac{-\Delta}{Q \cdot [\eta]} \,, \qquad (5)$$

Q – heat flow power, W;

$[\eta]$ – an array of heat transfer coefficients.

The results of maintaining the set temperature using obtained extremum parameters are shown at Fig.4.

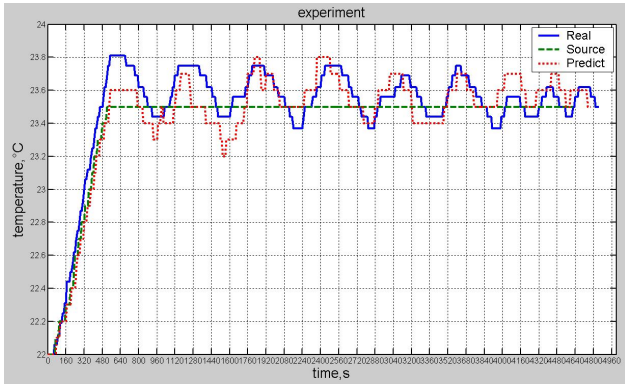

Fig. 4. The result of maintaining the desired temperature of the object

The maximum deviation of actual temperature from the required temperature was 0.25°C.

Conclusion

The control method of PWM-modulation with prediction for thermal objects was proposed. The process of finding the optimal parameters of heater control was presented. An experiment of maintaining the require temperature of the object was made. The results showed fairly good accordance between the required and obtained values.

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Analysis of Robust Stability of Electromechanical Systems, Described by Fractional Order Transfer Function

Bohdan Kopchak

Department of Electric Machines and Apparatus,
Institute of Power Engineering and Control Systems,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: kopchakb@gmail.com

***Abstract* – The majority of electromechanical systems are characterized by parametric uncertainty. This paper develops the approach to determine the stability of control object, which is an important step in the selection process of fractional controller parameters during its robust synthesis of desired quality of the transition process. The research of transfer functions of electromechanical systems on the stability of fractional order differs from traditional systems. The method of approach to the definition of stability suitable for stability analysis of electromechanical systems, described by transfer functions of both fractional and integer order, has been examined. Informative parameter for quality control and stability of electromechanical systems has been established, which allows to obtain information about the stability, oscillation and the quality of the transition process of an output coordinate of electromechanical system in the first approximation.**

Key words – stability, robustness, electromechanical system, fractional order transfer function.

I. Introduction

Robust stability of integer order systems has been examined in the number of works [1]. The question of stability of fractional order systems has been considered in [2,3] regardless of the uncertainty of its parameters, that is why the question of robust stability of fractional order electromechanical systems (EMS), and developing approaches to its operational control with the prospect of developing self-tuning systems remains topical. This paper develops the approach to the creation of "restrictive zone" of control object stability in the selection process of fractional controller parameters during its robust synthesis of desired quality for the transition process.

Most EMS are characterized by parameter uncertainty and therefore the problem of stability of the system can be reduced to characteristic polynomial robust stability [1]. Research of fractional order EMS on the stability differs from traditional systems, which are described by transfer functions (TF) of integer order, in particular, stable system of fractional order may have roots in the right half of the complex plane.

II. Stability Analysis

In order to develop rational variant of alternative operational analysis of EMS robust stability condition in the construction of self-tuning systems, below there are considered the following options of approaches with the use of:

- complex ω plane of Riemann surface,
- Kharitonov theorem.

These studies should result in the particular informative parameter concerning EMS in the area of stable, unstable functioning or on the boundaries of these zones, and approaching of this parameter to one of these zones to predict the nature of the transition process.

The first approach is based on the research presented in [2]. According to this approach, EMS characteristic equation is written in the form of fractional order general linear system:

$$a_n s^{\alpha_n} + \ldots + a_1 s^{\alpha_1} + a_0 s^{\alpha_0} \equiv \sum_{i=0}^{n} a_i s^{\alpha_i} = 0\,, \qquad (1)$$

rewritten in the form

$$\sum_{i=0}^{n} a_i s^{\frac{\mu_i}{\upsilon_i}} = 0\,,$$

and transformed in the ω plane

$$\sum_{i=0}^{n} a_i \omega^i = 0\,, \qquad (2)$$

where $\omega = s^{\frac{k}{m}}$, m is the lowest multiple υ_i common.

Next, stability analysis is conducted in the following sequence.

1) To set a_i it is necessary to calculate the roots of equation (2) and find their absolute phase $|\phi_\omega|$.

2) The roots of the original sheet of Riemann surface ω plane must comply with roots on the s-plane and can be obtained by finding all the roots which lie in $|\phi_\omega| < \pi / m$ with the further application of the reverse transformation $s = \omega^m$. The sector with $|\phi_\omega| > \pi / m$ no has no physical meaning.

3) Stability condition $\pi / 2m < |\phi_\omega| < \pi / m$. Condition of oscillations $|\phi_\omega| = \pi / 2m$, otherwise the system is unstable. If there are no roots on the physical s-plane, the system will always be stable [2].

The search of the informative parameter for implementing robust control in the framework of this approach to stability analysis is exemplified by a linear system of fractional order, described by transfer function

$$W(s) = \frac{1}{0.8s^{2.2} + 0.5s^{z} + 1}\,, \qquad (3)$$

by changing the value of the fractional exponent z = 0.9; 1.9; 1.7.

The corresponding characteristic system equation:

$$P(s): 0.8s^{2,2} + 0.5s^{z} + 1 = 0 \Rightarrow$$

$$\Rightarrow 0.8s^{\frac{22}{10}} + 0.5s^{\frac{z}{10}} + 1 = 0$$

at m=10, $\omega = s^{1/10}$ polynomial has the form

$$P(\omega): 0.8\omega^{22} + 0.5\omega^{10z} + 1 = 0\,.$$

Let us consider just the root ω_i with lowest module angles and their respective angles ϕ_i. The results are summarized in Table 1 where TF (3) with the change of z

is checked, and Fig. 1 shows the placement of the roots in the complex ω plane of Riemann surface of function on condition of stability $\pi/2m < |\phi_\omega| < \pi/m$, i.e. $0.157 < |\phi_\omega| < 0.314$ rad.

TABLE 1

RESULTS OF STABILITY CONDITION OF LINEAR SYSTEMS STUDY

N	TF $W(s)$	$\omega_{21,22}$,	$\lvert\phi_{21,22}\rvert$, rad.	State of system
1	$\frac{1}{0.8s^{2.2}+0.5s^{0.9}+1}$	1.0045± 0.1684i	0.1661	stable
2	$\frac{1}{0.8s^{2.2}+0.5s^{1.9}+1}$	0.9774± 0.1486i	0.151	unstable
3	$\frac{1}{0.8s^{2.2}+0.5s^{1.7}+1}$	0.9786± 0.1546i	0.157	on the stability boundary, oscillating

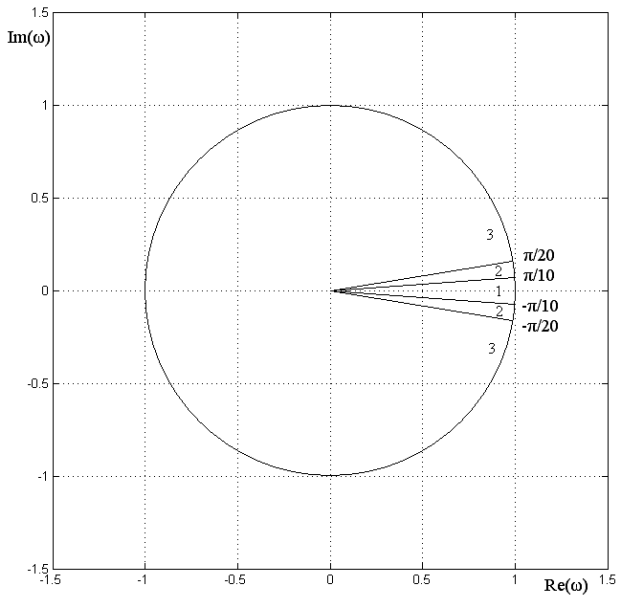

Fig. 1. Complex ω plane of Riemann surface of function $\omega = s^{1/10}$ with indicated zones of stability / instability: 1 – unstable zone; 2 – stable zone; 3 – the zone has no physical meaning.

Fig. 1 shows complex ω plane of Riemann surface of function $\omega = s^{1/10}$ with indicated zones of stability / instability (1 – unstable zone; 2 – stable zone; 3 – the zone, which has no physical meaning). Thus, the change in z degree leads to changes in the roots of a polynomial and, consequently, state of the system.

Reliability of the results is checked by studying polynomials (3) in MATLAB Simulink environment by using Ninteger packet. Figure 2 shows the results of these studies, including the "a" - a reaction to a single jump for TF (1), "b" - TF (2) and "c" - TF (3).

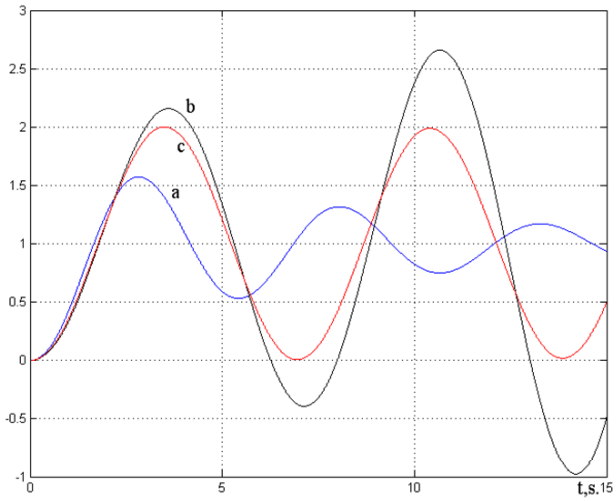

Fig. 2. Transition function units EMS with TF (1) – curve "a", (2) – curve "b" and (3) – curve "c".

So, robust stability analysis of fractional order linear systems with regards to this approach makes it possible to monitor the placement of the obtained roots of polynomials in the complex ω plane of Riemann surface of function $\omega = s^{1/10}$ (Fig. 1) and thus to control the condition of stability.

Conclusion

1. The method of approach to the definition of stability as considered in the article is suitable for stability analysis of EMS, described by both fractional and integer order transfer functions.

2. Parameter $|\phi_{n-1,n}|$ is informative to control quality and stability of EMS. If the parameter $|\phi_{n-1,n}| = 0.314$ rad., then in the transition function of output EMS coordinate the overshoot is missing. With the reduction $|\phi_{n-1,n}|$ from 0.314 rad. overshoot is growing and at $|\phi_{n-1,n}| = 0.157$ rad. the oscillating mode arises. That is, the value of the parameters $|\phi_{n-1,n}|$ can provide information about the stability, oscillation and the quality of transition of output EMS coordinate in the first approximation.

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The Influence of «Cross-Subvention» on Economic Efficiency of Thermal Insulation of Buildings

Andriy Muzychak, Olya Voznyakovska

Department of power distribution systems for industrial, urban and agricultural facilities, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: mAndriy@polynet.lviv.ua

Abstract* – *Influence of «cross-subvention» on economic efficiency thermal insulation of buildings is viewed. The optimum thickness of thermal insulation for each tariff group is calculated. Awarded the negative role of the modern tariff policy. It is shown that to improve the attractiveness of the energy efficiency measures required state participation. The proportion of state compensation must be up to the «cross-subvention».

Key words – heating, tariffs, cross-subvention, thermal insulation, economic thickness.

I. Introduction

National energy and utilities regulatory commission in April increased the average tariff for heat for the population to 71.8 % [1]. This would be an impact to the residents of its buildings thermal insulation.

An important issue of the energy efficiency measures is appropriate thermal insulation thickness.

According to regulations of Ukraine heat consumption rate for the second zone is 70-95 kWh/m^2/year, heat transfer resistance – 2.1-2.4 m^2·K/W [2]. In Europe, according to the Directive 2010/31/EU total energy consumption of new buildings must be 15 kWh/m^2/year or zero [3].

From another point of view appropriate thickness of thermal insulation is also economic concept [4].

It should be based on technical and economic modeling to determine the economically attractive thickness thermal insulation of buildings and corresponding heat transfer resistance of enclosure for current prices on thermal insulations and tariffs on heat energy.

II. Criterion Feasibility of Energy Efficiency Measures

The feasibility of implementing energy efficiency measures determined by two components – primary investment K (cost thermal insulation) from on the one hand and annual costs B_a (the cost of heat energy) on other hand. Integral criterion of thermal insulation feasibility is minimum of discounted costs B_{dc} over a horizon T_e

$$B_{dc} = K + \sum_{i=1}^{T_e} B_{ai} E_{di} \quad (1)$$

where E_{di} – discount rate; i – number of years.

Investments in building thermal insulation

$$K = (k + c)F \quad (2)$$

where k – cost of 1 m^2 thermal insulation, c – the cost of work, F – square of enclosure.

The cost of heat for different categories of subscribers in Ukraine is not the same – existing so-called «cross subvention». In the Table 1 shows tariffs of Lviv municipal utility company (LMUC) «Lvivteploenergo».

TABLE 1

TARIFFS ON HEAT ENERGY OF LMUC «LVIVTEPLOENERGO»

Category consumer	Components of tariff	
	variable component, UAH/Gcal	constant component, UAH/(Gcal/hour) in month
home	572	21927.14
budget	1335.62	17557.3
spiritual	737.74	17557.3
other	1335.62	17557.3

Cross-subvention is the reason that the return on energy efficiency measures for each category of consumers will be different.

III. Definition Economically Expedient Thickness Thermal Insulation

Consider four-floors house sizes 10m×24m×13m, that belong to different categories according Table 1.

Calculation is made using the application «Energy Efficient Building» a specialized package of energy ma-nager [5]. Thermal load this building P = 0.0722 Gcal/hour, annual heat consumption for the regulatory climate conditions Q = 146.2 Gcal.

Annual costs on heating

$$B_a = c_1 Q + c_2 P \quad (3)$$

where c_1, c_2 – variable and constant components of tariff on heat energy.

Annual costs on heating this building for different categories of consumers signify-cantly different (Table 2).

TABLE 2

ANNUAL COSTS FOR HEATING

Category consumer	Components of cost, thousand UAH		
	variable component	constant component	sum
home	83.63	19.00	102.62
budget	195.27	15.21	210.48
spiritual	107.86	15.21	123.07
other	195.27	15.21	210.48

The cost of heating a residential building and budget organization differ more than doubled. So through «cross-subsidization» state protects residents from excessive utility costs.

Consider how this affects the need of residents to insulate houses.

Of all the components of the heat loss buildings consider reducing loss through walls and through the attic. The total area of building walls F_w = 10368 m^2, ceiling attic – F_a = 240 m^2. Heat transfer resistance of wall R_w = 0.92 m^2·K/W and of ceiling attic R_a = 1.44 m^2·K/W.

A common thermal insulation material is foam plastic PSB-C-35, thermal conductivity 0.046 W/(m·K), price 1140 UAH/m^3. The cost of work – 120 UAH/m^2.

Heat transfer resistance of enclosure with insulation $R_{\square}$

$$R_{\Sigma} = R_t + \frac{\delta}{\lambda} \quad (4)$$

where R_t – heat transfer enclosure, m^2·K/W; δ – thermal insulation thickness, m; λ – thermal conductivity of insulation, W/(m·K).

Foam plastic has a number of shortcomings and it is forbidden to insulate public buildings. As an alternative the mineral wool deals. Thermal conductivity 0.048 W/(m·K), price – 3600 UAH/m^3.

The calculation is made for materials thickness 20, 50, 100, 150, 200, 250 and 300 mm. The calculation results economically expedient foam plastic thickness is displayed graphically on Fig. 1.

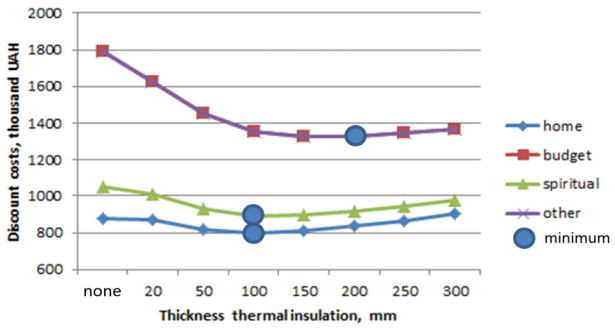

Fig. 1. The dependence of the discounted cost of foam plastic thickness

Economically feasible thick foam plastic insulation for residential building – 10 cm, budget building – 20 cm, spiritual building – 10-15 cm.

Another picture is observed in the case of wall insulation mineral wool, which cost higher (Fig. 2).

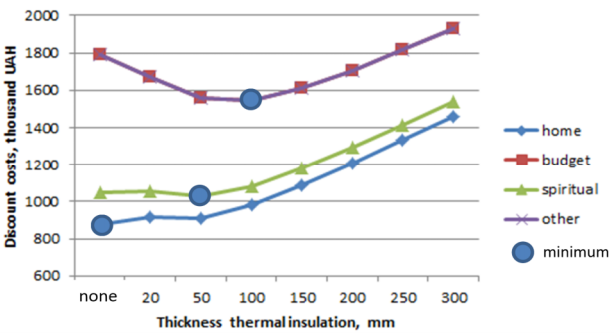

Fig. 2. The dependence of the discounted cost of mineral wool thickness

According to Fig. 2 insulate the residential building altogether inappropriate. This is due to lower prices for heat caused by «cross-subvention». Insulation thickness desired for the budget building 10 cm.

The dependence is similar in the case of attic insulation by glass-wool. Thermal conductivity 0.044 W/(m·K), price – 1860 UAH/m^3, cost of work – 42 UAH/m^2.

Economically feasible thick glass-wool insulation for budget building 10 cm, for spiritual building – 5 cm.

Heat transfer resistances of enclosure, that corresponding to the calculated cost-appropriate insulation thickness shown in Table. 3.

TABLE 3

HEAT TRANSFER RESISTANCES ENCLOSURES WITH DIFFERENT THERMAL INSULATION

Category consumer	Heat transfer resistances, m^2·K/W		
	foam plastic	mineral wool	glass-wool
home	3.094	0.920	1.440
budget	5.268	3.003	3.713
spiritual	3.094	1.962	1.440
other	5.268	3.003	2.576

As seen from Table 3 economically expedient heat transfer resistance for houses is often less than the regulatory requirements 2.1–2.4 m^2·K/W, as required [2].

Conclusion

«Cross-subvention» is intended to protect the population from undue financial burden utilities. However, such subvention make appropriate insulation residents their homes and implementing other energy efficiency measures.

The necessary replacement of «cross-subvention» targeted assistance or state participation in partial compensation costs for energy-saving measures.

Share compensation cost of heat insulation must meet the proportion of «cross-subvention» rate.

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Definition Factors Cubic Approximating Polynomial for Locking Characteristics of Steel Pipelines

Andriy Muzychak[1], Roman Pasternak[2]

[1]Department of power distribution systems for industrial, urban and agricultural facilities, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: mAndriy@polynet.lviv.ua

[2]Department of power distribution systems for industrial, urban and agricultural facilities, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: pasternak.romaha@yandex.ru

Abstract* – *An important part of mathematical models of hydraulic state engineering grids is locking ratio. Traditionally it represent a cubic approximation polynomial, which adequately reproduce locking characteristics of pipelines of various diameters and materials. Defined simple functions to determine the factors of the approximation polynomial based on the diameter. These functions are a convenient tool to obtain baseline data necessary in mathematical models of engineering grids.

Key words – engineering grid, hydraulic condition, locking ratio, approximation polynomial.

I. Introduction

Usually hydraulic state of engineering grid describe the contour or nodal mathematical models. These models include the equation of the first and second rules Kirchhoff and equations of branches [1]. Contour mathematical model has the form

$$\begin{cases} \mathbf{A}\vec{X} = -\vec{F} \\ \mathbf{B}\vec{Y} = 0 \\ \vec{Y} = \vec{E} - \Delta\vec{p} \end{cases} \quad (1)$$

where **A**, **B** – incidence and circle matrix; $\vec{X}$, $\vec{Y}$ – column vectors of flow environment and pressure drop of branches; $\vec{F}$ – column vector of flow environment in nodes; $\vec{E}$ – column vector of efforts of branches; $\Delta\vec{p}$ – column vector of pressure loss (includes pressure loss due to friction, change of speed and inertia pressure).

Linear equations of this contour model (1) complementary nonlinear locking ratio

$$\Delta p = f(X), \quad (2)$$

which usually approximated by a equation of cubic polynomial [2]

$$\Delta p(X) = \gamma\left(s_1|X| + s_2|X|^2 + s_3|X|^3\right)\mathrm{sgn}(X), \quad (3)$$

where s_1, s_2, s_3 – factors of approximation polynomial; γ – specific volume environment, sgn – sign function (characteristic needed to continue in the third quadrant).

Cubic polynomials adequately reproduce locking characteristics of pipelines. But the values factors of this polynomial s_1, s_2, s_3 are unknown.

II. Setting Objectives

Cubic approximation polynomial (3) has a number of advantages:

- fidelity real locking characteristics;
- reproduction locking characteristics of pipelines for different materials (steel, plastic, etc.) and performance.

He also has a number of shortcomings:

- coefficients of cubic approximating polynomial unknown;
- these factors should be determined for each diameter pipeline for their real locking characteristics.

To remove these shortcomings need to determine the analytical dependence, which would allow to easily identify approximating polynomial coefficients depending on the value of the diameter of the pipeline.

Each pipeline has its own locking characteristics. Graphic representation of the set of characteristics for steel pipes of different diameters in a logarithmic scale, shows that a pattern available (Fig. 1).

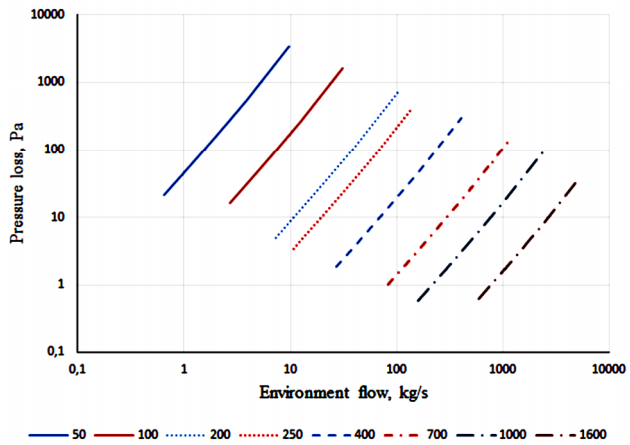

Fig. 1. Locking characteristics of steel pipelines

You must express this law and express it in an analytical form.

III. The Solution to these Objectives

As in [2] search approximating polynomial factors for locking characteristics of steel pipelines perform weighted least squares method.

By the weighted least squares method [3] criterion for selecting components s_1, s_2, s_3 parametric vector approximation function is

$$R = \sum_{i=1}^{m} w_i^2 \left(f(x_i) - F\left(x_i, \vec{s}\right)\right)^2 \Rightarrow \min, \quad (4)$$

where $f(x_i)$ – the real values of the function at the points x_1, x_2, …, x_m; $F\left(x_i, \vec{p}\right)$ – approximating function values in appropriate points (approximating cubic polynomial); w_i – weights characterizing the relative importance of each $f(x_i)$. Accuracy approximation estimated relative terms – coefficient of variation [4]

$$k_v = \frac{\sqrt{D}}{\overline{X}} 100 \ \%, \quad (5)$$

and maximum relative error

$$\delta f_{max} = \max \frac{f(x_i) - F(x_i, \vec{p})}{f(x_i)} 100\%, \quad (6)$$

where $D = \sum_{i=1}^{m} \left(f(x_i) - F(x_i, \vec{p}) \right)^2 / m$ – residual variance; $\overline{X} = \sum_{i=1}^{m} f(x_i) / m$ – average value.

The results of calculating the factors of the cubic approximation polynomial locking characteristics of steel pipes (GOST 10704-63) for different diameters is provided in Table 1. The polynomial factors (3) inversely proportional to the size of the diameter – with increasing diameter factors decreases.

TABLE 1

FACTORS CUBIC POLYNOMIAL APPROXIMATION OF SET PIPES

Diameter, mm	Factors cubic polynomial approximation		
	s_1	s_2	s_3
50	1.29E+01	3.27E+01	2.14E-01
100	2.19E+00	1.49E+00	4.48E-03
200	2.48E-01	6.24E-02	3.09E-05
250	1.17E-01	1.99E-02	3.44E-06
400	2.58E-02	1.68E-03	1.72E-07
700	4.47E-03	9.91E-05	3.30E-09
1000	1.38E-03	1.54E-05	2.42E-10
1600	3.65E-04	1.22E-06	2.28E-11

For all sets pipelines coefficient of variation varies 0.48-1.42 %, maximum relative error – within 2.4-4.75 %. Moreover error calculation does not depend on the diameter of the pipeline (Fig. 2).

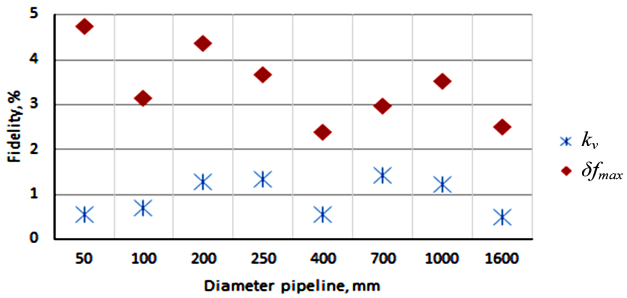

Fig. 2. Dependence fidelities locking characteristics of the diameter of the pipeline

This dependence factors on the diameter can be reproduced using power function. Power function provides adequate reproduced all three relationships (Fig. 3).

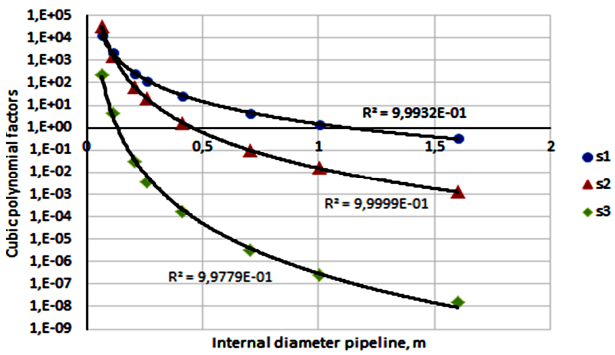

Fig. 3. The dependence of the approximation polynomial factors to the diameter of the pipeline

Approximating power function is determined in relation to the internal diameter of the pipelines. Analytical expression functions to determine factors of the cubic approximation polynomial (3), is as follows

$$s_1 = 1.4823 \cdot 10^{-3} d_{in}^{-3.3127},$$
$$s_2 = 1.5345 \cdot 10^{-5} d_{in}^{-5.3255}, \quad (7)$$
$$s_1 = 3.3241 \cdot 10^{-10} d_{in}^{-7.3553},$$

where d_{in} – internal diameter of pipeline.

For all sets pipelines coefficient of variation varies 1.2-3.5%, maximum relative error – within 3.4-4.7%.

We may be apply functions (7) in general

$$s = a d_{in}^{b}, \quad (8)$$

where a, b – coefficients of function.

Then factors such functions can be summarized in tabular form (Table. 2).

TABLE 2

ODDS FUNCTION (8)

The cubic polynomial factors	a	b
s_1	1.483E–03	–3.3127
s_2	1.535E–05	–5.3255
s_3	3.324E–10	–7.3553

The proposed functions are easy to use. They are a convenient tool to obtain baseline data for nodal or contouring mathematical models of hydraulic state engineering grids.

Conclusion

In this paper identified common depending for factors of cubic approximating polynomial from the diameter of the pipeline.

Such dependence easily determine all the necessary parameters of mathematical models of network grid with purpose analysis and optimization of hydraulic state.

Further development of this research is to disseminate information on pipelines made of other materials.

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Switched Reluctance Motor for City Electro-Car Drive

Lidiya Kasha[1], Ihor Bilyakovskyy[2]

[1]Electric Machines and Apparatus Department,
Institute of Engineering and System Control, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12,
E-mail: kashalidiya@gmail.com

[2]Electric Machines and Apparatus Department,
Institute of Engineering and System Control, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12,
E-mail: ibilyakovsky@gmail.com

Abstract – Switched reluctance motor with capacity storages for city electric car are offered in this paper. Regulation and mechanical characteristics of such motor are significantly better than in asynchronous traction motors, operational speed and energy performances slightly changed during voltage oscillations and variation load. Project calculation based on the construction features and the theory of electromagnetic energy conversion. Research results indicate the possibility of using the proposed electric motor in the electrocar drive.

Key words – switched reluctance motor, electrocar drive, capacity energy buffer, U-smilar stator construction.

I. Introduction

In October 2010 at the Paris Motor Show was launched the so-called International Initiative for electric cars, aimed at achieving rapid market development of electric and hybrid electric vehicles (EVH and HVH) worldwide and focused on the appearance of about 20 million electric and hybrids cars on the roads in 2020 more than 200 million by 2030 and one billion in 2050, which was the key element for the entire world economy and was supported by the Group of Eight (G8) to reduce CO_2 emissions by half in 2050 compared with 2005. In 2013, already, the production of electric and hybrid cars has reached more than 240.000, and on the road early in 2014 it was already 405.000 of these electric vehicles (174.000 in the US, 68.000 in Japan and 45.000 in China).

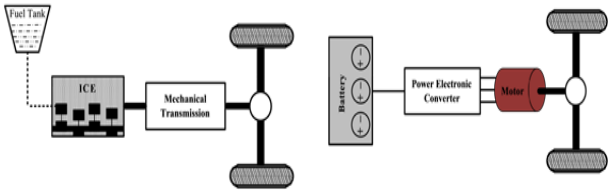
Take note the characteristics of the population living in Ukraine's cities, and the benefits of electric vehicles, such as lack of harmful emissions, low operating costs of the car, simplicity of construction and management, high reliability and durability – motors creation for electric drives are urban urgent task.

II. Analysis of Recent Achievements and Publications

The efforts of foreign scientists in electrocar industry aimed at creating new types of electric motors in recent years. There are asynchronous and brushless permanent magnet, which marked a high specific (per unit mass) point in the absence of mechanical transmission; motors with two rotors; hybrid vehicles with permanent magnet and electromagnetic excitation; machines with two stator and magnetic transmission; electrical machinery, integrated with magnetic transmission. On the base of such motors can realize compact and robust direct drive for motor-wheel of electric vehicles. For new types of electric motors control used modern methods of control theory: vector control with elements of adaptive control, sliding control, predictive control [1].

Complex of researches was formed towards building a top-level control system – coordinated multymotors electric control to ensure stearing, mobility, high energy efficiency of movement, default tires amortization, the road ability (ABS, EBD, and ARS).

In the first electric cars the internal combustion engine replaced the DC motor (DCM), which supplying of batteries (Fig. 1). Subsequently, to replace the DCM were used asynchronous motors (AM), which have a simpler design and smaller dimensions, and the absence of brush-collector unit, deprive AM of such defects as DCM brush and collector items amortization.



a b

Fig. 1. Block diagrams car (a) and electric car (b)

Unlike induction motors, the efficiency of which significantly depends on the voltage and load changes, speed and energy performance brushless motor (BLM) slightly changed during voltage oscillations and load changes. Therefore, it seems logical to use in car drive switched reluctance motor (SRM) with capacitive energy storage (CES) [2].

III. Research Results of SRM

The electromagnetic load and the active area of RPS are increasing to improve the usage of SRM. Thus in different times to supplying source connected different number of sections that causes significant current ripple of SRM, which is undesirable in drives.

One-period switch commutator with parallel buffers connection [1] allows to improve energy performance and reduce the current ripple in power supply in switched reluctance motor with passive rotor.

Designing calculation of SRM used developments, which were carried at the department of electrical machines and apparatus [3]. System consists of a main program, 16 sub-programs and different data files.

Requirements of design task for concrete switched reluctance motor can be so different, and that is inadvisable universal CADS creation. Therefore, the basic parameters of switched reluctance motor, such as supply voltage, power or load moment and rotation speed, are set in this CAD. Other parameters are set in the design process in the dialog mode.

The structure of CADS for SRM's calculation is shown in the Fig. 2.

As a rule, the design techniques of traditional electric machines (asynchronous, synchronous, DC motor) are based on the choice of electromagnetic loading values.

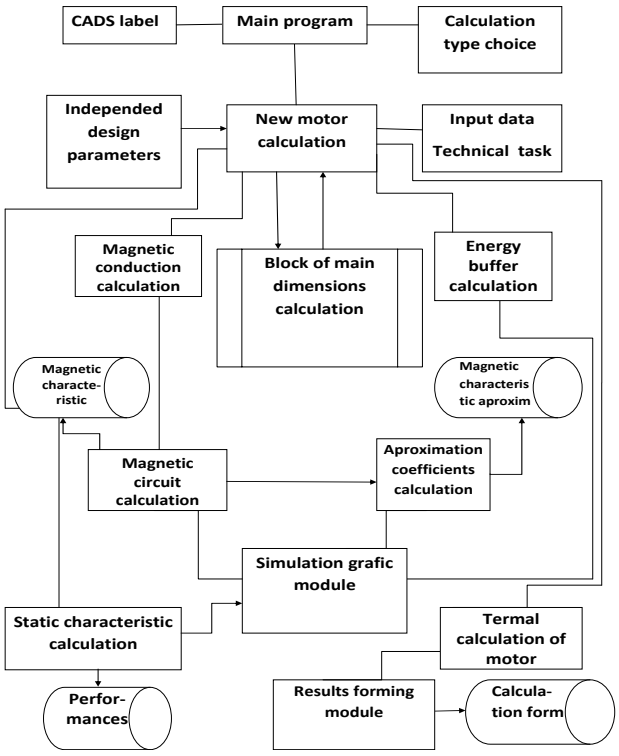


Fig.2 Block structure of CADS of SRM.

Using the theory of electromechanical energy conversion in SRM with energy buffers [2], equations for the stator's geometry dimensions calculation of SRM with the passive rotor and classic and pseudo-U-similar construction. Calculation of main dimensions of active part of EMC is based on the correlation for motor's torque

$$M = \frac{D^2 \cdot m \cdot q \cdot B_\delta^2 \cdot K_\mu \cdot K_L \cdot \alpha_\delta \cdot \lambda \cdot \delta \cdot (1 - \cos\gamma)}{4\mu_0}.$$

As a result, design motor received the following information: power supply – 220 V; net power – 32 kWt; rotational speed 1.500 rev/min; the efficiency – 75.38 %; load moment – 254 Nm; stator diameter – 370 mm; stator outer diameter – 480 mm; stator axis length – 370 mm; capacity of energy buffer – 2.5 uF.

SRM can studies on the computer-aided research system (CARS) of SRM with BE [4].

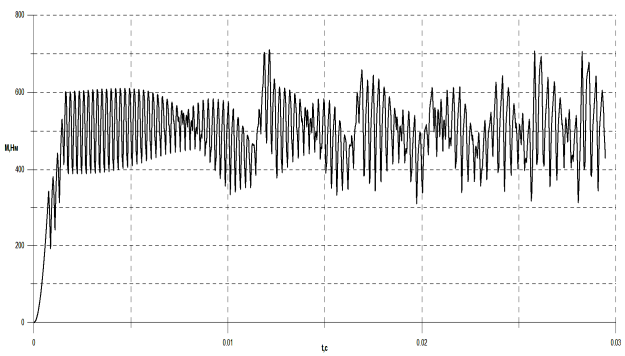


Fig. 3. Time oscillation of load moment in start-up

In Fig. 3 time oscillation of load moment at the firs moment of start are given.

In Fig. 4 – mechanical characteristic is shown. By research SRM results adjusted dynamic electrical car indexes.

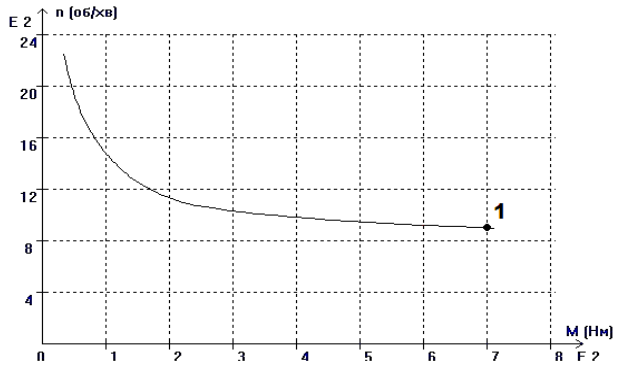


Fig. 4. Mechanical characteristic of SRM

Conclusion

SRM with CES for electric car drive, which control and mechanical characteristics are significantly better than in asynchronous traction motors; speed and energy performance slightly changed during voltage oscillations and load changes, is developed. Project calculation based on the construction features and on the theory of electromagnetic energy conversion. Researches of such motors show the possibility of it's using in the electric car's drive.

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Ferroresonant Processes in 10 kV Power Grids and There Control

AndriyYatseyko, Kateryna Hyrska

Department of Electrical Systems and Networks,
National University "Lviv Polytechnic", UKRAINE,
Lviv, S. Bandery street 28a,
E-mail: yats80.andriy@gmail.com

Annotation – The problem of ferroresonance processes in power gris with isolated neutral was reviewed. Conditions of the existence of such phenomena and basic principles of theis control were establihed. A new approaches of protection for 10 kV electric systems from ferroresonant processes were given. The research was conducted using digital simulation and reasons for offered protection methods were defined.

Key words – electric systems, power grids, ferroresonant processes, digital model, isolated neutral, voltage transformers.

I. Introduction

Providing reliable and uninterrupted electric supply is one of the most important tasks of design and operation of power grid and their elements. An important role in the performing of these tasks play the 6-10 kV power grids. Many of these power grids operate with isolated neutral. It enables to provide supply of electricity in case of single-phase ground fault for quite a long time, required to find and eliminate damaged network area. But, this approach of networks building revealed a number of significant disadvantages associated with single-phase ground fault regimes: negative impact on network isolation and electrical equipment, occurrence of ferroresonance processes (FRP), leading to equipment damage, primarily voltage transformers, the possibility of electric shock of people and animals and so on. Damage of voltage transformers leads to the loss of electricity metering, some protection of electrical equipment, explosions and fires of voltage transformers and long interruption of electricity supply for consumers.

To overcome the ferroresonance phenomenon measures were applied various organizational and technical measures: change of neutral regime in electric systems, the use of special antiresonance voltage transformers, the use of devices to prevent the occurrence the ferroresonance processes [1, 2].

Operating experience of 10 kV electric systems shows that existing approaches for power grids protection from ferroresonance processes are not effective enough. This is due to the fact that some of them are impossible to realize or their application requires considerable expenses.

Taking into consideration all given above, it is necessary to analyze the conditions of FRP, specify their area of sustainable existence and offer a more effective method of protecting power grid.

II. Conditions of Appearance and the Existence of FRP In 10 kV Power Grids

According to [3] in the circles of voltage transformers (VT) possibility of emergence and existence FRP is determined according to such three conditions:

1. The size of the equivalent network capacity (Cekv) must be within the specified change inductor of voltage transformers:

$$\frac{1}{\omega^2 \cdot L_x} \le L_x \le \frac{1}{\omega^2 \cdot L_x} \tag{1.1}$$

where L_x – inductor on the transformer of the idling, Hn; ω – angular frequency voltage in network, 1/s.

Perturbations FRP is associated with have linear change in the inductance VT. Moreover, the changes that begun must occur until conditions of resonance arise:

$$\omega \cdot L = \frac{1}{\omega \cdot C} \tag{1.2}$$

2. For the occurrence of ferroresonance processes in the circuit with parameters corresponding to the condition (1.1) must be necessary events that leads to change inductance of the VT. That event on the power grids with the isolated neutral is disconnection a metallic ground fault in which the voltage at the VT changes jumps from U_f to U_l [1].

3. The value of energy entering in ferroresonance circuit at every change of parameters inductance VT, must be greater than the value of losses in it.

It is known that with the sudden increase of inductance VT, energy in circuit increases in size:

$$0.5 \cdot (L_{XX} - L_S) I_C^2 \tag{1.3}$$

where I_c – capacitive earth fault current.

The frequency of free current oscillations in the parametric circuit is equal to:

$$f = \sqrt{\frac{1}{L \cdot C}} - \sqrt{\left(\frac{R}{2 \cdot L}\right)^2} \tag{1.4}$$

This natural frequency is determined exclusively by the parameters L, C and R circuit. In this circuit natural frequency depends on the circuit inductance and capacitance, and coincides with its resonant frequency. When active resistance increases relative value the second term under in root of the expression (1.4) and the natural frequency decreases, free oscillations of current becomes slower.

When the resistance reaches a value:

$$R = 2 \cdot \sqrt{\frac{L}{C}} \tag{1.5}$$

natural frequency is zero, fluctuations terminate. Occurrence of resonant oscillations is impossible. The value of the resistor required for breakdown of FRP may be calculated by (1.5), but the presence of a linear relationship $L = f(I)$ complicates calculations and requires the use of a computer.

All research results presented in this paper were done with a digital simulation based on the model in 10 kV power grids, which is formed of computer software RE [4] (Fig. 1). This model reproduces 10 kV power grids and voltage transformers NTMY-10 (НТМИ-10), NAMU-10 (НАМИ-10) and NTN-10 (НТН-10).

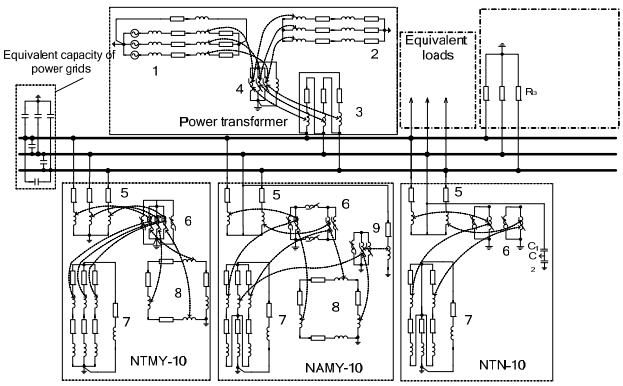
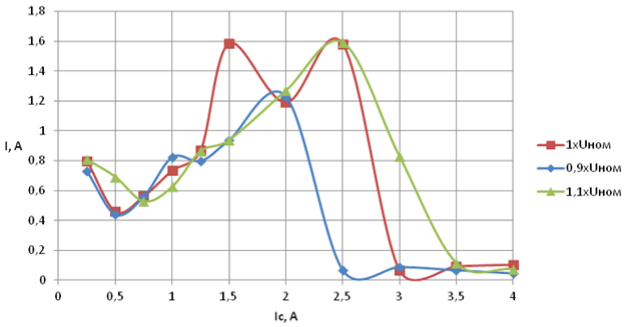


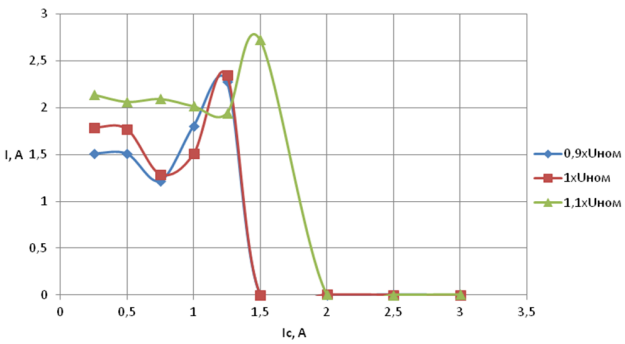
Fig. 1. Summarized calculation model for the study of ferroresonance processes in the power grid 10 kV

Figure 1 shows: 1 – equivalent estimation EMF of power grid with the primary winding of power transformer T; 2 – equivalent circuit estimation of power transformer secondary winding , star connection; 3 – the tertiary power transformer winding connected in triangle; 4 – equivalent circuit of diagram of the magnetic system of power transformer; 5 – equivalent circuits of the voltage transformers primary winding; 7 – equivalent calculation circuit secondary windings VT; 8 – schemes VT secondary windings connected in open delta, with load; 9 – winding phase B of TN type NAMY (НАМИ) equivalent of its magnet system; C1, C2 – capacitive divider used in the NTN(HTH) instead of electromagnetic VT phase B.

As a result of the calculations boundaries of stable subharmonic processes in 10 kV power grids were set. Fig. 2 shows the dependence of current that flows through the windings of high voltage VT from capacitive current earth fault mains. Fig. 3 shows tsyfrohramy of mains voltage electric network, the voltage winding "open triangle" and the current of primary winding TN.

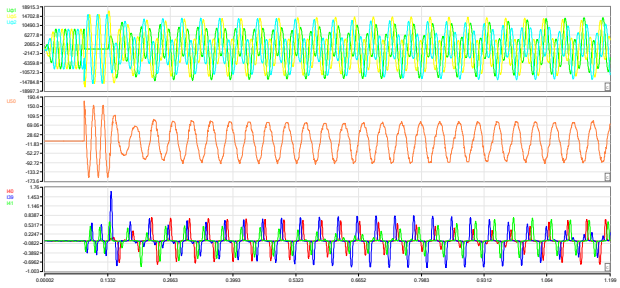


a) NTMY-10

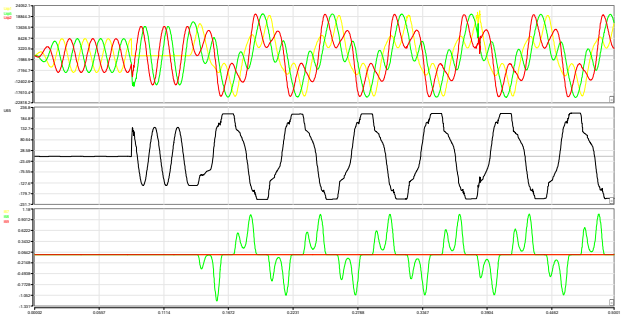


b) NAMY-10

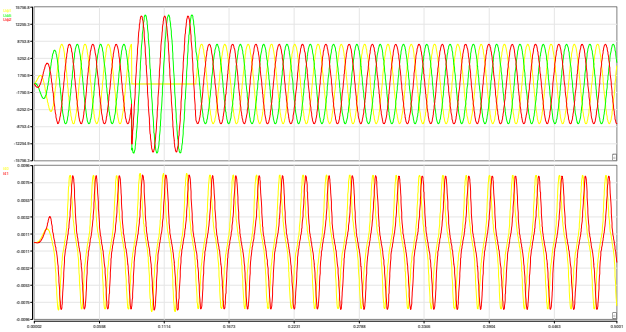
Fig. 2. Dependence of current on high voltage winding of voltage transformers from capacitive current earth fault electric network



a) NTMY-10



b) NAMY-10



c) NTN-10

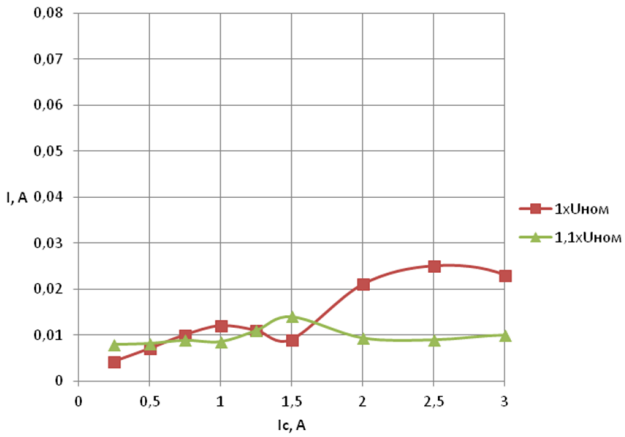
Fig. 3. Tsyfrohramy of the voltage electric network, voltage winding "open triangle" and primary currents VT provided that there is a steady FRP

Analysis of the results shows that steady FRP arise while capacitive currents ground fault, that are 0.25… 3 A if we use type NTMY TN-10 (НТМИ-10) 0.25… 1.5 A, 0.25… 1.5 A if we use type VT NAMU-10 (НАМИ-10) and do not occur at all during VT type NTN-10 (HTH-10) installation.

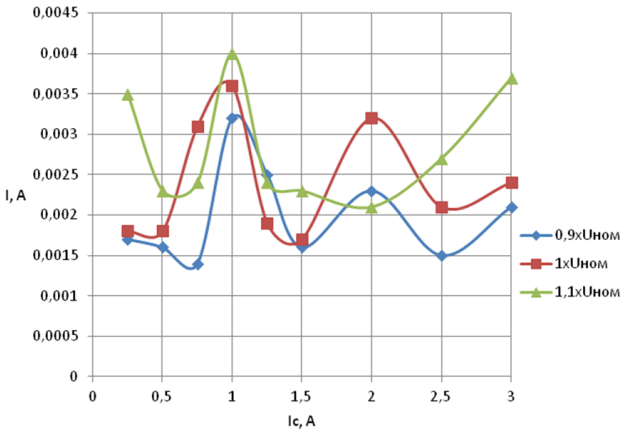
III. Analysis of Methods for Ferroresonant Processes Control

Methods for FRP control are based on reducing the existence conditions for ferroresonance processes. As it is shown above, the use of voltage transformers NTN-10 (HTH-10) prevents the FRP emergence in power grids. This is due to the fact that this VT has no contact of its primary windings with ground loops, that is why the ferroresonance circuit is not formed. But, its use has certain limitations: in power grids many VT type NTMY (НТМИ) and NAMY (НАМИ) which can not be replaced on the NTN immediately, are used; to date is not established serial production of the voltage transformer. It is therefore advisable to focus on methods that allow you to protect VT from damage of ferroresonance processes.

In [5] proposed to protect VT the use of devices PZF operating principle, is based on introducing additional active losses in the resonant circuit, of which leading to extinction of ferroresonance fluctuation. Is proposed to protect VT the device operates as follows: when there feroresonance processes on the findings of windings “open triangle” VT appears zero-sequence voltage $3U_0 = 100$ V, with subharmonic frequency 17 ÷ 25 Hz, device PZF turns on to the findings of windings "open triangle" resistor R = 6 Ohm. The connected resistor R provides a fading of ferroresonance fluctuation during the time $t \leq 1.5$ s, what excludes the possibility of thermal damage of high voltage windings VT, by FRP. Fig. 4 shows the results of studies of the device PZF.



a) NTMY-10



b) NAMY-10

Fig. 4. Dependence of current on high voltage winding of voltage transformers from capacitive current earth fault when using the device PZF

Having analyzed the data (Fig. 4), we can say that the device of breakdown ferroresonance (NRF) is one of the most effective devices for ferroresonance processes control. The current in the primary winding does not exceed the maximum allowable current, which is 0.1 A. But, disadvantage of this device is its complex structure, need to install the device on all transformers in the network where there is FRP, that is, if the pover grid has three voltage transformers, and the device PFZ is installed only on one, it does not protect voltage transformer from damage. To prevent damage is possible only when the device is installed on all transformers that operate on the network.

If we want to avert FRP, we must change ferroresonance circuit that means the change of the inductance VT or capacity power grids. A new method of FRP (NMBF) control which will provide reliable FRP failure and eliminate the major shortcomings of existing devices and systems is proposed. We have considered possibility additional capacitance, inductance or active resistance to one of the section tires of substations electric system or in neutral.

Studies have shown, that for effective disruption of ferroresonance processes in the power grid short-term connection of additional capacity to one of the electric systems phases or a short-term connection of active resistance in HV winding neutral voltage transformers can be applied.

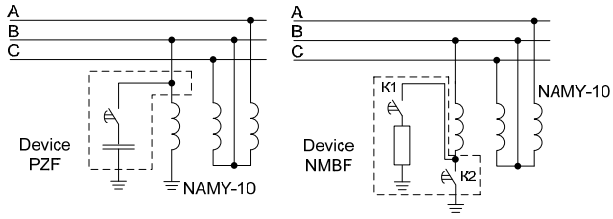
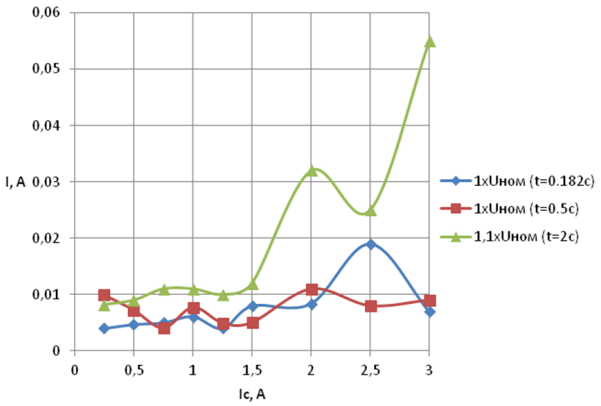
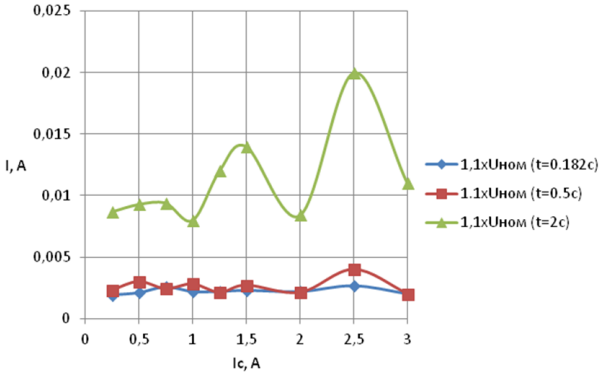


Fig.5 Scheme of NMBF device connection HV to the winding to voltage transformers (for example VT type NAMY-10).

Figure 6 shows the results of breakdown FRP, provided there is a short-term connection of additional capacity and Figure 7 – oscillogram transitional process when a short-term connection of active resistance exists.

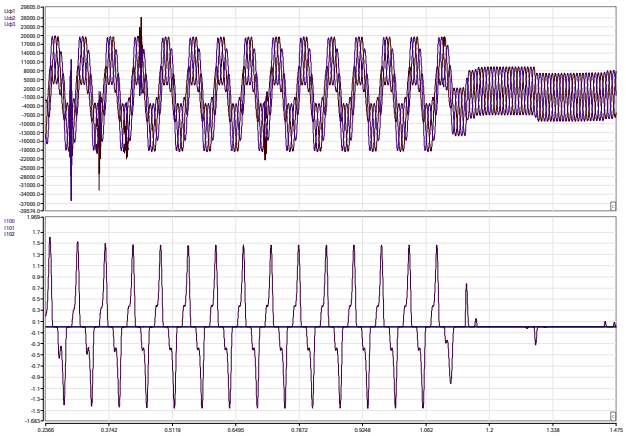


a) NTMY-10

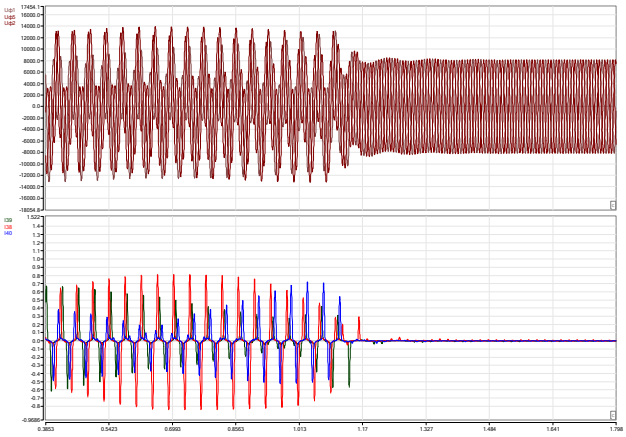


b) NAMY-10

Fig. 6. Dependence of current in on high voltage winding of voltage transformers from capacitive current earth fault using the device NMBF(connection of capacity)



a) NAMY-10



b) NTMY-10

Fig. 7. Tsyfrohramy of voltage in power grid and primary VT currents using the device NMBF (connection of active resistance)

Thus we see that the installation of the NMBF device helps to prevent ferroresonance processes and damage to electrical equipment.The main advantage of the proposed method is elimination of FRP when device is mounted on only one of the voltage transformers.

Conclusions

1) Ferroresonance processes in power grids with isolated neutral is a dangerous phenomenon which causes damage of electrical equipment, especially voltage transformers.

2) Studies have shown that the probability of occurrence of sustainable FRP is influenced by the capacitive current earth fault and the type of established VT. In 10 kV power grids FRP they can arise if in one transformer there is from 0.25 to 3 A of capacitive current earth fault.

3) The use of the PZF devices can effectively protect the power grids from FRP, provided that the devices is installed at each transformer voltage.

4) Using the method wich is implemented in the devices NMBF can stop the ferroresonance processes and the device is sufficient to install only in one of the voltage transformers.

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Development of Analyzer for Paper Stock Concentration Measurement

Oleksandr Romaniuk, Bohdan Kril

Automation of Heat and Chemical Processes Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: o.m.romaniuk@gmail.com

***Abstract* – Measurement and regulation of paper stock concentration is of great importance in pulp and paper industry Deviations of concentration from the optimal value lead to deterioration of the product quality and can damage technological equipment of the factory. As a result a necessity of paper stock concentration measurement arises. In this article the improved rotational method of paper stock concentration measurement is examined, that is based on indirect measurement of concentration by viscosity. The influence of temperature on the measurement results was studied. The main sources of errors in concentration measurement by means of viscometer method were analyzed. A principle of improving accuracy of a paper stock rotational consistency meter is presented and a structural scheme of its realization is designed.**

Key words – concentration, viscosity, consistency meter, rotational viscometer, paper stock, non-Newtonian fluid.

I. Methods of the Pulp Concentration Measurements

The condition of pulp and paper industry is inseparably associated with the general industrial level of countries, when one of the indicators is the multiplicity of paper stock use in this recycling production. It is recognized that paper stock can be recycled up to six times. The approximate relationship between the major components of raw materials in recent years in world production of paper and paperboard following: waste paper is up to 50 % of raw materials for the paper industry and cellulose – only 27.5 %.

One of the important parameters in pulp and paper industry is paper stock concentration measurement. This measurement is employed at all stages of paper manufacturing from waste paper dissolving to paper-making machine [1]. Deviations of concentration from the set values leads to technological process failures, affects quality of the product and economic performance of manufacture.

The main methods of measuring paper stock concentration include blade, rotational, optical and ultrasound methods [2]. The most widespread consistency meters are blade and rotational ones that work on the principle of measuring paper stock viscosity. This is one of the known cases of indirect measurement of fluid concentration by its viscosity. Instruments, operating by above mentioned methods, can be used as a pulp consistency meters only when some special condition is realized.

Rotational methods based on measurement of torque that occurs on the rotor axis (cylinder, disk, cone etc.) that is rotating in the medium measured. There are constructions of devices with one rotating element, but those with two elements are more promising. One of them has a propeller that constantly rotates and pulls the other element - impeller - through the measured medium. The impeller's turning angle depends on viscosity, and correspondingly on pulp concentration.

II. Structural Scheme of Paper Stock Concentration Meter

The following factors impact the result of viscosity measurements: pressure, temperature, flow type (laminar or turbulent). Fluid viscosity undergoes little change with pressure growth, but strongly depends on the temperature [3].

Viscosity of non-Newtonian liquids decreases exponentially as the absolute temperature T increases:

$$\mu = A\exp\left(\Delta U/kT\right), \qquad (1)$$

where A – is a pre-exponential factor (it's value has a little dependence on shear stress and temperature), ΔU – energy of viscous flow activation, that relates to one kinetic unit. It depends not only from the system structure but also from share stress and shear rate, $k = 1.3806488\times10^{-23}\ J/K$ – Boltzmann constant [4]. Change of viscosity value may be up to few percent per one degree. Thus for viscosity measurement temperature should be accurately defined and stabilized.

Fluids which viscosity does not depend on flow speed gradient are known as perfectly viscous or Newtonian fluids. Viscosity of non-Newtonian fluids depends on the gradient of the flow speed (shear rate). Depending on the character of flow properties non-Newtonian fluids are divided into pseudoplastic, plastic, dilatant, thixotropic and rheopectic. Paper stock belongs to pseudoplastic fluids that are characterised by reduction of viscosity and increase of shear stress. The typical diagram of shear stress on shear rate for Newtonian and non-Newtonian pseudoplastic fluids is presented on Fig.1.

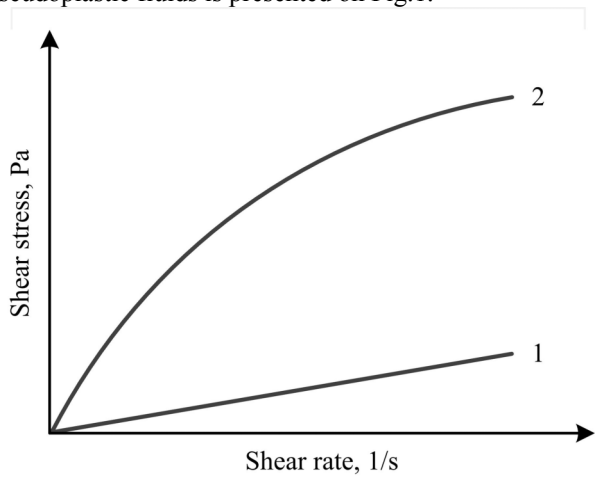

Fig. 1. Dependence of shear stress on shear rate for Newtonian fluids (1) and non-Newtonian pseudoplastic fluids (2)

Let's examine the main sources of errors in measurement of paper stock concentration by means of rotary viscometer. Viscosity depends to a great extent on temperature E. 1, therefore temperature changes cause significant measurement errors. Presence of fine gas

bubbles significantly increases viscosity. Fibrous inclusions and paper stock structures wrap around rotor and drive axis. At significant fluid flow speed gradients certain flow laminarity failures are possible in rotary viscometers. It is recommended not to use rotary viscometers in flows with Reynolds number higher than 1000. Also, during viscosity measurement of a fluid with a high flow speed gradient by means of a rotary viscometer heating occurs, created by internal friction of the substance. Rotary method belongs to mechanical measurement methods to which instrumentation error is appropriated. Due to these errors the sensor element can't determine small changes of concentration in mechanical methods of viscosity measurement.

III. Structural Scheme of Paper Stock Concentration Meter

To measure paper stock concentration by its viscosity it is most reasonable to measure temperature and make correspondent correction in algorithmic way.

Fig. 2 shows the structural scheme of a paper stock consistency meter.

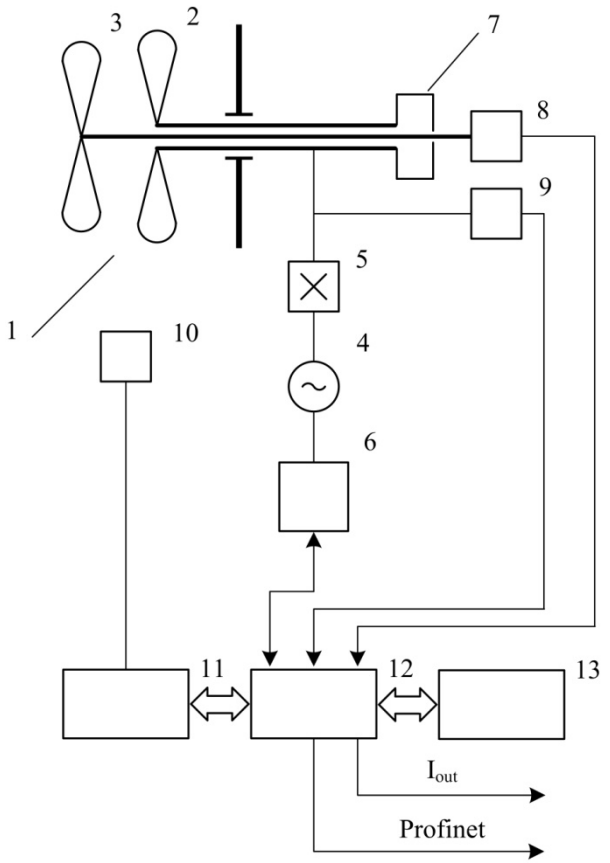

Fig. 2. Structural scheme of paper stock concentration meter
1 – medium measured; 2 – propeller; 3 – impeller; 4 – engine; 5 – toothed belt transmission; 6 – frequency converter; 7 – resilient torsion element; 8, 9 – rotary encoder; 10 – resistance thermometer; 11 – temperature measuring module; 12 – controller; 13 – operator panel

We studied an analyzer for paper stock concentration measurement that realizes rotational method with two rotating elements – propeller and impeller. The main difference between this option and known designs is that measurements are done with two different values of propeller rotation speed and two different directions of rotation. Such decision allows to reduce errors in measurement of non-Newtonian fluids viscosity value, to which paper stock belongs. Non-Newtonian fluids have non-linear character of rheogram, i.e. dependence of share stress on shear rate. Therefore in order to increase accuracy of viscosity assessment shear stress should be measured with at least two different values of shear rate. For this purpose a frequency changer is used to power the engine that rotates propeller through the belt transmission. Measurement is done at 30 and 60 Hz frequencies of engine power both in direct and reverse directions of rotation. This option also allowes to take into account errors caused by mechanical elements of the machine, e.g. sealing glands of the rotating elements, hysteresis of the resilient torsion element that creates the opposing torque.

The most reasonable is realization of similar short-batch devices with a high volume of algorithmic processing of measurement results based on low-power free-programmable logical controllers. This design is done using a S7-1200 Siemens controller. Such solution enables reducing costs of short-batch device and streamlining its design for specialists who are specialised in technological measurements and technological process automatization.

Conclusion

A principle of improving accuracy of a paper stock rotation consistency meter was proposed and a structural scheme of its realization on a low-power free-programmable logical controller was designed. A paper stock consistency meter based on this principle can be used in automatized control systems for technological processes in pulp and paper industry.

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Impact of the Operating Mode of Neutral in 35 kV Power Grids on the Arc Overvoltages and Voltage Teasuring Transformers

Andriy Yatseyko, Volodimir Andrushko

Department of Electrical Systems and Networks,
National University "Lviv Polytechnic", UKRAINE, Lviv,
S. Bandery street 28a, E-mail: yats80.andriy@gmail.com

Abstract – has been analyzed possible methods of earthing of neutrals in 35 kV power grid. Among the most common injuries in these electrical system are arc circuits, that is why the dependence of overvoltage multiplicities on the nature of earth arcing and on the method of earth arrangement of electrical system neutral. Given that in 35 kV power grids may arise ferroresonant processes, operation of voltage measuring transformers has been researched during unstable earth arcing.

Key words – power grid, arc overvoltage, digital model, insulated neutral, resonant-earth neutral, overvoltage ratio, resistance-earth neutral, voltage transformers.

I. Introduction

Power grids with a voltage of 35 kV are distributive networks. They are one of the longest on the total length [1], so their work largely depends on the reliability of consumers' electricity supply, which is now very topical due to the constant deterioration of the technical condition of electrical networks and stable growth of energy consumption.

According to [2] Power grids with a voltage of 35 kV in the mode of arrangement of neutral earthing can be divided into: power grids with insulated neutral, power grids with neutral earthing through a ground-fault neutralizer (resonant-earth or compensated neutral), power grids with neutral earthing through resistance (high-resistance or low-resistance) and power grids with combined earthing.

One of the weighty reasons of failures in 35 kV power grids are internal overvoltages that arise at following electromagnetic processes: arc, ferroresonance and switch. This case requires research and determination of limit multiplicities of overvoltage at specified electro-magnetic transients and development of recommendations for the coordination of insulation.

Significant risk to the electrical equipment of electrical networks of 6-35 kV are overvoltages during the earth arcing in the occurrence of single-phase earth fault. These processes are dangerous by frequency of occurrence in the power grids, by their duration and overvoltages magnitude.

During unstable earth arcing is the saturation of magnetic system of the measuring voltage transformers, which can lead to the development of ferroresonance processes, significant growth of currents of primary windings of voltage transformers and their thermal damage.

II. Rated Model

We perform all researches using digital simulation based on the model of electrical network with a voltage of 35 kV, developed in the software package RE [3] (Fig.1). This model reproduces in 35 kV power grids, which includes power transmission lines, buses, power triple-wound transformer 110/35/10 kV and voltage measuring transformer. Resistor and inductor are connected to the neutral of medium voltage winding of power transformer in parallel via switching elements, which, respectively, simulate the earth resistor and ground-fault neutralizer.

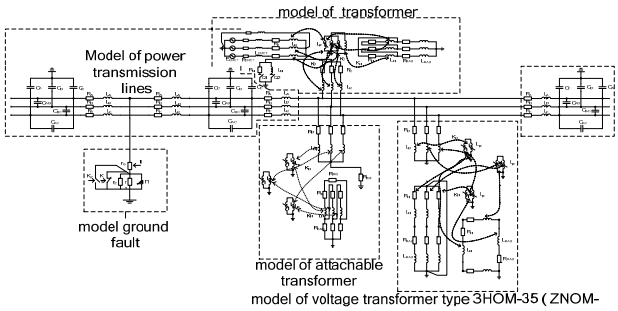
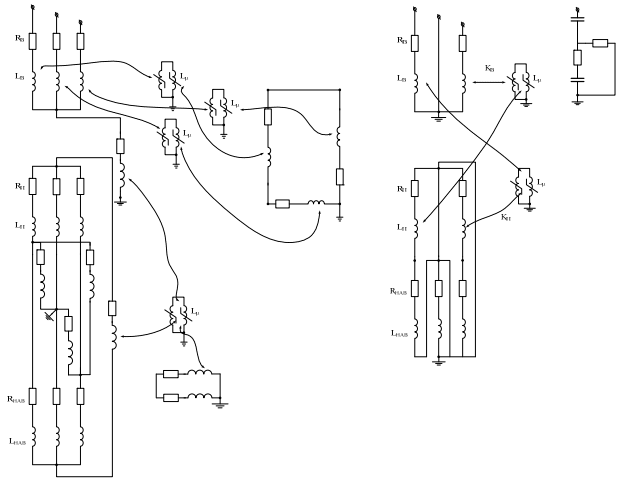


Fig. 1. Rated model of electrical network

In Ukrainian the 35 kV power grids are operated voltage measuring transformers types ЗНОМ-35 (ZNOM-35), НАМИ-35(NAMY-35) and НТН-35 (NTN). Voltage transformer model type ЗНОМ-35(ZNOM-35), is shown in Fig.1, and voltage transformer models type НАМИ-35(NAMY-35) and НТН-35 (NTN-35) – in Fig.2. Rated models of voltage transformers are formed in accordance with the scheme of connection of their windings and passport data in consideration of characteristics of the magnetic circuit magnetization.



a) НАМИ-35 (NAMY-35) b) НТН-35 (NTN-35)

Fig. 2. Rated models of voltage measuring transformers types НАМИ-35(NAMY-35) and НТН-35 (NTN-35)

The magnitude of arc overvoltages is determined by the nature of earth arcing during single-phase earth fault.

The real picture of arcing depends on many factors, the main of which are: magnitude and nature of current earth fault, disruptive pressure at the injury site after arc extinction, cooling conditions [4, 5]. The closest to real operational conditions is the nature of arcing on the theory of N.N. Beliakov and C.M. Dzhuvarla [6], according to which arc tries to extinguish at each passage of current through zero. However, extinction of the arc occurs only if the first voltage peak at the injury site is less than $0.4U_{nom}$. For unipolar regular arc each subsequent breakdown occurs approximately after the period of industrial frequency, when the voltage on the damaged phase reaches the peak value. For bipolar

regular arc each subsequent breakdown occurs in approximately half of the period of industrial frequency, for amplitude value achieving by a voltage.

According to the above mentioned algorithm were investigated single-phase earth fault with unipolar arcs, when the arc gap breakdown happened at one polarity of renewable voltage, and bipolar symmetric and asymmetric arcs, when the arc gap breakdown happened both along the positive and negative polarities of renewable voltage.

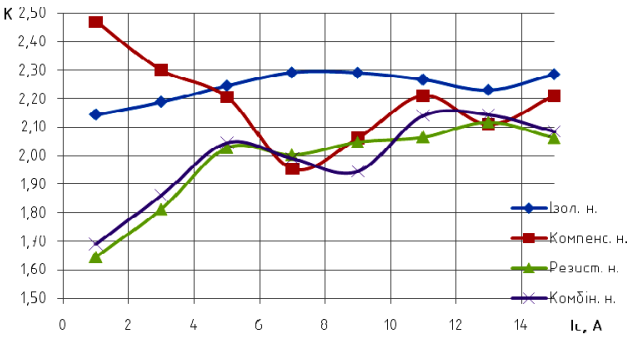
III. Analysis of Arc Overvoltages

For all possible methods of arrangement of earth mode of electrical system neutral, the magnitude of arc overvoltages has been investigated for two natures of earth arcing: unipolar and bipolar.

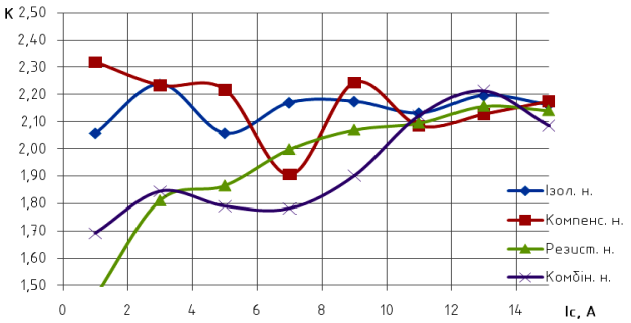
All the researches are performed for different values of the capacitive current earth fault from 1 A to 15A. For network with compensated neutral, the value of inductance of the earth reactor has been designed for capacitive current earth fault 7A. Therefore, studies that were conducted with this ground-fault neutralizer for the values of capacitor current 1 – 6.9 showed the process of overcompensation of the current earth fault, and in the range 9 – 15 A – process of undercompensation of capacitive current earth fault.

Also regarding capacitive current earth fault 7 A was calculated: the value of active resistance of 3040 Ohm for network earthing via a high resistance resistor, and the value of resistance 6735 Ohm, which is connected in parallel to ground-fault neutralizer in network with a combined neutral earthing.

The results of calculation are shown in Fig.3. Typical voltages digital diagram during the unstable arcing are shown in Fig.4 (high-resistive neutral earthing) and Fig.5 (resonant neutral earthing).

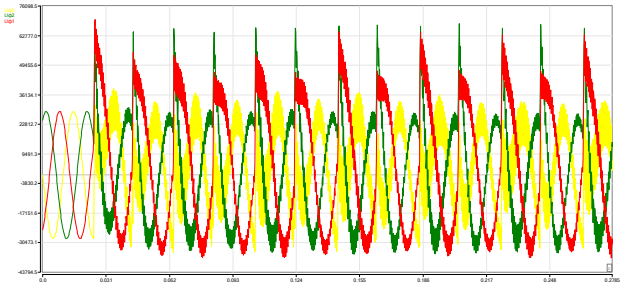


a) unipolar arc

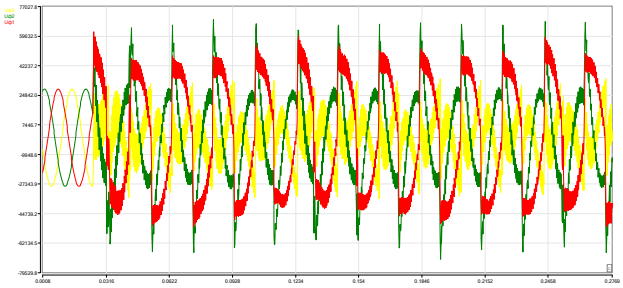


b) bipolar arc

Fig. 3. The dependence of the multiplicity of the arc overvoltages on the mode of neutral earthing and on the amount of capacitive current earth fault

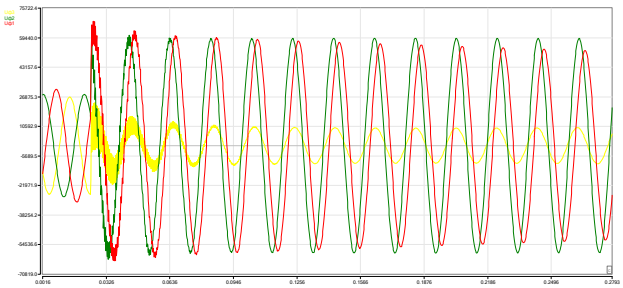


a) unipolar arc

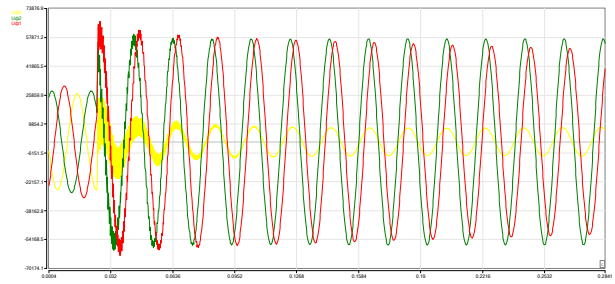


b) bipolar arc

Fig. 4. Typical voltages digital diagram during the unstable arcing at resistive neutral earthing



a) unipolar arc



b) bipolar arc

Fig. 5. Typical voltages digital diagram during earth arcing at resonant neutral earthing and full compensation of capacitive current earth fault

As you can see from the obtained results, the highest overvoltages multiplicities occur in the mode of overcompensation of the capacitive current in the network with compensated neutral: 2.47 for unipolar arc and 2.32 for bipolar arc. The least multiplicities of arc overvoltages we can observe at the full compensation of capacitive current, and at combined neutral earthing for unipolar arc 1.9 and 1.78 for bipolar arc.

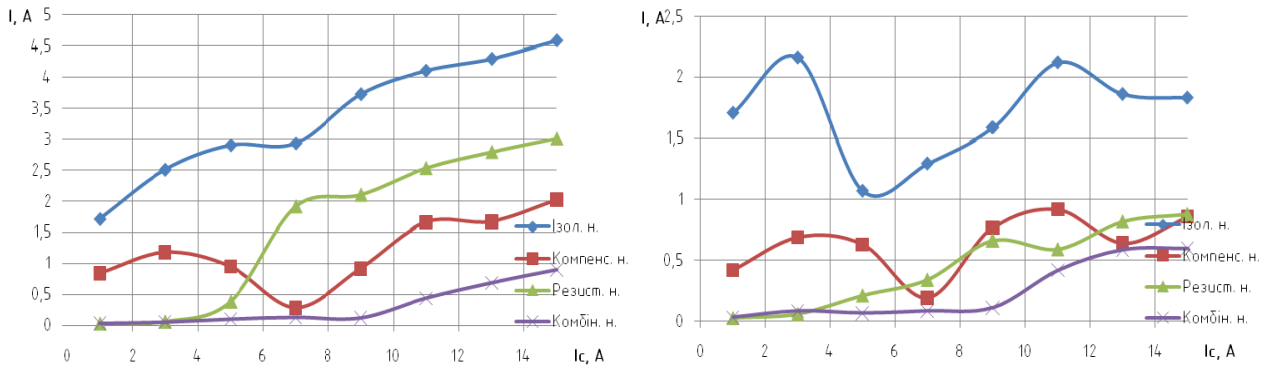
Of course, as seen in Fig.3 and 5, the lowest overvoltages and the easiest arcing nature are to be observed during the power grids operating with resonant neutral earthing at almost perfect resonance compensation

adjustment. To achieve this mode in actual use is extremely difficult because of the need for almost continuous variable control of the inductance of the earth reactor.

IV. Analysis of Measuring Voltage Transformers

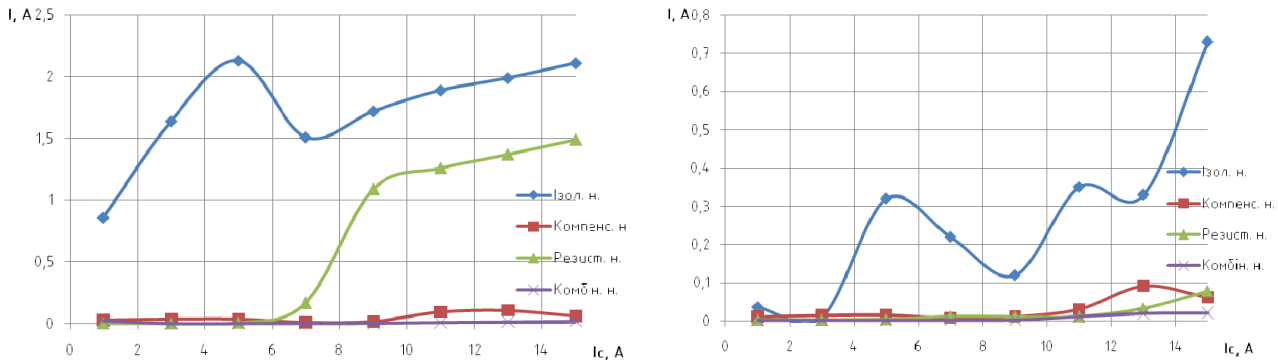
The unstable arcing at single-phase earth fault may lead to significant growth (in hundreds and thousands of times) of current in primary windings of voltage transformers. Since the earth arcs can burn for long periods of time, such current growth causes thermal damage of the windings of voltage transformers.

A research was conducted of the influence of earthing mode of the network neutral, the value of the capacitive current of earth fault and type of voltage transformer on the current value that will flow in primary windings of the measuring voltage transformer at unstable arcing. The results are shown in Fig. 6-8.



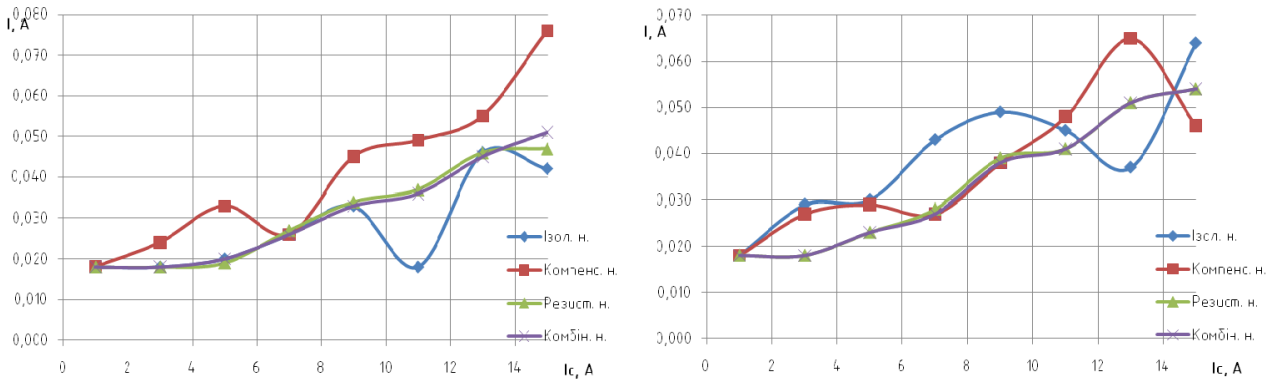
a) unipolar arc b) bipolar arc

Fig. 6. The dependence of the current magnitude in primary winding of the voltage transformer type ЗНОМ-35 (ZNOM-35) on the magnitude of capacitive current and the method of network neutral earthing



a) unipolar arc b) bipolar arc

Fig. 7. The dependence of the current magnitude in primary winding of the voltage transformer type НАМИ-35 (NAMY-35) on the magnitude of capacitive current and the method of network neutral earthing



a) unipolar arc b) bipolar arc

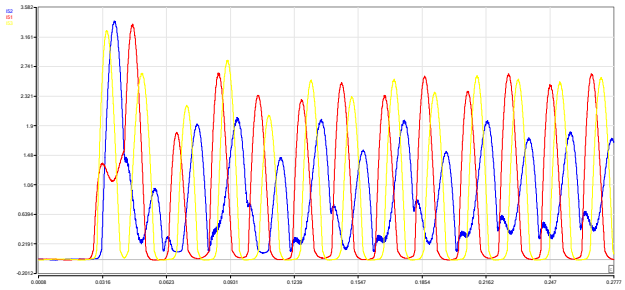
Fig. 8. The dependence of the current magnitude in primary winding of the voltage transformer type НАМИ–35(NAMY-35) on the magnitude of capacitive current and the method of network neutral earthing

The research results show that the highest currents flow in the primary windings of the voltage transformer type 3НОМ-35(ZNOM-35) at the power grids with insulated neutral – 4.59 A if unipolar arc and 2.16 A if bipolar arc. The lightest operating conditions of TH 3НОМ-35 (ZNOM-35) during the earth arcing to be characterized by the electrical network operation mode with a combined neutral earthing.

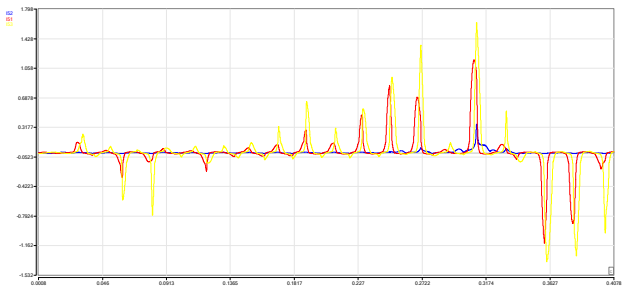
A similar pattern is observed for voltage transformer type НАМИ-35(NAMY-35). For this voltage transformer increase of the current of primary windings to 2.2 A is possible in the mode of the insulated neutral. For this voltage transformer an optimal is an operation in networks with resonance and combined neutral earthing, regardless of the setting of compensation of capacitive current earth fault. In these networks during the unstable earth arcing currents of the primary windings of voltage transformer type НАМИ-35(NAMY-35) will not exceed values of 0.09 A.

The lowest values of the currents in primary windings can be observed in the voltage transformer type НТН–35(NTN-35). In it, almost regardless of the method of neutral earthing, currents do not exceed 0.08 A, which is not destructive value from the point of view of the thermal stability of the windings, which is 0.1 A for almost all voltage transformers.

In Fig. 9 it is shown a digital diagram of currents of primary windings of voltage transformer type 3НОМ-35 (ZNOM-35) during earth arcing.



a) unipolar arc



b) bipolar arc

Fig. 9. Typical digital diagrams of currents of primary windings of voltage transformer 3НОМ-35 during earth arcing and insulated network neutral

Conclusions

1) Method of arrangement of neutral earthing mode significantly affects the nature of burning and development of overvoltages in 35 kV power grids.

2) The highest overvoltage multiplicities occur in the mode of overcompensation of the capacitive current in the network with compensated neutral: 2.47 for unipolar arc and 2.32 for bipolar arc. The least multiplicities of arc overvoltage occur at full compensation of capacitive current and fine tuning of ground-fault neutralizer, as well as at the combined earthing of neutral 1.95-1.99 for the unipolar arc and 1.78 and 1.9 for bipolar arc;

3) During unstable arcs the highest currents flow in the primary windings of the voltage transformer type 3НОМ-35 (ZNOM-35) in the power grids with insulated neutral – 4.59 A if unipolar arc and 2.16 if bipolar arc.

4) The lowest values of currents in primary windings can be observed in the voltage transformer type НТН–35 (NTN-35) regardless of the method of power grids neutral earthing, so this voltage transformer is not damaged during the arc earth fault.

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Development and Research of Bulk Material Moisture Meter

Roman Greh, Oleksandr Kril

Department of Automation of Heat and Chemical Processes,
Lviv Polytechnic National University, Lviv,
S. Bandery Street 12, Ukraine, e-mail: roman_greh@ukr.net

Abstract – In this paper, ways of moisture meters enhancement are considered, with the purpose to use them in cereal-processing technologies. The paper suggests a new design concept of moisture meter for measuring grain moisture. Multiparameter measurement is the main principle of the given moisture meter. Capacitance method with correction for bulk grain weight and temperature is basic.

Key words – moisture meter, moisture, electric capacity, dielectric permittivity, bulk weight.

I. Introduction

Bulk material moisture measurement is a widespread procedure in many technological processes. It is used to measure moisture of ready-made bulk food products, semi-finished products, and products on particular stages of production. Moisture is a quality parameter of materials, its measuring can determine the net weight of materials, it has a great impact on the course of technological processes [3, 4].

Almost all branches of industry and agriculture apply the processes of drying and moisturizing to change the moisture of solid materials. Further studies are aimed at improving measuring devices for measuring moisture in the technological process of grinding in flour manufacturing. It is known that the grain is stored with low moisture content, and the process of grinding should be carried out with much higher moisture content. Therefore to increase moisture, the water is supplied to the flow of grain into the mill before grinding [1].

II. Presenting main material

The most popular method of grain moisture measuring is capacitance method of measurement.

1. The method consists in measuring transformer capacity, which is formed by two parallel plates around loaded grain. The difference between dielectric permittivity of the measured material and air is a necessary condition for the work of transformer [2].

2. Plates' capacity of measuring cell can be approximately expressed by the formula:

$$C \approx \varepsilon \cdot \frac{S}{d} \tag{1}$$

where:

ε – dielectric permittivity of the measured medium;

S – surface of plate;

d – distance between plates.

To determine the dielectric permittivity of grain, first it is necessary to find the capacity of capacitor when the capacity cell is empty:

$$C_0 = \varepsilon_n \cdot \varepsilon_0 \cdot \frac{S}{d} \tag{2}$$

where:

ε_n – dielectric permittivity of air, $\varepsilon_n = 1.0005$.

The dielectric permittivity of grain is calculated by the following formula:

$$\varepsilon_з = \frac{(C_0 + C) \cdot d}{\varepsilon_0 \cdot S} \tag{3}$$

Analysis of this formula suggests that granulometric composition of bulk material influences the measurement result, as with its changing – the ratio between the contribution to the value of resulting dielectric permittivity of this index for the grains of material and air in between them will change.

Since the volume of the cell is constant, it is possible to amend the measurement result by changing the granulometric composition while weighting measuring cell. There are other uninformative parameters that affect the measurement result, particularly temperature changes of bulk material.

As you can see from formula 1, geometric size of the measuring cell affects the dielectric permittivity. Figure 1 shows comparative graphs of the dielectric permittivity of grain moisture with different geometrical parameters.

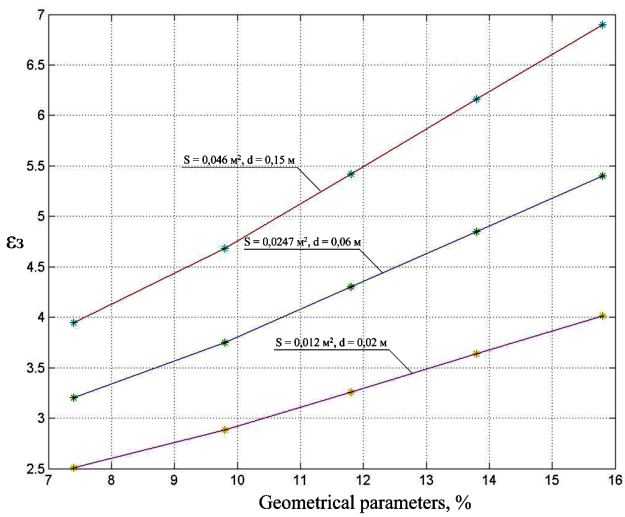

Fig. 1. Comparing graphs of the dielectric permittivity of grain moisture with different geometrical parameters

After analyzing the graphs, we can tell that dependence of dielectric permittivity from moisture does change its character with increasing the geometric size of capacitive cell, but the graphics are shifted upward on the vertical axis.

The potential of capacitive method of measuring moisture content of bulk materials can be fully implemented in the implementation of device conducting continuous measurement in the flow of material with simultaneous measurement of multiple parameters of this material – dielectric permittivity, bulk weight, temperature.

Block diagram of the multiparameter meter shown in Fig. 2.

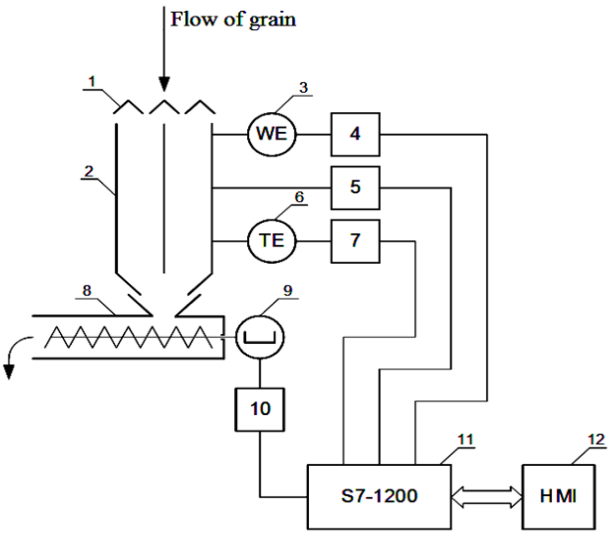

Fig. 2. Block diagram of the multiparameter moisture meter

Figure 2 contains the following components notes:
1 – flow divider;
2 – capacitive cell;
3 – weight sensor;
4 – matching unit of weight sensor and controller;
5 – transformer of capacity into unified current signal;
6 – temperature sensor;
7 – matching unit of temperature sensor and controller;
8 – screw conveyor;
9 – stepper motor;
10 – stepper motor control unit;
11 – programmable logic controller;
12 – operator panel.

Capacitive cell 2 is placed in the grain flow. Grain flows through the flow divider 1 to eliminate the flow influence on the process of cell weighing. Weighing is carried out by strain gauge 3, which signal is processed by block 4. The cell wall temperature is measured separately by thermometer 6, the signal is processed by transformer 7. To determine the moisture content of grain we measure electrical capacitance of cell when the grain flows through it. Capacity is processed by transformer of capacity into unified current signal 5. These signals are transferred to the programmable logic controller 11 which calculates moisture. Programmable logic controller can also perform service operations – periodic air blowing of unloading unit and unloading after termination of grain flow. Unloading of grain from the cell goes through the screw conveyor 8 driven by the stepper motor 9.

Programmable logic controller SIEMENS S7-1200 (Figure 3) chosen to implement this system in a compact package combines a microprocessor, input and output range. After loading the program, PLC contains the logic required to monitor and control devices. Programmable logic controller monitors the inputs and changes the outputs according to the logic of the program, which can include Boolean logic operations, count, timing, complex math operations, and communications with other smart devices [5].

Fig. 3. Programmable logic controller

The advantages of systems with digital control counting, compared with analogue and relay control systems, include:
- the possibility of implementing various control algorithms without changing the hardware of control unit;
- high speed data exchange;
- high integrity of date received;
- wide range of input and output signals;
- weight and size saving of control unit;
- improving reliability of equipment, easy reservation;
- ability to reconfigurate control algorithms and control equipment;
- implementation only on digital microcircuit.

Conclusion

The block diagram of multiparameter grain moisture meter for continuous measurement in the flow was developed. The functioning algorithm for this device was developed, and depending on the change of device values from the change of bulk weight and temperature was experimentally removed.

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Renewable Energy Sources in Hot Water Supply System

Marta Kuznetsova[1], Myroslav Maliovanyy[2]

[1]Department of Heat Engineering and Thermal Power Stations, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: kuznetsovam83@gmail.com

[2]Department of Ecology and Sustainable Nature Management, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: mmal@lp.edu.ua

***Abstract* – possibility of renewable energy sources use in heat water supply system has been studied. Potential renewable energy sources to be effectively used in Lviv climatic zone have been analysed, and their main advantages and disadvantages have been shown. Efficiency of use of vacuum solar collectors and "air-water"-type heat pump in hot water supply system has been ascertained based on the analysis of performance of the facility operating at Lviv Polytechnic National University.**

Key words – energy efficiency, renewable power engineering, solar collectors, heat pump, hot water supply.

I. Introduction

Rise of urban population and advance of requirements to social conditions quality considerably increase demand for electrical and heat energy. Continuous increase of urban demand for heating and hot water supply is directly connected to increase of organic fuel consumption, consequently increasing amounts of harmful atmospheric emission and worsening of environmental situation in general. Considering these factors, the issue of renewable energy sources utilization, including energy of sun, wind, floods, geothermal heat, biomass, becomes more and more urgent. These energy sources are environmentally friendly and not hazardous for environment. Besides, they are practically inexhaustible, unlike conventional organic energy carriers [1]. Use of technologies based on renewable energy sources would enable to decrease organic fuel consumption and enhance environmental situation in our state.

Utilization of nonconventional power engineering becomes more and more urgent for Ukraine, taking into account increase of prices for energy carriers, in particular natural gas, being used for heating and hot water supply of domestic buildings, as well as a fuel at many Ukrainian thermal power plants and heat electropower plants. Considering the acute political situation in the state, this fuel becomes deficient because amount of gas extracted in Ukraine is insufficient to satisfy needs for it in full. The situation concerning coal is also difficult, as most of it is extracted in the mines of Donetsk coal basin, and because of hostilities in Ukrainian East coal extraction is almost stopped.

Practical utilization of nonconventional and renewable energy sources in Ukraine is behind world level. Main obstacles for their implementation include low specific power, high capital cost, low level of state support and absence of experience of continuous exploitation.

Choice of certain renewable energy source is determined by its availability and possibility to be efficiently used. Thus, heat of ambient air as a renewable energy source is characterized by temperature fluctuations over season and day depending on weather conditions. That is why the heat of ambient air is reasonable to be used in climatic zones with rather high (not less than +5 °C) temperature and stable weather conditions.

Considerable temperature fluctuations in heating period along with often and long thaw in winter are typical for Lviv climatic zone. Use of ambient air heat as an energy source is expedient only in transition periods (autumn–winter, winter-spring), as well as during winter thaws in daylight.

Expedience of solar energy use strongly depends on climatic conditions of the region. Potential of this energy source is rather high but density of solar radiation flow is comparatively small – about 0.6 – 0.8 kW per 1 m^2. This requires considerable absorbing surfaces areas of solar collectors. In addition, this source has another considerable disadvantage – solar radiation comes unevenly. This requires to use heat accumulating devices for both day and season accumulation.

It is impossible to use potential of mentioned energy sources directly in heating and hot water supply systems, and use of certain technical facilities intended for collecting, transformation and transferring energy to ultimate consumer, are needed. Heat pumps are used to utilize ambient air heat, and solar collectors are used to utilize solar energy.

Heat pump is a device for transferring heat energy from the source of low potential heat energy (with low temperature) to the heat carrier with higher temperature. In terms of thermodynamics, heat pump is analogous to refrigerating machine [2].

Two physical phenomena underlie the operating principle of most widespread steamcompressive heat pumps:

- absorption and release of the heat by a substance when changing its aggregate state – vaporization and condensation, respectively;
- change of vaporization (and condensation) temperature when changing pressure.

Solar collectors are devices for collection of the Sun energy transferred by visible light and infrared radiation. The solar collectors, which are the main element of solar water heating and heat supplying facilities, are made of available materials (steel, copper, aluminium etc.), i.e. without usage of expensive silicone, being used to produce photoelectric cells for electric power generation, and this allows to decrease considerably the cost of the equipment and the energy generated by it. Nowadays, water heating by the Sun is the most efficient way of solar energy utilization.

There are two most widespread types of solar collectors: vacuum solar collectors and flat solar collectors [3]. Vacuum solar collectors are more efficient.

II. Research-and-Production Facility of Nonconventional Energy Sources Utilization

Research-and-production facility of Renewable Energy Sources Laboratory of Lviv Polytechnic National University was used to study the issues of efficiency of ambient air heat and solar energy utilization.

The research-and-production facility of nonconventional energy sources utilization is intended for hot water preparation using a system of solar collectors and "air-water"-type heat pump. The energy obtained from the heat sources is transferred to two hot water reservoirs of 500 litres each. In the first reservoir heated by vacuum solar collectors NSC 12-58 GREENEN, fitted with tubes HEAT-PIPE, preliminary heating of water takes place. The heat produced in solar collectors is transferred to the reservoir through tubular heat exchanger (coil pipe) or high-speed plate heat exchanger, fitted to the facility. Three-way valve is used in the facility to commute heat carrier flow from solar collectors between the reservoir and high-speed heat exchanger. "Air-water"-type heat pump of 10 kW is connected to the second reservoir. Heated water is supplied from the reservoirs into hot water supply network of students' canteen.

Devices connected to the hot water reservoirs are controlled by DigiENERGY controller, fitted with the counter of produced and consumed energy, with possibility of writing down and real time review of all the parameters of the facility. Water-glycol mixture is used as a heat carrier in the system of solar collectors and the heat pump. This ensures no-failure operation of the facility at ambient temperature up to -35 °C.

During the operation of the facility electric energy is used only for drive of circulating pumps and the heat pump compressor, and the amount of electric energy consumed is much less then amount of heat energy produced.

To analyze the facility efficiency we carried out the research aimed on determination of the energy consumed by the heat pump and the solar collector, and the energy produced by them over a month (March 2015). Based on the results obtained it has been ascertained that:

- amount of electric energy consumed by the solar collector over a month is 214 kW·h;
- amount of heat energy generated by the solar collector over a month is 585 kW·h;
- amount of electric energy consumed by the heat pump over a month is 584 kW·h;
- amount of heat energy generated by the heat pump over a month is 1185 kW·h.

Previous analysis of the renewable energy sources and the obtained results of the facility operation show that solar collectors efficiency is limited by daylight time duration and cloudiness, while heat pump efficiency is limited by air temperature. Daylight time duration at latitude of Lviv in March is 12 hours on average (10 h. 59 min. for Mach 1st and 12 h. 51 min. for March 31st). The analysed period was characterized by high cloudiness, 22 days among 31 days (2 fine and 7 low cloudy days), and average temperature +4.2 ºC.

Conclusion

Based on the analysis of the results obtained and weather conditions under which the facility operated, it has been ascertained that high cloudiness and short daylight time resulted in rather low productivity of solar collectors, and low average air temperature resulted in low productivity of heat pump. However, even in such unfavourable period of the facility operation we managed to decrease heat consumption from the university boiler-house, wherein natural gas is used as an energy source.

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Mathematical Modeling and Experimental Study of Impulse Lines of Flowmeters

Roman Fedoryshyn, Fedir Matiko, Ihor Kostyk, Khrystyna Stefurak

Department of Automation of Heat and Chemical Processes, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: romanfedoryshyn@yahoo.com

Abstract* – *Mathematical model of an impulse line with a pressure transducer (PT) was built. This model provides the possibility to simulate and analyze the transient processes in an impulse line. Experimental studies of the step response curves of an impulse line with PT were carried out with application of a high-frequency analog-to-digital converter of the pressure signal in the PT chamber. The simulated step response curves were compared to the experimental ones. Maximum relative deviation of the simulated step response curves from the experimental ones is 6.3 %.

Key words – impulse line, mathematical model, step response, experimental study, simulation.

I. Introduction

The accuracy of flow rate measurement is a very important issue today especially for fluid energy carriers flow rate and volume measurement. The differential pressure method is one of the most widespread methods for flow rate measurement. The flow meters based on this method are simple in construction and they do not need individual calibration. However, flow pulsations may take place in the measuring sections of the pipes. These pulsations may lead to a negative impact on the accuracy of flow rate and volume measurement since they may cause the additional errors of measurement.

Impulse lines may be a source of the error of measurement. Based on the experimental and theoretical study [1, 2] it was defined that an impulse line (IL) together with the chamber of a pressure transducer is an oscillating system where resonance may take place. The resonance in the impulse line leads to the additional error of flow rate and volume measurement.

II. Mathematical Model

In order to develop the mathematical model of the IL it was considered that the pressure signal from the pipe (or from the carrier ring of an orifice plate) was transferred by means of the IL to the chamber of the PT (or the differential pressure transducer (DPT)) and there was a connecting nipple (throttle) between them. The internal diameter of the connecting nipple (throttle) is smaller than the internal diameter of the IL. That is why the nipple was considered as a cylindrical throttle. The following assumptions were made during the development of the mathematical model:

- the temperature of the gas in the IL is the same along the IL and does not vary in time;
- the volume of the chamber of PT is constant;
- the molar mass and the compressibility factor of the gas are constant within the time of investigation of the pressure pulsations.

The mathematical model was developed based on the following equations and formulae:

- the modified Mendeleev-Clapeyron equation of state for defining the mass of gas in the chamber of the PT;
- the Newton's second law for the description of the gas movement in the IL;
- the Poiseuille equation for the laminar regime of flow;
- the Darcy-Weisbach equation for the turbulent regime of flow;
- other equations of the classical fluid dynamics theory.

The mathematical model of IL was built and studied for the following three cases:

- laminar flow in the IL and laminar flow through the nipple (throttle);
- turbulent flow in the IL and turbulent flow through the nipple (throttle);
- laminar flow in the IL and turbulent flow through the nipple (throttle).

Based on the investigation results it was found that the mathematical model of IL for the laminar flow in the IL and laminar flow through the nipple (throttle) provides transient processes similar to those derived experimentally.

By analyzing the results of experimental study (see below) it was found that the transient processes in the IL should be described by means of a system of three differential equations. That is why one more equation was introduced into the initial system of two differential equations. The third equation was the equation for the pressure measuring transducer.

The mathematical model of IL can be presented by the following system of three linear differential equations

$$\begin{cases} T_{MT}\dfrac{dP_{Meas}}{dt} + P_{Meas} = P_{Ch}, \\ A\dfrac{dP_{Ch}}{dt} = Q\cdot\rho, \\ T_1\dfrac{dQ}{dt} + Q\cdot(1+\dfrac{K_L}{K_{L_N}}) = K_L\cdot\dfrac{(P_{in}-P_{Ch})}{\rho}, \end{cases} \quad (1)$$

where T_{MT} is time constant of PT, P_{Meas} is measured pressure by PT (output signal), P_{Ch} is pressure in the chamber of PT, Q is gas flow rate in IL, ρ is gas density, P_{in} is pressure at the input of the IL.

The system of differential equations (1) was reduced to the following transfer function:

$$W(p) = \frac{1}{(k_3T_{33})^3p^3 + (k_2T_{32})^2p^2 + k_1T_{31}p + 1}. \quad (2)$$

This transfer function was applied for simulation of transient processes in IL.

III. Experimental Study

The experimental study of the step response curves of the impulse lines with the pressure transducer was carried out by means of a rig where air was used as a working gas. There were the following main devices and components in the rig:

- impulse line with the internal diameter of 4 mm and with the following three different lengths (L_{IL}): 2.1 m; 4.2 m; 6.3 m;
- electro-magnetic valve ZGRCH6UP, Bürkert;

- pressure transducer PPS.3-PN (overpressure), Techprylad, the upper limit of measurement is 10 kPa, the main error of measurement is 0.15 %;
- differential pressure transducer Sitrans P DSIII (applied for pressure measurement), Siemens, the upper limit of measurement is 10 kPa, the main error of measurement is 0.15 %;
- analog-to-digital converter NI USB-6009, National Instruments, the resolution is 12 bit, the sampling frequency is 48 kHz;
- compressor UK25-16M with the maximum output pressure of 343.2 kPa;
- pressure stabilizer SAD-305;
- vessel (D = 180 mm, H = 310 mm, V = 0.0079 m^3).

Three series of tests were carried out for the ILs of different lengths (2.1 m; 4.2 m; 6.3 m). There were 10 tests in each series for the IL of a particular length, i.e. 10 transient processes were obtained for the same step change of the pressure for each IL. The tests were carried out in the following way:

1) The electro-magnetic valve was opened and the pressure in the whole system (vessel and the IL) was set to 4 kPa.

2) The electro-magnetic valve was closed.

3) New value of the pressure (8 kPa) was set in the vessel by means of the pressure stabilizer.

4) The electro-magnetic valve was opened abruptly. The transient process in the chamber of the PT took place and the electric output signal of PT was recorded.

5) To carry out the next test the pressure in the whole system was reduced down to 4 kPa and steps 2-4 were accomplished.

The value of the step change of pressure at the input of the IL in each test was 4 kPa.

At the result of processing and averaging the 10 transient processes for each IL the averaged step response curves were obtained. The values of the averaged curves for each specific moment of time were obtained as a mean arithmetic value of the 10 transient processes in the specific moment of time.

IV. Comparison of Experimental and Simulation Results

The values of time constants T_{31}, T_{32}, T_{33} and correction factors k_1, k_2, k_3 in (2) were calculated for the parameters of the experimental test rig. The results of calculation are presented in Table 1 and Table 2.

The simulated transient processes in IL on the basis of the mathematical model (2) were compared to the experimental step response curves. The comparison for L_{IL} = 2.1 m is presented in Fig.1. The same comparison was made for other values of impulse line length (L_{IL}).

TABLE 1

TIME CONSTANTS T_{31}, T_{32}, T_{33}

L_{IL}, m	T_{31}, s	T_{32}, s	T_{33}, s
2.1	0.0074	0.0106	0.0075
4.2	0.0105	0.0150	0.0095
6.3	0.0135	0.0184	0.0108

TABLE 2

CORRECTION FACTORS k_1, k_2, k_3

L_{IL}, m	k_1	k_2	k_3
2.1	0.5541	0.2736	0.3600
4.2	0.5143	0.2800	0.3579
6.3	0.5185	0.2772	0.3889

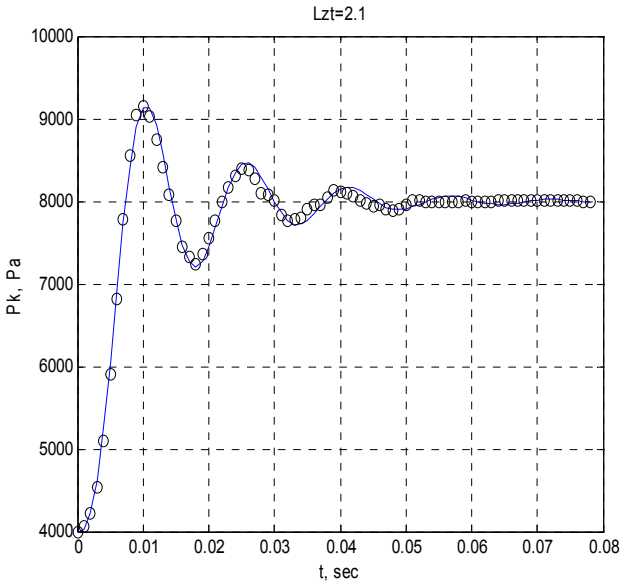

Fig. 1. Comparison of simulated transient process (-) with the experimental step response curve (o)

As we can see from Fig.1 the simulated transient process is close to the experimental step response curve. The maximum relative deviation of the simulated curve from the experimental one is 6.3 %.

Conclusion

Mathematical model of an impulse line was built. Simulated transient processes were compared to the experimental step response curves.

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Features of the Boiler (Centralized Heat Supply) During the Heating Season and Hot Water Supply

Marta Martynyak

Thermal Engineering, Thermal and Nuclear Power Stations Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12,
E-mail: marta.martynyak@gmail.com

Abstract – The work is relevant as it concerns the unresolved issues of municipal heat supply, heating supply industrial and household objects, as well as contributing to the development of decentralized heating. Currently during operation of district heating systems that exceeded their technical resource and upgraded systems we required only generalizing methods of calculation and analysis of exploitation and efficiency. For the first time developed a method for analysis boilers work in the district heating boiler plants during the heating season and hot water. It is shown that depending on the period, the heat loss into the environment must be considered as part of warmth or useful for own needs ΔQ_5^{κ} and ΔQ_5^{hl}.

Key words – boiler, heating, heat loss, centralized heat supply, heat consumer.

I. Introduction

The current state of outdated boilers and centralized heating systems require huge one-time expenses for their renewal. Often the new consumer dos'nt have possibility to connect to the already overloaded district heating system or it is a long way from centralized networks. The article deals the features of the boiler (DH) during the heating season and during summer.

II. Results of Research

At the the heating season boiler working modes provide hot water and heating for municipal and industrial facilities. During the summer boilers in boiler rooms working in a hot water mode.

The amount of heat-generating boilers n in boiler rooms in period τ during the summer can be defined:

$$Q_1 = \sum_{i=1}^{i=n} \int_0^{\tau} Q_i d\tau \qquad (1)$$

and for the year considering heating system facilities we will find as:

$$Q_1 = \sum_{i=1}^{i=n} \int_0^{\tau_p} Q_i d\tau_y \qquad (2)$$

The amount of heat that goes to heating system for residential and industrial objects we can define as:

$$Q_{hs} = Q_y - Q_1 \qquad (3)$$

or

$$Q_y = \sum_{i=1}^{i=n} \int_0^{\tau_p} Q_i d\tau_y - \sum_{i=1}^{i=n} \int_0^{\tau} Q_i d\tau \qquad (4)$$

The total heat Q_n which is generating in boilers is defined by:

$$Q_n = Q_{\kappa} + \Delta Q_{\kappa}^{hl} \qquad (5)$$

Q_{κ} – useful heat that generates in the boiler; ΔQ_{κ}^{hl} – heat loss in the boiler.

During heating season to enable secure and trouble-free operation of boiler in the boiler room is necessary to maintain at plus temperature equal to 10 °C and above. Sustaining that temperature provided certain expenses of heat for heating and for hot ventilation of air Q_{on} that goes for own needs.

In this case in regulatory documents and in the relevant calculations do not include the component of heat loss to the environment Q_5, which in this period need to refer to your preference boiler as useful heat, the total heat Q_{on}^{sum} and for own needs will consist of the amounts Q_{on} and Q_5^{on}

$$Q_{on}^{sum} = Q_{on} + Q_5^{on} \qquad (6)$$

Figure 1 is presented the boiler heat flow diagram in district heating system during the heating season.

In this case, the net efficiency of boiler will be find:

$$\eta_b^{н} = \eta_b (1 - e_{on}) \qquad (7)$$

where $e_{on} = \dfrac{Q_{on}^{sum}}{Q_{\kappa}} = \dfrac{Q_{on} + Q_5^{on}}{Q_{\kappa}}$ (8)

e_{on} – coefficient characterizing the cost of heat for own needs; η_b – gross efficiency of the boiler.

Depending on the season, and perfect surfaces enclosure boiler e_{on} could significantly vary from 0.5 to 5.6 %.

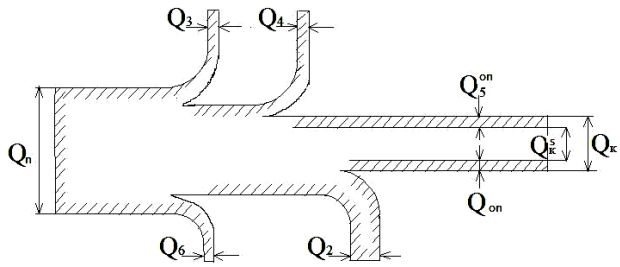

Fig. 1. Figure of the heat flow boiler in the district heating system during the heating season.

Q_n – the warmth of fuel, which is formed during its combustion fuel; Q_2 – the loss of heat from the exhaust gases; Q_3 and Q_4 – respectively heat losses from incomplete combustion and chemical mechanical air-dried brick Q_6 – heat loss of physical warmth of ash Q_5^{on} – heat used for own needs obtained through the boiler surface protecting.

$$Q_{on}^{sum} = Q^{on} + Q_5^{on} \qquad (9)$$

Q_{on}^{sum} – the total amount of heat used for boiler own needs; Q^{on} – the amount of heat spent for boiler own needs; Q_{κ}^{c} – useful heat entering the consumer; Q_{κ} – heat considering for own needs.

During the summer, when the boiler does not need to waste heat to maintain the positive temperature a certain heat loss into the environment Q_5 – must be considered as a useful heat and partly provided with air supply into the boiler fireplace. Boiler heat Q_5 through the building surface transferred to the environment and the air temperature in the boiler room can vary considerably by getting extra energy. Taking air from the boiler and feeding it into the boiler fireplace energy regeneration of occurs partial compensation of heat Q_5^{κ}.

The total amount of heat Q_5^{κ} will consist of two parts: a useful heat ΔQ_5^{κ} and heat losses ΔQ_5^{hl}

$$Q_5 = \Delta Q_5^{\kappa} + \Delta Q_5^{hl} \quad (10)$$

Diagram at fig. 2 shows the heat flow of boiler in district heating system with hot water supply in summer.

ΔQ_5^{hl} – heat loss into the environment; ΔQ_5^{κ} – useful heat entering the of boiler fuel with air; Q_{κ}^{s} – boiler useful heat that goes consumer with water or water steam; Q_{κ} – heat considering for own needs; Q^{on} – heat used for own needs.

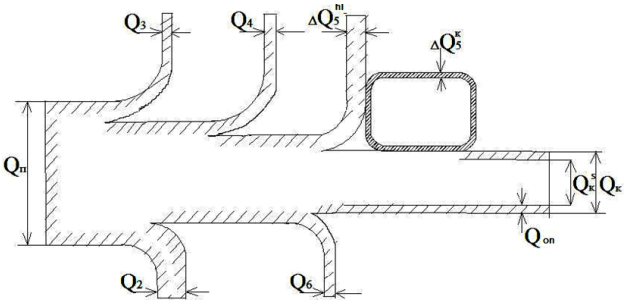

Fig. 2. Figure of the boiler heat flow in the district heating system used only for the hot water supply facilities during the summer

As we can see from the chart (Fig. 2) share of heat ΔQ_5^{κ} is a useful and it enters into the boiler fuel with air.

Implementing experimental research 4 boilers KVHM-50 in boiler room during the year shows that useful heat ΔQ_5^{κ} varies seasonally and varies from 0.25 % in winter to 0.06 % during the summer.

Fig. 3 shows the change of heat from the boiler room according to the time of year.

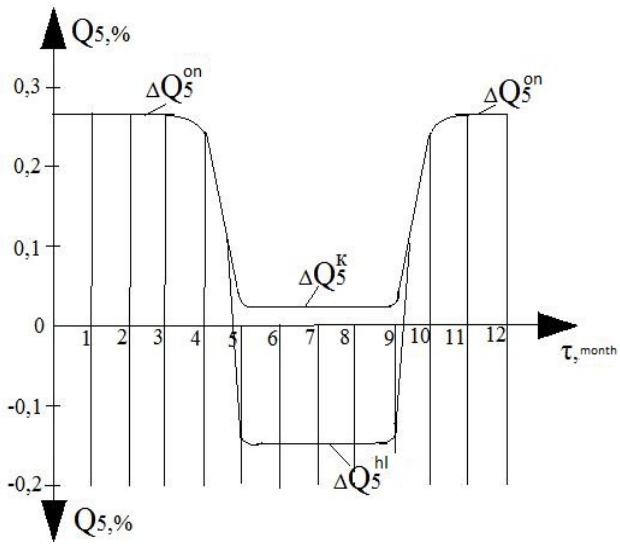

Fig. 3. Diagram of the distribution of heat boiler room with heating capacity 200 Gcal/h with 4 boilers KVHM-50 per months during the year (for the Western region of Ukraine)

Conclusion

The current state of outdated boilers and central heating systems requires huge one-time investment for their renewal and modernization. However we have not enough information in the literature about the analysis of complex systems of centralized and decentralized heating. There are no methods for calculating efficiency of their work as the only heating system including taking into account the heat consumers. In considering such systems changes in the heat balance are not taken into account, which leads to some errors in the calculation of their efficiency. So improving methods of analysis efficiency and development of centralized and decentralized heating and heat consumers is a topical task.

The experimental research of changes the efficiency of different types of boilers to the district heating system in different periods in Western Ukraine shows that during the winter boiler heat goes to heating equipment of boiler plants for its own needs and it changes depending on the operating conditions, such as boilers and seal constructions in a wide range from 0.2 to 2.5 %, also during summer useful heat fuel goes to the boiler room and it directly depends on the particular operation, such as boilers or buildings construction and it ranges from 0.04 to 0.7 %.

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Mathematical Model for Investigation of Wave Processes in High-Voltage Transformers

Oleksander Kurylyshyn

Lviv Polytechnic National University,
Institute of Electric Power Engineering and Control Systems,
Department of Electric Stations, S. Bandery street 28a,
E-mail: k.oleksandryk@gmail.com

Abstract – A mathematical model intended for research of wave processes in high-voltage transformers was developed. The variable separation method was used to solve the integral-differential equations describing the process under research. The voltage distribution in the transformer windings under the influence of the impulse overvoltages was analyzed.

Key words – transformer winding, mathematical modelling, impulse overvoltage, partial derivatives, initial conditions, boundary conditions.

I. Introduction

In general the mathematical modelling of wave processes transformers can be classified respectively to mathematical methods used for analysis of the problem. These approaches are known as "white box", "black box" and "grey box" modelling methods.

The “white box” modelling method requires formation of separate mathematical models of different elements of the electric power system with consideration of all parameters of its equivalent circuit. Such an approach allows us to analyse the process inside the element under research.

The "black box" approach does not require construction of the mathematical model for every element of electric power system. In this approach the coordinates of element’s model are calculated or measured on the input and output terminals of the oblect. For this purpose the method of state variables is used because it allows to analyse and synthesize electric power system from the point of view of electromagnetic compatibility of all its elements. It makes it possible to define currents and voltages at any time moment.

The “Grey box” method is a combination of “White box” and “Black box” approaches as it was introduced in [3].

The main reason to develop the mathematical model of the transformer based on "white box" modelling method is to calculate the voltage along the transformer winding under the impulse overvoltages of different shapes and free oscillations inside the winding that allows to coordinate the insulation of the windings. Coordination of insulation is a set of measures which prevent the damaging of the insulation of all electric power system elements with minimal costs.

The mathematical analysis of internal voltage oscillations in the transformer windings can be divided into the next stages:

1) formation of differential equations describing the voltage fluctuations based on equivalent circuit of the transformer winding;

2) formation of the boundary conditions at the windings ends;

3) determination of the initial voltage distribution along the winding under the pulse overvoltage;

4) determination of the final voltage distribution;

5) initial voltage distribution along the winding voltage to be equal to the final distribution functions plus free oscillations for the initial point ($t = 0$);

6) solving of the equations under influence of the wave with an arbitrary shape.

Voltage oscillations in the transformer windings cause appearing of overvoltages relatively to the ground as well as between the winding coils and transformer windings. These amplitudes and gradient overvoltages can be reduced by:

1) decreasing of internal oscillating overvoltages in the transformer winding;

2) influencing the overvoltage applied to the winding;

3) influencing the transformer neutral voltages.

These three factors are very important during the transformer circuits protection from overvoltages.

Therefore the goal of the research is to develop the mathematical models intended for the research of wave processes in the windings of high voltage two- windings transformers influenced by impulse overvoltasges based on solving of differential equations in partial derivatives by separation of variables. During the study of wave processes in the transformer windings it is necessary to consider the relationship between the propagation time of electromagnetic wave along the entire length of the winding and time interval when current and voltage change more evidently in comparing with their full changes during process to be considered. Voltage oscillation in the coil arises with the frequency corresponding to the whole winding, and with its own frequency of the coil. These oscillations depend on the inductive and capacitive coupling in the winding. Free oscillations are characterized by high frequencies and they almost completely damp.

In the paper a new approach to form a mathematical model which will consider the distributed parameters and allow to conduct calculation of pulse overvoltages with considering of all parameters of the equivalent circuit. In order to study the wave processes in transformers while external overvoltages take place it is necessary to simulate the shape of the wave. Empirical equation, which describes the shape of the pulse wave is [1, 2]:

$$e = E(e^{-at} - e^{-bt}), \tag{1}$$

where E is maximmum value of the wave potential; a and b are parameters of the wave and t is a time parameter.

Impulse wave is characterized by the following parameters: the maximum value of the wave potential (amplitude); the length of the front; part of the wave from 0 up to E_{max}; the length of the wave; part of the wave from E_{max} to the half of the amplitude; and by the sign of the amplitude.

The wave tail can be reached approximately for 20 ms. Therefore it is necessary to select parameters of the equation (1), and if a and b have real values then the equation (1) can represent the wave with rounded front and exponential tail.

II. Mathematical Model

Equations in partial derivatives which describe the wave processes in the transformer windings can be written down as [3-6]

$$-\partial i_n / \partial x = g_0 u_n + C_0 \partial u_n / \partial t - \\ -C_{M0} \partial^3 u_n / (\partial x^2 \partial t), \tag{2}$$

$$-\partial u_n / \partial x = r_0 i_n + L_0 \partial i_n / \partial t. \tag{3}$$

Let us use in equations (2) and (3) one variable $u(x,t)$ For this purpose the equation (2) should be differetiated by t and multiplied by L_0:

$$L_0 \partial^2 i_n / (\partial t \partial x) + L_0 g_0 \partial u_n / \partial t + \\ + L_0 C_0 \partial^2 u_n / \partial t^2 - \\ - L_0 C_{M0} \partial^4 u_n / (\partial x^2 \partial t^2) = 0, \tag{4}$$

and the equation (3) was differentiated by x

$$\partial^2 u_n / \partial x^2 + r_0 \partial i_n / \partial t + L_0 \partial^2 i_n / (\partial t \partial x) = 0. \tag{5}$$

Let us subtract the equation (5) from equation (4). As a result of this operation we have

$$-L_0 C_{M0} \partial^4 u_n / (\partial x^2 \partial t^2) + L_0 C_0 \partial^2 u_n / \partial t^2 - \\ -\partial^2 u_n / \partial x^2 + L_0 g_0 \partial u_n / \partial t - r_0 \partial i_n / \partial x = 0. \tag{6}$$

Let us substitute into the equation (6) instead of the derivative di_n/dx its value from the equation (2). After this operation we can obtain an equation which contain just one unknown function $u(x,t)$ or in other words we have

$$-L_0 C_{M0} \partial^4 u_n / (\partial x^2 \partial t^2) - \\ -r_0 C_{M0} \partial^3 u_n / (\partial x^2 \partial t) + \\ + L_0 C_0 \partial^2 u_n / \partial t^2 - \partial^2 u_n / \partial x^2 + \\ (r_0 C_0 + L_0 g_0) \partial u_n / \partial t + r_0 g_0 u_n = 0. \tag{7}$$

To solve the equation (7) let us use the method of variable separation.

We will consider that $a = L_0 C_{M0}$, $b = r_0 C_M$, $c = L_0 C_0$, $h = r_0 C_0 + L_0 g_0$, $s = r_0 g_0$.

In such a case

$$-a \partial^4 u_n / (\partial x^2 \partial t^2) - b \partial^3 u_n / (\partial x^2 \partial t) + \\ + c \partial^2 u_n / \partial t^2 - \partial^2 u_n / \partial x^2 + h \partial u_n / \partial t + s u_n = 0. \tag{8}$$

Initial and boundary conditions can be written down as follows:

$$u\big|_{t=0} = u_0(x), \ x \in (0,l); \tag{9}$$

$$\partial u / \partial t\big|_{t=0} = u_1(x); \tag{10}$$

$$u\big|_{x=0} = f_0(t), \ t > 0; \tag{11}$$

$$u\big|_{x=l} = f_1(t). \tag{12}$$

We have a concorance of conditions

$$f_0(0) = u_0(0); \quad f_1(0) = u_1(l); \\ f_0'(0) = u_1(0); \quad f_1'(0) = u_1(l). \tag{13}$$

We should find functions $A(t)$ and $B(t)$ to ensure the homogeneus conditions (11) (12) when substitition of

$$u(x,t) = V(x,t) + A(t) + xB(t), \tag{14}$$

will give for $V(x,t)$ homogeneus conditions (11)-(12),

$$V\big|_{x=0} = 0; \ V\big|_{x=l} = 0. \tag{15}$$

So, according to (14) we have that

$$u\big|_{x=0} = V\big|_{x=0} + A(t) = f_0(t);$$

$$u\big|_{x=l} = V\big|_{x=l} + A(t) + lB(t) = f_1(t),$$

from where we can see that

$$A(t) = f_0(t); \\ B(t) = 1/l(f_1(t) - f_0(t). \tag{16}$$

Instead of (9)-(10) the following conditions apper

$$u\big|_{t=0} = V\big|_{t=0} + A(0) - xB(0) = u_0(x); \\ \partial u / \partial t\big|_{t=0} = \partial V / \partial t\big|_{t=0} + A'(0) + \\ + xB'(0) = u_1(x), \tag{17}$$

or

$$V\big|_{t=0} = u_0(x) - A(0) - xB(0) \equiv V_0(x); \\ \partial V / \partial t\big|_{t=0} = u_1(x) - A'(0) - xB'(0) \equiv V_1(x). \tag{18}$$

An equation for the variable V we can obtain after substitution of equation (14) into the equation (8)

$$-a \partial^4 V / (\partial x^2 \partial t^2) - b \partial^3 V / (\partial x^2 \partial t) + \\ + c(\partial^2 V / \partial t^2 + A''(t) + xB''(t)) - \\ -\partial^2 V / \partial x^2 + h(\partial V / \partial t + A'(t) + \\ + xB'(t)) + s(V + A(t) + xB(t)) = 0, \tag{19}$$

or

$$-a \partial^4 V / (\partial x^2 \partial t^2) - b \partial^3 V / (\partial x^2 \partial t) + \\ + c \partial^2 V / \partial t^2 - \partial^2 V / \partial x^2 + \\ + h \partial V / \partial t + sV = F(x,t), \tag{20}$$

where $F(x,t)$ is known right part, namely

$$F(x,t) = -cA''(t) - cxB''(t) - hA'(t) - \\ -hxB'(t) - sA(t) - sxB(t). \tag{21}$$

Equations (8)-(12) where replaced by equations (20), (18), (15).

A solution should be found out in the form of Fourier series

$$V(x,t) = \sum_{k=1}^{\infty} c_k(t) \sin \pi k x / l, \ 0 < x < l. \tag{22}$$

The condition (15) is fulfilled if $C_k(t)$ fast enough approaches zero if $k \to \infty$.

Let us expand functions $V_0(x)$ and $V_1(x)$ in a Fourier series, hence

$$V_0(x) = \sum_{k=1}^{\infty} \alpha_k \sin(\pi k x / l);$$
$$V_1(x) = \sum_{k=1}^{\infty} \beta_k \sin(\pi k x / l). \quad (23)$$

Conditions (18) for the function (22) will be fulfilled if

$$C_k(0) = \alpha_k;$$
$$C'_k(0) = \beta_k, \quad (24)$$

where $k = 0,1,\ldots$

Using 22 transform the left side 19 so

$$-a\partial^4 V(x,t)/(\partial x^2 \partial t^2) - -c\partial^3 V(x,t)/dt^2 = = \sum_{k=1}^{100} (a(\pi k/l)^2 + c) \times \times \partial^2 C_k(dt^2)/(\partial t^2) \sin(\pi k x/l)); \quad (25)$$

$$-b\partial^3 V(x,t)/(\partial^2 u dt) - h\partial V(x,t)/dt = = \sum_{k=1}^{100} (b(\pi k/l)^2 + h) \times \times \partial C_k(t)/(\partial t^2) \sin(\pi k x/l); \quad (26)$$

$$-\partial^2 V(x,t)/(\partial x^2) - s\partial V(x,t)/dt = = \sum_{k=1}^{100} (b(\pi k/l)^2 + s) C_k(t) \sin(\pi k x/l). \quad (27)$$

We introduce the notation:

$$a_1 = (\pi k/l)^2 + c;$$
$$b_1 = (\pi k/l)^2 + h; \quad (28)$$
$$c_1 = (\pi k/l)^2 + s.$$

The result is equation

$$a_1 d^2 C_k(t)/(dt) + +b_1 dC_k(t)/dt + c_1 C_{k(t)} = \gamma_k(t), \quad (29)$$

or

$$a_1 e_1(t) + b_1 e_2(t) + c_1 = 0. \quad (30)$$

Write characteristic equation

$$a_1 \lambda^2 + b_1 \lambda + c_1 = 0, \quad (31)$$

at $k \to \infty$ get

$$\lambda^2 + \lambda + 1 = 0. \quad (32)$$

Solve the solution of equation as

$$\lambda_{1,2} = \delta + j\theta;$$
$$e_1(t) = e^{\delta t} \cos(\theta \cdot t);$$
$$e_2(t) = e^{\delta t} \sin(\theta \cdot t).$$

According to the method of variation of arbitrary constants we obtain C_k as

$$C_k(t) = B_1(t) e_1(t) + B_2(t) e_2(t). \quad (33)$$

Function $B_1(t)$ and $B_2(t)$ looking from the system of equations

$$\frac{dB_1(t)}{dt} e_1(t) + \frac{dB_2(t)}{dt} e_2(t) = 0;$$
$$\frac{dB_1(t)}{dt} \frac{de_1(t)}{dt} + \frac{dB_2(t)}{dt} \frac{de_2(t)}{dt} = \frac{1}{a_1} \gamma_k(t), \quad (34)$$

entering a designation

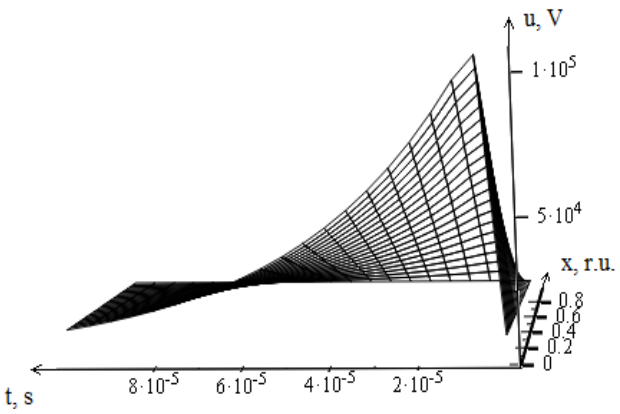
$$\Delta = \begin{vmatrix} e_1(t) & e_2(t) \\ de_1(t)/dt & de_2(t)/dt \end{vmatrix},$$

and find

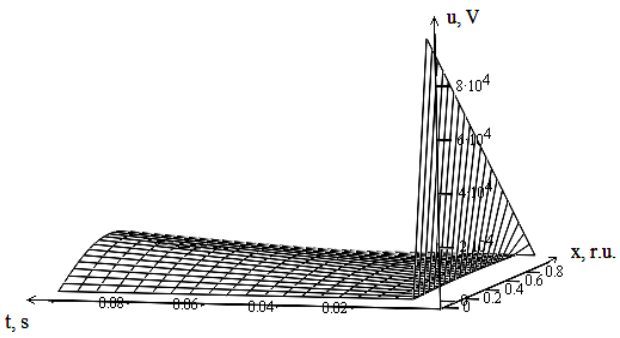
$$dB_1(t)/dt = -\frac{1}{a_1 \Delta} \gamma_k(t) e_2(t);$$
$$dB_2(t)/dt = -\frac{1}{a_1 \Delta} \gamma_k(t) e_1(t). \quad (35)$$

$B_1(t)$ and $B_2(t)$ get as

$$B_1(t) = \int_0^t dB_1(t)/dt + B_1(t)_{t=0};$$
$$B_2(t) = \int_0^t dB_2(t)/dt + B_2(t)_{t=0}.$$



a) $t = 1 \cdot 10^{-7} \ldots 1 \cdot 10^{-4}$ s



b) $t = 1 \cdot 10^{-4} \ldots 0.1$ s

Fig. 1. The voltage distribution along winding of transformer for variable values of time

Conclusion

Derived mathematical approach makes it possible to investigate the wave processes in the windings of the high-voltage transformers taking into account the dependence of voltage and current on the winding length and time. Under research of wave processes in the windings of transformers it is necessary to take into account the ratio between the time interval of propagation of electromagnetic waves along the entire length of the winding and an interval of time when current and voltage are changed more significantly in comparing with their full change in the process that was under research.

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Modeling and Analysis of Processes in Synchronous Generator with PWM Controlled Excitation System

Mykola Semeniuk[1], Vasyl Tutka[2]

[1]Institute of Power Engineering and Control Systems,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: mykola.semenyuk@gmail.com

[2]Burshtyn Power plant, UKRAINE, Burshtyn,
E-mail: TutkaVV@dtek.com

Abstract – The mathematical model of synchronous generator with PWM contlolled excitation system has been developed by using mathematical modelling method. The research results of the transient and steady-state mode of generator voltage regulation are presented.

Key words – static excitation system, synchronous generator, closed loop system, automatic voltage regulator, PI voltage controller, full bridge DC/DC converter, AC/DC converter, rectifier, pulse width modulation, power system simulation.

I. Introduction

The main task of static excitation system of synchronous generator is to provide voltage stability with high accuracy [2-5, 7]. Static excitation system with semiconductor controlled rectifier (SCR) provides relative terminal voltage stability of ± 2.5 % [6]. In this paper it is offered to use full bridge DC/DC converter with pulse width modulation (PWM) for static excitation system instead SCR.

II. Static Excitation System

The power unit consists of synchronous generator with static excitation system and three power load. (Fig.1). The static excitation system includes: AC/DC converter (rectifier), full bridge DC/DC converter and automatic voltage regulator (AVR). Power scheme of the static excitation system is shown in Fig.2.

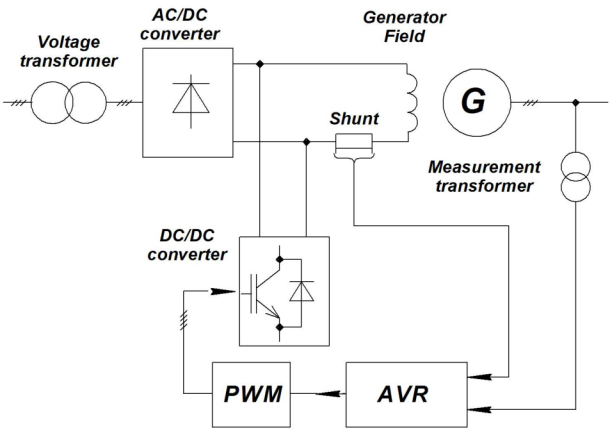

Fig. 1. The function scheme of the power unit

The closed loop system is used for the termainal voltage stability of synchronous generator (Fig.3). The actual value of synchronous generator terminal voltage is compared with an adjustable generator voltage setpoint and is taken to the input of the PI voltage controller.

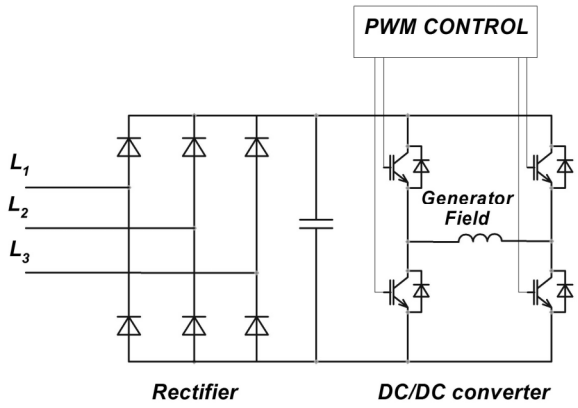

Fig. 2. The power scheme of synchronous generator excitation system

The PI voltage controller with adjustable gain and time response provides an output signal which is applied to the setpoint input I_{ref} of the secondary field current controller. The output of this controller governs the generation of frequency-modulated driving pulses for the power IGBT of associated output stage, which is operated with a clock frequency of about 1 kHz.

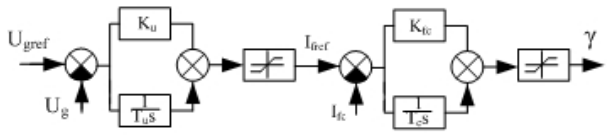

Fig. 3. The structure scheme of synchronous generator AVR

III. Mathematical Model

The mathematical model of the power unit, which includes synchronous generator, three phase power load and static excitation system, is developed using mathematical modeling method of prof. Plachtyna [1]. Power network, AC/DC converter and full bridge DC/DC converter, that are used for supply synchronous generator field, are represented in the mathematical model as a voltage supply. Excitation voltage of synchronous generator is shown in Fig.4.

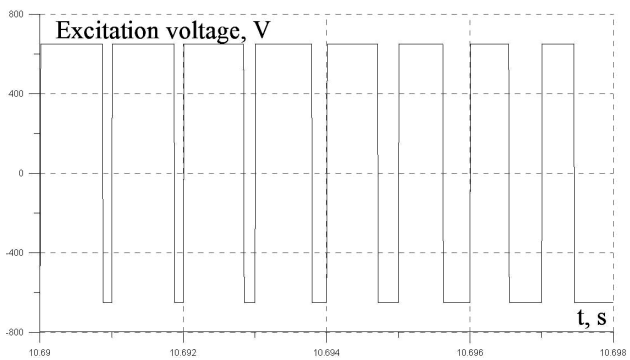

Fig. 4. The synchronous generator excitation voltage

Technical data for synchronous generator: active power 210 MW; nominal voltage – 15750 V, nominal stator current – 9060 A; no load excitation current – 715 A; nominal excitation current – 1545 A; stator resistance -

0.0024 Ω, exciation resistance - 0.174 Ω; inductive reactances X_d = 1.997 RU, X_{ad} = 1.723 RU, X'_d = 0.34 RU, X''_d = 0.223 RU. Number of pole pairs – 1. Moment of inertia - 18500 kg·m^2.

Developed mathematical model of power unit works in real time. It means that computer model can be used for testing of synchronous generator excitation systems.

IV. Resaerch Results

The research results of generator switching-on to the power load with 95 % active power load are shown in Fig.5 - Fig.8.

The stator current has increased with three fluctuation and oscillation damping time is about 2.5 s in the loading mode of synchronous generator (Fig.5).

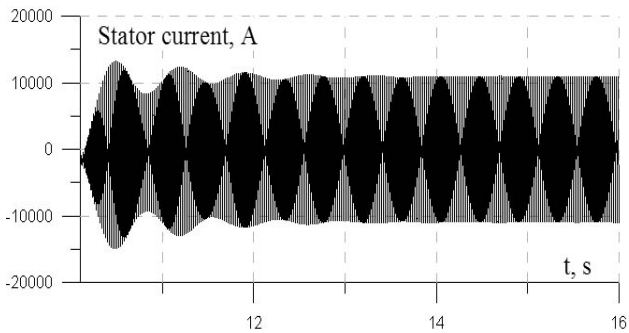

Fig. 5. The synchronous generator stator current

The terminal voltage has decreased in 1.5 % in the dynamic mode. Terminal voltage has stabilizited in the steady-state (Fig.6).

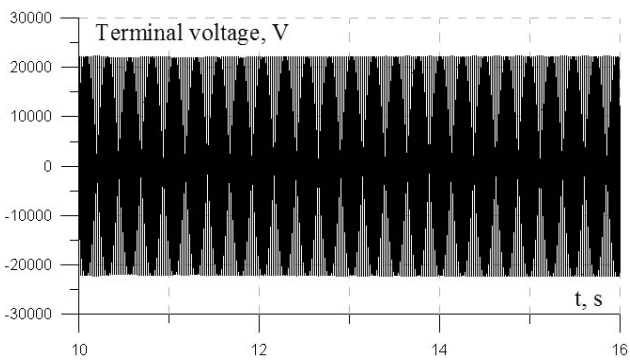

Fig. 6. The synchronous generator terminal voltage

The excitation current of synchronous generator has increased to 1500 A for stabiliziting terminal voltage (Fig.7).

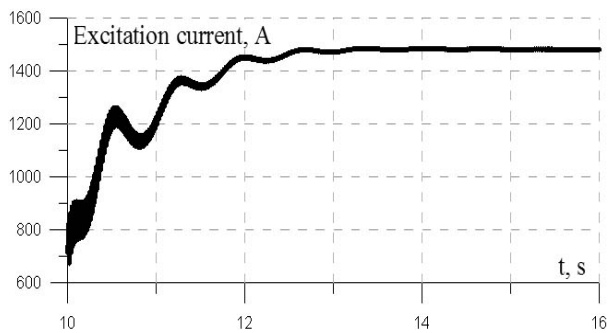

Fig. 7. The synchronous generator excitation current

Torque angle of synchronous generator has increased to 55° (Fig.8).

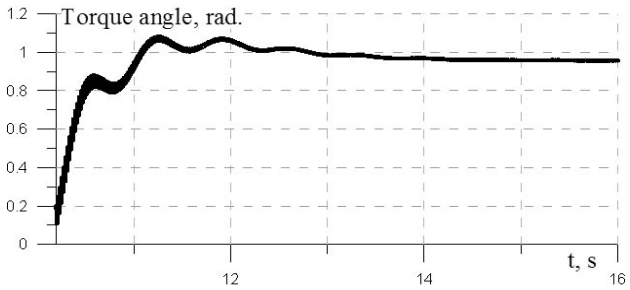

Fig. 8. The synchronous generator torque angle

Research results of processes in power unit with synchronous generation and PWM and PI automatic voltage regulator show that terminal voltage stability of synchronous generator is provided by static error circa 0 % and dynamic error – 1.5 %.

Conclusion

Static excitation system of synchronous generator with PWM regulation of excitation current provides high accurancy of terminal voltage stability through better quality of field generator current than SCR excitation regulation.

PWM controlled excitation systems of synchronous generator are recommended to be used instead of SCR excitation systems because of high regulation characteristics.

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Determination of Cost of Contra-Rotating Wind Turbine with Transformer with Rotating Half

Andrii Kovalchuk[1], Vasyl Khai[2]

[1]Department of Electrical Machinery and Apparatus, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: kovalchukandrii88@gmail.com

[2]Department of Electrical Machinery and Apparatus, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: vkhay@hotmail.com

Abstract – For effective use of low-speed potential of a wind use low-power wind turbines with vertical axis of rotation (VAWT). A new design of contra-rotating noncontact VAWT in which two wind rotors rotate in opposite directions is proposed. The contactless transmission of generated power from the multipole permanent magnet synchronous generator (PMSG) and the regulation of electric power carries a special device – a transformer with rotating half (TRH). The cost of VAWT of the classical and offered sample is determined. The offered design of contra-rotating VAWT has till 42 % lower cost than a traditional design of wind turbine with vertical axis of rotation, and this cost advantage grows with reduction of power.

Key words – contra-rotating wind turbine, wind turbine with a vertical axis of rotation, a transformer with rotating half.

I. Introduction

In different territories of Ukraine the potential of wind power is characterized by low average annual speeds of a wind which makes 4 – 5 m/s. low-power wind turbines with vertical axis of rotation (VAWT) which are installed directly at consumers [1] can use this potential. Because of simplicity and reliability of a design, possibility of installation directly on houses, and also low noise level, expedient is use of VAWT. For maximum efficiency in VAWT is used synchronous generators with excitement from permanent magnets (PMSG).

Use of VAWT in which the inductor PMSG is connected to a rotor and an anchor with a contra-rotating part, which are rotating diversely, allows to reduce the sizes and cost of the generator [2]. However there is a problem in transfer of the made electric energy from a mobile anchor of PMSG.

The new design of contra-rotating VAWT in which for transfer of the made electric power from mobile part of PMSG the transformer with the rotating half (TRH) is offered. In TRH a half of the core rotates together with a mobile anchor of PMSG, and other part is motionless. Also TRH carries out regulations of output voltage of VAWT by switching of branches on its secondary winding. It gives the chance to get from a wind the maximum quantity of energy [3].

II. Material and Results of Researches

To be convinced of prospects of application of a contra-rotating design of VAWT, it is necessary to carry out comparison of cost of a traditional design (a wind a rotor, the generator, the active rectifier, the battery) and offered (two wind-rotors, the generator, TRH, the electronic control unit and the battery).

The cost of mechanical part of classical VAWT is determined on the basis of the VAWT market analysis. For the contra-rotating VAWT the cost of mechanical part is increased by 20 % because of complication of the rotating parts.

For generation of electric energy in VAWT much polar axial PMSG is used. Design data of such generators for a number of capacities is specified in the Table 1. It is determined by results of the carried-out design calculations according to the developed technique. On the basis of the received electric, magnetic and mass-dimensional results of determination of cost of active materials of a designed generator. Costs of generators in general is determined by equation

$$C_G = k_p k_m (m_{Cu} c_{Cu} + m_{Fe} c_{Fe}) + m_{pm} c_{pm}, \qquad (1)$$

where:

k_p = 1.4 – the coefficient considering production cost;

k_m = 1.3 – the coefficient considering the cost of the materials necessary for production of the basic and rotary device;

m_{Cu}, m_{Fe}, m_{pm} – the mass of copper, steel and magnets with NdFeB;

c_{Cu}, c_{Fe}, c_{pm} – prices of copper, steel and magnets.

Coefficients k_p and k_m in equation (1) do not include parameters of magnets because of their high cost and rather small work which is needed for installation. Angular speed of the generator of contra-rotating VAWT is twice above, than in a classical design. It means that it has twice smaller number of couples of poles p. As values of capacities and currents of an anchor of PMSG in traditional and contra-rotating VAWT have to be identical, a ratio between their angular speeds and the moments have to be the following:

$$\omega_{cr} = p\omega_{cl}; \; M_{cr} = \frac{M_{cl}}{p}, \qquad (2)$$

Indexes "cr" and "cl" are for contra-rotating and classical options. Dimensions of the generator will decrease with reduction of the number of couples of poles in contra-rotating VAWT in comparison with the classical. For the purpose of receiving good technical and economic results of the generator it is necessary to leave in both designs invariable value of the amplitude of induction in an air interval $B_\delta = const$.

For this purpose, at preservation of invariable axial length l_δ of the generators, between their diameters D and number of conductors per unit of length of boring of the stator N following conditions should be executed:

$$D_{cr} = \frac{D_{cl}}{p^{\alpha}}; \; N_{cr} = \frac{N_{cl}}{p^{-\alpha}}, \qquad (3)$$

α – coefficient which value lies in limits $0 \le \alpha \le 1$.

$$C_A = \frac{D_{cr}^2 l_\delta \omega_{cr}}{P_e}, \qquad (4)$$

P_e – electromagnetic power.

TABLE 1

THE COST OF AUTONOMOUS ELECTROMECHANICAL SYSTEM OF VAWT

The elements of VAWT	Typ of VAWT					
	Classical with 1 windwheel and the uncontrollable rectifier			The contra-rotating noncontact TRH		
Power of VAWT, kW	0.4	1	2	0.4	1	2
Mechanical part	3730	8930	17040	4480	10720	20450
Generator	7810	10320	12960	5550	7330	9200
Active rectifier	9830	12180	14680	-	-	-
TRH	-	-	-	1820	3580	5650
Electronic control unit	-	-	-	480	480	480
VAWT in general	21370	31430	44680	12330	22110	35780

Having substituted expressions (2) and (3) in (4) we will receive the final equation:

$$C_A = \frac{D_{cl}^2 l_\delta p \omega_{cl}}{p^{2\alpha} P_e} \quad (5)$$

From expression (5) it turns out that Arnold's constant remains to a constant, when α = 0.5. This value was also used for calculation of mass of active materials of designs of generators for the contra-rotating VAWT proceeding from the corresponding masses for generators of the same capacities, but with biger twice value p for classical VAWT.

Using the aforesaid, it is possible to write down dependences for determination of mass of active materials of the generator of contra-rotating design of VAWT:

$$m_{Cu.cr} = p^{0.5} m_{Cu.cl} \quad (6)$$

$$m_{Fe.cr} = p^{0.5} m_{Fe.cl} \quad (7)$$

$$m_{pm.cr} = p^{0.5} m_{pm.cl} \quad (8)$$

Costs of generators for contra-rotating VAWT are specified in Table 1.

Costs of active rectifiers of voltage which are one of elements of classical VAWT which are given in Table 1, are received on the basis of the analysis of the market of such devices. In contra-rotating VAWT instead of this element the simple electronic block providing contactless switching of branches of TRH is used. The simple logical controler, simistor and the diode bridge are a part of this block. Its estimated cost is also given in Table 1.

The cost of the batteries (B) is a constant for contra-rotating and classical systems of VAWT through the identical power of these systems. Because of it, and also because of other factors which influence on B capacity they aren't included in the total cost of electromechanical system of autonomous VAWT.

Costs of active rectifiers of tension which are one of elements of classical VAWT which are given in Table 1, are received on the basis of the analysis of the market of such devices. In counter rotor system of VAWT instead of this element the simple electronic block providing contactless switching of branches of TRH is used. Simistor, the simple logical controler and the diode bridge are a part of this block. Its estimated cost is also given in Table 1.

The cost of the batteries (B) is a constant for a counter rotor and classical systems of VAWT through the identical power of these systems. Because of it, and also because of other factors which influence on capacity of B they aren't included in the total cost of electromechanical system of autonomous VAWT.

The cost of elements paid off at the hryvnia exchange rate relation to dollar exchange rate – 23:1.

Conclusion

The technical and economic assessment of a new design of contra-rotating noncontact VAWT showed that it is competitive with classical system of VAWT with one vertically focused rotor. Its cost is up to 42 % lower, than the cost of a traditional design of VAWT with VAR in a power range from 0.4 to 2 kW, and this cost advantage grows with reduction of power.

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Investigation of Ultrasonic Flowmeter Error in Conditions of Distortion of Flow Structure

Vitalii Roman, Fedir Matiko

Department of Automation of Heat and Chemical Processes,
Lviv Polytechnic National University, UKRAINE,
Lviv, S. Bandery street 12,
E-mail: roman.vitaliycfd@gmail.com

Annotation – Ultrasonic flowmeter error caused by distortion of flow structure has been investigated in this paper. Minimum number of acoustic chordal paths of multi-channel ultrasonic flowmeter was determined that ensures the error caused by distortion of flow structure less than the specified limits ±0.3 %. The authors used Salami velocity function as a model of distortion of flow structure. Acoustic path configurations of ultrasonic flowmeter were determined using classical numerical methods of integration of Gauss-Jacobi. The authors improved the flow rate equation of ultrasonic flowmeter by introduction of calibration coefficient that was determined using symmetric component of Salami function.

Key words – ultrasonic flowmeter, flow structure, local fitting, Salami function, numerical method of integration, acoustic path, calibration coefficient.

I. Problems

Ultrasonic flowmeter (USM) is often installed at measuring pipeline (MP), which contain different types of local fittings (LF) – flap, bend, group of bends, etc. Each LF distorts the flow structure (velocity profile) that passes through it. The USM installed at a short distance after the LF (downstream the fitting) can measure flow with error δ_A, which is caused by distortion of flow structure. Value of the error δ_A varies with the type and location of LF, as well as the acoustic path configurations (their number) and may reach 10 % [1, 2]. One of the main way to reduce errors δ_A is increasing the number of acoustic paths (AP) of USM. In this paper a technique to reduce error USM which is caused by distortion of flow structure is investigated. This technique means determining of the minimum number of APs USM that provides δ_A error less than limits set by regulations.

II. Investigation USM error

Equation for the volumetric flow rate measured by multi-path USM can be written as this

$$q_{USM} = \pi R^2 \sum_{i=1}^{N} \left(\frac{w(i) 2\sqrt{R^2 - x(i)^2}}{\pi R} u_h(i) \right) \qquad (1)$$

where q_{USM} – volumetric flow rate at working conditions; R – internal radius of USM section (pipe in wich USM is installed) ; $x(i)$, $w(i)$ – position coordinate and weighting factor of i-th chordal AP USM; u_h – average flow velocity along the i-th chordal AP USM; N – number of the AP USM.

To select the $x(i)$ and $w(i)$ for a specified value of N use classic numerical methods of integration (NMI) [5]. In this paper two NMI is uses: Gauss-Jacobi (α, β = 0.5) and Gauss [3].

To apply the formula (1), it is necessary also to determine the flow velocity along the chordal AP u_h. In this work, the authors used to determine u_h analytical models of distortions of flow structure which professor L.A. Salami proposed. Functions Salami are dependencies of the relative flow velocity u/u_{max} of polar coordinates – angle θ and relative radius $r = R/R_{max}$. Functions Salami are based on experimental data and describe adequately kinematic structure of the flow at the exit of the fittings different types [4]. Each function Salami consists of two terms: one – describes the undistorted velocity profile (u_{sym}), and the second – describes the distorted velocity profile (u_{asym}).

We propose to use the following formula with polar functions Salami for calculation the average flow velocity along the AP

$$u_h = \frac{\left[\int_0^{\sqrt{R^2-x^2}} u_{SAL}\left(\sqrt{x^2+l^2}, \theta + arctg\frac{l}{x} \right) dl + \int_0^{\sqrt{R^2-x^2}} u_{SAL}\left(\sqrt{x^2+l^2}, \theta - arctg\frac{l}{x} \right) dl \right]}{2\sqrt{R^2-x^2}} \qquad (2)$$

where u_{SAL} – velocity profile (function Salami); θ – angle of measuring plane which passes chordal AP relative to the horizontal plane; l – length of chordal AP USM.

Position coordinates $x(i)$ and weights factors $w(i)$ APs defined for the flow velocity profile that is different to the velocity profile (u_{sym}) function Salami. Therefore, the results of calculating flow rate in equation (1) differ from the flow rate calculated by direct integration undistorted velocity profile (u_{sym}) function Salami. The calibration coefficient k_{cal} is proposed to introduce to the equation (1) in order to improve it:

$$k_{cal} = \frac{q}{q_{USM}} = \frac{2\pi \cdot \int_0^1 r(1-r)^{\frac{1}{n}} dr}{q_{USM}} \qquad (3)$$

where q – the volumetric flow rate calculated at an average flow velocity of the cross section of MP, obtained by direct integration of a power law distribution flow velocity (corresponding u_{sym}); q_{USM} – the value volumetric flow rate defined by the formula (1) in which the flow velocity along chordal AP u_h determined by the formula (2) provided u_{asym} = 0. Equation (1) with calibration coefficient k_{cal} is applied for investigation of USM error δ_A caused by distortion of flow structure:

$$\delta_A = \frac{(q_{USM} - q_{SAL})}{q_{SAL}} \cdot 100 . \qquad (6)$$

We propose to calculate the values of flowrate q_{SAL} using the values of the flow velocity at each point of the cross section of pipe defined with Salami function

$$q_{SAL} = \int_0^{2\pi} \left(\int_0^1 r \cdot u_{SAL}(r, \theta) dr \right) d\theta . \qquad (4)$$

Particularly integrating of function Salami P09 (5) with formula (4) is made in this work. Salami P09 function

describes the distortion of the velocity profile downstream of a single bend:

$$u_{SAL} = u_{sym} + y_{asym} = \\ = (1-r)^{\frac{1}{9}} + \frac{2}{\pi^5} r (1-r)^{\frac{1}{4}} \theta^2 (2\pi - \theta)^2 \quad (5)$$

Fig.1 shows a three-dimensional flow velocity profile calculated with function Salami P09.

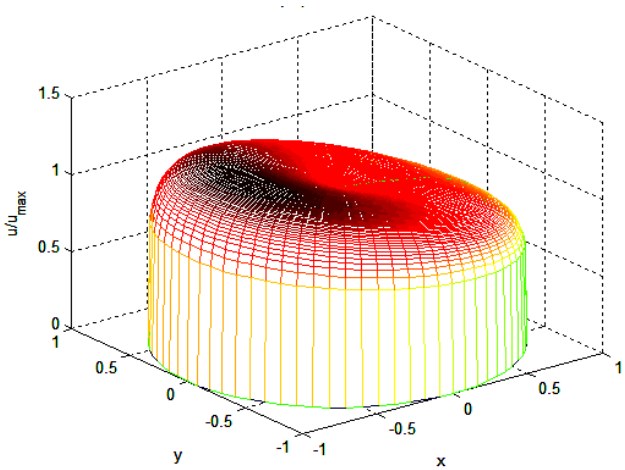

Fig. 1. 3D velocity profile described function Salami P09

For calculation USM error δ_A following limitations we use: the value of the angle θ = 90° (corresponding to a horizontal plane position chordal AP USM); $N = 1...6$; calculation of x and w made for two mentioned above NMI.

Values of the calculated USM error δ_A using the velocity Salami function P09 is shown in Fig.2.

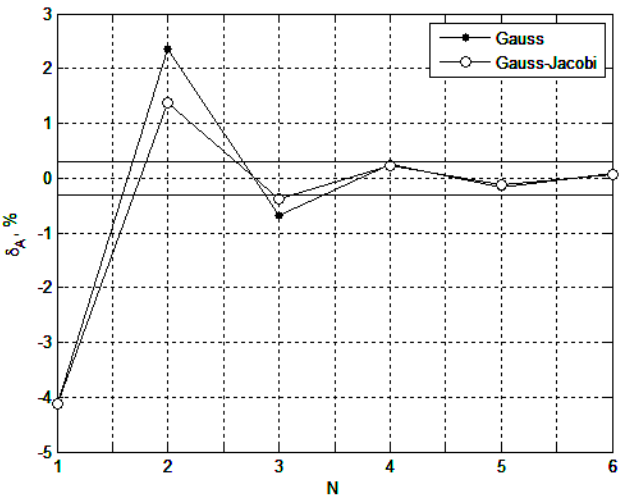

Fig. 2. Dependence of the USM error δ_A relatively N (θ = 90°) for flowmeters with the values of x and w found two NMI (flow structure – velocity function Salami P09)

As shown in Fig.2 of error δ_A decreases with increase in the number of AP USM.

For USM position coordinates placement and weighting factors APs which are calculated by the Gauss-Jacobi NMI at $N = 3$, the value δ_A = -0.385 %, and when $N = 4$, error δ_A = 0.220 %.

For USM position coordinates placement and weighting factors APs which are calculated by the Gauss NMI at $N = 3$, the value δ_A = -0.690 %, and when $N = 4$, error δ_A = 0.253 %.

According to [5] the influence of the distortion of flow structure on the result of the USM measurement is negligible at the following two requirements:

1) $|\delta_A| \leq 0.3$ %;

2) $(|\delta_{A(N)}| - |\delta_{A(N+1)}|) \leq 0.3$ %.

We confirm that these requirements are true for USM for which the characteristics x and w were received using Gauss-Jacobi NMI and Gauss NMI for the number of APs $N \geq 4$. Thus we recommend the number of APs $N = 4$. A further increasing of the APs number is not reasonable.

Conclusion

To measure the flow rate of distorted flow it's necessary to apply USMs with a multi-path chordal arrangement of APs. Applying the USM with four chordal APs allows measuring the flow rate of distorted flow with the error that does not exceed the limit values set by existing regulatory documents and are acceptable for commercial accounting of energy carriers.

It should also be noted that choice of NMI for construction of multi-path chordal USM is necessary only at $N < 4$.

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Determining of Volume of Natural Gas Losses Caused by Damages of Distribution Networks

Viktor Dzhyhyrei, Fedir Matiko, Dmytro Klymkovskyi

Department of Automation of Heat and Chemical Processes, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street, 12, E-mail: dv-@ukr.net

Abstract – The algorithm of calculation of gas volume losses caused by damages of above-grounded pipelines is proposed in this paper. The mathematical model of natural gas movement in the pipeline is developed for the implementation of the algorithm. The model is used to determine the parameters of the gas flow at the leakage point. The equation for calculation gas flowrate through the holes in the pipeline wall is developed on the basis of the formula of Saint-Venant-Wentzel. The equation is valid for subcritical and critical regime of gas flow. The equation for determining discharge coefficient of the holes in the pipeline wall for gas pressure up to 1.2 MPa is proposed.

Key words – pipeline, damage, mathematical model, gas leakage rate, gas losses.

I. Introduction

Losses of natural gas occur during the operation of gas distribution networks (GDN). They are the result of the constant leakage of gas through pipelines and equipment tightness and of equipment damages. The methods for determining the losses of gas at suppositive normative tightness of the GDN elements are presented in the existing Ukrainian normative documents for determining the technological losses of natural gas, particularly in [1]. However there is no method for determining volume losses of natural gas caused by pipelines damages. Therefore developing the mathematical model of gas losses from the pipelines and equipment caused by their damages is an urgent task.

II. Determining the Volume Gas Losses

The problem of determining the parameters of natural gas at the damage point and the gas flowrate through the damage arises during the modeling the process of gas leakage through the holes in pipelines.

Differential equation of changes of gas pressure along the length of the tilted section of pipeline is obtained from the equation system that contains the equation of saving of mechanical energy of isothermal gas flow [2], the flow continuity equation and the equation of state of real gas

$$\begin{cases} \dfrac{dp}{\rho} + \dfrac{d\left(v^2\right)}{2} + gdy + gdh_x = 0; \\ q_m = \rho v F = const; \\ p = \rho z \dfrac{R}{M} T. \end{cases} \tag{1}$$

where ν is the linear velocity of natural gas in the pipeline; g is gravity acceleration; dy is change of the height of vertical marks of pipeline; dh_x is the pressure loss along the length of the pipeline (friction loss); q_m is mass flowrate of gas; F is the line flow area of the pipeline; p, T, ρ, z, M are pressure, temperature, density, compressibility factor and molar mass of natural gas; R is universal gas constant.

The differential equation of change of the gas temperature along the long tilted pipeline is obtained from the heat balance equation of the pipeline section. Thus mathematical model of natural gas movement in pipeline is a system of differential equations of changes in pressure and temperature of gas along the pipeline, which is completed with the equation of state of real gas [3]:

$$\begin{cases} \dfrac{dp}{dx} = \dfrac{-\left[\dfrac{p^2 gM}{zRT}\dfrac{\Delta y}{L} + \dfrac{8\lambda q_m^2 zRT}{M\pi^2 D^5}\right]}{\left(p - \dfrac{16 q_m^2 zRT}{pM\pi^2 D^2}\right)}; \\ \dfrac{dT}{dx} = -\left[\alpha\left(T - T_{gr}\right) - D_i \dfrac{dp}{dx} + \dfrac{g\Delta y}{c_p L}\right]; \\ \alpha = k_t \pi D_z / (q_m c_p), \\ z = f\left(p, T, x_a, x_y, \rho_c\right); \end{cases} \tag{2}$$

where T_{gr} is the absolute temperature of the soil; Δy is the difference between the final and the initial heights of pipeline location; L is the length of the pipeline section; λ is the coefficient of hydraulic resistance; D_i is Joule-Thomson coefficient; c_p is isobar heat capacity of natural gas; k_t is the coefficient of heat transfer from the gas to the soil; D_z, D are the outer and the inner diameters of pipeline; ρ_c is the gas density at standard conditions.

The example of application model (2) to build gas pressure distributions along the damaged pipeline is presented in Figure 1.

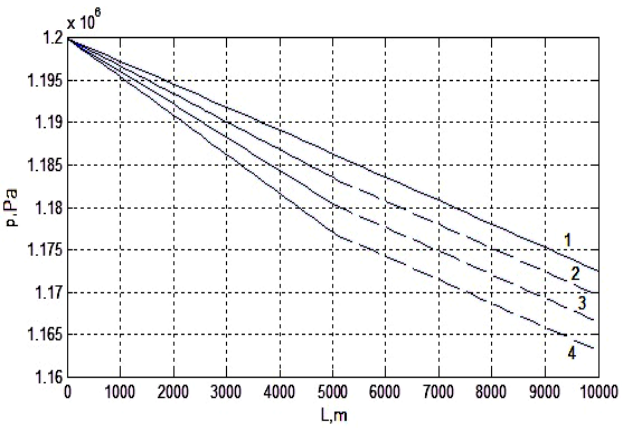

Fig. 1. Pressure distribution along the length of the pipeline: without leakage (line 1), with leakage $0.1q_1$ - (2), $0.2q_1$ - (3), $0.3q_1$ - (4)

The authors proposed the formula to calculate the gas flowrate through the holes in the pipeline based on the parameters of gas at the damage point calculated using (2). It is obtained using the formula of the gas velocity at the adiabatic outflow through the nozzle (the formula of Saint-Venant-Wentzel) taking into account the conditions of subcritical ($p_b / p > 0.54$) and critical ($p_b / p \le 0.54$) modes of gas flow:

$$Q_c = \begin{cases} 0.1564 \cdot \mu_p F_{hole} p \cdot \\ \sqrt{\dfrac{1}{\rho_c TK}\left[\left(\dfrac{p_b}{p}\right)^{1.53} - \left(\dfrac{p_b}{p}\right)^{1.77}\right]}, \\ for \quad (p_b / p) > 0.54; \\ 0.0359 \cdot \mu_p F_{hole} \dfrac{p}{\sqrt{TK\rho_c}}, \\ for \quad (p_b / p) \le 0.54. \end{cases} \tag{3}$$

where p_b is the barometric pressure; μ_p is the leakage coefficient; F_{hole} is the area of hole; K is the compressibility coefficient.

The authors determine the maximum gas losses caused by the pipeline damages and use discharge coefficients of round holes that are obtained experimentally by the other researchers for calculating the gas losses. In addition, the authors have got experimentally the values of the discharge coefficient at low pressure ($p < 5$ kPa). The equation for determining the discharge coefficient is proposed by the authors based on their research [3]

$$\mu_p = 0.588\left(p_b/p\right)^3 - 0.983\left(p_b/p\right)^2 + \\ + 0.163\left(p_b/p\right) + 0.843; \tag{4}$$

The methodic error of equation (4) is $\delta_m = 1.7$ % for the range of gas pressure in the gas distribution networks ($0.1 \le p \le 1.2$ MPa) taking into account the error of reference data on the basis of which this equation is obtained.

Applying the proposed mathematical models the authors have developed the following algorithm to determine the volume of gas losses caused by pipeline damage: a) localization of the damage and determining its parameters (the distance from the measuring stations of gas parameters, the area of damage); b) calculating the gas parameters (pressure, temperature) at the point of leakage by solving the system of equations (2); c) calculating the volume of gas losses caused by damage using the equation (3).

Algorithm for computing the volume of gas losses can be iterative or noniterative depending on the configuration of the area of damage and a set of measuring parameters at stations. Particularly for the configuration of the damaged pipeline, shown in Figure 2, this algorithm is noniterative (see. Figure 2, b). However there are some configurations with the larger number of unknown parameters than the presented configuration. In this case iterative algorithms should be used.

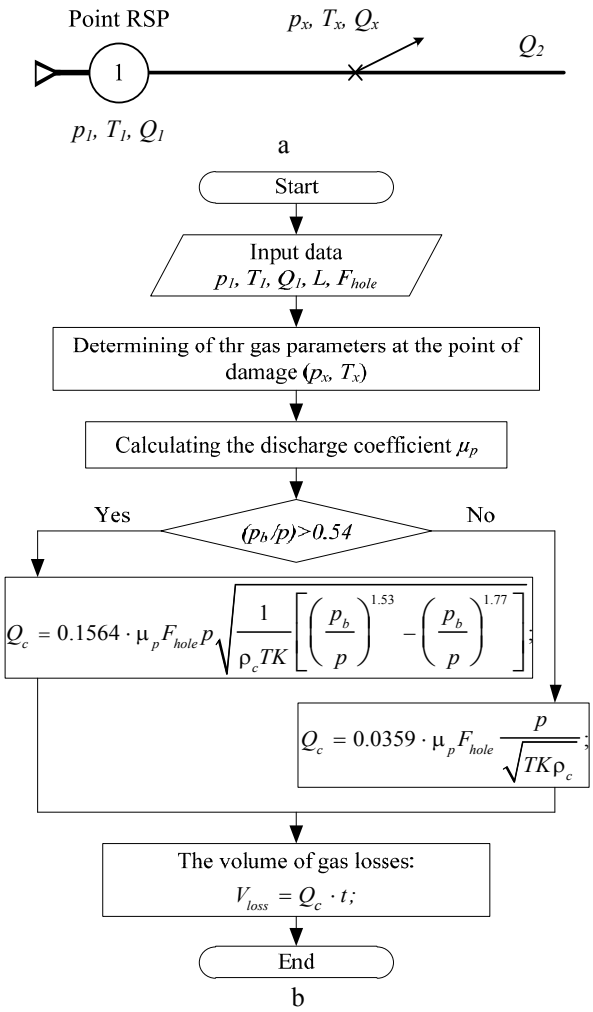

Fig. 2. Calculating the volume of gas losses: (a) configuration of the damaged section of the pipeline; (b) the block diagram of calculating the volume of gas losses

Conclusion

Application of the developed mathematical models and algorithms of calculation of the volume of gas losses allows determining the maximum value of the volume of gas losses from the damaged sections of pipelines.

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Control Systems of Permanent Magnet Synchronous Machine as Port-Controlled Hamiltonian System

Yurii Biletskyi

Department of Electric drive and computerize electromechanical systems, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12,
E-mail: biletskyi.y.o@gmail.com

Abstract – One of the most perspective methods of control system design for permanent magnet synchronous motor as a part of electromechanical systems are energy-based approaches. The regulation in such systems is realized by forming energy function of the system. The energy-shaping control systems with present regulation elements provide worse response compare with classical systems and are hard to be configured. The main aims of this article are quick view of current energy-shaping control systems, overcoming disadvantages of them and popularization of energy-based approaches in general.

Key words – permanent magnet synchronous machine, energy-based approach, vector control, energy-shaping control system, structural and parametric synthesis.

I. Introduction

One of the most perspective methods of control system design for permanent magnet synchronous motor as a part of electromechanical systems are physical control theory approaches, based fundamental physical laws. Exactly such are energy-based approaches, which are based on physical laws of energy transferring and conversion [1].

First of all, to simplify such energy-shaping control system (ESCS) synthesis procedure, control object and automatic control system could be represented as port-controlled Hamiltonian systems (PCHs) [2]:

$$\begin{cases} \dot{\mathbf{x}}(t) = [\mathbf{J}(\mathbf{x}) - \mathbf{R}(\mathbf{x})]\dfrac{\partial H}{\partial \mathbf{x}} + \mathbf{G}(\mathbf{x})\cdot\mathbf{u}(t) \\ \mathbf{y}(t) = \mathbf{G}^{\mathrm{T}}(\mathbf{x})\dfrac{\partial H}{\partial \mathbf{x}} \end{cases}, \qquad (1)$$

where $\mathbf{x}(t)$ is the state vector of the controlled system (the object), $\mathbf{J}(\mathbf{x}) = -\mathbf{J}^{\mathrm{T}}(\mathbf{x})$ is a skew-symmetric matrix which reflects the interconnection structure of the system, $\mathbf{R}(\mathbf{x}) = \mathbf{R}^{\mathrm{T}}(\mathbf{x}) \geq 0$ is a symmetric positive semi-definite matrix which reflects the dissipation in the system, $\mathbf{H}(\mathbf{x})$ is the energy function of the controlled system, $\mathbf{G}(\mathbf{x})$ is the port matrix, and $\mathbf{u}(t)$ and $\mathbf{y}(t)$ are vectors of input and output system energy variables.

Then, in general, synthesis ESCS will consists in decomposing the system into simpler subsystems interlinked in some way, and finding such additional interconnections and subsystems, and such intensity of their interactions (IDA) [3] that total energy of a closed loop system $H_d(\mathbf{x})$ would attain a minimum in the desired (defined by the asking signal) equilibrium point $\mathbf{x}_0$. The desired system will be asymptotically stable.

According to [4], ESCS synthesis procedure is reduced to the writing of the mathematical model of the object in the PCHs (1) form, the selection of a matrix of the control system and, thanks to the energy shaping principles, interconnection and damping assignment, to the solving of the following matrix equation:

$$\begin{aligned} &[\mathbf{J}(\mathbf{x}) + \mathbf{J}_{\mathrm{a}}(\mathbf{x}) - (\mathbf{R}(\mathbf{x}) + \mathbf{R}_{\mathrm{a}}(\mathbf{x}))]\frac{\partial(H_{\mathrm{d}} - H)}{\partial \mathbf{x}} = \\ &= [\mathbf{J}_{\mathrm{a}}(\mathbf{x}) - \mathbf{R}_{\mathrm{a}}(\mathbf{x})]\frac{\partial H}{\partial \mathbf{x}} + \mathbf{G}(\mathbf{x})\cdot\mathbf{b}(\mathbf{x}) \end{aligned}, \qquad (2)$$

where $H_a(\mathbf{x})$ is the energy function of the control system, $\mathbf{J}_a(\mathbf{x})$ and $\mathbf{R}_a(\mathbf{x})$ are matrix of additionally injected factitious interconnections and factitious damping, provided by the control system

II. Energy-Shaping Control Systems

The literature offers a large number of ESCSs for PMSM based systems (Fig.1), with different mapping of control system matrix $\mathbf{J}_a(\mathbf{x})$ and $\mathbf{R}_a(\mathbf{x})$, and also combinations of different energy-based approaches of between themselves and with the known classical approaches.

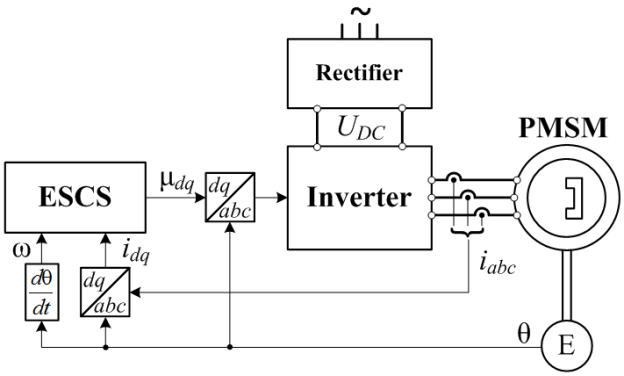

Fig. 1. General function scheme of PMSM control

The most common are ESCSs with different structures of $\mathbf{J}_a(\mathbf{x})$ and $\mathbf{R}_a(\mathbf{x})$, which use electrical damping. Such control systems have next drawbacks: the regulation is not carried out by the main control magnitude (velocity); nonlinearity of controlled object make setting up more difficult; there is no algorithm for configuring such control systems; also in the formation of a control system desired equilibrium point existing selections of controlled matrix involved elements that are completely independent of signal errors, which leads to errors in determination of this point and delaying the transition process.

One of the simplest energy-based control systems is ESCS only with passivation [5]. This system was deprived of the possibility to take into account windings losses in the formation of the desired equilibrium point and any additional regulatory possibilities.

Other decision was combination of classic and passivation regulators [6]. However, this system was losing the main advantage of energy-based management approaches - namely physical interpretation. Setting up of such systems was reduced to selection of classic parameters of applied regulators.

One of the most successful areas of energy-based control was energy balancing forming. Initially it was developed for Lagrangian systems and then applied to the Hamiltonian [6]. This ESCS was directed to compensate nonlinearities in controlled object, ensuring asymptotic stability of the closed-loop system and including the possibility of combining ESCS with classic controls similar to previous one. Despite the large number of control system parameters, which significantly complicates the procedure for setting up, the shortcomings of such system include the providing of errors in the desired equilibrium point formation and the sensitivity to parametric changes.

Besides there was attempt to synthesize digital passive control system by forming interconnections and desired damping. For use in digital systems, ESCS was improved by addition of corrective elements [7]. Adjustment of desired power function here is carried out to neutralize errors associated with the operation of a digital system. The large number of complex corrective elements in the system complicates the procedure of multiparameter setting up, and also don't suggests asymptotic stability of the system, which is inherently providing by all ESCS. Another drawback of this control system is that it does not provide an optimal formation of the desired equilibrium point.

One of the most successful was combination of ESCS with perturbations damping principle of L2-gain [8]. The resulting system provide significant forcing of transients and reduce static error in the absence of moment information. The main disadvantage of this system is that the main regulating parameter is in the mechanical and electrical processes control loops at once. On one hand, it makes impossible separate regulation of transient mechanical and electrical parts of the axis d and the axis q, on the other hand - impose restrictions on the use of this parameter adjustment. Another disadvantage of using such damping system is a high sensitivity to a change in control signal error. Reaction to this change leads control system to restrictions zone and as a result, the system becomes uncontrollable. It should also be noted that the introduction of such damping does not apply to energy approaches.

According to known systems drawbacks (low efficiency in control, complexity of understanding and configuration), the most simple and affective are ESCSs with interconnections and damping forming.

III. ESCS with Mechanical Damping

Existing ESCSs not always provide appropriate quality of response and have no clear algorithm of setting up. Therefore, it was proposed to use mechanical damping, provided by control system through electrical part. This mechanical damping would correct process of desired velocity forming to improve static and dynamic characteristic of the system [9]. We also suggest to carry out parametric synthesis of ESCS by finding parameters of its regulators through forming transfer function of desired the closed-loop port-control Hamiltonian system. There are some obstacles in providing such method connected to differential elements appearance in control loop, but they could simply be neutralized [9].

Such ESCSs are easy in configuration (there parametric synthesis), they provide acceleration of transition process, linearity of the dynamics of the whole system, possibility of regulators forming depending on the task.

Conclusion

ESCS with existing regulatory elements are complex to set up and provide worse quality of the transition process in comparison with classical control systems, and therefore their use is ineffective.

The proposed ESCS with electric and mechanical damping makes it possible to carry out effective regulation of electromechanical system based on PMSM and can be easily synthesized by a procedure of structural and parametric synthesis.

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The Operation of Current Transformer with Open Secondary Circuit

Roman Ferensovych

Department of electrical systems and networks,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: femary@ukr.net

Abstract – Disconnection of current transformer secondary circuit is accompanied by the appearance on the terminals of its secondary winding high-voltage pulses which are dangerous for isolation of a current transformer, its secondary circuit equipment and attending personnel.

In the paper analysis of operating modes of current transformers with open their secondary circuits is carried out.

The comparative analysis of calculation results of amplitudes of voltage pulses on the open secondary winding terminals of current transformer type TLM-10 (ТЛМ-10), which have been obtained by using computer simulation of its emergency operating mode and analytical calculations, is carried out.

Key words – current transformer, secondary circuit, disconnection, high-voltage pulse, overvoltages, calculation scheme, methods of analytical calculations.

I. Introduction

Current transformers operate in both steady-state and transient operating modes of electrical networks. In such modes they should provide corresponding characteristics and accuracy of primary current transformation.

The opening of current transformer secondary circuit is accompanied by the sharp increase of magnetic flux in the magnetic core as a result of disappearance of demagnetizing magnetomotive forse of the secondary winding that will cause an increase of active losses in the magnetic core, its overheating and, as a result, insulation damage of windings and in the end – a failure of the current transformer.

Besides, the magnetic flux induces in the secondary winding of current transformer high-voltage pulses with an amplitude which can achieve values of several kilovolts (in contrast to several tens of volts in the normal mode). Such overvoltages on current transformer secondary winding terminals cause, as a rule, insulation damage of secondary current circuits, relaying and automation systems, especially modern microprocessor devices, which are connected to this winding. Also they can cause an electrical injury of attending personnel.

Therefore the questions of safety service of current transformers and a designing of the reliable protection methods from overvoltages after the opening their secondary circuits are extremely topical.

In the literature the operation modes of current transformers with open their secondary circuits aren't widely investigated. Only in [1-4] such modes are described and in [1, 3, 4] some possible methods for current transformer protection from operation with open secondary circuit are proposed. But there are no such efficient current transformer protection devices in our electric power systems.

II. The Results of Research

For the simulation and analysis of various operating modes of current transformers in specialized computer program "RE" [5] the calculation schemes of single-stage and cascade current transformers has been created. They consist of few units, each of them simulates certain parameters and characteristics of the transformer, which is investigated.

In the paper the operation mode of current transformer type TLM-10 (ТЛМ-10) (Fig. 1) with open its secondary circuit is analysed. The calculation model of this transformer has been created in program "RE" with purpose of computer simulation its operation in such mode.

Fig. 1. Current transformer type TLM-10 (ТЛМ-10)

The current transformer type TLM-10 (ТЛМ-10) is a small-size current transformer with cast insulation and rated voltage 10 kV, rated primary current 1500 A AC and rated secondary current 5 A AC.

Transformer is designed as a supporting construction with two magnetic cores, one primary and two secondary windings.

The calculation scheme of current transformer type TLM-10 (ТЛМ-10) is shown on Fig. 2.

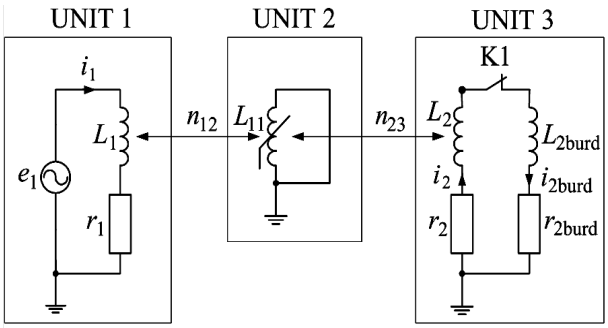


Fig. 2. Calculation scheme of current transformer type TLM-10 (ТЛМ-10)

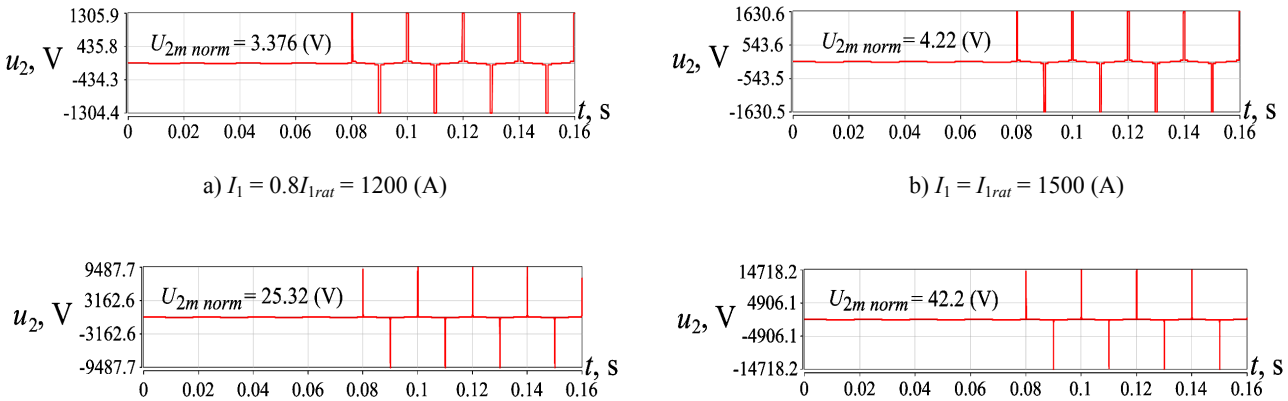
The unit 1 of scheme simulates a primary circuit of current transformer. In unit 2 the magnetization curve of transformer magnetic core is simulated (non-linear inductance L_{11}). In the program "RE" magnetic characteristic is set by the reductive to a primary circuit weber-ampere characteristic $\Psi_1 = f(i_{exc.})$, which has been calculated from experimental obtained volt-

ampere characteristic of current transformer type TLM-10 (ТЛМ-10).

The unit 3 simulates parameters of transformer secondary winding (r_2, L_2) and its secondary burden (r_{2burd}, L_{2burd}). The disconnection of secondary circuit is carried out by a switch K1.

A coupling factor n_{12} between first and second units is equal to unity and the coupling factor n_{23} between second and third units is equal to rated transformation ratio of current transformer type TLM-10 (ТЛМ-10).

On Fig.3 the oscillograms of secondary voltage of transformer type TLM-10 (ТЛМ-10) before and after opening its secondary circuit for various values of primary current are shown. The disconnection is carried out at the time 0.08 sec, when sinusoid curves of transformer primary and secondary currents flow through the zero value. The voltage $U_{2m\ norm}$ characterizes the amplitude value of secondary voltage of current transformer type TLM-10 (ТЛМ-10) in normal before opening its secondary circuit operation mode.



a) $I_1 = 0.8I_{1rat} = 1200$ (A)

b) $I_1 = I_{1rat} = 1500$ (A)

c) $I_1 = 6I_{1rat} = 9000$ (A)

d) $I_1 = 10I_{1rat} = 15000$ (A)

Fig. 3. The oscillograms of secondary voltage of current transformer type TLM-10 (ТЛМ-10) before and after opening its secondary circuit

After opening secondary circuit of current transformer the voltage on its secondary terminals sharply increases in comparison with normal operation mode and its curve becomes non-sinusoidal in the result of trapezoidal curve of magnetic flux in transformer magnetic core during its saturation.

For current transformer type TLM-10 (ТЛМ-10) the voltage amplitude on the open secondary winding terminals reaches value 1305.9 V already for a primary current which is equal to 1200 A. As is shown on Fig. 3, in the normal operation mode secondary voltage is equal to 3.376 V.

As is shown in [6], the value of test voltage for secondary circuits of current transformers in operation conditions is equal to 1000 V.

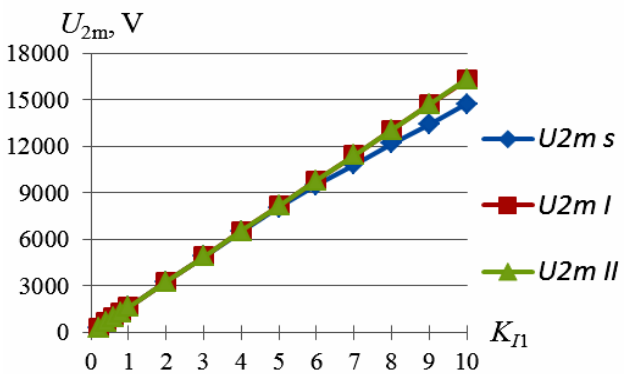


Fig. 4. The dependence of voltage amplitudes on open secondary winding terminals of current transformer type TLM-10 (ТЛМ-10) on multiplicities of its primary current

Such high voltage levels on the open transformer secondary winding terminals cause a dangerous factor during all operation time of current transformers. So the main purpose of our researches is to design effective and reliable their protection systems from overvoltages in such operation modes.

On Fig.4 the dependence of voltage amplitudes on open secondary winding terminals of current transformer type TLM-10 (ТЛМ-10) on multiplicities of its primary current is shown, which has been obtained by using computer simulation of transformer emergency operation mode (*U2m s*) and the methods of analytical calculations (method 1 – *U2m I* and method 2 – *U2m II*).

Conclusion

The results of research have theoretical and practical significance for further analysis of operation modes of current transformers with open their secondary circuits with purpose of creating effective and reliable protection systems from overvoltages in such modes.

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Analysis and classification of historical-oriented Internet sources

Andriy Peleschyshyn[1], Tetiana Bilushchak[2]

[1]Social Communication and Information Science Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: apele@ridne.net

[2]Social Communication and Information Science Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: Tetiana.M.Bilushchak@lpnu.ua

Abstract – The article analyzes the online sources with historical information available there. The Internet sources are analyzed according to the groups and types of information they contain.

Key words – Internet-sources, social networks, search engines, classification, types, primary sources, secondary sources.

I. Analysis of research and publications on the issue

The topicality of the research is brought about by the fact that today's impact of information technologies, which cover various spheres of society, allows the unlimited possibilities of their use, particularly in historical research. The use of new information technologies in historical research allow to select, seek out the necessary information according to types, various sources and forms of material presentation. **The goal** of this article is to classify the groups of online sources with available historical information. **The analysis of recent research and publications which start to seek the solution of this problem and are the basis for other author's works.** The research of Internet-sources in the study of historical subjects is within the focus of such scholars as H.Boryak, O.Zhdanovych, V.Kulikov, Zh.Myna, H.Papakin, A.Peleschyshyn, N.Hymytsya, O.Yurkova and others.

Oksana Yurkova analyses the research of Facebook as a new type of historical source. In her works she classifies Facebook sources according to written sources, linguistic records, figurative sources, photos, cinedocuments, photographs, ethnographic sources. She also classifies them according to the origin, the degree of faking, the publicity (mass or individual), the place of storage [1]. Volodymyr Kulikov carried out a review of the Internet information resources in his textbook. In particular, the author introduces the structure and basic functions of information services of the Internet, considers the services of the two most popular information retrieval systems in Ukraine - Google and Yandex and principles of work with them, as well as describes the main directions of the search for historical information, search for facts, documents, bibliography and principles of bibliographic descriptions of Internet resources [2]. However, it would be reasonable for the author to consider in his work the quality of search of similar objects with the help of search engines or by the method and the quality of the information provided. Oleksiy Zhdanovych researched the source studies on the classification of sites. He argues that the approaches to classification may be different depending on the subject, the volume of information on the principles of interaction with users, in terms of achieving the goal etc. He also analyzes a large number of typology schemes and schemes of systematization, however, the most effective way of allocating resources is their thematic marking by experts of the corresponding profile [3]. The works by Andriy Peleshchyshyn and Natalya Hymytsya are dedicated to the analysis of historical data types created by virtual communities, and point the most popular examples of virtual communities that generate military and historical information on events of 2014-2015 in the East of Ukraine [4]. The investigations of Zhanna Myna and Andriy Peleshchyshyn are also related to the current issue as they research the features of the content of Internet resources in the global computer network connected with general historical problems (individual sites, including personal ones, electronic encyclopedia "Wikipedia", online libraries) that cover various historical periods [5, 6].

II. Classification of Internet-sources by groups and types

The processed set of Internet-sources for the study of historical processes enables a classification of groups of Internet-sources. *The first group* of Internet-sources is formed by the archival, library and museum resources digitized by agencies and presented as web exhibitions and 3D tours. *The second group* includes the websites of leading Ukrainian scientific institutions. *The third group* are Internet-sources which are presented quite diversely in the Internet and form a huge segment of virtual communities and social networks. To *the fourth group* of Internet-sources belong the reference web resources, i.e. web encyclopedia and web portals. *The fifth group* of sources are online versions of the electronic media. *The sixth group* of Internet-sources encompases bibliographic and review databases. Figure 1. schematically shows the general classification by groups of Internet-sources for study of historical information.

The group that is associated with the web sites of leading Ukrainian scientific institutions includes: the site of the Institute of History of Ukraine, National Academy of Sciences of Ukraine - the official site of Institute of History of Ukraine, National Academy of Sciences of Ukraine – a scientific and research institution, which represents a wide range of issues of national history (http://www.history.org.ua), Institute of Archaeology of the National Academy of Sciences of Ukraine - the site of the Institute of Archaeology of the National Academy of Sciences of Ukraine highlights the problem of ancient and medieval history and culture of Ukraine (http://www.iananu.kiev.ua).

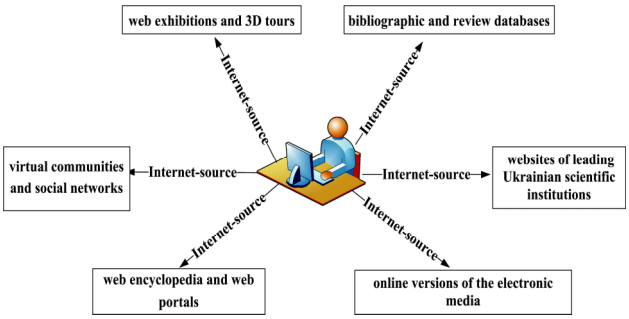

Fig. 1. Schematic representation of the general classification by groups of Internet-sources for study of historical information

Among virtual communities (historical forums, blogs) are social networks (Facebook, Twitter, LinkedIn, Twitter).

Internet versions of the electronic media include official sites of TV stations (TV interviews, talk shows), newspapers and magazines that are presented in the Internet and use «YouTube» video hosting.

To the bibliographic and review databases belong: Scopus, WebofScience (WoS), Index Copernicus, Academic Search Premier, Master FILE Premier, Wilson Business Abstracts, Econlit, Index Copernicus, Newspaper Source, Wilson Social Sciences Abstracts, Wilson Humanities Abstracts, Journal Citation Reports®, Scimago Journal&Country Rank (SJR), Google Scholar.

From the aforementioned total of Internet sources that contain historical information can be identified Internet sources of scientific information by types: primary and secondary. The primary include: web sites of leading Ukrainian research institutions, bibliographic and review databases. The secondary include: web encyclopedia and web portals; web exhibitions, 3D tours. And the groups of Internet sources, such as virtual communities and social networks; Internet versions of electronic media can be classified as primary and secondary.

We mean, for example, that social networks can publish photos of events that occurred during Euromaidan, transcripts of public inquiries or interviews placed by people who took part, offering thus their view of the event from inside. However, a source of information in social networks can be a secondary context information. If the publication in social networks offers the reader a generalization, analysis, synthesis, interpretation or evaluation of information and data. Figure 2. schematically shows the classification by type of scientific information in the Internet-sources: primary and secondary.

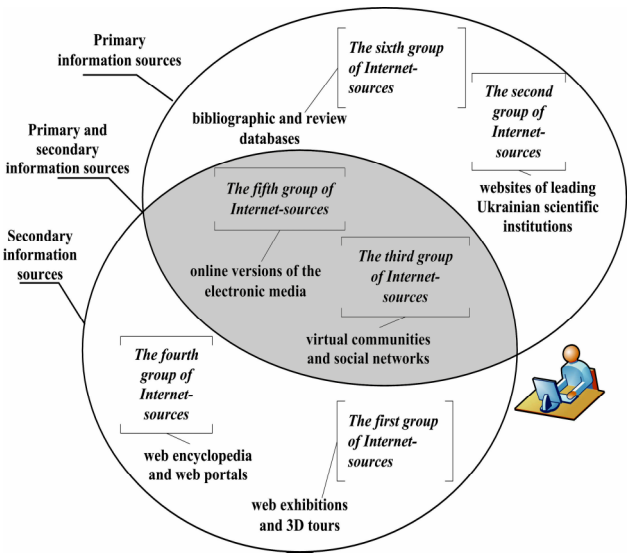

Fig. 2. Classification by type of scientific information in the Internet-sources: primary and secondary

Conclusion

So, summarizing overview of online sources containing historical information, we can note that the optimum number of Internet-sources necessary to obtain accurate and verifiable results of investigation has been detected. It has been determined that the basis of the study are six groups of Internet - sources and their division by the types of information that allow modern historians to identify and analyze information potential they have for further research in archive-source studies.

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Gender Metaphors in Modern American Prose

Anna Kaspryshyn

Department of Applied Linguistics,
Lviv Polytechnic National University,
UKRAINE, Lviv, 12 S. Bandera Street,
E-mail: ms.kaspryshyn@gmail.com

Abstract – The research paper presents analysis of gender metaphors in the works by modern American authors – Jay Asher, Nicholas Sparks, Laurie Halse Anderson and Lorrie Moore. In this paper the metaphors with the donor zones of man and woman are analysed. Age parameters and relationships are taken into account.

Key words – gender, metaphor, donor zone, recipient zone, male, female.

I. Introduction

The modern world is interested in gender issues. The notion of gender is new and it has not to be confused with the notion of sex.

Sex refers to the biological differences between women and men. Gender is a socio-economic and cultural construct for differentiating between roles, responsibilities, constraints, opportunities and needs of women and men in a given context [3].

Four American novels are the sources of metaphors (Jay Asher *13 Reasons Why*, Nicholas Sparks *The Best of Me*, Laurie Halse Anderson *Twisted,* Lorrie Moore *A Gate at the Stairs*).

The research includes descriptive (used for metaphors determining and their division), stylo-statistical (in order to count and compare metaphors) and taxonomic (for metaphors classification) methods.

The aim of the paper is to define gender metaphors among the whole sample of metaphors and to analyse their usage.

II. Definition of Gender Metaphor

Gender metaphors are part of our daily life. They are often used in advertising, politics, literature and culture.

Gender metaphor is comparatively a new notion, which on the one part is a particular case of corporal metaphor, on the other part it denotes transferring not only physical, but also all mental qualities and virtues combined by words *feminity* and *masculinity* on the objects that are not directly connected to gender [2].

Gender metaphor is the main method of comprehension for sociocultural reality. This metaphor has ontological status as it is connected not only with reality perception, but also with a way of human existence in the world [1].

III. Types of Gender Metaphors

There are two types of gender metaphors. In the first type qualities of feminity and masculinity are the basis for comparison. The second type is metaphors denoting men and women, which are the means of marking for "typically male" and "typically female" qualities.

IV. Results and Analysis of Gender Metaphors

Four novels are analysed and the whole sample of the metaphors is organised in Microsoft Excel 2010. The attention is paid on gender metaphors of the second type. During the research, the gender metaphors are classified, depending on the donor zones. Age parameters are determined according to "school" criterion: children under school age (little boy and little girl), teenagers of school age (boy and girl), grown-up persons (man and woman). "Couple" zones are based on a type of the relationship (married couple, homosexuals).

The writers use gender metaphors unevenly: the male authors (3%) and the female authors (16%).

Jay Asher applies 2 gender metaphors, when Nicholas Sparks – 6. Their gender metaphors are presented in Table 1 and Table 2. The frequency (more than 1) of metaphors is mentioned in brackets.

TABLE 1

13 REASONS WHY

Boy	Zach's not the only one **with a slow boil**.
Man	a teacher **moonlighting** as a counselor.

Jay Asher uses only male donor zones, but Nicholas Sparks describes men and women metaphorically.

TABLE 2

THE BEST OF ME

Man	Tuck Hostetler's still a **wizard** with cars; grace of an **athlete** (2); guy was practically **green.**
Woman	Amanda had always been a **mystery**; I was somehow able to **soldier.**

In Laurie Halse Anderson's work 34 gender metaphors are determined and they are provided in Table 3.

TABLE 3

TWISTED

1	2
Boy	This guy's **made of steel**; I'm the biggest bag of **sh-**; I'm the biggest bag of **manure**; Chip's an **ass**; I am your **servant**; I was a **walnut** or a **pecan**; I was turning into a **wolfman**; I was not a rude, disgusting **pig**; you **pig**; I was **Wolfman**, **the Hulk**, **Casanova**; I was a **train wreck**; I was a piece of **garbage**; I sit silent, a **rock**; you're **hosed**; I'd be a **legend**; I became an armed **beast**; Tyler Miller, **Lord of the Universe**.
Man	my father's **Hell** level; he was a **dragon**; to face the **dragon**; his yellow **dragon** eyes; you're a real success **story**.

1	2
Girl	**angels** with ponytails; tennis-**angel** butts; my fairy **angel**; the body of my **angel**; a **goddess** rose up; Holy **Goddess** of Hotness; **Goddess** Bethany; the **queen bee**; Which way, Your **Highness**?
Woman	society **queen**; my **sainted**, blessed mother.

Laurie Halse Anderson uses metaphors denoting **Boy** and **Man**, **Girl** and **Woman**. The recipients zones of gender metaphors describing **Boy**: *material*, *part of body*, *fruit*, *history*, *animal*, *cloth*. The author gives for **Man** the following zones: *computer game*, *animal*, *story*. The common male recipient zone is *animal*. The quantity and diversity of zones for **Boy** may be explained: these zones provide information about the personality of the teenager. The recipients zones for **Girl** are *christianity*, *mythology* and *history* and for **Woman** are *history* and *christianity*. These zones for female characters may denote author's respect to women, as two common zones (*christianity* and *history*) are determined.

Lorrie Moore uses 36 gender metaphors, which are given in Table 4.

TABLE 4

A GATE AT THE STAIRS

1	2
Little boy	**Gabriel** became the flying golden **angel** after which he was named
Man	**honey** (2); his **aquiline** profile; Noel, Noel, **the toilet bowl** (2); he's **a horse's patoot**; Thank you, **holy warrior**; What if I am **the plant**?; What if I am **the scheme**?; He's **translucent**; **Gunny**!" and "**Gunny**, got your gun?
Homo-sexuals	we two could be **the downstairs;** we would be **the back stairs**.
Little girl	little Emmie's a **doll**; Hey, **sweetie**; she is **Rapunzel**.
Woman	I was a shiftless **bum**; Mom's a little **emo**; Thanks, **honey**; lady's not the sharpest **tool** in the shed; to be instead her happy **maidservant**; the more you were **the servant**; a struggling drag **queen**; I was also **the train**; a **state trooper** with earrings; **the witch** who has adopted her; I am a **hawk**; my **hawk** outfit; my **bird** outfit; there I was a bass-faced **bird**; I would be the **daughter** of storm; end up a **gorgon**; a sci-fi tragic **mulatto**.
Married couple	Edward and I are not good at being **canaries.**

In Lorrie Moore's novel the age difference is determined with the marker *little*: **Man** – **Little boy**, **Woman** – **Little girl**. The rezipient zones for **Man** are *food*, *animal*, *furniture*, *history*, *material*, *building*, *weapon* and for **Little Boy** is *christianity*. The zones for **Woman**: *part of body*, *subculture*, *food*, *item*, *history*, *transport*, *occupation*, *fairytale*, *animal*, *element*, *mythology* and *race*. The recipient zones for **Little Girl**: *toy*, *food* and *fairytale*. The common recipient zone *fairytale* reflects connection between the mother and the adopted child.

Conclusion

Male authors use fewer gender metaphors than female authors (Jay Asher 2%, Nickolas Sparks 4%, Laurie Halse Anderson 17%, Lorrie Moore 16%). Due to the age and relationship of male and female characters different donor zones are analysed: *little boy, little girl, boy, girl, man, woman, couple, homosexuals*. Three authors use gender metaphors, depending on the age parameter. Jay Asher's novel does not contain metaphors denoting female characters. Lorrie Moore takes into metaphorical consideration couple relationships.

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Training the future teachers of technologies to work with students in extracurricular scientific and technical institutions

Oleksandr Blagosmislov, Ph.D. in Pedagogy, Associate Professor

Department of Pedagogy and Methodology of Technological Education, Oleksandr Dovzhenko Hlukhiv National Pedagogical University, Ukraine, Hlukhiv, Kievo-Moscowska street 24, E-mail: blagosm@meta.ua

Abstract – Components and structure's willingness the future teachers of technology to work with students in extracurricular scientific and technical educational institutions are defined in this article. Model and technologies of training for the future teachers to work with students in extracurricular educational institutions have been developed. Legitimacy the proposed organizational and methodological training conditions for the future teachers of technology to work with students in extracurricular scientific and technical educational institutions have been proved experimentally.

Key words – non-formal education, extracurricular educational institutions, training to work with students in extracurricular educational institutions, willingness to work with students in extracurricular educational institutions.

I. Introduction

Studying of the current status of extracurricular educational institutions in Ukraine proves the need to their replenish by competent teaching staff, who are aware and able to satisfy the children's interests and aspirations, to promote the successful and creative self-realization of students in different types and forms of scientific and technical activities.

In modern pedagogical science various aspects of professional training teachers for labor study have been discussed by N. Znamerovskaya, N. Kardash, A. Kaspersky, A. Kobernik, N. Korets, E. Kulik, V. Kurok, E. Megem, V. Sidorenko, D. Tkhorzhevsky and other scientists.

Among above-mentioned scientists there are scientists, who researches problems of professional training teachers to work in the system of extracurricular education. In particular, E. Bykovskaya has investigated theoretical and methodological basics of extracurricular education in Ukraine. S. Vasil'chenko has investigated the problem of training the section's leaders of extracurricular educational institutions to work with children. T. Sirotenko has explored problems of preparing students for section's leadership to work with pupils in Ukrainian arts and crafts.

In background of importance mentioned works it is necessary to notice, that the problem of training the future teachers of technologies to work with students in extracurricular scientific and technical institutions have not adequate reflection in the research and publications. Therefore, there is need to justify and verify the content, methodology, organizational and pedagogical conditions of teacher's training on specialization "technological education". Also there is need to prepare such teachers to work with students in scientific and technical extracurricular institutions.

II. Materials and methods

The purpose of research is a theoretical justification and experimental verification of the organizational and pedagogical conditions of training the future teachers of technologies to work with students in extracurricular scientific and technical institutions.

The object of research is professional training the teachers of technologies in the higher pedagogical educational institutions.

The subject of research is organizational and pedagogical conditions of training the future teachers of technologies to work with students in extracurricular scientific and technical institutions.

To achieve this goal at all stages of research a complex of research methods has been used: 1) theoretical methods: analysis, comparison, systematization and generalization of data obtained in the study of philosophical, scientific, psychological, pedagogical and instructional materials; 2) empirical methods: pedagogical observations of educational process, diagnostic methods (questionnaires, interview, survey), pracsymetric methods (analysis of textbooks, instructive materials); pedagogical experiment and statistical methods for processing experimental data.

Our research includes three stages. In the first stage "Theoretical basics of training the future teachers of technologies to the professional activity in extracurricular educational institutions" the essence of the basic concepts has been researched; components and structure of willingness the future teachers of technologies to work with students in extracurricular scientific and technical educational institutions are identified.

Based on an analysis of regulatory documents such as Law of Ukraine "On the non- formal education" and "Concept of extracurricular education and upbringing", approved by Ministry of Education in Ukraine (Protocol #16/3-8, 12/25/1997), non-formal education is the process and the result of improving skills and creative abilities of the person, when it reaches social maturity and individual growth while working outside school hours in extracurricular educational institution [3, 4, 5].

It is proved that good conditions for identifying, learning, developing and, if it is necessary, adjustments of interests and intentions of students are possible to create within extracurricular educational institution.

In our research training the future teachers of technologies to work with students in extracurricular scientific and technological educational institutions is considered as an activity aimed at changing the motives, knowledge, skills and creativity of students, that leads to the result i.e. willingness for professional activity. Based on the analysis of definition "willingness for professional activity" we can define definition "willingness to work

with students in extracurricular educational institutions". This is a complex neoplasm of personality that comprehensively reflects the knowledge, skills, competencies and personality traits, which are necessary for a successful career in non-formal educational institution; also it is an indicator the quality of specialist training.

Based on a comparative analysis of the structure the future teacher preparedness to work with students (M. Dyachenko, L. Kandybovich, G. Trotsko, G. Shrolik) we identified four structural components of willingness for future teachers of technologies to work with students in extracurricular educational institutions: motivational-targeted, cognitive, methodological (technological) and control-evaluated [2, 6].

As the components of willingness we understand certain interrelated components that form the level of willingness of students for professional careers in extracurricular institutions. Selected components are transformed into appropriate criteria [1].

Motivational-targeted component describes the existing interest of students to work in extracurricular educational institutions; awareness goals and organizational objectives of student's extracurricular activities of scientific and technical creativity; desire to replenish acquired in non-formal education knowledge.

Cognitive component of preparedness for a future professional pedagogical activity involves the mastery of complex psycho-pedagogical, technical, technological and methodological knowledge, which are necessary to organize the work with students in extracurricular educational institutions.

Essence the methodological (technological) component of willingness the future teacher of technologies to work with students in extracurricular educational institutions is to assimilate principles, forms and methods of teaching and educational activities in sections of extracurricular educational institutions.

Control-evaluated component determines the willingness of future teachers to monitor and estimate the educational process in the section, also the ability to analyze the student's correctness to solve separate technical problems. Each of these components we transformed into the criteria, indicators and forming levels (high, medium and low).

In the second stage "Organizational and pedagogical conditions of training the future teachers of technologies to work with students in extracurricular scientific and technical educational institutions" we considered the features of training the future teachers of technologies in higher educational institution, structure of willingness and pedagogical principles of teaching. It has developed a model of training the future teachers of technologies to work with students in extracurricular scientific and technical educational institutions (Figure 1). Model is presented in the form of a holistic educational process, including goals, objectives principles, content, organizational forms, teaching methods and tools of formation a certain structural components of preparedness the future teachers of technologies [1].

Indicated in the model purpose and objectives could be realized under the influence of organizational and pedagogical conditions such as: 1) systematic positive motivation of students for future professional activities during non-formal education; 2) development the content and technology of their theoretical, practical and methodical training; 3) formation of students' ability to apply individually-oriented techniques in extracurricular institutions; 4) abilities to learn systematically the individual characteristics of students in scientific and technical activities same as general didactic principles of education.

Based on defined objectives and principles of education we determine the training content the future teachers of technologies to work with students in extracurricular scientific and technical educational institutions. Content of training has a three-pronged basis:

1)°theoretical, 2) practical and 3) methodical. All types of training the future teachers of technologies have a close connection. Theoretical training is the basis; practical training is form to raise skills in teaching. Improving knowledge actualizes them and gives an opportunity to be successful in practice.

The future teachers have rose skills by means of learning during the training (lectures, seminars and practice), substantive work of students and control tasks (testing).

Teaching methods (organization, implementation, incentives and motivation, control and correction of the effectiveness of educational and cognitive activity) in the model are the way to achieve the educational goals. This is system of consecutive and ranked teacher's actions who organizes with the help of special tools cognitive and practical activities of students. The result of student's training is a willingness the future teachers of technologies to work with students in extracurricular scientific and technical institutions. Training technique the future teachers of technologies to work with students in extracurricular scientific and technical institutions includes the study author's course "Methodology of work in extracurricular educational institutions" and the organization of teaching practice there as a heads of technical sections. It provides the formation all components of preparedness: motivational-targeted, cognitive, methodological and control-evaluated.

The third stage of our research "Experimental verification the organizational and pedagogical conditions of training the future teachers of technologies to work with students in extracurricular scientific and technical educational institutions" is conducted to test these conditions. Ascertaining stage was aimed to determine the original level of student's preparedness to work in extracurricular scientific and technical educational institutions at the moment. The main task of this stage is to determine the effectiveness of traditional methodical system of training the future teachers of technologies to work with students in extracurricular scientific and technical educational institutions. Diagnostics was conducted in accordance with the criteria of willingness: motivational-targeted, cognitive, methodological and control- evaluated and levels (high, medium and low). It is found that 14.7% of respondents have a high level; 37.4% of respondents have average level and 47.9% of respondents have low level.

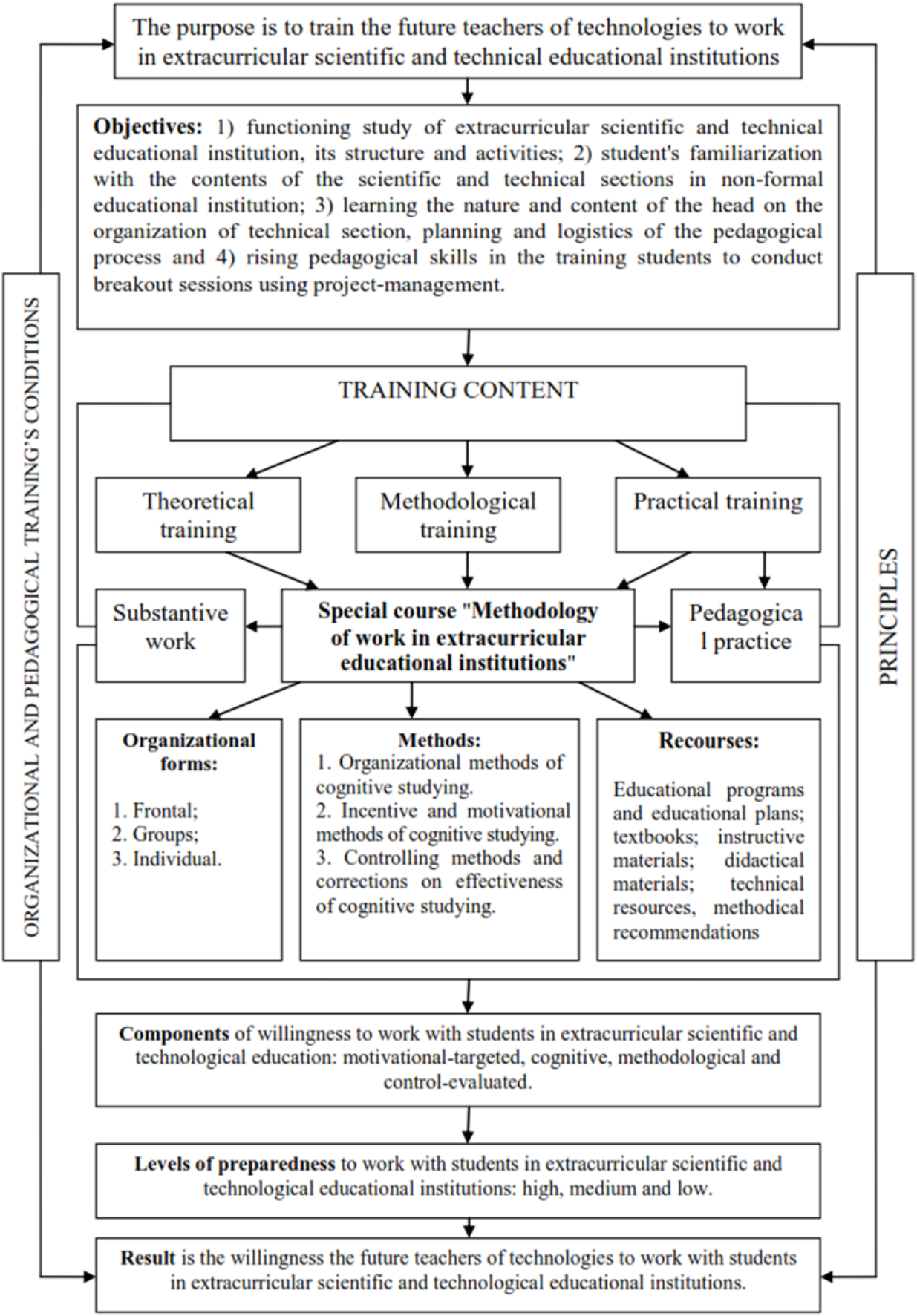

Fig. 1. Model of training the future teachers of technologies to work with students in extracurricular scientific and technical educational institutions

TABLE 1

STUDENT'S DISTRIBUTION BY LEVEL OF PREPAREDNESS TO WORK WITH STUDENTS IN EXTRACURRICULAR SCIENTIFIC AND TECHNICAL EDUCATIONAL INSTITUTIONS

Components of willingness	Level / Groups	Beginning of experiment (%)			Finishing of experiment (%)		
		high	medium	low	high	medium	low
Motivational-targeted	control	12,8	54,8	32,4	14,8	57,9	27,3
	experimental	15,8	58,2	26	29,6	60,2	10,2
Cognitive	control	11,1	34,5	54,4	12,3	39,4	48,3
	experimental	13,7	39,7	46,6	23,6	63,1	13,3
Methodological (technological)	control	14,5	27,7	57,8	16,1	33,2	50,7
	experimental	17,2	30,1	52,7	23,2	49,8	27
Control-evaluated	control	20,6	32,4	47	21,3	35,5	43,2
	experimental	22,6	33,5	43,9	27,6	54,1	18,3
RESULTS	control	14,7	37,4	47,9	16,1	41,5	42,4
	experimental	17,3	40,4	42,3	26	56,8	17,2

The purpose of the formative stage of pedagogical experiment includes testing of certain organizational and pedagogical conditions of training the future teachers of technologies to work with students in extracurricular scientific and technical educational institutions. At this stage, a comparative evaluation of the effectiveness of student's training to work in extracurricular scientific and technical educational institutions (i.e. control and experimental groups) was performed by comparing the levels of formed components of student's preparedness to work in certain educational institutions (Table 1)

The results show that significant changes were observed in the experimental group. Reducing the number of students with low level of willingness was significant (from 42.3% to

17.2%); in contradiction the number of students with medium level (from 40.4% to 56.8%) and with high level (from 17.3% to 26%) was raised.

Further analysis of the data indicates that most of students in the experimental group have the average level of willingness to work in extracurricular educational institutions (56.8%). However, compared with previous results (42.3%) the situation has improved. It means that most students have interest in non-formal education and section's work; they demonstrate a high level of willingness.

Experimental verification of training conditions the future teachers of technologies to work with students in extracurricular educational institutions confirms that there is a significant difference between the levels of student's willingness. Students, who have studied course "Methodology of work in extracurricular educational institutions" and who have had the teaching practice, they had reached a higher level of willingness to work in sections (see Table 1) than students who have studied the traditional training system.

Conclusions

Our research doesn't cover all aspects of considered problem. Perspective is to research problems of student's self-realization in the training process to work with children in extracurricular educational institutions; implementation of IT and communicational technologies in the training process of such specialists, as well as rising skills of section's executives in higher educational pedagogical institutions.

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Boris Loutzky – the founder of Ukrainian aircraft engine-building

Oleksandr Firsov

Department of Humanities and Social Studies,
European University (Cherkasy Branch), UKRAINE,
Cherkasy, 83 Smilyanska St., E-mail: firsov2010@gmail.com

Abstract – This paper analyses a great contribution of Boris Loutzky to the development of Ukranian aircraft engine-building. It was proved that Loutzky was at the origins of domestic aircraft engine-building. He was both a teacher and a mentor for many domestic engine and aircraft designers.

Key words – Boris Loutzky, designer, inventor, founder, aircraft engine-building, Boris Vorobyov.

I. Introduction

Ukrainian aircraft engine-building owes its development to many scientists, designers and inventors. Today we constantly mention the names of O. Mikulin, A. Lyul'ka, S. Grizodubov, S. Tumansky, V. Chelomey, O. Ivchenko, V. Lotarev, V. Glushko and other prominent figures of science and technology who made a great contribution to the development of aircraft engine-building. Unfortunately we hardly ever mention the name of Boris Loutzky (1865–1943), our compatriot, a native of Berdyansk, who was at the origins of domestic aircraft engine-building. From the late XIX to the first half of XX century Boris Loutzky was one of the most famous designers and inventors in Europe [1, 2, 3]. He lived almost all his life in Germany, but never forgot his native land. First of all he proposed to implement all his designs and inventions in his homeland, however, tsarist officials refused to build or subsidize his projects because they preferred to get the finished product from Germany. Without a hope of breaking in Tsarist red tape to realize his plans he knew that on the technical level Russian empire did not have sufficient means to implement his ideas. That's why Boris Loutzky continued his work in Germany but never left the idea to use his achievements for the benefit of his homeland. Unfortunately Boris Loutzky did not leave behind descendants inherited, memoirs or archives and therefore his name was forgotten in Ukraine.

II. The contribution of Boris Loutzky to the development of Ukrainian aircraft engine-building

Boris Loutzky was both a teacher and a mentor for many domestic engine and aircraft designers. In particular we should mention that I. Sikorsky was the creator of multiple-motor airplane «Ilya Muromets» and MRB-6 engines; B. Vorobyov and V. Kireev were the developers of the first aircraft engines at DEKA factory in 1916 in the town of Alexandrovsk (Zaporizhia since 1921). In 1995 the enterprise was converted into Motor Sich Joint Stock Company. Before the First World War all mentioned designers went to Germany for consultations for improving design of aircraft-engines and aircrafts issues, as well as for assistance in acquiring aircraft engines "Argus", "Mercedes" of his design [4, P. 66]. Boris Loutzky was one of the directors in various German companies where these engines were manufactured. He was able to assist his compatriots in acquisition. Engines of Loutzky design were also used by aircraft designers as M. Rebikov, Y. Gakkel, G. Chechet, I. Stehlau, M. Sorokin [5].

In autumn 1913 Loutzky realized the importance of domestic aircraft engine-building came to his homeland and together with his apprentice and friend engineer Boris Vorobiev started looking for sponsors who could agree to finance the construction of a plant for manfacturing aircraft engines of his design. They developed the plant design and aircraft engine production technology from domestic materials. In order to accelerate the process of production, it was desirable to have both samples of finished engines and the drawings. Therefore, in spring 1914 Loutzky found sponsors and returned to Germany to make his most advanced aircraft engines of 100 and 150 horsepower at "Daimler" company, where he served as one of its directors. These engines were simpler in comparison with "Mercedes" aircraft engines and had a smaller specific weight and dimensions. In particular, his 150-hp engine had the same length as "Mercedes" 100-hp engine [6, P. 93]. Loutzky had intention to mount his new engines onto finished aircrafts and airlift them to homeland. In June 1914 the engines were made and mounted onto new Doppeldecker aircrafts designed by Loutzky, but the flight to his homeland from Germany never took place. As early as July Loutzky was arrested on a charge of alleged espionage and sentenced to be shot. Former Personal Representative of Tsar Nicholas II under Kaiser of Germany Major General Tatischev, who knew and valued Loutzky, managed to achieve mitigation of punishment with the help of Spanish government and the death sentence was replaced by imprisonment for life. Throughout the war Loutzky spent in Spandau prison and only after the revolutionary revolt in Germany, when the Weimar Republic was formed, he was released and all his rights were returned.

Incidentally, in 1915 while Loutzky was imprisoned in a German jail "Daimler", the company produced a detailed promotional prospectus, in which Loutzky's designs and patents of aircraft engines were presented, but his name wasn't mentioned in it [6, P. 95]. After being released from prison Loutzky returned to his homeland to Andriyivka and lived there almost a year and a half. However, due to the civil war and the possibility being executed by "white" or "red" or "Makhno" (at that time the authority was changed several times in Andreevka), he was forced to return to Germany. In Germany, he founded his own company, which was called "Loutzkoy Werk". Based on Loutzky's patents various equipment for engines and vehicles were produced by this company.

After the end of the Civil War Loutzky started looking for ways to return to his homeland. Loutzky's friend Vorobyov tried to assist him with getting entry permit to the Soviet Union but, unfortunately, failed [6, P. 96-97]. Significant bureaucratic forces came into effect and for all

that it was so powerful that since 1930 Vorobyov had been even compelled to interrupt correspondence with Loutzky. After that Boris Loutzky addressed a request to the Soviet Embassy in Berlin to allow him to return home, but was denied. Loutzky was a patriot of his homeland and never became a citizen of another country.

However, his efforts to organize the production of aircraft engines in his homeland were not in vain. While he was in Spandau prison, engineer Vorobyov continued his work [6, P. 93-94]. Under his leadership in 1916, in Alexandrovsk (native land of Loutzky) aircraft engine-building plant was built and engines made of domestic materials were manufactured. The first engine built on the basis of Loutzky's engine design was called DEKA M-100 (Fig. 1, 2), it was tested and produced in August, 1916. This date is considered to be the foundation date of JSC "Motor Sich". Incidentally, the plant created in Zaporizhia was the first specialized aircraft engine-building plant in Ukraine and the Russian Empire. After the revolution in 1918-1920 the Main Department of the Air Force sent engineer Vorobyov to equip aircraft factories in Simferopol, Kherson and Odesa.

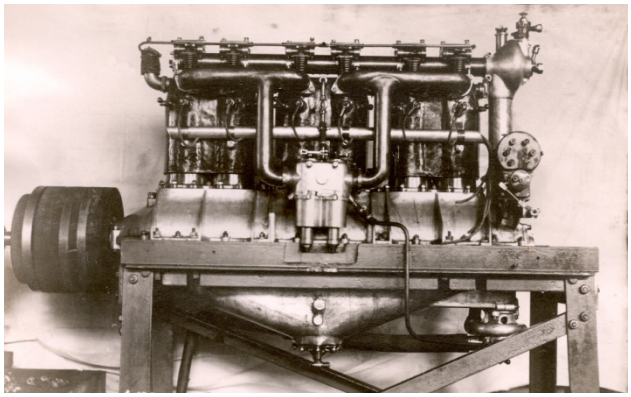

Fig. 1. Aircraft engine DEKA M-100, 1916

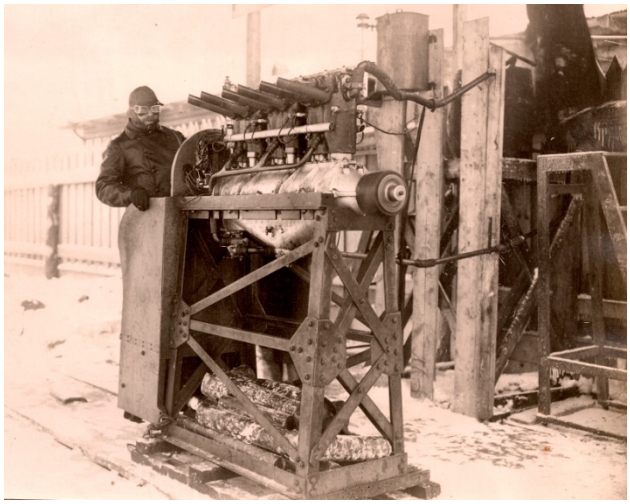

Fig. 2. Aircraft engine DEKA M-100 trials, 1916

From 1922 till 1930 while living in Germany, Boris Loutzky and his friend Vorobyov influenced the development of domestic engine- and aircraft-building. At that time Vorobyov held management positions in the Aviation Trust of Supreme Council of the National Economy of the USSR and he often went on business to Germany for equipment purchases for aircraft factories and study foreign aircraft production. Each time during his visits he met Loutzky, who gave him a good piece of advice concerning engine-building issues and assisted him with the best equipment purchases for USSR aircraft factories.

During World War II a prominent designer of aircraft engines Academician Oleksandr Mikulin used ideas and inventions of Loutzky in the field of aircraft engine-building. Creating aircraft engines AM-38 and AM-42 (for the high-flying bombers) he used the supercharge method that was invented by Loutzky in 1901, for aircraft engine AM-43 he used the method of direct injection of fuel into the cylinder. It was a new step in the aircraft engine-building. This method was also invented by Loutzky in 1892.

Today Ukrainian scientists and engineers continue to use Loutzky's ideas and inventions creating new designs of aircraft engines and their improvement. In particular, the scientists of Kharkiv Polytechnicnical Institute are engaged in research in the field of improvement of engines with hemispherical chambers which were invented for the first time in the world by Boris Loutzky in 1895. Ukrainian designers implement a supercharge in all modern powerful aircraft engines.

Conclusion

Summing up we can state that our compatriot Boris Loutzky and his apprentice an engineer Boris Vorobyov are the founders of Ukrainian aircraft engine-building. Besides living in Germany Loutzky never forgot about his native land. He constantly via Vorobyov offered his inventions and designs for the use in his own country.

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Manifestation of Stylistic Devices in German Media Texts on Ukraine Crisis

Olha Pochapska

Applied Linguistics Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12,
E-mail: olha.pochapska@gmail.com

Abstract – The paper attempts to describe stylistic peculiarities of modern media text. The articles for research were chosen from the German newspaper; they cover the events in the east of Ukraine which are known in the western mass media as Ukraine Crisis. As a result, this study raises a question: how the application of stylistic devices is connected with the function of media texts.

Key words – media linguistics, media text, news coverage, stylistics, stylistic devices, Ukraine crisis

I. Theoretical background

The first newspaper *Relation aller Fürnemmen und gedenckwürdigen Historien* was published in 1607 in Strasbourg and laid the ground for print media. [5] Obviously, the modern news industry is completely different from the one in the 17th century; nowadays along with traditional print media, it comprises broadcast news, which are distributed via radio and television, and Internet news, which target at the Internet users.

According to the German scholar Margarete Rehm, printed newspapers have to fulfil four criteria. Firstly, the content of a newspaper must be accessible to the readers, so that is a criterion of publicity. Secondly, any newspaper or magazine is to come out on regular basis, it corresponds to periodicity. Thirdly, people are interested in learning the latest news, which is why the print media should deal with up-to-date information and meet the criterion of currency. Finally, if the newspaper aims at responding to information needs of wide circle of readers and consists of multiple sections such as domestic news, international news, politics, business, sports, arts, weather, etc., it satisfies the criterion of universality. [4]

Delivering news to the audience is a kind of verbal communication, so scholars took a strong interest in mass media language and its use. Since 1970s, they issue research papers on language functioning in mass communication. The Russian linguist Tatiana Dobrosklonskaya in her book notices that "the authors of those papers analyzed media texts within the framework of various academic traditions, including sociolinguistics, functional stylistics and pragmatics, discourse theory, content analysis, cognitive linguistics and rhetorical criticism. The attention was focused on a wide range of issues: from defining the status of media language in terms of functional stylistics and methods of describing different types of media texts to the impact of sociocultural factors and language techniques of media influence on mass and individual consciousness." [2] As a result, a new academic discipline was founded; it got its name by British scholar John Corner in the article *The Scope of Media Linguistics.*

Media linguistics is a branch of applied linguistics, the International Association of Applied Linguistics (AILA) established the research network Media Linguistics which links applied linguists who address crucial aspects of text production (written, oral and online) in the domain of public discourse in general and news media in particular. The aim of the newly emerging field of media linguistics is to investigate the highly complex and dynamic interplay of language use in public spheres, newsrooms, and news source domains such as business or politics. Teun van Dejk, Martin Montgomery, Allan Bell, Norman Fairclough, and Robert Fowler belong to those scholars who made a significant contribution to the new field of studies.

The basic notion of media linguistics is a concept of media text. In contrast with traditional notion of text, the definition of the media text is broader. Ronald Carter explains that the essence of this concept could be summed up as follows: a traditional for linguistics definition of a text as a "coherent and integral stretch of language either spoken or written", when taken to the sphere of mass communication, considerably expands its meaning. In mass media, the concept of a text goes beyond the formal boundaries of a verbal sign system, and approaches its semiotic interpretation, when a 'text' refers to a stretch of any type of signs, not necessarily verbal. [3]

Media texts fulfil different functions, this fact let classify them into four types – 1) news, 2) comment and analysis, 3) features, and 4) advertising. [2]

All news stories can be labeled as hard news or soft news. In the general run of things, hard news deals with such topics as international and internal politics, economics and finance, science, whereas soft news usually center on the lives of individuals and has little, if any, perceived urgency. Hard news refer to events of considerable significance and usually appear on the front page

The *aim* of the research is to analyze major stylistic characteristics of media texts. The *object* is the media text as a specific type of text. The *subject* is stylistic peculiarities of the text. The investigated articles were selected from the German newspaper *Frankfurter Allgemeine Zeitung* (FAZ) and they all concern the Ukraine crisis and the events in the east of the country Ukraine.

The FAZ is a centre-right liberal-conservative German newspaper, founded in 1949. The newspaper is comes out daily in Frankfurt am Main. The articles in question were published in the issue Nr. 31 on February 6, 2015 prior to the summit in Minsk on 11 February 2015, and fall under umbrella of hard news.

II. Analysis of lexical stylistic devices in the media text

The articles were analyzed from the stylistic aspect.

One of important feature of news article is use of **attributive and adverbial modifiers (epithets)**. This stylistic device is aims at giving an evaluation of properties, features or qualities of living beings and phenomena. In the analyzed articles the following examples of were found: *unbeirrbare und bisher unaufhaltsame militärische Aggression; neoimperalistische Politik; berechtigte Sorge; ein blutiger und opferreicher Krieg; die grundlegende*

Asymmetrie in diesem Konflikt; Die jüngste Eskalation; rationale Argumenten; agieren und reagieren zögerlich; agieren opportunistisch.

Another lexical stylistic device found in the media texts is **metaphor**. Metaphor is a transference of names of two living beings, things or phenomena based on the associated similarity of their features or properties.[1] This device is illustrated by the following sentence:

Ist die Welt ein Pulverfass?

Newly coined words – **neologisms** – are also present in the researched texts. Thus, the term *Putinismus* is used to characterise the policies of the Russian president Vladimir Putin and his system of government.

Die Wertehierarchie des real existierenden Putinismus anders aussieht als die der westlichen Demokratien.

The writer also employs some **terms** related to specific terminological systems. For instance, we meet an economic term *Kosten-Nutzen-Rechnung* (Eng. Benefit-cost analysis)

Describing stylistic characteristics of lexical units, one concludes that the articles are written in formal **register**, however for some reasons the author uses words or phrases that usually occur in literary or spoken context of language. For example, *Einhalt bieten; preisen; agieren; auf einer Mission definitive sein; sondieren die Schwächen; den russischen Präsidenten aber nicht zu bremsen; um Frieden in der Ukraine ringen.*

The use of figures of contrast is common for such kind of texts. Antithesis is a rhetorical figure based on deliberate co-occurrence of two opposite in their essence, but having certain connection notions or things. In our case, these are *ein kraftstrotzender Ostens und der dekadente Westen.*

III. Analysis of syntactic stylistic devices in the media text

Syntactic stylistic devices are based on word order changes, interaction of syntactic structures in context and transposition of meaning and connection of constituent parts.

Parcellation is a stylistic device the essence of which lies in splitting a sentence into parts separating them by full stops. [1]

Leider nicht. Wir sollten ihn mit allen Mitteln vermeiden. Aber die Lage ist sehr gefährlich.

In order to lay emphasis on some points, the journalists use **rhetorical questions** that actually can be manifested in the form of a question itself or in the form of an exclamation statement.[1]

*Der vielstimmige Aufschrei „**Bloß keine Waffen liefern!**“ wird dabei, um ein Wort der Kanzlerin zu benutzen, nicht hilfreich sein.*

Ist die Welt ein Pulverfass?

Diese Feuer kommen uns sehr nah. Wird das Moskau Einhalt gebieten?

IV. Compositional patterns in media text sentences

Anaphora is the repeated word or word- combination at the beginning of each consecutive syntactic structure. In the given articles the following examples of the rhetorical device occur:

Es brennt im Osten, es brennt im Süden.

Es geht nicht nur um die Zukunft der Ukraine, es geht um die Zukunft Russlands und die Zukunft Europas.

Mal zu viert zusammen noch mit dem französischen Präsidenten François Hollande, mal bilateral.

Conclusions

In general, this research shows the variety of stylistic devices employed in the modern media text. Among the most used devices, we singled out epithets and metaphors on the lexical level of language; parcellation and rhetoric questions on the syntactic level, as well as anaphor that is a compositional pattern of a sentence. The usage of these rhetorical figures is related to the functions of the newspaper texts, which are to inform the target audience and to form public opinion about current events in the society.

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Forming intending primary school teachers' social and cultural competence as a means of integrating into European educational space

Olha Shramko, Ph.D. in Pedagogy, Associate Professor

Primary Education Theory and Methods Department, Oleksandr Dovzhenko Hlukhiv National Pedagogical University, Ukraine, Hlukhiv, Kievo-Moscowska street 24, E-mail: ooshramko@gmail.com

Abstract *– The notion «socio-cultural competence» is defined in the article, the structural model of an intending primary school teacher's socio-cultural competence is given, the components and structural units of socio-cultural competence are considered; pedagogical conditions of forming an intending primary school teacher's socio-cultural competence are formulated.*

Key words – social competence, socio-cultural competence, cultural competence, informational and communicative competence, intercultural competence.

I. Introduction

Modern integrating processes on the European continent strengthen relationships and mutual influences between national educational systems. As a result, the new concept of «European Dimension in Education» is appeared in the international pedagogical dictionary. It reveals the process of developing common European educational space.

Reforming the Ukrainian educational system and its entering into the European educational space requires finding adequate means of forming intending primary school teachers' socio-cultural competence, which comply the demands (meet the requirements) of humanization and democratization of education, the principles of subject-subject interaction.

Modern multicultural society requires training an integrated, versatile thinking, creative personality who would be able to manage with innovative activities, would be able to make personal decisions quickly and accurately /aptly and be responsible for them; a person, who would have extensive communicative skills that are units of an important component of overall human culture – socio-cultural competence.

II. Materials and methods

The socio-cultural competence is a very important fundamental personality characteristic of a modern teacher concerning his/her professional and personal readiness to implementation of the humanistic oriented pedagogical process.

Forming intending primary school teachers' socio-cultural competence requires from a teacher not only a certain system of any didactic knowledge and skills, but such ones that allow his/her pupils to withstand the pressure of not only a lot of information but also the communication with those people who think differently, because the pupils will have to live and work among them in future. In addition, a teacher must possess the appropriate personal orientation, individual culture and experiences of social reflection. Such professionally significant personal qualities and abilities, in our opinion, touch the phenomena of socio-cultural competence.

The concept analysis of socio-cultural competence, revealing the main approaches to defining its content and structure in modern pedagogical science are represented in the general philosophical researches (O. Karpukhin, O. Zakharova, O. Astafyeva), linguistic works (Jan van Eck, V. Safonova, P. Sysoyev, I. Bim, H. Yelizarova, H. Vorobyov, Ye. Vereshchahin) and pedagogical studies (H. Yehorov, N. Lavrychenko, T. Zhukova, A. Khutorsky, O. Verbytsky, H. Vorobyov).

Social competence is the personal ability to cooperate productively with different partners in a group and a team, to perform different roles and functions in a team. Socio-cultural competence is one of the components of communicative competence, which is understood as the capacity for adequate interaction in everyday life situations, establishing and maintaining social contacts by means of language. Socio-cultural competence is understood as not only possession by the information about the direct connection between the linguistic and socio-cultural environment, but also as the interconnection between language and society development.

We have to note that all the components of socio-cultural competence are interconnected through the concept of cultural and social contexts. In contrast to the cultural context requires the knowledge of common culture realities of all the people (native speakers), the social context is the knowledge of specific social conditions of communication adopted in the country whose language is being studied.

Considering the cultural approach to forming socio-cultural competence such concepts become important:

spirituality is an indicator of the existence of a hierarchy of values, meanings, higher level of exploration of the world by human (L. Buyeva) [1];

social values is value attitude to the family, nation and other social groups, to a man as a social being;

socio-cultural context is general sense of socio-historical and cultural conditions that make it possible to clarify the importance of human activities (V. Kononenko, K. Khoruzhenko) [2; 3].

Some questions of the socio-cultural competencies establishing are examined in the works of V. Humboldt, O. Potebnya, F. Buslaev, I. Bilodid, I. Franko, V. Vinohradov, S. Yermolenko, L. Matsko, O. Bilyayev, M. Vashulenko, O. Savchenko, M. Pentylyuk and others.

Forming students' socio-cultural competence requires the knowledge of the national and cultural features of the country, which language we study, the rules of not only speech behavior of native speakers but also the ability to behave oneself according to such characteristics and standards.

It is advisable the process of forming socio-cultural competence was implemented within the core professional training, on the subject content, which is the basis for future educational specialization. In such case, socio-cultural competence as a new psychological trait will become the central personality characteristic.

Socio-cultural competence approach in education allows to consider individual's experience as a system of competencies in various fields of social and spiritual life (I. Gudzyk, I. Zymnya, O. Lebedyev, V Luhovy, O. Ovcharuk, O. Pometun, I. Rodyhina, L. Skurativsky, A. Fasolya). The characteristics which ensure both learning and the best ways of interaction in the society have special significance.

In pedagogical studies according our research problem, much attention is paid not only to understanding the interconnection between the language and society developing, but also about the getting the information about direct connection between language and socio-cultural environment. We think socio-cultural competence involves not only the availability of knowledge in different social and cultural spheres, but also the ability readiness to interact with other people in different areas of life, based on their experience and the ability to use information resources in their activity.

The structure of most models of socio-cultural competence has much in common with the European model. Most researchers (Ye. Vereshchahin, V. Kostomarov, G. Tomahin, V. Safonova, H. Vorobyov, V. Sysoyev, L. Matsko, O. Semenoh, K. Klymova etc.) distinguish the following components:

- lingua-regional geographic is the knowledge of lexical items according to their national semantics and the skills to apply them in intercultural situations;
- social and psychological is possession of socio-cultural predefined scenarios, national and specific behaviors using communication techniques adopted in this culture;
- socio-linguistic is the knowledge of the language features of social groups of population, representatives of different generations, social groups, dialects: linguistic stereotypes, situational speech patterns, communication speech patterns, speech etiquette formulas, models of speech behavior;
- cultural is the knowledge of socio-cultural, historical and cultural, ethnic and cultural background and the skills to use them for mutual understanding of the culture native speaker.

Some researchers believe the socio-cultural competence include «cultural competence» (A. Flier [4]), «Information and communicative competence» (O. Astafyeva, A. Zakharova) and «intercultural competence» (O. Sadohin [5]).

Cultural competence is the degree of identity knowing of the social experience of the nation in general and especially with the norms of interpersonal relations and values hierarchies. Person's cultural competence (so as social adequacy) is formed in the process of education and social contacts in the surrounding society, which allows to learn complex of the customs and rituals, the etiquette and ceremony.

Person's information and communicative competence is the possibility of a man both to be orientated in a dynamic socio-cultural environment, in different cultures and to increase the amount of information and knowledge, to build their own style of communication that has high personal activity, new principles of interaction in the conditions of modern cultural transformations.

Intercultural competence is a form of reproduction, keeping, developing and transmission of each ethnic group culture in the minds and behavior of its individual representatives, as well as in a single fund of people's universal values of the world culture. It is a particular socio-cultural phenomenon which promotes the interpenetration of cultures and their openness, serving the most essential condition for the interaction of different cultures in globalized multicultural space of the world community [5].

Socio-cultural competence is considered by many scientists as a complex structural formation. I. Yartseva, T. Zhukova, O. Zhezhera distinguish the following structural components:

- cognitive (the knowledge of the culture and the culture of the language, which is being studied);
- axiological (cultural value);
- personal and operational (communication skills, the ability to organize the cultures dialogue);
- estimated-reflective (autonomy, reflection, self-evaluation);
- communicative (methods and techniques of verbal and nonverbal communication);
- emotional and ethical (socio-cultural awareness and social and cultural responsibility of a person);
- activity (motivation, reflection and creativity).

Purposeful obtaining of knowledge, skills, their transformation into personal competences by youth promote personal cultural development.

Conclusions

Therefore, in our opinion, socio-cultural competence of an intending teacher is a holistic, integrative, multileveled, personal formation, which is the result of a person's professional training in a higher educational establishment and in the process of continuous pedagogical education, the success of which is caused by complex of formed professional's competencies, that promote personality's socialization, forming the philosophical, scientific and professional views, forming the pedagogical creativity and mastery, that determine the success of professional pedagogical activity, the ability to self-realization, self-development, self improvement and learning throughout life.

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The prospect of distance education in Ukraine

Maria Shurdenko

Physics and Mathematics and Technology Education Department, Berdyansk State Pedagogical University, UKRAINE, Berdyansk, Kurortnaya street 118-a,
E-mail: phelka_pchelkin@mail.ru

Abstract – The article is headlined of distance learning. Distance learning is defined as a kind of open learning using computer and telecommunication facilities that provide interactivity teachers and students at different stages of training and individual work with the latest materials information network, most of which prepared teachers. The purpose of our publication is to highlight trends of distance education in modern society and focus on the advantages and disadvantages of distance learning. The article goes on to say that distance ðearning this kind of educational services is gaining popularity worldwide. Analysis of distance education shows that all institutions, organizations and agencies that implement or use of distance learning technologies, encounter real difficulties to overcome which requires targeted financing, joint efforts with the efforts of schools of public authorities, coordination of joint actions and regulatory and legal software that will help accelerate the process.

Key words – distance learning, e-learning, educational space, information education, learning platforms.

Distance learning is gaining popularity worldwide. Now there is a form of distance education in almost all universities in the world.

The research of many scientists in the field of distance learning process has revealed its main features: focus on independent learning activities of students; significant potential for activation of distance learning teaching and learning of students; possibility of open learning, expanding audience of consumers of educational services; global integration of educational services; reduction under certain conditions material costs for the organization and implementation of the learning process.

Particularly noteworthy new approaches to learning that are implemented in a fairly conservative among European universities often chaotic - "bottom up". And the time has come to develop comprehensive national strategies and programs of the university.

Ukrainian universities are able to open distance learning. One of the problems of implementation of distance learning in universities is the lack of legal basis. Scientists predict that near the time when distance learning does not concede full-time study. In distance learning in Ukraine is considered a range of services provided by the creation of special educational environment in which the location of the computer does not play any role.

According to the current legislation of Ukraine in distance learning refers to the individualized process of transfer and assimilation of knowledge, skills and methods of human cognitive activity that occurs on indirect interactions distant from each other participants training in a specialized environment is created based on modern psychological and pedagogical and information technology.

The main purpose of distance learning pedagogical university is to provide students opportunities of development of educational programs directly to the place of residence or temporary residence (location).

Consider the main benefits of distance education in universities.

The difference of distance form is that it provides individual training for each student developed a plan for him.

The system of distance education, as well as any system, imperfect and has a "+" and "-". The main disadvantages of distance learning options, firstly, include the lack of "live" interaction between students and teachers, which is the basis of the traditional forms of education for the formation of ideology. This factor is a major influencing the quality of education. In distance learning using both text and graphics, sound files, video files. Many internet users have a problem with the speed of obtaining information. Some do not have access to the Internet or not to remain on the network takes time. Thus, poor call quality can adversely affect the quality of educational services and more. The best solution to this problem, experts suggest to combine traditional universities and distance learning in the study of individual modules.

Distance learning allows differentiated lessons, such as lesson learning new material, lesson practical lesson control knowledge, lesson - tour, a lesson to the decision of technological problems (these classes are dedicated for design and simulation products, assembly drawings and sketches, planning processes and development of instructional cards) lesson with elements of historicism (using interdisciplinary communication history, you can acquaint students with the life of our ancestors) lesson - game tutorial - project.

New technical and technological means of network communications offer new methodological possibilities of distance learning for future teachers of technology.

Possibility to build individual advancement for each trajectory through choices and types of presentation material depending on the characteristics (limits) and individual development, organize self promotion topics.

Remote technology to some extent allow basic problem of "special" students, which is a lack of communication with other people, and especially with classmates. Despite the physical distance there is a real possibility of mutual communication of students in joint sessions in the e-mail, conferences, chat, online lectures and seminars.

Remote technology focused on the use of various forms of self-study, studying can choose as forms and ways of learning, time and form of interaction with the teacher. The development of skills of independent learning greatly enhances the future teachers of technology and may continue to cause his professional interests.

Analysis of distance education shows that all institutions, organizations and agencies that implement or use of distance learning technologies, encounter real difficulties to overcome which requires targeted financing, joint efforts with the efforts of schools of public authorities, coordination of joint actions and regulatory and legal software that will help accelerate the process. Recent advances in Ukrainian universities are

implementing distance learning in developing their own platforms and development of distance education world-known developers.

Development of an integrated approach to the creation of a national educational and scientific information environment of Ukraine, which would include telecommunications infrastructure, information resources education and science, network digital libraries, virtual laboratories Interuniversity; accession to the European educational and research networks and information resources; development and improvement of the legal framework of distance learning; Weighted democratization licensing requirements for distance learning on the volume of professional training, information and staffing.

The development of distance education in Ukraine held two fundamental stages of development. According to the "Concept of development of distance education in Ukraine" dated 20 December 2000 in the first phase of development of the national distance education took place during 2001:

- creating the organizational structure of distance education;
- development of legal framework and standards;
- creation of material base of regional and local centers;
- creating initial fund distance learning courses and ensure their experimental implementation;
- financing of development principles to.

In the second phase of distance education in Ukraine in 2002-2003:

- full-scale deployment and implementation of distance education as a form of training, of equivalent full-time, part-time and external;
- the introduction of multi-channel financing businesses and individuals the system distance learning;
- the development and introduction of incentives for using computer networks and telecommunications infrastructure components for the system distance learning (businesses and individuals);
- introduction of licensing, certification and accreditation distance learning.

Distance learning integration of Ukraine into the global system. Over the next 20 years, Ukraine completed the transition to modern forms of intellectual and professional socialization, one of the most important educational technologies which will be distance learning. This happens not only because distance learning is more efficient from an economic point of view, it is more informative, less physical energy costs and time, but also because of its accessibility to all citizens for the first time creates conditions for the implementation of the principle of "learning - throughout life"which is the most important part of the dynamic pace of modern society.

Distance learning form, a single information and educational space where to include all sorts of electronic information sources (including network), virtual libraries, databases, consulting services, electronic textbooks, kiberklasses. The main organization in distance learning is to create e-courses, development of teaching the basics of distance learning, training teachers coordinators. The main objectives of the current stage of development of distance education are:

- awareness directors of education, by the management, academic staff i broad pedagogical communities of feasibility, necessity and implementation of distance education opportunities in education in the domestic;
- establishment of national, sectoral, regional, local subsystems distance education and relevant to them telecommunications networks with access to the Internet;
- development of teaching methods of distance learning and certification;
- creation of local telecommunication networks with access to the Internet education and formation of their web-site distance learning;
- training for distance learning;
- formation of experimental educational groups and their distance learning.

A lot of modern distance learning courses do not meet educational requirements meet or only partially. Hence the significance of the problem with most developing distance learning courses and methods of their use for different purposes basic, advanced, additional study.

In general, the distant education in Ukraine does not meet the requirements relating to the information society and does not ensure full integration of Ukraine into the international educational space. To distance learning has taken its rightful place in the education system Ukraine need, above all, to create a global computer network of education and science, because it allows the computer to receive educational material is both a library and a center of reference information, and a communication center, making it one of the participants of the program of continuing education in Ukraine.

The results of our research, there is an urgent need to further improve the content of the educational process by means of remote sensing technology will eventually realize modern performance requirements for training and competitive professional education.

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Physical education for people living with HIV: the concept and legal basis.

Nikita Nikitin[1], Victor Pelmenev[1], Anastasiya Nikitina[1], Michael Avakyan[2]

[1]Institute of Recreation, Tourism and Physical Culture, Immanuel Kant Baltic Federal University, RUSSIA, Kaliningrad, A. Nevskogo street 14, E-mail: nnikitin@kantiana.ru, vpelmenev@kantiana.ru

[2]Law Institute, Immanuel Kant Baltic Federal University, RUSSIA, Kaliningrad, Frunze street 6, E-mail: avakyan1992@gmail.com

Abstract – The article concerns juridical aspects of the rehabilitation for people with HIV infection. Despite the fact that there are many legal safeguards provided by legislature, social status of HIV-infected people in Russia is characterized as unsatisfactory. Besides, the study analyzes the social rights of HIV-infected patients performing physical work-outs.

Key words – HIV infection, social rehabilitation, physical education legislation.

I. Introduction

HIV infection is a global problem, which extends to almost all spheres of public life. There is no exception for jurisprudence as well. Legal science studies HIV in order to settle relations between a particular HIV-infected person, the state and society about the phenomenon in question. Nowadays, the issues of the legal status of HIV-infected individuals directly or indirectly are regulated by the rules of civil, labor, family, administrative, criminal and other branches of law.

The purpose of the study is legal substantiation of using physical training for the HIV-infected people.

During the research, it has been analyzed more than 15 international legal acts, 7 normative legal acts and subordinate legal acts of the Russian Federation which are related to HIV issues. The results of 5 integrated scientific researches on the impact of adaptive physical education the state of HIV-infected people were also taken into account. These researches are relevant and were held in different parts of the world over the past few years.

During the research, the universal dialectical approach and methods of observation, description, analysis, synthesis, and deduction have been applied.

II. Rehabilitation of people with HIV: strategy and main problems

On 13 May, 1989 the World Health Organization adopted Resolution WHA41.24 «Avoidance of Discrimination in Relation to HIV-Infected People and People with AIDS". It is the first normative act that secured the legal status of HIV-infected individuals, pointing to the need to respect and respect for their civil rights and freedoms, the impossibility of any discrimination of such people. Moreover, this act became a starting point for the development of international law-making procedure on this topic. General principles of respect and protection of the rights of HIV-Infected people were developed and adopted only in 1996 at the Second International Consultation on HIV/ AIDS, organized by the United Nations in collaboration with the WHO. Among the fundamental principles, a norm that requires all UN member states to develop and adopt a national legal framework on the problems of prevention, combat and treat HIV / AIDS as well as the consolidation of the legal status of infected individuals became number one. By the moment, there are lots of various legal acts (declarations, laws, concepts, national policies, etc.) on the legal situation of HIV-infected people and measures to control the spread of the virus in most countries of the world including the USA, the UK, Germany, Australia, Brazil, China, and etc.

The main legal act that is dedicated to the problem of HIV-positive people in the Russian Federation is the Federal Law N 38-FZ "On the Prevention of Spread of the disease caused by the human immunodeficiency virus (HIV)" (hereinafter – the Act) was adopted on March 30, 1995. In addition to measures aimed at prevention and combating the virus, the Act provides delegation of infected or at risk individuals of certain legal guarantees and opportunities. Thus, according to a regulatory act, the following is guaranteed: the availability of medical examination for the detection of HIV, providing care for HIV-infected people, welfare assistance to those infected patients free provision of drugs for medical use for the treatment of HIV infection in the outpatient treatment. Dealing with the question of the legal status of HIV-infected people, Article 5 of the Act proclaims the equality of citizens of Russia, regardless of their HIV status, and indicates that infected citizens have all the rights and freedoms as well as they bear responsibilities established by the current legislation on general grounds.

Moreover, the legislator takes a very hard stand in relation to HIV-infected people without citizenship of the Russian Federation. Firstly, foreign citizens and stateless people are required to confirm the lack of HIV infection when they enter the territory of the Russian Federation (otherwise enter the territory is not possible).Secondly, if the virus is found within a foreign citizen that has already reached the territory of the Russian Federation, he will be definitely deported from the Russian Federation in accordance with the law.

Legal regulation of the social sphere of life of HIV-infected people is presented in the third chapter of the Act. In accordance with Article 20, the legislator guarantees non-discrimination and the provision of state support for HIV-infected people in the field of labor, medicine, economic and education. There are also legal safeguards and support measures for infected people who are under the age of 18. In particular, patients and caregivers of HIV-positive are assigned with a social pension, benefits and are provided with social support measures, which established for children with disabilities by the legislation of the Russian Federation (Article 19).

Despite broad spectrum of legal safeguards provided by the applicable legislation, the situation of HIV-infected people in Russia can hardly be described as satisfactory.

Firstly, if the order of providing medical care for HIV-infected people in the second chapter of the Federal Law N 38-FZ adopted on March 30, 1995 is described in details and it is revealed by other regulations as well, the measures of social support have more framework character and succinctly stated in four articles of chapter 3 of the Act. The law does not contain any clarification or a list of specific measures and steps that the State undertakes to implement the social support of the vulnerable categories of citizens. At the same time in the United States people living with HIV or AIDS are equated to categories of disabled people at the federal legislative level, and therefore have the relevant social, economic and other rights.

Secondly, there is much more serious problem of the enforcement of both national and international current legislation dedicated to the subject. Despite the adoption and codification of a huge amount of legal acts (declarations, recommendations, resolutions and other documents), modern civil society still has no chance to avoid discrimination against HIV-positive people. Present-day society, including the Russian one, consider HIV-infected people negatively. It can be explained by the absence of a sufficient level of knowledge in the field of HIV infections, as well as the influence of rumors, speculation and superstition. It is possible to face with the discrimination based on HIV-status almost everywhere. For example, colleagues avoid HIV-infected people and try to minimize contact with them. It should be mentioned that it is also a difficult task to find a job for HIV-positive people in Russia. There are quite frequent protests of parents who have learned that their children have to study together with an HIV-infected child at school, in the kindergarten or other educational institutions. According to statistics, 46% of respondents believe that people with HIV should be isolated from the society; 55% of respondents would transfer their child to another kindergarten (school), if they knew that there was an HIV-infected child. However, the low effectiveness of legislation cannot be entirely eliminated by using legal mechanisms (the implementation of new acts or amendments to already existing laws). This problem is caused by social factors rather than a gap in the legal technique and can be overcome only with the help of methodological work in order to improve the overall level of legal consciousness of the population. Such work should be carried out by information propaganda in various forms, starting from workshops with the participation of medical professionals at schools, universities, labor groups and finishing with administrative enforcement of the media to create socially-oriented products that will be aimed at condemnation and combat the discrimination of HIV-positive citizens.

However, the most difficult question is the psycho-emotional state of HIV-positive people [4]. The acquisition of an incurable disease is a serious shock to each individual and it often leads to the development of various kinds of mental disorders, stressful experiences, suicidal ideation, frustration, apathy, phobias, etc. According to statistics from the interregional public organization "The community of people living with HIV", more than 78% of respondents have experienced various negative feelings about themselves because of their HIV-status; 13% of respondents have admitted that their suicidal thoughts visit them from time to time. An HIV positive status of a person can also strongly influence the psyche of his relatives. At the same time, even if we eliminate all discriminatory factors and qualitatively improve the efficiency of current legislation, the problem of HIV-infected atomization will not be solved immediately. Thus, it is impossible to influence the process of deterioration of social ties between HIV-infected individuals and society with the help of various mechanisms of legal regulation.

However, the interdisciplinary method can provide medical and social assistance to people affected by HIV and can help them to return to full social activity.

One way of medical and social support within the framework of this interdisciplinary approach requires participation of a specialist in physical culture and sport [3]. This interaction is considered as a mutual activity of a specialist in physical culture and people living with HIV with the purpose to reduce the negative impact of HIV infection on the quality of life. The use of physical training as a kind of medical and social support of HIV-infected people promotes the implementation the maximum maintaining of social functioning and increases the quality of life.

The interest on quality of life levels of patients with various diseases has been growing within public health sector during the past decades. The quality of life is looked at as an integration of physical, psychological, emotional, and social functioning of a patient with focus on subjective perception [4]. Investigating quality of life issue is important has scientific and practical implications on functioning of public health to protect and maximize medical services available in order to improve the quality of live of patients. Importance of researching quality of live of people living with HIV/AIDS (PLHA) is explained by the fact that HIV is one of the most sinister, dangerous and fast spreading disease in the current world. This highly dangerous and incurable disease is a source of a constant stress in patient's life which leads to limitations in all aspects of one's life as well difficulty to socially and psychologically adapt to living with the disease. Social integration of PLHA allows HIV victims to have longer and more productive life, which brings positive input into family and society and prevent further spreading of the disease. A very important role to ingrate PLHA plays physical activity.

Effect of exercise on health status of HIV patients have been extensively researched since the beginning of the HIV pandemic. Earlier exercises have been used in HIV patients to maintain muscle mass, more recently they have been used to slow down body fat redistribution syndrome. Studies show that use of adaptive physical activity in rehabilitation not only improves psycho-social status of HIV patients, but also positively affects their clinical condition. One of the acceptable types of adaptive physical activity used in HIV population rehabilitation is

adaptive movement reaction. At this time there is strong development of the theoretical base of adaptive movement reaction being a subtype of the adaptive physical activity. Recreational physical activity involves integration of functionally important activities into the rehabilitation with great focus on social functioning and quality of life. Recreational rehabilitation boosts patient's sense of control over a situation and minimizes perception of being disabled.

There is a large number of international scientific researches that show the positive experience of the usage of different means of adaptive physical activity in rehabilitation purposes for HIV-infected individuals [1,2,3]. Thus, an international nonprofit organization Cochrane Collaboration has recently published reports of two complex studies. According to their empirical results, it was found that the involving of HIV-infected people, on a permanent or periodic basis, into a series of aerobic exercise for at least 20 minutes with a frequency of three times a week adduce to a substantial improvement of general-physiological state (increase strength, endurance and a significant decrease in stressful experiences). It should be said that in a series of practical experiments, HIV-infected people were offered lots of sports and fitness techniques and other types of physical activity, including exercises on bikes, treadmills, rowing, swimming and much more. However, the type of physical activity which a patient selected did not correlate with the overall results of the study and in general had the same positive effect on physiological condition and emotional background of an HIV-infected person. It also strengthens the immune system.

Another noteworthy study was conducted by a group of scientists in Puerto Rico in 2004 [3]. The test group was consisted of 68 men and women with a positive HIV status, and the purpose was the validation of the theoretical results of scientific researches with the main hypothesis that there is a direct connection between the level of physical activity of HIV-infected people and their sense of social satisfaction. In the experiment, people who lead an active life claim that in general they do not feel any discrimination or harassment because of their HIV-positive status and are satisfied with the quality of life. However, representatives of the slow-moving test group complain about their poor positions both socially and medically. Clinical studies have not confirmed the significant difference in terms of medical representatives of different test groups (in particular the level of CD4 cells was approximately equal). Thus, the researchers concluded that the use of adaptive physical education has a positive impact on the emotional well-being of people living with HIV and promotes their socialization.

These studies show that sustained interaction of the specialist in physical culture with an HIV-infected person optimizes functional, emotional and mental state of people living with HIV; improves fitness and social quality of life of HIV-infected people.

Unfortunately, principles of adaptive movement reaction training as part of rehabilitation of PLHA did not find wild application in Russia. Since specialists in adaptive reaction training are rarely involved in rehabilitation of PLHA this issue has to be studied in greater detail.

III. Methods

This study looked comparatively at the level of knowledge about issues in HIV that future fitness and rehab specialists possess. The study was conducted at universities at Russia, Lithuania, Belarus and Canada. Universities in Lithuania and Belarus were chosen due to the fact that these countries have extensive scientific and cultural ties with Russia. Therefore, the topic could be studied further in joint studies. Moreover, studies show that in Belarus and Lithuania ways to involve physical activity in rehabilitation of HIV patients are quite limited as well as in Russia. On contrary, Canada has tremendous experience in using physical exercise in rehabilitation of HIV infected individuals. Moreover, it has been recognized in that country that there is huge need for development of professional development programs focusing on issue of working with HIV patients. This study included 658 subjects all of whom were students of fitness and sports faculties at universities of Grodno, Kaliningrad, Kaunas, Krasnoyarsk, Moscow, Perm and Toronto. Students were asked questions which determined their knowledge about issues of HIV and their attitude towards possibility of using exercises in rehabilitation HIV patients. When questioned what sources do you get information about AIDS/HIV infection from 78.3% reported receiving information from mass media, there was no significant difference among the cities ($p>0.05$). Only 20.8% of questioned students reported to receive information about HIV from specialized literature. Nevertheless, 43.1% students from Grodno and 44.0% from Toronto report receiving information from the above source. Very little percentage of students from Russia (Moscow - 0.0%, Kaliningrad - 5.1%, Perm-4.7%) and Belarus (4.8%) receive information on the topic from discussions with parents. In Lithuania (10.1%) and Canada (20.0%) parents are more likely to discuss HIV with their offsprings. University professors in Belarus and Canada provide significantly more HIV related information to students comparing to professors in Russia and Lithuania (Grodno - 52.7%, Toronto - 52%, Kaliningrad – 4.0%, Kaunas - 13.3%, Krasnoyarsk - 8.6%, Moscow - 0%, Perm - 4%). Information about HIV from the internet receive 28.7% in Grodno, 29.1% in Kaliningrad, 54.4% in Kaunas, 39.6% in Krasnoyarsk, 34.2% in Moscow, 25.6% in Perm, and 6.6% in Toronto. Not receiving any information on the topic reported 18.4% students from Moscow, 4.8% from Krasnoyarsk, 4.4% from Kaunas, 1.7% from Kaliningrad, and 4.7% from Perm. None of the students from Grodno and Toronto reported not getting any information about HIV/AIDS at all. Therefore, it can be concluded that future fitness and sports specialists in Grodno and Toronto are well better informed on the topic of HIV/AIDS comparing to their peers in other cities. Also, it is important to note that students from Grodno and Toronto receive majority of information from special literature and university professors. Majority of students (73.1%) believe that the issue of HIV/AIDS requires wider attention from the society. Moreover, 84.3% of students could define what HIV infection is and on how it

can be detected in human body. There was no significant difference among the cities on the above questions ($p>0.05$). Further, students have been asked to determine the ways of HIV transmission. Most of the students could identify main ways of HIV transmission; only 25.6% of students in Perm could not identify the ways of HIV transmission. Interestingly, none of the students had considered direct contact as a mode of HIV transmission except for 8.0% of students from Krasnoyarsk. Moreover, 20.1% of all students reported HIV was possible through vector borne transmission. In addition, 22.0% from Kaliningrad think that one can contract HIV infection through kissing and handshaking. From the said above, we can conclude that the modes of HIV infection transmission should be looked at more detail in university curriculum. It is a fact that it is impossible to avoid direct contact during physical rehabilitation between HIV patient and rehab specialist. Therefore, it is essential to improve knowledge of fitness and sports students on the topic in order to understand how to prevent spread of HIV infection as well as preventing biased attitudes towards HIV patients. When questioned how the HIV infection can be avoided, 71.7% answered that it is necessary to use condom during any sexual intercourse, and 64.3% said that only disposable and sterile medical tools have to be used for procedures involving interruption of the skin and protective tissue. Worrisome that 15.3% of students believed that it is impossible to prevent spread of HIV infection. Moreover, 17.7% of students from Kaunas and 16.3% from Perm think that vaccination could be used to develop immunity to HIV infection. There has been significantly different response among the cities regarding whether HIV patients should be involved in regular exercise activity. 46.6% of all questioned students report that physical activity helps HIV patients fight off stress, sense of lack of possibilities and hopelessness. 35% said that physical activity helps to satisfy HIV patients' needs for active rest, entertainment, change of activity and socializing. On contrary, 34.2% of students from Moscow and 19.2% from students from Kaunas think that physical activity negatively affects HIV patient's condition. Students from Toronto, on the other hand, think that aerobic workouts lead to improved cardio-vascular fitness (54.0%) and weight training allows keeping muscle mass constant (58.0%). Only 25.0% and 24.3% of students, respectively, from all other cities share that opinion. Therefore, students from Canada in most case believe that complex physical rehabilitation is beneficial to HIV patients. Opinion on what kind of physical activity should be used while working with HIV patients seem to be significantly different between Canadian and other students.

From all of the described above a few conclusions can be drown.

1. Future fitness and sports specialists in most of the cases know definition of HIV/AIDS.

2. Ways of HIV transmission and preventative measure should be taught in more detail while educating specialists in fitness and sports.

3. Opinion of Canadian students regarding opportunities to use physical exercise in rehabilitation of HIV patients greatly differ from opinion of students from Lithuania, Russia and Belarus. Canadian students, contrary to others, believe that exercise positively affects HIV patients health, as well as report being ready to train and train with PLHA.

Conclusion

Thus, it seems appropriate to adopt a legal act that will provide as a measure of social support to implement adaptive physical education for HIV-infected people at the regional level of the Kaliningrad region This initiative will allow a short-term (presumably three years) social experiment aimed at obtaining empirical data on positive effects of physical culture and sport on the emotional and mental state of HIV-infected individuals. The regional level of the experiment will allow not amending current federal laws. Material-technical base of the experiment: the budget of the Kaliningrad region, budget of the city district "The city of Kaliningrad", budgetary appropriations and private donations. As specialists in physical culture and sport, it is offered to attract graduates from the Faculty of Physical Education and Sport of Immanuel Kant Baltic Federal University, which currently has developed and conducted a training course "Pedagogical features of the use of physical training at medical and social support of people living with HIV." Conducting this research within the Kaliningrad region suggests that the result obtained by mathematical analysis of the data can be modeled for each subject of the Russian Federation.

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Complex Metaphor in the Novel of Cecelia Ahern "Thanks for the Memories"

Natalya Keklyak

Student of Applied Linguistics Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: natalya-keklyak@yandex.ru

Abstract – The paper aims at describing the unique techniques of secondary metaphorisation an Cecelia Ahern's writings. The examples of combination of primary metaphors to form complex ones are analyzed, which reveals the peculiarities of metaphor as a trope.

Key words – metaphor, primary metaphor, complex metaphor, direction of metaphorisation, target concept, trope.

I. Introduction

The paper is dedicated to studying the technique of complex metaphorisation in the novel of Cecelia Ahern "Thanks for the Memories". **The topicality** of the study is brought about by the fact that metaphor is one of the linguistic phenomena, which still needs thorough research, since its classical determination as the transition by similarity has become far too narrow. Nowadays the new cognitive studies open up the broader outlook on metaphorisation. Furthermore, metaphor remains one of the most productive ways of creating language units.

The aim of the study is: to study the major directions of metaphorisation and target concepts; to analyse the examples of complex metaphors from the novel by Cecelia Ahern "Thanks for the Memories" and to classify them according to the way they are formed.

The object of the research is metaphor in the novel by Cecelia Ahern "Thanks for the Memories". **The subject** of the research is to find the individual author's peculiarities of metaphorisation

II. Linguistic Metaphor

The number of sound combinations that human speech organs can produce is limited. Therefore at a certain stage of language development the production of new words by morphological means becomes limited, and polysemy becomes increasingly important in providing means for enriching the vocabulary. From this it should be clear that the process of enriching the vocabulary does not consist merely in adding new words to it but, also in the constant development of polysemy [5]. Especially it is important when we talk of fiction, where the beauty of the author's words lies in the ability to build them into a unique and sophisticated architecture, and metaphor is a valuable tool the writers use abundantly.

Linguistic metaphor is the type of meaning transference when a new meaning appears as a result of associating two objects (phenomena, qualities, etc) due to their outward similarity.

The example can be the noun drop, which in addition to its meaning "a small particle of water or liquid", has the meanings: "ear-rings shaped as drops of water"(e.g., *diamond drops*) and "candy of the same shape" (e.g., *mint drops*). It is quite obvious that both these meanings are also based on resemblance. In the compound word snowdrop the meaning of the second constituent underwent the same change (also, in bluebell). In general, metaphorical change of meaning is often observed in idiomatic compounds [1].

In its broad meaning the word "metaphor" is applied to all types of using words in their indirect meaning [4].

In stylistic approach – metaphor is considered to be one of the tropes. Occasionally made-up metaphor has always been the creation of the author's individual reflection of the world, which is based on a peculiar experiment with the language. A lot of scientists state that the literary occasionalism is created as a result of conscious, stylistically motivated, deviation from general norms when a word is collocated in a non-standard way. In linguistics the problem of metaphor, as a process reproducing new meanings of the expressions by their reconsidering, and also as a ready metaphoric meaning, has been studied for a very long time, but more often as a stylistic or artistic method, more seldom as the means of nomination, and even less often as the means of creating the picture of the world with the means of language, which appears as a result of cognitive manipulations with the already existing in the language meanings to create new concepts, especially for spheres of reality that do not exist in the real life [6].

III. Complex Metahpor

Lakoff G. and Johnson M. have suggested that all conceptual metaphors must be grounded either in a co-occurrence of experience between the two domains of a mapping or through the unification of primary metaphors which are themselves experientially grounded [2].

A primary metaphor is a basic, intuitively understood metaphor (or figurative comparison) – such as *knowing is seeing* or *time is motion* – that may be combined with other primary metaphors to produce complex metaphors. The concept of the primary metaphor was introduced by Joseph Grady [3].

Cecelia Ahern's often uses such metaphors in her text, and we have classified her techniques of building complex metaphors into several types:

1. Adjunction.

Instead Justin finds himself continuing to walk with Sarah, his mind as active as Mount Saint Helens, his eyes jumping around like an addict needing a fix.

In this example the metaphors stand separately in one sentence. The first one is targeted at a natural object, namely a volcano, and the second one – at the human sphere, personifying the eyes of the hero. What is interesting in this example is the fact that the author used two completely different tangible concept spheres to describe one intangible emotional condition of a person. The researches have already pointed out that very often the human mind is capable of comparing the concepts, which have something in common but at first sight seem absolutely different, that is how the metaphor appears. So the metaphor expects some similarity and difference between the semantic referents, as it should be clear to

understand and at the same time create some new sense, new knowledge. Metaphorisation is the process that has three aspects: the aspect of language, connected with the changes in the language; semantic or deep, which explains the transactions in the categories of linguistic theory; and the cognitive aspect, which is responsible for gaining new knowledge, creation of new senses [6].

2. Insertion

Grafton Street is crowded at lunchtime, as though the gates to the Dublin Zoo have been opened and all the animals have flooded out, happy to escape confinement for an hour.

In the given example we can find combined two primary metaphors. The first one is targeted at the animal world comparing a busy street with the zoo full of animals. The second primary metaphor is embedded into the first one, thus comparing the movement of animals, which are the metaphor of people themselves, with the flow of water. This way a complex structure is built, which unfolds as a telescope directed into the world of nature.

3.Combination

Her fork playfully pokes at a piece of chicken; the chicken hangs on, falls off, grabs on again, and manages to hang on while she waves the fork around, using it as a sledgehammer to knock pieces of lettuce over to see what's beneath.

There are two objects that undergo metaphorisation in this sentence: a fork and chicken. Chicken is personified as being actually alive and not cooked by giving it the ability to move voluntarily, which is the first primary metaphor. The fork, however, indergoes metaphorisation twice in one sentence, being personified the first time and compared with a sledgehammer, i.e. not living object, the second time. This is a very interesting instance of showing how actually the same object and its operaton may be metaphorised directed into absolutely opposite concept spheres.

Finally words start spilling out of his mouth, as though they'd been queuing up impatiently. Fired from his heart as usual, not from his head, and catapulted to his mouth, only to bounce against the walls of his closed lips. But now the gates open, and the words fly out in all directions like projectile vomit.

The abovegiven is a vivid example of combination, where words are both personified being given the ability to feel impatience and queue and compared to bullets and even *projectile vomit.*

Such sophisticated technique of metaphorisation sends the reader's mind rushing through different concept spheres in just milliseconds.

4. Infusion

Dad's rubber ears go back on his head, his bushy eyebrows lift upward, as we reach the airport.

In this example we have a metaphor comparing eyebrows with natural object, and a metaphor comparing ears with a rubber object, however, at the same time this object is personified and given the ability to voluntary move away from the head and back again. Unlike in the previous example with the fork, the two metaphors are not presented in different phrases, but are combined in a single one.

5. Accumulation

...old man, who is easily spotted on the pavement, swaying in horizontal motions like a drunken sailor amid the crowd's vertical stream…. Like a salmon he swims upstream, pushing against the throngs of people going in the opposite direction… I smile now as I watch my great big salmon of knowledge moving upstream, weaving in and out of the pedestrians pounding the pavement toward him. … look that has set his chin in that defiant stance, jutting outward like Cork and Kerry's rugged coastline from the rest of the land.

In the given above example the sentences containing primary metaphor occur in the text page after page as the story evolves. This way the metaphor accumulates as a snowball gaining weight and creates a character of the heroine's father first compaired to a sailor and then to a salmon. This metaphor is mostely characteristic of fiction as a whole story or book may be one complex metaphor. It should be also mentioned that in order to build complex metaphors Cecelia Ahern uses both usual primary metaphors and occasional ones coined by herself.

Conclusion

In this paper the phenomenon of building a complex metaphor has been studied. Five main types of forming complex metaphors have been identified: adjunction, insertion, combination, infusion and accumulation. It has been revealed that a complex metaphor may include primary metaphors directed into various target spheres and include target concepts, which may seem to have little in common.

All of them help to make the word of fiction more eloquent, which proves the fact that metaphor is one of the most productive tropes. Some of the forms of complex metaphors can be actually met mostly in books.

The further research may include carrying out statistical analysis of the examples and creating a corpus of individual author's metaphors for the novel by Cecelia Ahern "Thanks for the Memories". The results of the work may help to understand deeper the mechanisms of metaphorisation process in the modern English language.

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Determinants of knowledge transfer as a context for models of knowledge brokers

Adam Janiszewski

Faculty of Management, University of Economics in Katowice, POLAND, Katowice, 1 Maja street 50,
E-mail: adam.janiszewski@ue.katowice.pl

Abstract – The purpose of the paper is to present research propositions that concern the matter of knowledge brokers' participation in knowledge transfer. The novelty relates to the fact that there is a combination of conclusions that cam be stemmed from social network research, inter-organizational learning research as well as regional studies.

Key words – knowledge transfer, knowledge brokers, institutional environment

I. Introduction

Knowledge transfer that enables knowledge receiver to making use of experiences of knowledge source is an important phenomenon from the point of view of modern economic entities. The effectiveness and efficiency of the transfer of competencies that results from using organizational rules that coordinate communication may lay the foundation for the existence and the development of enterprises [Zander, Kogut 1995]. What is more, the possibility to observe and adapt ideas concerning solutions exploited by co-localized competitors may generate variability that may determine the existence and the development of clusters [Malmberg, Maskell 2006].

Transfer of knowledge may have different forms as well as be influenced by many factors. For example, taking into consideration that they all are at least to some extent combined with themselves, we may indicate on factors related to relationships among organizations (quality, embeddedness in the superordinate relationship like R&D alliance or regional network of knowledge intermediaries, geographical proximity), characteristics of both knowledge receivers and knowledge senders (market success, absorptive capacity, motivation), characteristics of the knowledge transferred (degree of knowledge implicitness or complexity) and characteristics of the transfer process, e. g. its ongoing basis form [Argote 1999, pp. 167-175]. In order for the author to give reasons for the imprtoance of knowledge brokers it is necessary to analyse some of them in detail.

II. Role of knowledge brokers

The great importance is attached to factors related directly or indirectly to knowledge. When talking about intra-organizational context of knowledge transfer one should pay attention to casual ambiguity or a lack of absorptive capacity. These factors can also be related to the transfer that occurs in other empirical contexts, e. g. transfer between organizations that are parts of Joint Venture [Lane, Salk, Lyles 2001], transfer among non-profit organizations [Pallotti, Lomi 2011] or clusters of enterprises [Giuliani, Bell 2005]. What is especially important now, is that a lack of ability to recognize value of knowledge and next to assimilate and commercialize it is a category with reference to it one justifies the existence of knowledge brokers in literatures [Argote 1999; Camuffo, Grandinetti 2011; Parjanen, Melkas, Uotila 2011]. If knowledge brokers need to deal with supporting of enterprises that try to create explorative strategies of building knowledge resources based on resources possessed by other organizations that possibly operate in different technological domains, then knowledge brokers face with technological barriers as well as social ones [Fleming, Waguespack 2007; Rosenkopf, Nerkar 2001]. The analysis of network linkages of enterprises show that companies that have high absorptive capacity, tend to change knowledge within closed sub-groups [Giuliani, Bell 2005]. Due to the fact that the existence of social boundaries cause that coping with technological boundaries becomes to be more difficult, the role played by knowledge brokers as well as their models should be deeply analysed.

Besides resource based view on conditions that both determine knowledge transfer as well as work undertaken by knowledge brokers, one needs to emphasize that also the engagement on the part of competitors who try and develop similar products, may limit the time when knowledge is transferred within hierarchy [Zander, Kogut 1995] or in clusters where co-localization of competitors may increase the awareness of making use of new technologies [Malmberg, Maskell 2006]. It is worth adding that knowledge can be protected within hierarchical organizational contexts by internalization or by the use of formal tools of control [Rugman, D'Cruz 1996]. In clusters, strong relations among suppliers and users may make knowledge transfer more easy, because interpersonal relations that accompany transactions make it possible to monitor and shape common standards of behaviour [Uzzi 1997; Jones, Hesterly, Borgatti 1997]. However, as the pace of technological changes is growing, actors operating within given institutional environment may rely less on trust built by investments in relation. It is more important to be able to monitor others who should be reputable and all parties may have a chance to have realistic expectations with regard to their cooperators who share common standards of behaviour [Maskell, Lorenzen 2004; Rutten, Boekema 2007: Lorenzen 2007]. That is why geographical proximity remains an important factor [Maskell, Malmberg 2006].

An analysis of networking relations shows that the maintenance of linkages with other enterprises/researchers that represent different knowledge domains may enable others to transfer knowledge, especially when it is supported by a lack of too strong focus on chosen field. It also helps companies to build their reliability because it makes it easier to protect knowledge because spillovers among different domains tend to be limited [Bergenholtz 2011, Capaldo 2007]. Hence, it can be said that knowledge brokers are faced with the task to build suitable, often informal, patterns of interactions.

On the one hand, it has been shown that strategically positioned knowledge brokers in companies, have the impact on innovativeness e. g. Tushman 1977]. On the

other hand, the same models emphasize passive role of social networks in knowledge transferring [Obstfeld 2005]. It may partly result from the fact that researches on the topic have been conducted in hierarchical organizational context. Then, apart from social mechanisms, one needs to take into account some additional formal integrative mechanisms or formal control [e. g. Gupta, Govindarajan 2000]. They all may cause that the problem of undesirable use of transferred knowledge by broker has not been explored sufficiently yet. When facing with implementation problems, one has to pay special attention to the role of actors' mobilization that can help with diffusion of innovations [Obstfeld 2005]. When the degree of interdependence among knowledge elements grows, which is reflected by its complexity, brokers may be faced with problems of a lack of trust, limited rationality, or distorted knowledge that can be transferred with delays. It requires that researchers focus on the role of intermediaries structures that can be more decentralized [Zhao, Anand 2013] or specialized [Whelan et al. 2010]. When operating they may be focus mainly on facilitating of direct relations among parties that take part in transfer [Obstfeld 2005].

They can also make use of tasks division in such a way that some parties build suitable knowledge resources and other parties focus on the maintenance of broad network of social relations [Whelan et al. 2010]. These phenomena lead to at least partly redefinition of roles played by brokers. However, with regard to growing importance of the role of social relations, it can be assumed that clusters of companies operating in region can be proper context for verification of hypothesis concerning determinants of knowledge transfer as well as different forms of work undertaken by knowledge brokers [Rutten, Boekema 2007]. In current literature, problems of the exposition of regions to resources of global knowledge or the presence of public knowledge as well as possible activities undertaken by local authority that involve building regional competitive advantage based on regional networks seem to fully justify this choice. It enables the author to show the crux of the matter regarding the role played by knowledge intermediary structures whose activities are additionally conditioned by different determinants of knowledge transfer.

Two ways of conducting business can be distinguished now. The first one is related to relational way. It is important here to say that it does not relate to high level of trust and possible reputation built by repeated transactions with the same cooperator [Ring, Van de Ven 1992], which is when there is relational contracting that was described with comparison to the assumptions of transaction costs economy [Jones, Hesterly, Borgatti 1997]. It was claimed that when risk was high as well as trust among parties was high, it was possible for parties to exchange resources and at the same time to decide on issues related to costs, quality or volume as time went by and these issues did not have to be defined precisely from the beginning of the cooperation [Jones, Hesterly, Borgatii 1997].

Here, the author tends to analyse interorganizational relations that are highly changeable, because partners can be abandoned due to current situation on the market. Also, companies may create their relation based on project relations, which is when companies look for solutions for specific customers' demands within strictly defined time period. Then information can be spread through meetings, rumours or direct observations, which can cause that the cost of information acquisition is lowering. The culture of community comprised of collective beliefs, values, conventions and language shapes. And these all factors make it easier for companies to collect and understand information [Maskell, Lorenzen 2004]. So, it can be claimed that for localized network of interoganizational relations, it is possible to rely on reputation even if the network is not cohesive and the collective institution that allows companies to cooperate is a weak tie. Actors may not create cohesive, strong relations based on triads structures, however, they can be informed really well.

The important point here is that view on knowledge transfer that occured in clusters was that knowledge how to work with other organizations, which generally needed to be shaped as a result of both big and risky investments in relation, is common. In this way all community incured costs that are necessary to create knowledge of such kind, but the assumption was that the same community can derived advantages from the access to this diversified knowledge in region without incurring additional investments that are connected with given relationship [Lawson, Lorenz 1999]. Now one can consider companies that rely on collective institutions that can have the impact on the costs reduction without the necessity to incur high costs when they want to change partner [Maskell, Lorenzen 2004]. Here one may say about so called social trust, which means that "collective group of agents takes mutual cooperation for granted, even if they have no direct experience with each other" [Rutten, Boekema 2007: Loreznen 2007, s. 214]. But some problems arise when knowledge that flows through clusters becomes to be more and more complex. It can happen even in case of codified knowledge which stems from global and distant sources and from that reason it can be difficult to be understood by local players [Camuffo, Grandinetti 2011].

Then problems inherently related to knowledge transfer that involve both some mismatch between experience of knowledge sender and knowledge receiver and possible lost of some important pieces of transferred knowledge can become to be difficult to be overcome. That is why the importance of knowledge brokers who should help companies to deal with complex knowledge is emphasized. However, it is important to distinguish between two different knowledge environment that are characterized by different institutional foundations. It lays foundations for building research propositions.

III. Research propositions

When knowledge that is transferred is highly complex, the level of uncertainty that stems from the threat that a given piece of knowledge can be captured by competitors is lower. Simultaneously, an opportunity to acquire some valuable insights as to how this knowledge can be used

may turn out to be advantageous and lead companies to the success. Then companies do not hesitate to rely on the mechanisms of reputation and aligned expectations. They are willing to begin to cooperate based on general prone to trust others. This is why companies are less interested in patterns of informal relations which are maintained by knowledge brokers. The broker should possess accumulated abundant knowledge resources, which in this case determines the level of attractiveness of broker' market offer. The second situation can be quite different. Then knowledge that flows though clusters is of medium level of complexity. Hence, it is relatively easier to recognize its value. This is why the level of uncertainty that is generated by the possibility to make use of it by competitors is higher. The greater importance is attached to the issues of knowledge protection.

Then it is important for knowledge broker to operate among knowledge domains that are diversified. It can limit the risk that knowledge can leak in undesirable way at least to some extent. At the same time the problem connected with cooperation across social boundaries is visible which is why compnies try to assess how good knowledge broker is at maintaining social relations. When it possesses many relations with entities that represent different knowledge domains it is a source of competitive advantage for this broker. It helps cooperators to protect and transfer knowledge. Simultaneously the ability to communicate among different knowledge domains may prove that given knowledge broker can facilitate direct relations among companies which firstly can be prone to use hierarchical governance mechanisms instead of relational ones which are characteristic for the first situation. The author wants to propose research on the relation between components of knowledge brokers' models and the effectiveness of knowledge transfer. It can be claimed that factors like knowledge base as well as pattern of interactions are main components of knowledge brokers' models. Their importance is dependent on two factors which include such as knowledge attributes and characteristic features of knowledge transfer that can involve differentiated institutional stimulus.

The main research hypothesis **(h1)** is that *both knowledge base and pattern of interaction are main components of knowledge brokers' models that have the impact on the effectiveness of knowledge transfer.* In addition to this, it can be hypothesized **(h1a)** that *the stronger knowledge base possessed by knowledge broker is when companies in order to transfer knowledge rely more on relational mechanisms, the more likely is that knowledge transfer is completed successfully*. Also, it can hypothesized **(h1b)** that *the more diversified pattern of interactions possessed by knowledge broker is when companies in order to transfer knowledge rely more on formal mechanisms, the more likely is that knowledge transfer is completed successfully.*

Conclusion

Abovemnetioned hypothesis constitutes a trial to implement considerations on the impact which different institutions and norms of behaviour can have on the process of knowledge transfer within regional context. Hargadon and Sutton [1997] considered their importance but they focused mainly on the retrieval process when people tried to remind themselves facts from the past that could be useful from the point of view of current problems. What is more, they conducted their research on these phenomena in the context of hierchical organization where there were addictional factors that could influence how these norms shaped. When discussed in the context of knowledge transfer among different co-located organizations these problems become to be more complicated and their solutions requires that researchers take into account different approaches to the problem. It is especially worh doing due to the fact that discussion concerning institutional environment and their impact on innovative activities undertaken by companies in different regions in Europe is common for authors from many countries. The globalization processes that result in the acceleration of processes of knwoledge flows cause that analysis of knowledge attributes and their consequences appear to be important. The trial of synthesis of different possible points of view has been included in this paper. Further research can focus on the identification of next important elements that can be included in knowledge brokers' models. Also, it can be an idea to investigate the extent to which one can say about the existence of "relational competences" [more on tis topic Janiszewski, Pyka 2014] that can exist for possible dyads created by given knowledge broker and its cooperator. This is important when current pace of technological development causes that relations that are maintained by companies become to be relatively unstable. Maybe it is a factor that can counterweigh this lack of stability but to say it for sure further researches on the topic are necessary.

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Problems and development ways of regulatory-methodological support of socio-economic diagnostics in conditions of European integration

Olha Melnyk[1], Marta Adamiv[2]

[1]Foreign Economic and Customs Activity Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: olia_melnyk@ukr.net

[2]Foreign Economic and Customs Activity Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: marta_adamiv@i.ua

Abstract* – *In the paper on the basis of studying and comparison of national and international practices of socio-economic diagnostics the key problems of regulatory-methodological support in this sphere are grounded. The solution of identified problems is to develop the methodical recommendations on socio-economic diagnostics at micro-, mezzo-, and macro-levels of national and international economies, being universal, uniform and harmonized with the international standards and being based on justified indicators-criteria and identification-interpretation support of the diagnostical process with the account of modern challenges of European integration processes in Ukraine.

Key words – socio-economic diagnostics, European integration, contradictions, legal and regulatory basis, indicator, criteria, identification-interpretation support, unified methodical recommendations.

I. Introduction

In modern conditions of the active integration of Ukraine into the European economic area there are a lot of problems in the sphere of socio-economic diagnostics at different levels (macro-, mezzo-, and micro-) of national and international economies, concerning with the divergence of national and international legal and regulatory basis in this sphere; the low level of effectiveness of implementation and use of International Financial Reporting Standards in domestic practice; multiplicity, variety and discordance of existing regulatory-methodological support; as well as with the scientific groundlessness and low effectiveness of some diagnostical instruments. All this leads to the urgent need to harmonize, unify and develop the regulatory-methodological support of socio-economic diagnostics at all levels in accordance with the challenges of European integration on the basis of the development of standardized and universal methodical recommendations, that would regulate the key principles of socio-economic diagnostics and unify the diagnostical results for domestic and foreign subjects.

II. Main part of research

European vector of the national economic development envisages deepening of cooperation between different domestic and foreign actors of micro-, mezzo- and macro-environment (government authorities, financial and credit institutions, investors, intermediaries, counter-agents, business structures). The foreign partner's decision to initiate cooperation with a domestic entity as well as the nature of further relationships with it are basically affected by the substantial information base obtained through the target diagnosing of different aspects of the entity's activities.

Thus, socio-economic diagnostics is forming information foundation for establishing, maintaining and expanding the relationships among different actors of micro-, mezzo-, and macro-environment at the national and international levels, first of all, in the context of revitalizing European integration processes in Ukraine. Unfortunately, in practice, there are a lot of problems in the sphere of implementation and use of International Financial Reporting Standards by domestic business-structures when they are entering foreign markets. In addition, in practice, there exist the situations when the results of simultaneous diagnostics of identical entities performed by different domestic and international stakeholders bring absolutely different, disproportionate results, different identification and interpretation of the entities conditions. This, in turn, substantially hinders the creation of efficient relationships between domestic and foreign partners.

Such a situation is caused by a number of factors, among them: contradictions and unconformity of national and international standards in the sphere of socio-economic diagnostics; low suitability of the use of foreign diagnostic methods in national conditions; non-compliance of the national regulatory framework provisions concerning indicators and criteria as well as identification and interpretation support of socio-economic diagnostics; unsubstantiated criteria of diagnostic indicators optimization with the account of the domestic economy realities; the variety of methods applied to diagnosing of identical objects (thus, only in the sphere of financial conditions diagnostics there are about two dozens of methods used in legal framework and about fifty methods described in educational and research literature) etc. The majority of regulatory documents present economically ungrounded and meaningless evaluation indicators, duplicating and reciprocal indicators, and unjustified criteria, ambiguous and subjective methods of diagnostics, outdated information provision. In the areas of socio-economic diagnostics regulated by the regulatory framework it is quite common to obtain inadequate data not reflecting and sometimes even distorting information about the real state of the object being diagnosed. Besides, in non-normalized spheres, the stakeholders performing diagnostics can manipulate the results through applying more favorable methods and criteria and this again leads to distortion of the information picture.

So, it is expedient to consider and analyze the key national legal and regulatory documents in the sphere of socio-economic diagnostics with the aim to identify the drawbacks and contradictions; this will allow to form the universal base for unification and standardization of diagnostic methods, indicators and criteria.

In particular, "Methodical recommendations concerning identification of the signs of the enterprise insolvency and the features of the actions signaling concealment of bankruptcy, false bankruptcy or incitement to bankruptcy" approved by the Order of the Ministry of Economy of Ukraine No.14 of January 19, 2006 (with amendments and additions) [1] are based on the analysis of about 50 absolute and relative indicators, contain mostly economically insignificant indicators, the indicators that are identical as to the formula of their calculation but have different names, the indicators that are characterized by absolutely incomplete and ungrounded criteria base, shallow interpretation and identification pool that does not account all the operating areas of the diagnosed enterprise necessary for obtaining the adequate results but mainly concentrates on the evaluation of the entity's profitability. Besides, these Methodical Recommendations form the basis for arbitration managers to manipulate the diagnostic results concerning the threat of the enterprise bankruptcy and allow them to adopt lobbied judgments because some indicators have no criteria value at all, while others have absolutely unsubstantiated criteria.

There exist quite a number of problems in the sphere of diagnosing the solvency (credit status) of enterprises. Thus, in "Regulations on the procedure of formation and use of the reserves for reimbursement of possible losses on active banking operations by the banks of Ukraine" approved by the Resolution of the Management Board of the National Bank of Ukraine No.23 of January 25, 2012 (with amendments and additions) [2] there are presented different models of calculating the integral indicator of the debtor-legal entity depending upon the type of their business activity and the size that are based only on calculating the quantitative indicators and do not take into account the indicators that characterize credit support, credit history of the enterprise, its responsibility. Such an approach fails to provide banks with the chance to adequately identify the class of the borrower as it ignores the individual characteristics of the previous, current and perspective activities of each particular enterprise in the credit sphere.

As to diagnosing the investment attractiveness, the key regulatory document in this sphere is "Methods of integral evaluation of investment attractiveness of enterprises and organizations" approved by the Order of the Agency on Preventing Bankruptcy of Enterprises and Organizations No.22 of February 23, 1998 [3]. The major drawbacks of the presented methods are: they are based on the accounting system that does not exist; they use more than 60 diagnostic indicators, it being inappropriate given their interdependence and content identity; they contain no recommendations on the interpretation of the results obtained.

The solution of above-mentioned problems can be possible on the basis of the development of methodical recommendations on harmonization of national and international legal and regulatory basis in the sphere of socio-economic diagnostics, grounded implementation and use the international standards in domestic practice of socio-economic diagnostics, realization of objective diagnostic procedures via the formation of scientifically grounded methodical instruments, universal indicators-criteria basis and unified interpretation support. These methodical recommendations should concern all basic spheres of the objects being diagnoses by subjects of national and international environment, such as financial and property conditions, the threat of bankruptcy, solvency (credit status), investment attractiveness, competitiveness, rating positions. The development of such recommendations is connected with the harmonization of national and international legal and regulatory basis in the sphere of socio-economic diagnostics; optimization of ways of appling the International Financial Reporting Standards in domestic practice; unification of the valid legal and regulatory basis in terms of identity of indicators names, formulas for their calculations, criterias; scientific grounding of existing diagnostic methods and instruments; optimization of the number and list of indicators for each diagnostic area on the basis of their minimization, the usage of the most representative, informative and meaningful indicators by removing of the most correlated and reciprocal of them; forming the reasonably objective interpretation basis of the received diagnostic results.

Conclusion

Thus, at present the valid national legal and regulatory framework in the sphere of socio-economic diagnostics is characterized by essential contradictions and inconsistencies, lack of uniformity and versatility in diagnosing identical entities. The national diagnostic methods are incomplete, ungrounded and not adjusted to international standards. All these drawbacks lead to obtaining inappropriate, non-correlating, and disparate results of diagnostics at national and international levels and this fact greatly hinders the efficiency of cooperation between national and international diagnostic subjects. The solution of these problems, elimination of any manipulations with the diagnostic results, obtaining comparable, complete and reliable results on the diagnosed entity operation can be possible on the basis of unification of regulatory-methodological, indicators-criteria, identification-interpretation support of socio-economic diagnostics at the national level.

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Structural Changes and Patterns of Development Economics

Liliia Holovko

Economy of Enterprise Department,
The Institute for Entrepreneurship "Strategy", UKRAINE,
Zhovty Vody, Haharina street 38,
E-mail: liliya.rmv@gmail.com

Abstract – Author shown the model of the structural transformation on the basis of the empirical analysis of most countries of the Third World countries. Its focus is not only on methods of promoting economic growth and structural change but also on improving the potential for the mass of the population, for example, through health and education and workplace conditions, whether through public or private channels. The result of researches is the identifying of some points of the developing countries and of the countries with economical transformations.

Key words – economic growth, economical system, economical development, agriculture, industry, wage, workforce, globalization, innovation.

I. Introduction

In the process of the transformation of Ukrainian economical system the structural aspect of economical development is becoming very important. It is shown by changes in quantity and quality in economy. There were actual and competitive theories of the economical development and growth: linear stages theory, growth theory and development economics, structural-change theory, international dependency theory, neoclassical theory. The usage of the main points of these theories and practical experience can transform the researches of economical systems into the new multi-science level.

II. The main research matherial

Structural-change theory deals with policies focused on changing the economic structures of developing countries from being composed primarily of subsistence agricultural practices to being a "more modern, more urbanized, and more industrially diverse manufacturing and service economy." There are two major forms of structural-change theory; W. Lewis' two-sector surplus model, which views agrarian societies as consisting of large amounts of surplus labor which can be utilized to spur the development of an urbanized industrial sector, and Hollis Chenery's patterns of development approach, which holds that different countries become wealthy via different trajectories. The pattern that a particular country will follow, in this framework, depends on its size and resources, and potentially other factors including its current income level and comparative advantages relative to other nations [4][5]. Empirical analysis in this framework studies the "sequential process through which the economic, industrial and institutional structure of an underdeveloped economy is transformed over time to permit new industries to replace traditional agriculture as the engine of economic growth" [4].

One of the famous theoretical models is the theory of the structural transformation of the winner of the Nobel award Arthur Lewis, who was described by him in the fiftieth of XX century.

In the general understanding of this theory is the base for the industrial civilization in general and it reflects the historical process of the transformation globally from the agricultural to the industrial model of the economical development.

The content of the structural transformations more fully described in the Lewis model. It is based on the general historical experience of the countries which have passed the stage of the industrialization, so the economy is divided on two main sectors:

Firstly, the traditional sector with the natural agriculture which is hidden by the high amount of the population and zero limited of the labor productivity. This situation let A. Lewis to provide the term of extra labor workforce in this segment, which can be cut without reducing of the production. By providing the usage of the new equipment and the technology it becomes real to transfer the workforce from the agricultural segment to industrial, which is characterized by higher productivity and pay for the work [2].

Secondly, there is a high-productive modern sector, which contain the local industry and the workforce is gradually being transforming into it from the agriculture. So, the process of modernization of the whole economy takes place and the industrial base is becoming stronger. The main attention of the A. Lewis model is paid to the workforce migration from the countryside to the city and to the growth of the production and employment in the modern sector. [9]. It needs extra investments for the creation of the main factors in the industry and for more qualified extra workforce. The investment comes from the reinvestments in the same sector in conditions of the economical growth of the effective running, and by the way of using international investments and financial help. The salary is thought must be fixed on the level is higher than usual in the traditional sector. In the condition of fixed salary in the city, the proposition of the workforce from the countryside is thought by A. Lewis as absolutely flexible.

As a result, A. Lewis model can be used for the countries with the high level of population, weak capital and limited natural resources, the system of the national agricultural system with clear identified condition – result relativity which stimulates the development of the high - technology production is created. In general, the theory of the structural transformation of A. Lewis reflects the historical experience of the development of Eastern countries, but some of its main points are not connected with the institutional and economical reality mostly for the countries with the transferred economy.

The main principle of workforce transformation from the countryside to the city:

- higher wage (according to the Lewis model is not less than 30 %) in the industry in compare with the agriculture;
- better social life - conditions.

The Lewis model determinates the difference between two types of the growth. In the industry it is the result of the using of the added workforce – mainly the reducing the amount of employed. In agriculture the loss of the extra workforce leads to the growth of marginal work productivity. Then the extreme growth of the wage, general payments and automated production is needed. The mechanism of the economical growth in the agriculture is motivated now. These two types of the economical development comply with two different functions of the investments. The process of the structural transformation according to this model is the self-based growth in employment, which is going on till all extra workforces in agriculture will transform into the production industry. On this stage there is a balance between the industry and agriculture, the structural economical transformation ends, the main resource of the local national product creates in production, the other factors of economical growth start

working. They are connected with the scientific and technological, modern management, marketing, IT achievements. As the other equal economical models this conception has some limits, abstractions from the real agricultural processes.

More expended and fully theory of the structural transformations was shown by the Harvard's economist Hollis B. Chenery. He created the model of the structural transformation on the basis of the empirical analysis of most countries of the Third World countries. The result of his researches is the identifying of some points of the developing countries and of the countries with economical transformations.

Firstly, it is the fundamental research of the structure including the general economy, industrial economy and institutional. Secondly, the growing investment is seen as a necessary but not only condition of the economical growth and development.

In the Chenery's model the main attention is paid to the dividing as recourses and causes, as limits the difficulties in economical growth and development on internal and external. It is caused by the development of the internationalization, trance-internationalization of the agricultural life, the development of the globalization and intensification of the international integration processes. The internal causes and limits are divided in two big groups: economical and institutional. Among them there are: the natural resources potential, the amount of the population and the education, the area, the size if the domestic market, historical traditions and skills etc., which can be as causes as limits of the economical development. The institutional factors and limits are connected with the developed system of political, low and market institutions, which give the possibility to do the economical politics. By the analogy the external recourses, factors and limits are divided. The main of them is the access to the foreign investments, technologies and markets.

On the basis of the differences between the countries in the internal and external factors of the economical development there is a substantial differentiation between the developing countries and the countries with the transformation of the economy in the conditions of the economical growth [2]. The structure of the economy can be analyzed according to the production and according to the dividing, exchange and consuming of the product from the point of view of the enterprises, branches, regions and others agricultural elements; separate structure-building factors and processes. In such conditions the industrial structure of the economy characterizes the comparativeness of investments from different industries in the creation of the GDP; the restrictive structure – is the turnover of the production factors; technological – comparativeness functionalized different technologies etc. The researches of the branch structure of the economy of different countries of the world in 2013 shows that the main sphere in the developed countries is the sphere of services, which provides the growth of the economy because of the growth of the workforce and the economy of the natural resources. Development economics is a branch of economics which deals with economic aspects of the development process in low-income countries. Its focus is not only on methods of promoting economic growth and structural change but also on improving the potential for the mass of the population, for example, through health and education and workplace conditions, whether through public or private channels [1]. Development economics involves the creation of theories and methods that aid in the determination of policies and practices and can be implemented at either the domestic or international level.[2] This may involve restructuring market incentives or using mathematical methods like inter-temporal optimization for project analysis, or it may involve a mixture of quantitative and qualitative methods [3].

Conclusion

So, the choice of the ways of the economical system development in Ukraine needs the researches in the domestic practice of the systemic economical transformations, detailed study of the way of world development, generalization of the world experience in the adaptation in the industrially developed countries to the reality of the modern world market. The Lewis theory of development is one from the most popular theoretical construction of the development. The structural transformation of natural consumer economy is its center. The two - sectors Lewis model is the leader theory of the development for extra – working economy for the 'Third world countries'.

For comparing, the model of the structural transformations of Chenery points the attention to the mechanism of the transformation mainly of the agricultural economy of the countries of the 'third world' into the industry with the higher level of the urbanization. While analyzing the neoclassical definitions are used, such as: the price and the derivation of the resources. The main hypothesis of the structural transformations theory is the development is followed by the growth and different changes that are equal to all countries. But there are some differences between the countries in the speed and forms of the development connected with several specific factors: the natural resources, the area of the country, aims, the ways of the governmental politics, access to the foreign investments and technologies, the external condition of the country. The tools of the modulation are the modern econometric methods.

While the modulation of the structural transformations the Chenery empiric analysis of the form development is followed by the Lewis model of the extra workforce. The empiric researches of the movement in the structural transformations show that the speed and the forms of the development can differ depending on the internal and external factors are mostly not controlled by the country. Despite of these differences, the model of the structural movements show this that it can be determinate several ways and forms of the development, which are general to all countries. They can be influenced by the governmental politics, rational organization of the external trade and the external development help programs [6].

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Social and economic efficiency of the decentralization of power in Ukraine (on the example of the Odessa region)

Nataliia Ivanytska[1], Vitaliy Serhiychuk[2]

[1]Department of Theoretical and Applied Economics,
Lviv Polytechnic National University,
UKRAINE, Lviv, S.Bandery street 12,
E-mail: iv.besh@gmail.com

[2]Student of Department of Economy and Management,
Lviv Polytechnic National University,
UKRAINE, Lviv, S.Bandery street 12,
E-mail: vetserg123@gmail.com

Abstract – The article describes the role of decentralization of power as a way out of the financial and political crisis in Ukraine. Social and economical efficiency defined the impact of decentralization to medicine, tourism and agriculture etc in particular the example of Odessa region. Analyzing benefits and downfalls we define the level of effective decentralization of power in Ukraine.

Key words – decentralization, social and economic efficiency, financial system, tax payment, medical service, corruption, development.

I. Introduction

One of the most widespread issues of today's world is a regions' desire to have more local power. The important issue is the need to consider of an effective decentralization of power. This will help to solve the financial and political crisis in Ukraine.

II. The main material

Decentralization is a clever division of power between the center and regions to run the country in a most favourable way. It should not be identify as separatism.

While implementing the decentralization not only the rate of national GDP is important but also it is important to correlate expenditures for development, subsidies and total income.

National legislation should be higher and operate throughout the country, with no region should not have special advantages.

Chiefly decentralization has following benefits and downfalls according to [1] and own research:

Benefits:

- The accordance of the decisions made with the desires of the local communities;
- The ability to hear the requirements of the region and realize them quickly;
- Transparency of all the authorities;
- Diminution of the bureaucracy;
- Elasticity of Project Management;
- More efficient use of human resources etc

Downfalls:

- The possible conflict of the interest of power at local and national levels;
- Issues with the concordance of the decision making process;
- Lack of the qualification of those who aim for the local governance etc.

Generally decentralization is going to affect every city, every citizen and every region. And we can observe its benefits and downfalls in the others' experience, that can show us how it works and what should we expect from the new changes to the Constitution. Firstly, we should define the optimal level of decentralization. Because there are examples when regions can totally ignore national interests and cause harmful effect on the nation. That is why, as it is mentioned in the project, every region will have an observing and monitoring group from the central government that will control the activities of local powers and reach the compromised decisions on the disputed issues. It is important to keep their mission on the observing stage though and to not let them gain the veto power to decide whether or not implement one or another project as it can be observed in Russia, where despite the federalized status all the commands and regulations are coming from the capital [2].

So, it is important to keep those monitors of the unregulated power. Other than that, if we as a nation carefully and dedicatedly follow the path, already positively used by the best developed countries, we will reach the goals that we set up and succeed in all the spheres of our life. Therefore there is a need to measure the regions' dependence on the central power. As it is mentioned in [3], some developed countries there is a percentage division: 60%- central power and 40%-local. In Ukraine for the first stages it can be 70% controlled by the government and 30% controlled by regional budgets. This number will change in a perspective. Other than that, if we as a nation carefully and dedicatedly follow the path, already positively used by the best developed countries, we will reach the goals that we set up and succeed in all the spheres of our life.

Talking about the specific region in Ukraine, Odessa region, it is the most powerful one in the southern part of Ukraine. It is the main water port in Ukraine. It stands on Danube and Dnipro, which means that it stands on ones of the main trade routes in Europe.

Odessa has an amazing potential as a powerful, modern, rich region with a great industrial base that is ready to set records in Ukraine and to produce goods for export.

After annexation of the Crimea, all investments and sponsors turned to a new old "Black Sea Perl" to recreate its tourism sphere. On annual International Tourism Exhibition ITB-Berlin in 2015 on 4-8 March Odessa was presented by the Department of Culture and Tourism of the Odessa City Council. The meeting included representatives of the National Tourism Agency of Germany, Austria, Serbia, Bulgaria, Romania and other [4]. The idea was that the direct relationship with neighbour countries will be more productive than one through Kiev. We have investors in the vinery and liquors production that stopped their activity in the Crimea and that are considering as a potential target a huge base of that production in Odessa. It will produce the excise that will be completely directed to the local budget and then improve the local education, culture and medicine.

We are also concerned on how the decentralized system will affect the social and cultured life of the average Ukrainian citizen. It is not a secret that the medical sphere has a huge amount of problems on all the levels. Those include corruption, obsolete infrastructure, old equipment and people's inaccessibility to the "free medicine". But also the medical education suffers a lot as we have the generation of just graduated doctors that lack the practical knowledge and are not able to change the older generation that is not able to maintain the productivity they used to have anymore. That is why there were a lot of efforts to change the broke system but yet we do not have the solution that we are so desperately looking for.

First of all, the financing: today more than a half of all the flows of money that are financing medicine are hidden in the shadow economy including the untaxed transfer, illegal payments etc. It is mainly caused by the inability of medical institutions to exist on negligible subventions from Kiev. That's why local medical institutions should pay themselves off legally by taxes, insurance policies or by taxed payments.

The matured countries' experience shows us that decentralization can improve the quality of medical services, provide the flexible health care system for the epidemiologic and ecological situation and that is adjusted to the specific region. The system should be oriented on the client, should use market technologies, should enlist regional scientific and educational centers and, of course, provide young specialists with the access to the practical education. Highlighting the higher medical education, Valeriy Zaporozhan brings up an example of the first steps to decentralization: opening the Regional medical center in Odessa's oblast [5]. One of the main goals of those kinds of centers is to stimulate and motivate the private sector to invest in the developing scientific-medicine sphere as the national financial help is far not satisfying, especially now with the military crisis.

Ukraine has an incredible agriculture potential. The main issue in the agriculture sphere in regions is the access to land. As we know this issue is deeply overlapped with corruption in the local administrations, created by the central powers. With decentralization local communities and institutions will be able to distribute their land between themselves on the legal basis, determining their own tax rate and rent durations. So the village community will finally be the owner of its land.

In a time of crisis, regions have issues with the financial system, corruption. Some financial analysts believe that being more decentralized can make more harmful wholes in that system. However, even now there are different strategies on how to deal with present problems: on how to prevent the economic crisis in the region, on how to create new jobs, on how to raise the social and cultural level of the society. But all new ideas were blocked in the lobbies of local administrations. And those few who wanted to help did not have enough power and resources to make it happen [6]. Now, with a new governor and new local powers with a western mindset and wider opportunities decentralized regions will slowly destroy the corrupt system that has been dragging them down for decades. For example, in Odessa the new, powerful leadership is a dominating factor in improving and developing all spheres of production.

The reason why most politicians from Odessa and others regions are against the new stream to simple and clear. It is based on primitive subjective interests. Being an international port, Odessa has a huge amount of illegal money coming in and out. And the new local leaders that will not be covered and backed by the authorities will be able to resist the temptation and work for his or her voters. So, it is important for Odessa region, and following its example the whole country, that has an incredible potential, and with new governor a good entrepreneurship, to destroy obstacles on the way to wealth And decentralization will serve as a tool for it.

Emphasizing all the issues, decentralized policy in this sphere is the best strategy.

Conclusion

Decentralization is very necessary for Ukraine. But it will not act until we'll do some steps towards. There are such ways to overcome the financial and political crisis through the lustration, destroying corruption, and lowering the unnecessary expenditures by giving the power at the regions to honest people.

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IPO of Ukrainian companies on the Warsaw Stock Exchange (WSE)

Iryna Kondrat[1], Oksana Malets[2]

[1]Docent of the Department of Finance of the National University "Lviv Polytechnic". E-mail: kondrat@point.lviv.ua

[2]Magister of the Department of Finance of the National University "Lviv Polytechnic". E-mail: malets.oksanka@gmail.com

Abstract – The paper analyzes the Initial Public Offering of shares of Ukrainian companies on the Warsaw stock exchange. Also, it provides a comparative analysis of the composition and dynamics of the WIG-Ukraine and WIG-Poland indexes.

Key words – Initial Public Offering; IPO; Warsaw Stock Exchange; GPW; index WIG-Ukraine; index WIG-Poland; capital; financial instruments; stock market; shares; investors.

I. Introduction

The vast majority of Ukrainian companies uses over-the-counter method of its share placement and raises share capital through a private share offering during its share issue process. This method of placement doesn`t allow to raise high volumes of share capital and determine the real market price of the shares. Therefore, the placement of shares through an initial public offering of shares on the stock exchange (IPO) may be a promising way to the company to attract the additional capital in the future.

II. Results

An Initial Public Offering of shares on the international stock markets has become a common practice in Ukraine recently only. IPO - is a process of initial share alienation of the public stock exchange company on the basis of reports of securities sale, which are addressed to unspecified persons. It is usually held by trading on the stock exchange [5].

Even though high costs of conducting, an initial public offering of shares gives the opportunity to attract significantly larger amounts of funds than other sources of raising capital.

Not all Ukrainian enterprises have fully understood the idea of this concept, but some have already enjoyed its main advantages in comparison with other sources of raising capital. The existence of those significant advantages obtained by the companies with public status is a major reason of the growing interest in the IPO.

Among the main advantages of public company status there should be mentioned such ones as: the ability to use almost unlimited opportunities of the international stock market, and accordingly, attract significant funds; increasing reputation and popularity in the market; ability to attract loans and place bonds under the lower interest rates.

The main disadvantages of the IPO are: substantial costs; lengthiness of the process in time; a certain loss of control over the company; the companies' responsibilities that are related to public status.

The implementation of the initial placement of Ukrainian companies usually takes from one to several years. First, it is connected to the fact that national companies often don`t meet the criteria for listing neither on worlds trading platforms, nor on the Ukrainian ones.

Speaking about the global stock exchange, the company will be able to enter them, only if they have a transparent system of doing business and ownership structure. Ukrainian companies are not used to hold regular audits of their activities and open all the information about them. Many companies have only started caring about their image. This means that if the owners of the company are not ready to disclose information about themselves and their business, there is no point of talking about IPO.

The Warsaw Stock Exchange (WSE) is quite popular world stock exchange among Ukrainian enterprises.

The Warsaw Stock Exchange (WSE) is one of the most promising European stock markets and the most dynamic IPO market - the official market, which enter the companies from different countries by opening all their data. From year to year, the stock market in Poland grows stronger and becomes more international. One of the reasons for this is an active marketing policy, which the WSE is carrying for the promotion of stock market infrastructure in Poland.

According to Polish experts, the IPO is quite an outstanding theme in Ukraine. There are investors on the Polish stock market who know and appreciate the tendencies of Ukrainian enterprises entering the international stock markets. They not only want, but also are ready to buy shares of Ukrainian companies at a competitive price. The most attractive sectors of Ukrainian economy are agriculture and food industry.

The Warsaw Stock Exchange is actually an ideal place for the placement of shares of companies with average capitalization. Conditions offered by this market exchange are attractive enough for Ukrainian companies, because, the placement of shares on the WSE worth less than on the London stock exchange, the market liquidity is high enough, and there is unlimited volume of placement as well as the optimal ratio of costs and result.

The usual way of entering on the WSE consists of the following steps (algorithm) [2]:

1. At the beginning, the owners have to make a decision about entering the Polish stock market.
2. Then, if the company is not a joint stock company, it must be reorganized into such one.
3. The general meeting of shareholders of the issuer should take a decision to enter on the stock market and, if it`s necessary, to increase the share capital.
4. The possible reorganization of the company is carried out.
5. The company selects its brokers and consultants.
6. The Company makes prospectus.
7. The approval of the prospectus is held by the Polish Financial Supervision Commission (KNF) or supervisors of the EU.
8. When the company fulfills all these requirements, it should register the shares in the Polish official depository (KDPW), and then they will be admitted to the market.
9. There is held a first listing of shares.

The Warsaw Stock Exchange has circulation of its financial instruments on the following markets [4]:

- New Connect, launched on August 30, 2007, is a platform for secondary trading, where new businesses with high growth potential can attract capital. This market functions as an alternative system of trading. It gives dynamic small businesses a simple and inexpensive access to the capital and trades, in comparison with the classical market. Total capitalization of the companies has reached 2 billion Euros.
- Catalyst – is the market of instruments intended for trading with municipal, corporate and mortgage bonds.
- Polish Power Exchange. Since 2010, the WSE activity has expanded, covering transactions in the commodity market. In 2012, the WSE has bought a controlling stake in Polish energy market, where trades are conducted by selling electricity, natural gas, property rights to certificates of origin of energy.

The index of Ukrainian companies is present on the WSE. Index WIG-Ukraine is the second (after the WIG-Poland) national index, the calculation of which is carried by Warsaw Stock Exchange since December 31, 2010. Its portfolio consists of companies whose shares are listed on the Main market of the WSE, their location or central office is situated in Ukraine, or whose activity is significantly carried out in on its territory [1].

The structure of the stock market indexes may include companies that meet the following criteria:

- The number of shares in free float must exceed 10%;
- The value of shares in free circulation must exceed 1 million Euros;
- The company shall not be included into the Lista Alertów (warning list) and can`t be in the low liquidity.

The company gets to the list Lista Alertów if its market capitalization falls below 5 million Euros or its stocks are characterized by low liquidity.

Ukrainian companies whose shares are represented on the Warsaw stock exchange are "far behind" from the market. The WIG-Ukraine index on the WSE demonstrates from the very beginning a steady decline. He reached his peak in 2010 (the maximum value was 1089.8 PLN), and since then has been falling steadily, reaching its minimum in 2015 with a value of 216.63 PLN. (Fig. 1).

International investors are attracted by high-quality assets. The peculiarity of Ukrainian companies is the fact that at foreign markets their shares are sold with a discount because of the risks of the country. Ukraine is a country with a high risk of conducting business. Military-political crisis in Ukraine has frightened investors. This trend is clearly displayed on the Polish stock market.

The situation looks much worse, if to compare dynamics of the WIG-Ukraine index with the dynamics of the national index of Poland - WIG-Poland (Fig. 2). This index for the past 5 years has shown significant growth, with the only significant drop in 2011. In the period from 2010 to 2015, the index has increased by almost 60% and has reached a maximum in 2015 with the price of 58998.61 PLN.

It is also necessary to emphasize the tendency of reducing the number of companies whose shares are included in the index WIG-Ukraine. Thus, at the end of 2013 there were 11 such companies (Table 1), and by the end of the 1st quarter of 2015 there has left only 7 ones (Table 2). That is, only some companies were able to comply with certain conditions in the stay list, and some have even stopped quoting its shares on the WSE.

The reducing of the value of WIG-Ukraine index to significant extent was caused by the rapid decline of such index market leaders shares value, e.g. of such companies as KERNEL, ASTARTA and OVOSTAR. For example, the cost of the package of the largest company in the list - KERNEL – has declined more than twice from 80080600 to 366446080 PLN. At the same time, the company's share in the portfolio grew from 38,77% to 48,72% [1].

That is, that the decrease of the index WIG-Ukraine is explained by the steady decline of market value of Ukrainian companies shares, the failure of some companies to comply with all the requirements for entry to the index list, and, as a result, their exclusion from the index, and the absence of new companies, which could be included into the index instead of the predecessors.

Fig. 1. Dynamics of WIG-Ukraine index on the WSE in the period 2010-2015 [4]

Fig. 2. Dynamics of the index WIG-Poland on the WSE in the period 2010-2015 [4]

TABLE 1

THE COMPOSITION OF THE WIG-UKRAINE (AS OF LATE 2013) [3]

№	Tool	Package	The market value of the package (PLN)	Share in portfolio (%)
1	KERNEL	13 807 000	800 806 000	38,77
2	ASTARTA	9 256 000	549 806 400	26,62
3	OVOSTAR	1 558 000	155 488 400	7,53
4	IMCOMPANY	9 809 000	147 135 000	7,12
5	MILKILAND	8 426 000	126 390 000	6,12
6	AGROTON	6 610 000	68 942 300	3,34
7	COALENERG	11 253 000	93 062 310	4,51
8	KSGAGRO	5 126 000	62 793 500	0,576
9	KDMSHIPNG	996 000	32 838 120	1,59
10	SADOVAYA	10 771 000	20 464 900	0,99
11	WESTAISIC	11 033 000	7 943 760	0,39

TABLE 2

THE COMPOSITION OF THE WIG-UKRAINE (AS OF APRIL 15, 2015; QUARTERLY PUBLICATION) [3]

№	Tool	Package	The market value of the package (PLN)	Share in portfolio (%)
1	KERNEL	9 856 000	366 446 080	48,73
2	ASTARTA	9 253 000	222 072 000	29,53
3	OVOSTAR	1 725 000	120 750 000	16,06
4	MILKILAND	8 276 000	23 917 640	3,18
5	AGROTON	6 399 000	7 358 850	0,98
6	COALENERG	11 252 000	7 201 280	0,96
7	KSGAGRO	5 093 000	4 329 050	0,58

The reasons of companies' value depreciation in WSE have become mainly some fundamental factors. Ukrainian economy has been already 17 months in recession and is still weak. The trade deficit, a sharp reduction in foreign exchange reserves, weakening of the hryvnia have not gone unnoticed.

No less important were the falling prices on agricultural goods on world markets and problems with the sale of coal.

"Astarta", whose shares are the most liquid ones that together with shares of "Kernel" occupy 70% of the weight of the index WIG-Ukraine, have had its own problems (reduction in the price of sugar).

All Ukrainian issuers whose shares are traded on international stock exchanges, including the Warsaw Stock Exchange, came under threat impact on their business by negative force majeure circumstances, which are the recent events in our country.

Thus, investors and owners of companies do not have sufficient grounds to expect the growth of the index WIG-Ukraine to the end of military-political crisis in Ukraine.

Conclusions

Public status of company and compliance with certain requirements allows the company to make an initial public offering on the stock markets. This method of raising financing has fully justified itself, despite large costs and long lasting process. Consequently, practically limitless possibilities of international stock markets become opened for these companies. In recent years, the Warsaw Stock Exchange has become increasingly popular among Ukrainian enterprises to carry out IPO.

The index WIG-Poland showed significant growth over the past five years as compared with the index WIG-Ukraine, which has been falling rapidly. The reason is in reducing number of companies whose shares are included in the index WIG-Ukraine, military-political crisis in Ukraine and the rapid decline of such index market leaders shares value, e.g. of such companies as KERNEL, ASTARTA and OVOSTAR. Thus, investors and owners of companies do not have sufficient grounds to expect the growth of the index WIG-Ukraine to the end of military-political crisis in Ukraine.

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The development of transfer system as one of the areas of management improvement by industrial enterprises

Vira Kosovska

Ecological politics and management of nature protection activity Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail:virakos21@ukr.net

Abstract – In a competitive market economy many enterprises feel that they the need an effective management, which can be achieved on the basis of system approach. That's why most managers invest heavily in search and application of new methods of management. However, the managers do not evaluate enough the potential opportunities of the companies, including transfer potential, which describes the opportunities for the effective transfer of various types of resources. However identifying the potential transfer of an enterprise does not mean solving commercial manufacturing and current financial problems, that's why for its implementation it is necessary to develop a transfer system and define the basic facilities of transfer for the purpose of effective use of transfer capacity.

The main purpose of the transfer system is to ensure efficiency for an enterprise management due to mutually operations exchange and transfer of the objects moving..

Key words: enterprise, management, transfer, transfer system, object of transfer, transfer operations.

I. Introduction

Competition in the domestic and international markets is constantly enhancing through the competition among producers to obtain high profits and gain new markets. It forces manufacturers of finished products to search and introduce various measures, including administrative measures aimed at increasing of the key indicators of the finished product competitiveness.

II. Formulation of the problem

One of the areas of improvement is the management development and implementation in industrial transfer system, which is due to optimizing the transfer of core resources, will significantly reduce the company the cost of the finished product

III. The solution of the problem

Modern economy is based on the use of different resources, which are transmitted from their owners and successful enterprises to less efficient companies as a result there is a growth of their industrial production. In this case, there is a transfer process of resources between different types of enterprises and the subjects of their outer environment.

During the activity of an enterprise its structural divisions operate as a single entire organism, while their performing production tasks are aimed at getting the best financial and economic results. The impact of the production to a large extent depends on the level of organization and interaction between these units that while form a hierarchical system.

The mentioned interaction is not effective enough, because it depends on the level of transfer coordination between different types of resources (raw materials, financial, energy, labour, etc.) intermediate goods, certain types of services, information, innovation etc.

In addition to this transfer efficiency of operations also affects not only the managers' decisions of senior management, but also affects directly the performers and middle management managers. This requires a transfer system that would ensure the efficient operation of an enterprise, by increasing motivation, initiative and personal responsibility as well as managers and direct executors.

In addition to the scientific literature it is widely used a concept of "technology transfer", "interbudgetary transfers", "transfer price", "transfer pricing", "transfer capital, "etc. [2]. These concepts are common, and some of them take place in enterprises of various industries. Industrial enterprises regardless of their industry sector, the processes are constantly sharing various resources, semi-finished and finished products. These movements are caused by the needs of an enterprise and occur between units and departments of an enterprise itself and beyond it that confirms the fact of continuity of transfer operations of enterprises that establish and implement the management and production targets.

Transfer operations are carried out starting from the purchase of raw materials and energy and ending with the finished product. These operations include transfer of financial resources, raw materials, various energy (electrical energy, thermal energy) scientific and technological information and innovative solutions, labour, technological equipment, semi-finished products and so on (Figure 1).

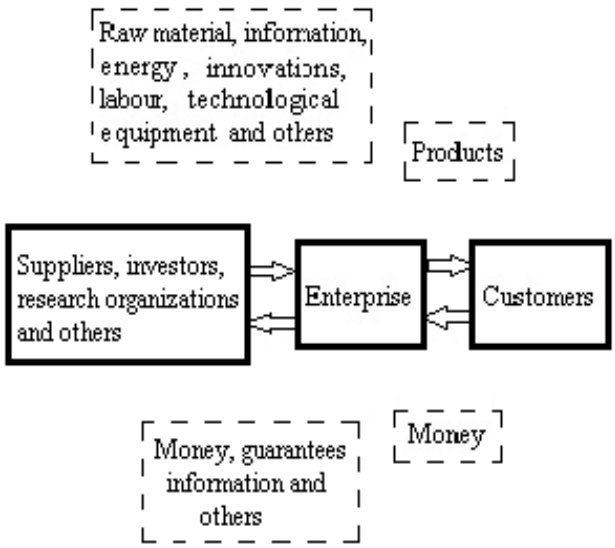

Fig. 1. The transfer operations of an enterprise

At each stage an enterprise management one finds out a common effect of these transactions on one another, which together characterize the dynamic transfer system.

Thus, the transfer system is a set of interrelated operations the movement and sharing facilities with the aim of ensuring optimal functioning of the company and its structural units.

Fig. 2 shows the basic elements of the transfer system of management an industrial enterprise.

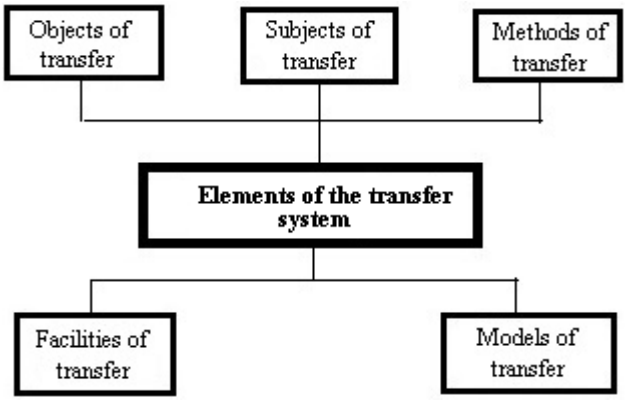

Fig. 2. The basic elements of the transfer system of management an industrial enterprise

For the solution of the above scientific task of creation of transfer system the need for defining the objects of transfer system occurs, which primarily include major types of resources used by the company in its activities (Figure 3).

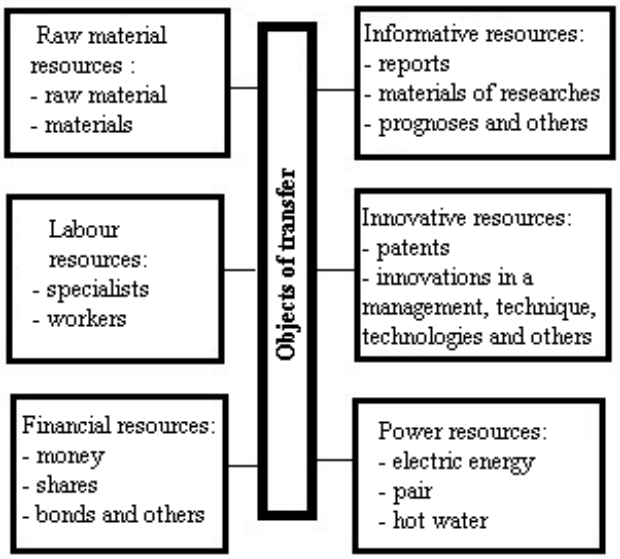

Fig. 3. The types of enterprise resources as an objects of transfer

Under the transfer of raw materials should be understood a set of operations of raw materials search, a realistic assessment of its cost, transportation and payments for it. Thus, the raw materials transfer forms a chain of interrelated transactions connected by one aim to obtain the necessary quality resources suitable for the implementation of technological process and in the right amounts at the best price.

Energy transfer lies in the choice of energy sources, systems of their transportation to the place of consumption at affordable prices and in required quantities. Taking into consideration the variety of energy sources for various properties, characteristics and energy transfer options are pretty diverse.

Labour resources of an enterprise are capable workers who are involved in the sphere of production. Accounting and control of labour resources of an enterprise is performed to determine their size and composition, qualifications and experience. Number and structure of labour resources describes the possibility of the amount of work an enterprise to provide primary and secondary production [1].

One of transfer operations of labour resources of an enterprise is recruitment professional staff. Of a particular value are the specialists who organize and implement of the basic process, as well as specialists who carry out operation and maintenance of process equipment. Not less important role plays the workers of major departments (technical, procurement, accounting, financial and economic, sales, and marketing) that organize and controls the production. Their proper theoretical preparation and practical experience enable the successful implementation of tasks and, accordingly, economic growth of the company.

Financial resources are the totality of funds that are at the disposal of an enterprise and are designed for a variety of financial transactions in order to provide the functioning of an enterprise. Partly they are formed at the beginning of an enterprise, so at the stage of creation of authorized capital. In the future, these funds are invested for production and economic activity, expansion and development of the production [3].

In addition, the financial resources are constantly providing and serving the productive, investment, innovative and other types of enterprise activities.

Speaking about information resources of industrial enterprises one understands the set of information about current status of financial and economic, productive and commercial, staff, investment and other types of enterprise activities that enable to organise operational management in the process of its operation.

Conclusion

The analysis of enterprise management systems shows that the transfer operation is essential elements of their operation. Thus, the lack of a systematic approach to management of these operations is a significant reserve of increase of enterprise performance in competitive circumstances in internal and external markets, that's why transfer system should be used for increasing the effective management industry.

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“Win-win deal”: prospects and risks for Ukraine

Oleksandra Lynnyk

Department of Theoretical and Applied Economics,
Lviv Polytechnic National University, UKRAINE, Lviv,
5 Metropolian Andrey str., Lviv-13, 79013,
E-mail: olexandralynnyk@yandex.ua

Abstract – In the article the 20% debt haircut agreement was analyzed with possible threats and benefits being showed. It was emphasized that encouraging the bondholders to agree on restructuring terms, Ukraine took a step into incertitude. First and foremost it promised to pay holders a percentage of its economic growth from 2021. Given the difficulty to make a proper forecast for Ukraine, it’s uncertain if the so called “win-win” deal will prove to bring economic stability and prosperity and the resources to pay off debt.

Key words – “win-win” deal, extension on repayments, debt restructuring, investment, forecast, economic growth, IMF, political situation, institutional quality, commodity prices, Global Competitiveness Index.

I. Introduction

In late August Ukraine has reached “win-win” debt deal with creditor group to slash its $18 billion debt by 20%, which was backed up by 75% of participants. This agreement is an endeavor to stabilise government finances and to avoid further meltdown, caused in many respects by the war on Ukraine’s eastern border. The debt deal should help keep Ukraine’s national currency stable and be able not only to maintain spending on defence in the east, but also to provide financial support for the poor. The restructuring covers 13 series of its sovereign bonds out of 14 involved in the debt procedure, that was approved by the Creditor Committee and the IMF. Now Ukraine plans to substitute these securities by Value Recovery Instruments (VRIs), which are extremely difficult to value. Instead of paying interests for the securities, Ukraine will pay holders a percentage of its economic growth from 2021. For the rest of debt the government got a four-year extension on repayments, the interests on which are going to be slightly higher – 7,75% comparing with 7,2% earlier (they are going to be paid off during 2019-27).

II. Threats for future prospects

Although Ukraine’s finance minister, Natalia Yaresko considers the 20% haircut agreement as advantageous for both sides, there can’t be ignored some warnings. In particular, Jokob Christensen, Exotix credit strategist, has doubts that this deal will help reduce debt to 71% of GDP in 2020, which is one of the crucial targets in the operation. Another economist Gabriel Sterne admits that there is a large likelihood that “they will be back at the negotiating table before too many IMF reviews have passed”. Besides, there exist some uncertainties. First and foremost, VRIs still have to be issued in November. Those 25% of debt holders, who don’t agree with the agreement have the right to institute a claim in the court (as in the case of Argentina). Secondly, debt restructuring deal means a technical default, that was stated on October, 5th by ISDA – International Swaps and Derivatives Association. From now on IMF remains the Washington-based lender of last resort. As it was neatly stated by Oleksandr Ohrimenko “It has no way to recede. Stepping back means a policy failure as to Ukraine”. Indeed, the Fund failed to make the proper forecasts of GDP growth in Ukraine in past periods. It’s important to note that Ukraine has been remaining a very risky investment place among creditors for a long period now. During the last two years lending rates at the secondary market were very high – 40% and higher, which made it impossible to float the new securities. The only effective instruments to provide the access to financial resources are USA securities.

One good aspect is that this agreement relieved the debt burden for a short time. But the other side of the coin is whether the country will pay more or less comparing with the current value of debt. It all depends on the GDP annual growth rate. Former Minister of Finance of Ukraine Viktor Pynzenyk says that we lose more than win. He emphasizes that the annual growth rate of Ukraine’s economy in the middle 1990s was more than 4%. Given the possibility of such well-being, Ukraine will pay a large share of its GDP. If the rate of growth is 3-4%, then the country will pay 15% of its accretion, if more than 4%, then - 40% of its accretion. A good thing is that the creditors will be interested in Ukrainian prosperity. Consequently, we can hope for investment inflow and growth promotion.

III. Forecasting difficulties of GDP growth

Making a proper forecast for Ukraine’s GDP and what is more important for debt servicing – for exchange rate – looks like a difficult task. First of all as an independent state Ukraine has a very short economic history, which doesn’t allow to build a correct long-run trend of economic growth. That’s why most forecasts are short-run. The one, taken from Eastern European Outlook Economic Research (October 2015) is shown in the table below.

TABLE 1

Economic indices	Years					
	2012	2013	2014	2015(f)	2016(f)	2017(f)
GDP, %	0,4	0,0	-6,5	-12,0	1,0	2,0
Inflation, average,%	0,6	-0,3	12,1	48,0	18,0	10,0
Unemployment, %	7,8	7,4	9,0	9,4	9,1	8,7
Current account,% of ВВП	-8,1	-9,2	-4,0	-1,5	-1,3	-1,4
Public sector financial balance, % of GDP	-5,5	-6,6	-7,0	-4,4	-3,0	-2,8
Public sector debt, % of GDP	37,5	40,7	71,2	98,0	96,0	90,0
USD/UAH, end of period	8,05	8,23	15,77	21,00	20,00	18,00

According to Economist Intelligence Unit forecasts for 2015-17 the forecast of main economic indicators is slightly different from that shown above, but the tendencies are positive too. In particular, the GDP growth in 2016 and 2017 is projected to be 1% and 3,2%, inflation – 14,5% and 9,5%, exchange rate – 24,0% and 23,1%, respectively. At the same time IMF is rather optimistic about Ukraine's GDP growth. More precisely, it expects the 2% growth in 2016, 3,5% − in 2017 with 4% annually farther on till 2020.

To make a proper forecast of economic growth the one should estimate many developing tendencies – external environment, political situation, institutional quality, human resources, etc. Nowadays the investment attraction indicator can be bond yields/demand for shares ratio. The investors aren't motivated to finance the production. If the bond yields go down, the investors will turn to underlying assets. At present there are no motives to improve the situation. Still further the bond yield raised rapidly to 47% on October, 14th, being the highest in the world at this moment. The same happened about a year ago, when as a result of investors' distrusts in Ukraine's solvency the rate on the dollar-denominated debt due July 2017 rose 54 basis points to 15,29%.

IV. Prospects of future growth

Internal situation. The slowdown trend of Ukraine's economy can be fixed by the normalization of the situation on its eastern-south border. As it was repeatedly stated the tensions and the cutting off the eastern territories, where the main production potential is located, extremely negatively affect the economy. According to the NBU head, Valeriya Hontaryeva, since the start of operations in Donbas Ukraine has lost 15% of GDP and 20% of currency returns.

Commodity prices. The global economy is expected to grow 2,8 percent in 2015 before strengthening moderately to 3,2 percent in 2016-17. The commodity prices fell drastically due to low demand and supply glut. In particular, the commodities boom, fueled by China's explosive growth in previous years, caused energy and metals companies to ramp up production to levels that today's market just can't support. Steel production, driven by increasing production in China, is expected to continue to exceed demand up to 2017, therefore dampening prices. Lower commodity prices are a reminder for commodity-exporting countries of the urgency to diversify the economies. The similar situation is with coal. Coal prices are expected to decline 17 percent in 2015 to $50/ton on continued surplus supply. Coal faces difficult market conditions going forward due to slowing import demand in China and increased competition from natural gas due to lower prices.

Meanwhile, according to the Economist Intelligence Unit forecasts the prices for steel and industrial raw materials are expected to recover their upward trends in 2016 and 2017 as well as the price for wheat. Even though given such a favourable prognosis, Ukraine would be unable to benefit fully from higher global prices because of the destruction of industrial plants, mines and infrastructure during the war in the Donbas region.

Institutional quality. The growth of the Ukrainian economy crucially depends on the quality of state institutions and reforming the business environment. The institutional environment is determined by the legal and administrative framework within which individuals, firms, and governments interact to generate wealth. The efficiency of institutions is important for many reasons. First, its quality has a strong bearing on competitiveness and growth, as it influences investment decisions. Second, it plays a key role in wealth distribution and bearing the costs of development strategies. At the same time, high quality institutions provide healthy competitiveness in the market, prevents excessive bureaucracy, overregulation, corruption, lack of transparency and trustworthiness. In addition, the proper management of public finances is also critical for ensuring trust in the national business environment. According to The Global Competitiveness Index 2013–2014, Ukraine placed 84th among 148 countries.

Conclusion

In the paper the main prospects and threats of 20% debt haircut agreement are shown. This agreement is an attempt to stabilise the government finances, exchange rate and to avoid further meltdown, caused as by the war on Ukraine's eastern border, so by inflation and rapid demand drop. The restructuring covers 13 series of its sovereign bonds which are to be substituted by Value Recovery Instruments (VRIs), according to which Ukraine is going to pay a percentage of its economic growth. Although Ukraine in some way smoothed down the situation, it still has to pay off the debt. Considering that it lacks the bankroll, IMF remains the Washington-based lender of last resort. During the last two years lending rates at the secondary market were very high – 40% and higher, which made it impossible to float the new securities. The amount of money Ukraine it going to pay after 2021 depends on GDP growth rates. On the one hand it's a good thing that debtholders will be interested in Ukraine's prosperity as the higher growth rates will be, the higher will be their returns. On the other hand, it's quite complicated to make a forecast taking into account the uncertainties around tensions on the eastern border, external environment and future political situation. Overall, most existing forecasts are quite optimistic. To make these predictions come true, there should be peace in Ukraine, high quality economic institutions, strong external demand for Ukrainian goods, high transparency and trustworthiness in the country.

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Psychology of relations "teacher-student": expectations and challenges

Olga Romanenko[1], Yuriy Baranyuk[2]

[1]Associate Professor of Financial Analysis and Control, chairman of the Scientific Society, Kyiv National University of Trade and Economics, UKRAINE, Kyiv, Kioto street 19, E-mail: romanenko_olya@ukr.net

[2]Student, chairman of the student government FOAEK Kyiv National University of Trade and Economics, UKRAINE, Ivano-Frankivsk region, Kosiv town, Quiet street 9A, E-mail: yura24041994@mail.ru

Abstract. – Peculiarities of teaching in higher education based on the totality of relations that arise between the parties to the educational process. The purpose of research is the system of psychological relationship between teacher and student. The research is isolating patterns of relationships and behaviors of the teacher, depending on the model. Results are based on research and practical recommendations are novelty designed for teaching staff of educational institutions.

Key words: psychology, personality, behavioral responses, pedagogical culture, communicative intent, communication styles, tactics dialogue

I. Introduction

Formation, in its general sense - the development of something under the influence of purposeful action.

The study of the socio-psychological climate can build on the practical and psychological methods that require special training.

The term "interaction" is now not only one of the basic psychological and educational categories, but also acts as an object of interdisciplinary research. In a broad sense, interaction - a kind of embodiment of ties, relations between people who are solving common tasks complement each other and achieve success in solving tasks.

Teaching process - a dynamic interaction between educators and students, aims to achieve educational goals and to obtain new knowledge last.

II. Main part

"Education - not just the transfer of information, knowledge, and the complex human relations ... Word – Thinnest and the sharpest tool that teachers, have skillfully touching the hearts of the pupils"

V.A. Sukhomlinsky, Ukr. teacher

Prepare any specialist depends not only on the student's ability to absorb certain material, but his professional filing with the teacher. The preparation process specialist (bachelor, master) - the process is complex, multifaceted and requires a lot of effort. Characteristics of labor expended on training professional based on length of professional pedagogical communication, which includes the following steps:

1) teacher modeling future communication with the student or group (prognostic stage);

2) organization of direct communication at the time of the initial interaction ("communicative attack");

3) management of communication during the educational process;

4) analysis of the situation and its last communication on the future modeling activities.

The relationship between teacher and student are formed on the basis of the relevant knowledge base by performing the following functions:

- Communications - the establishment and regulation of the relationship between teacher and students;
- psychological - creating conditions for psychological freedom of the student, our individual uniqueness of his personality;
- cognitive - ensuring full perception of educational information of students, formation of their personal, emotional and value attitude to knowledge;
- organizational - efficient organization of teaching and practice of students.

Factors that influence the formation of teacher-student relationship in teaching activities (see Chart 1).

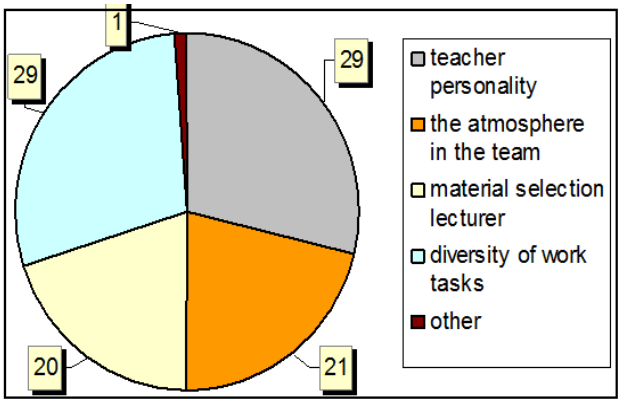

Fig. 1. Factors influencing the formation of relationships, %

For communication to be constructive (not destructive) at each stage, the teacher must have psychological and pedagogical culture of communication, namely:

- know the psychology of college-age students and characteristics specific audience;
- objectively evaluate behavioral responses, communicative activity of individual students adequately respond emotionally to them;
- be able to quickly organize and audience draw its attention to the content of training (techniques of self-presentation and dynamic effects), involve the active work of all students;
- choose their behavior follows that best corresponded to features and mental state of students;
- intellectual stimulation techniques have initiative and cognitive activity of students, organization dialogic interaction;
- timely adjust its communicative intention according to the real conditions of pedagogical interaction;
- analyze the communication process, set the value goals, means and results of communicative interaction.

The practical justification for the above items psycho-pedagogical culture is an analysis of non-verbal elements conducted by the candidate of psychological sciences, dean of Rivne Institute "Ukraine" Elena Savitskaya based on students led by faculty (see Table 1).

TABLE 1

FACTORS INFLUENCING THE FIRST IMPRESSION OF THE SUBJECT OF COMMUNICATION

№	On first impression of the subject of communication influences	Yes %	No %	Perhaps %
1	His gestures	52	30	18
2	His facial expressions	93	7	0
3	Location in the audience during class	59	18	23
4	Is it often looks into the eyes	63	37	0
5	Do touches upon meeting	11	63	26
6	The way he dresses	85	11	4
7	How loud it provides information	85	11	4

In pedagogical communication communications success also depends on respect for the unity of maxims (basic rules):

1) the completeness of information: information statement should contain no more and no less than required;

2) the quality of information, do not say that what you do not have sufficient reason (factor of trust is essential for successful communication);

3) relevance maxim: do not lean on the subject of the message (example, dispersed audience attention, if you are not able to link it with the proclaimed theme);

4) the manner maxim: speak clearly need to be organized and concise, to avoid confusing statements;

5) tact maxim, generosity detect (encumbrance interlocutor their interests), modesty (rejection of rejoicing in his address) consent (opposition).

Adherence to the basic rules will ensure the success of communication and establish effective dialogue with the students, but for professional communication is more important are the ability to:

1) transmit personal "I" to another entity;
2) to hear and see the other person;
3) empathize with another "I";
4) take the other for granted;
5) respect the other person;
6) store features its own "I".

Depending on the position of teacher and considering the use of appropriate skills psychologist V.A. Can-Kalyk singled out the following communication styles:

1) based on mutual admiration creative activities;
2) based on the friendly affection;
3) communication - distance;
4) communication-bullying;
5) communicating, flirting ;.

There are other classifications teacher communication styles and professional position of teachers. For example, the model of interaction of teachers and students offered M. Taglioni:

- Model 1 - "Socrates". This teacher with a reputation as a lover of controversy and debate, deliberately provoking them in the classroom.
- Model 2 - "Head of group discussion." Central to the educational process and believes an agreement establishing cooperation between students, assigning the role of a mediator.
- Model 3 - "Master". The teacher serves as a role model, to be unconditional copy.
- Model 4 - "General". Avoid any ambiguity, emphasized picky, hard seeking obedience since said that always and everywhere wrong.
- Model 5 - "Manager". Style, which has received widespread in radically oriented institutions associated with the atmosphere and efficient operation of the group, encouraging their initiative and independence.
- Model 6 - "Coach." The atmosphere in the group communication permeated the spirit of corporatism.
- Model 7 - "Guide". Incarnate image encyclopedia. Concise, accurate, discreet. Answers to all the questions he known in advance, as are questions.

Each of these models inherent in both positive and negative aspects of cooperation in order to achieve success in teaching activities need the ability to mix elements of each model, depending on the situation that arises in teaching practice.

Organizational-pedagogical interaction center management to communicate the position of the teacher is teaching:

Position 1. Understanding student.

Position 2. Recognition of a student teacher as a person.

Position 3. Unconditional acceptance of the student as a person.

"Well listen and respond well
- Is one of the most perfect features
that are only possible in a conversation"
F. Larochefoucauld, French. writer

The proof of the need to observe a student three positions are the words of F. Larochefoucauld, not always related to the students and teachers and to a certain extent. Therefore, the teacher must also choose the right tactics dialogue, the content of which is as follows:

- need to talk about the problem (action, a fact of observation), and not about personality;
- Do not generalize certain past facts, and talk about what is happening now;
- Do not rush to evaluation, and try to understand the problem, its causes and ways of its solution;
- take into account both verbal and nonverbal messages (respiratory, eye, head movements and hand, the height of voice, speech rate, rhythm, etc.).

Conclusion

Thus, based on the experience and mentality of different countries, peculiarities of educational process in high school, it becomes necessary scientific study of relations between teachers and students in order to determine the most appropriate ways of interacting, learning and creation of a new science.

Behavior of Systemically Important Banks on the financial market

Anna Buriak

Banking Department, Ukrainian Academy of Banking,
UKRAINE, Sumy, Petropavlivska street 57,
E-mail: a.buryak87@gmail.com

***Abstract* – This paper investigates costs and benefits associated with systemic size of the bank for different stakeholders' interests. Author of the research studying the behavior of systemically important banks on the financial market of Ukraine, firstly, identifies systemically important banks (first stage), secondly, analyzes behavior characteristics of these banks to find their specific features (second stage).**

Key words – behavior, systemically important banks, stakeholders, regulation, financial market.

I. Introduction

Today one of the key issues of economic recovery in Ukraine is to ensure the stable functioning of the banking sector. Bank losses, significant outflow of deposits, the panic on the currency market and lack of solvent bank customers has led to disastrous consequences in the banking sector of Ukraine, as a result, bankruptcy over a third of all banks. One of the burning issues is economic and social effects of the large banks bankruptcy. Set of bank failures provokes on the one hand the loss of a substantial amount of household savings causing low confidence to the national banking system and the lack of prerequisites for the economic growth resumption on the other hand social inequity escalation in view of taxpayer-funded bailout of large banks ("moral hazard risk").

II. Systemically important banks

Addressing systemic risk in banking is at the heart of new financial regulation in the world (such as the Dodd-Frank Act in the US and the new Basel III agreement). Today great progress has been made in solving the problem of systemically important banks - from their identification through to their regulation. Under the Financial Stability Board's coordination, methodologies to identify global systemically important financial institutions (SIFIs) have been developed ("Global systemically important banks: Assessment methodology and the additional loss absorbency requirement" (BCBS, November 2011), as well as guidance to help national authorities identify banks that pose systemic risks to their domestic economies ("A framework for dealing with domestic systemically important banks" (BCBS, August 2012).

III. Situation in Ukraine

In the context of the problem of distinguishing the country's systemically important banks, it should be noted that during the financial crisis of 2008-2009 the Ukrainian banking sector demonstrated its vulnerability and the need for financial assistance from the state and international financial institutions with a necessity of supporting the largest banks in order to prevent the spread of the crisis processes. The most troubled banks in Ukraine were the joint-stock company "Prominvestbank", the joint-stock company "Nadra bank", the limited liability company "Ukrprombank", "Ukrgazbank" and the joint-stock company "Rodovid Bank", which belong to the first group of banks. Unlike the causes of problems at international systemically important financial institutions, the main reason for the occurrence of problems in Ukraine was the lack of liquidity due to the massive outflow of deposits (according to the National Bank of Ukraine, within ten days of October 2008 the total liabilities of banks decreased by 18 billion US dollars) and the crisis of trust in the banking system of Ukraine. In order to prevent the further realization of systemic risk and insure the timely payments, the National Bank of Ukraine adopted anti-crisis measures by implementing the programs of banks' refinancing, including their recapitalization by means of the budgetary resources received under the "stand-by" program of the International Monetary Fund. On the whole, to recapitalize the troubled banks Ukraine initially spent 9.5 billion Hryvnias with subsequent infusion of 25 billion Hryvnias. In addition, in the beginning of 2012 nearly 20 banks were in the process of liquidation - mostly medium-size and small banks that could not withstand the wave of the financial crisis in Ukraine. Despite the first steps taken by the National bank of Ukraine towards the identification of systemically important banks (SIBs) in Ukraine (National bank of Ukraine, December 2014) it is less clear whether there are specific costs or benefits associated with systemic size for different stakeholders' interests.

IV. Behavior implications

At the moment there are no comprehensive studies concerning consequences of the systemic size for bank's strategy and behavior in the financial market, motives of the banks' owners, customers, and funding structure of the bank. In particular banks' owners are interested in the question whether the status of the SIB is better for them to get more profit or it is only accompanied by increased risks; financial market regulators are more concerned with differences of the bank business model regarding their systemic size as a consequence differentiated regulation of banks; governmental authorities trouble about opportunities of big banks to ensure credit supply for economic growth. Therefore there is need for providing empirical evidence on whether SIB are different in performance (risk and profit), business model, credit supply capabilities and bailout of large banks ("moral hazard risk").The answer on question "Does the behavior of SIB differ from not systemically important bank?" is valuable for specific groups of bank stakeholders. First of all, it is regulator of financial market - National bank of Ukraine. In response to the financial crisis of 2008, banking industry has been undergoing fundamental regulatory changes focusing authority's attention on risks to the financial system posed by SIFs. The question of SIBs identification and regulation is highly significant for national financial sector supervision system, since wrong understanding of SIBs behavior will bring incorrect

measures from regulators. The results of the research will allow to decide whether it makes sense to restrict some activities of SIBs, for example setting higher capital requirements, limiting the leverage of such banks as they are more risk-taking, capital structure. Besides it is important to know whether the mechanism of market discipline is effective for SIBs. In the absence of effective market discipline, regulatory intervention appears to be called for. Such intervention could take the form of a higher taxation of, say, the profits or liabilities of systemically large banks or direct intervention that forces systemically large banks to downsize or split up. Secondly, it is governmental authorities. It is important to know if SIBs are valuable from the point of view of providing the domestic economy with credit resources, and to determine the feasibility of state support (state guarantees, preferential interest rates) for these banks in the future.

Thirdly, it is bank shareholders and management. It is important to understand whether systemically large banks achieve higher profitability and operate with lower risk for understanding in bank shareholders' interest for a bank to become large relative to its national economy.

To find answers on these questions it should be understood what had been done before in the economic literature. Finding answers should touch the literature dealing with 1) systemic risk measures; 2) bank size and its behavior in the market; 3) the stakeholder theory.

Probably the most intensively researched question is the measuring of SIBs. The basis of SIBs identification is founded by the Basel Committee on Banking Supervision by adopting consultative document "Global systemically important banks: Assessment methodology and the additional loss absorbency requirement" (BCBS, November 2011). The methodology for identifying SIBs is based on the indicator-based measurement approach and distinguishes five criteria of banks' systemic importance on a global scale (size, interdependence, uniqueness of services, international activity, business complexity), each of which has the same weight (20%) and is represented by one or more indicators.

Secondly, in economic literature bank behavior usually is regarded through fundamental bank characteristics like profitability, risk, market discipline, business models as to their activity mixes and funding strategies, credit supply.

Thirdly, stakeholder theory suggests that corporations (banks) should look beyond the shareholder theory of profit maximisation, and take into consideration other stakeholder groups that the corporation is associated with, and who contribute to the company's achievements.

Also, Freeman's perspective of stakeholder theory includes that companies should be managed for the benefit of all stakeholders. With reference to the fact that banking sector and SIBs occupy a significant position in the economy in our research bank behavior implications will be analyzed through interests of main stakeholders – shareholders and management (in terms of profit and risk), regulatory authority (in terms of market discipline and business model) and government authority (in terms of credit supply).

Thus investigation of behavior of SIBs in the market should take into consideration interests of main bank stakeholders – shareholders and management, regulator of the banking market, governmental authorities. To gauge systemic size by identification SIBs it will be enough to use a bank's liabilities-to-GDP ratio as it corresponds to a country's maximum expenditure in a bank bail-out relative to its GDP, if all of a bank's assets go completely sour. According to the performed studies bank size is a reliable proxy of systemic importance due to the fact that bank size helps approximate each of more rigorous model-based measures of systemic importance and that indicator approach may be the most suitable route for practical purposes.

Conclusion

Investigation of behavior implications of systemically important banks poses and answers policy relevant questions. Whether the behavior of SIBs differs from other banks and how, will shed light on what kind of policies should be adopted by National bank of Ukraine toward regulation of SIBs aimed at imposing restrictions on the size, capital structure and income mix of such banks. Besides research will beg the question of why today's banks ever became so large. One potential answer is that bank growth can be in the interest of bank managers through higher manager pay and status, even if bank growth is at the expense of bank shareholders. This suggests that it is undesirable for banks to grow to reach large systemic size. If so, the question emerges whether the prevention of bank growth to large systemic size can be left to market discipline or should be the object of regulation.

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Organizational learning in complex world

Agnieszka Dziubińska

Faculty of Management, University of Economics in Katowice, POLAND, Katowice, 1 Maja street 50,
E-mail: agnieszka.dziubińska@ue.katowice.pl

Abstract – The article discusses the problem of organizational learning as a way of managing complex environment. As an empirical context for the study of the environment of emerging markets was assumed. In the sample of the studied enterprises, in context of single and double-loop learning, three distinct patterns of adjustment of the organization and the environment were identified, ie. avoidance, adaptation, and integration. In the complex environment, on the bases of the results of research, balancing of learning in single and double-loop learning seems to be key strategic competence of the enterprise.

Key words – organizational learning, emerging markets

I. Introduction

In comparison to the second half of past century, world of 21st century seems to be much more complex. Globalization and the rise of the Internet have led many to subscribe to the sense that "the world is flat", as information and communication technologies have made geographic distance less relevant (Friedman, 2005). The incidence of "black swan" events characterized by low probability, extreme impact and retrospective predictability has led many to reconsider their views on how the world works (Taleb, 2007). The discussion here concerning complexity builds closely on the work of Simon (1976) and the issue of interrelatedness of elements of a system. The complexity (or interrelatedness), may take the form of spatial (when one facet of a system affects other facet of the system) or temporal (e.g. when the value of moves is, in large measure, associated with their "stage setting" properties). Decisions made under similar circumstances are accompanied by fundamental uncertainty called an open-ended change by Stacey. Events based on such decisions might possibly transform the system they are a part of or/and themselves (Stacey, 1993). Learning is a way of managing complexity and unpredictability of changes in case of open-ended and partly closed changes (Rokita, 2009). In learning, reflective change occurs on the basis of progressing cognition (understanding) of knowledge and relations between past activities, their effectiveness and future activities (Fiol and Lyles, 1985; Huber, 1991). Such learning process is at the same time adaptive and "manipulative" in a way in which organizations defensively adjust themselves to reality and belligerently improve adjustment between an organization and environment (Hedberg, 1981).

Challenges within the scope of the organizational strategy that arose in relation to complex environment became an inspiration to conduct the author's own study. The environment of emerging markets (EMs) was assumed as an empirical context for the study. The research was aimed at identifying ways of adjusting activities of multinational enterprises (MNEs) in the conditions of EMs, in particular, at establishing whether and in what way experience gained on EMs is used in creating a strategy of a MNE at the level of a foreign market. Studies on enterprises from different contexts investing on EMs create an ideal opportunity to understand better the interactions between institutions of environment and organizations. The environment of western markets was shaped by comparatively similar philosophy of the market economy, which built a foundation for similar institutions. As formulated by Scott, "it is difficult, if not impossible, to recognize the influence of an institution on human structures and behaviour if all our cases are embedded in the same or very similar ones" (Scott, 2001, p. 146).

Qualitative approach with the use of case study was adopted in preparing the research project (Dul and Hak, 2008, 2010). The research procedure that contributed to the achievement of results presented in the article was designed on the basis of methodology proposed by Dul and Hak which is concerned with specifying the relation between known concepts, on the basis of theory-building research (Dul and Hak, 2008). Subjects of the study were ten deliberately chosen enterprises operating on an international scale and their foreign branches located on the EMs.

II. Results

The obtained results of studies revealed three different types of adjustment of MNEs and the conditions of EMs among enterprises involved in the study. Depending on the type of adjustment, specific conditionings of the foreign market were taken into consideration to a different extent in an organization. The identified patterns among the companies in the research sample, in some cases correspond to the typology presented by Cantwell, Dunning, Lundan (2010). Summary of the typology presented by these authors contains Table I.

TABLE I

ADJUSTING OF MNE AND THE ENVIRONMENT

Avoi-dance	Local environment is exogenous to firms Firms choose between different environments Firms react to poor institutional quality by adjusting their entry mode
Ada-ptation	Local environment is exogenous, but firms adapt their own behavior to achieve a better fit Firms may try to influence local institutions, but only to a limited extent Firms seek legitimacy by adapting to local isomorphic pressures As a result of local learning and adaptation, firms gain strategic options Embeddedness in an local context
Coevo-lution	Local (institutional) environment is partly endogenous Firms adjust to different environments by a process of co-evolution Firms introduce new institutions that are adapted to the local context Unintentional spillovers occur as a result of local imitation Active agency and institutional entrepreneurship

Source: J. Cantwell, J. H. Dunning, S. M. Lundan, "An Evolutionary Approach to Understanding International Business Activity: The Co-Evolution of MNEs and the Institutional Environment", Journal of International Business Studies, vol. 41, no. 4, p. 576, 2010.

The research sample involved companies the activities of which corresponded to the avoidance strategy characterized by Cantwell et al. Acknowledging the need of change under the influence of specific conditions in their case did not exceed the scope which concerned key products. By applying avoidance as a form of adjustment, MNEs tried to create the most faithful replication of experiences gained on other markets. In the absence of complementary institutions in the environment, enterprises used their market power (Hymer, 1976) so that the insufficiency would not cause the need of change on the level of basic processes, as well as organizational solutions. The condition for effectiveness of such course of action was for an enterprise to have an appropriate possibility to influence local environment. In the sample of the studied enterprises it resulted from the size and scope of action, therefore avoidance as an adjusted strategy was used effectively by the six biggest MNEs. The use of similar practices in smaller MNEs was not possible, therefore pressure of competition made them lean towards greater flexibility in the face of local conditions.

Enterprises, the activities of which corresponded to adaptation described above, under the influence of the environment also changed their products but this change was a consequence of adjustment within the scope of basic processes (understood as set of activities undertaken on the foreign market which directly add value for a customer). In the studied three cases previous models of activities on this level were suspended by decisions made by authorised managers. Thus, innovation within the scope of basic products appeared but it was an effect of "deeper" adjustment to unique conditions of EM. Among the studied enterprises such form of adjustment was used by mid-sized and small MNEs, which simultaneously had their key competences based on technical knowledge acquired on the local market developed.

The most open way of adjustment to the conditions of EM was a model which to the greatest extent corresponded to the type characterized above as co-evolution. In this case adjustment on the level of basic processes was a consequence of direct influence of environment as well as adjustment on the level of organizational processes. Processes on the level of an organization are comprised by intentional social groups, which control resources, create exchange relations, enter interactions with other individuals and use strategies in order to achieve their objectives. Organizational processes occur in the structural and strategic contexts (Burgelman, 2002, pp. 98-102). Top management in MNE uses the elements of structural context in order to maintain the intended direction of strategic activities. Forces which might impact change of this direction under the influence of experience from local environment are most often the result of autonomous grassroots movements. Following Burgelman, such cognitive processes consisting in identifying the occurring chances and building political support for development are referred to as strategic context.

Among ten studied enterprises only one – the smallest of all enterprises – operated in accordance with the model which to a certain extent corresponded to co-evolution. In this case the ideas came from various parts of the company as well as from the outside of it. The organization cooperated with a wide spectrum of strategic partners. The ideas on the level of basic processes came from employees who directly performed the tasks. The ideas for changes on the level of an organization (e.g. within the scope of various forms of cooperation) came from the President of MNE, however, they were inspired by experience gained in the course of action. Development of initiatives required legitimisation of "the main strategist", i.e. the President of MNE. Principles governing the selection on initiatives varied and were the consequence of decisions of the President of MNE. Changes of direction of action occurred relatively often, only "superior ideology" remained unchanged.

Summing up, the obtained results of the author's own study revealed various models of adjustment of activities of MNE in the context of EM. In case of avoidance and adaptation they were close to the characteristics presented by Cantwell et al. The third type differed from co-evolution described by Cantwell et al. in the context on EM mostly because interaction with the environment was significantly outlined in two directions. Thus, in the conclusion this type of adjustment strategy to emphasize the difference was called integration. On the one hand, dynamic environment of EM was susceptible to the *spill-over* effect "from" the foreign investor "to" the environment. On the other hand, enterprises adjusted their organizational forms, key processes generating results, as well as products to the environment. Thus, a complex structure of factors of change and relations connecting them arose. The studied case of the enterprise represented the level of technical knowledge higher than the standard ruling on the foreign market. However, the use of this source of advantage occurred because of combining knowledge from local market with customers' demands which resulted from their local specifics.

It’s worth emphasizing that the theoretical framework prepared by Cantwell et al. had the nature of an appreciative theory, rather than a formal theory (Nelson, 1994), but was based on a vast literature study. In the social science, an appreciative theory allows scholars to examine a more complex web of casual associations, by being more historically grounded, closer to real life situations, and by making greater allowance for variations in institutional and contextual specificities. At the same time, the concept presented by the authors does not provide unambiguous instructions regarding EMs.

III. Intepretation of the results and conclusions

Diverse scope of adjustment of MNE to local environment marked levels of analysis which refer to the process of learning as a way of managing unpredictability of changes. Referring to Argyris and Schön's (1978) terminology, organizations need to undertake activities in a single and double loop learning in order to sustain

continuity of action, coherence and stability. The difference between the first two levels lies in changes made on the basis of learning in the organization, Rokita describes them as adaptive and reconstructive (Rokita, 2005). The first level is corresponsive and adaptive, close-coupled with the changes in the environment through negative feedback, aimed at sustaining the existing equilibrium. This type of learning consists to a large extent in the stimulant-response mechanism. The second type of learning corresponds to characteristics of open systems, which implies self-reorganization or self-repositioning in the environment or change of rules of action and system behaviour. Argyris calls it a double loop learning, whereas Hedberg (1981) - meta learning, and Bateson (1972) - deutero–learning. Its essence is not a change of system behaviour, but a change of rules of system behaviour. Rokita distinguishes also the third level of learning in an organization and refers to it as process learning (Rokita, 2009, p. 117). He defines it as process learning, which involves all the phenomena which occur together with changes in the flow of action and gaining experience. In other words, it is about learning to understand adaptive and reconstructive learning on particular levels and how these levels interact.

It may be said, employing the above terminology, that adjustment consisting in avoidance is based on a single loop learning. Adaptation is about single and double loop learning, although change of rules of action under the influence of experiences of EM was limited to basic processes which were more directly exposed to selective impact of the external environment. In terms of integration, specific conditions of EM reached even deeper, since they inspired to changes in a double loop as well as in organizational forms. Thus, an even more complex model of adjustment to complex environment was created, which in each case finds its reflection in key products that are offered to customers. Understanding the importance of a hierarchy of levels, on which adjustment to specific conditionings of EM takes place and including this area in the scope of creating strategy of an enterprise is learning on the third level.

Each of the identified forms of adjustment to the conditions of the foreign market entails particular consequences. Single-loop learning favors exploitation of accumulated experience but also causes inflexibility. On the other hand, inferences which may be drawn from the obtained results prove that without an open attitude of an organization towards specific conditionings of the local market it is impossible to benefit within the scope of knowledge diversity at the level of an MNE. The appropriate level of diversity is a necessary condition for creative learning of an organization (Zollo and Winter, 2002; Doz, Santos and Williamson, 2001). However, excessive openness to the influence of environment, double-loop learning means constant questioning of assumptions, which may lead to chaos (Weick, 1982). The results of randomly chosen activities are even more serious for an organization if the form of adjustment is "deeper". A co-evolutionary approach towards changes in an organization suggests that the solution should be to balance single- and double-loop learning at various levels. However, such an approach requires relevant assumptions at the level of company (learning at the third level).

Summing up, it is worth emphasizing that the research was of qualitative nature and it does not give a basis for generalizations. Nevertheless connecting the types of adjustment described in the author's own study with the types of strategy at the level of MNEs and setting their conditions for effectiveness presents itself as an interesting direction for future studies. The problem more and more often attracts the attention of researchers, especially due to the fact that complexity and dynamics of the environment increasingly concern also mature markets. From this point of view, EMs are becoming an attractive research laboratory, which facilitates the conceptualization of the issue of adjustment based on learning in the "ragged landscape".

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The Role of Strategic Planning Technologies in Terms of European Cooperation Development

Nataliia Petryshyn [1], Dziubina Kateryna[2]

[1]Foreign Trade and Customs Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: natalya.petryshyn@gmail.com

[2]Foreign Trade and Customs Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: katedzyubina@yahoo.com

Abstract – The article is devoted to the essence and peculiarities of strategic planning technology, its introduction by domestic enterprises in terms of European cooperation development. The features of strategic planning are explored. The problems of implementation and factors that determine the choice of a particular strategic planning technology is clarified.

Key words – strategy strategic planning technology, European cooperation, management system, typology.

I. Introduction

Active participation of Ukraine in the European cooperation creates real perspective for domestic producers towards the European market entering. This implies the urgent need of radical changes and modernization in production processes, technical upgrading and technological transformation, administrative processes efficiency improvement and fundamental changes in a management system.

II. The results of the research

Strategic planning is an integral part of enterprises management system, since it allows to make reasonable decision concerning future development vector and provides the possibility of long-term successful functioning; it creates conditions for adaptation to the changes that regularly take place in a changing and unpredictable environment; to ensure efficient and targeted resources allocation; to minimize the risks and to modulate scenarios of future events etc.

Strategic planning effectiveness is determined by its conducting technology. The technology should meet specific requirements to ensure adaptability, adequacy and effectiveness of the strategic plans, developed on its basis. Strategic planning technology (SPT) is a sequence of strategic planning stages. It provides each stage details description of its resource support. SPTs differ from each other according to their basic requirements, steps, procedures and other characteristics of strategic planning activity.

Strategic planning is of particular importance while Ukrainian enterprises develop European cooperation. Therefore, the unified SPT is developed. It includes the following stages: collection and processing a massive of information; an enterprise strategic goals formulating; environmental factors analyzing; selecting criteria clarifying; strategic planning tools reasoning; alternative strategies forming; optimal strategies choosing; project documentation and implementing programs forming; formation of evaluation criteria of the effectiveness achievement.

While strategic plan developing, the adequate SPTs should be used. The plan must take into account all peculiarities of the enterprise environment. There are a lot of different types of SPTs in modern economic literature, but there are no comprehensive typology and systematic approach to the SPT definition. In order to ensure a holistic comprehensive study and research of various kinds of SPTs their classification was developed. The following requirements were observed: not to mix different types; to provide completeness of all possible types; to leave an opportunity to expand the typology; to use different and independent selection characteristics. Consequently the following typology features of enterprises SPTs in terms of European cooperation development were revealed: strategic planning object, procedure of strategic plans development, ability to adapt to environmental changes, hierarchy level of strategic planning, input basis, planning tools and automation level.

At the level of the SPT choice it is important to take into account the high degree of uncertainty of external and internal environment. Inside the company events have a high degree of certainty and entirely depend on the internal environment of an organization. Outside the company, in relations with suppliers, customers and other market counterparties the planning system faced with high uncertainty environment.

SPT is a key element of strategic planning. When SPT developing, particular importance should be given to the methodological basis of SPT formation and implementation, which provides the ability to implement the main goal of strategic planning, to determine the sequence and formation of specific actions aimed at its effective functioning ensuring, successful and long-term development. The choice of SPT is an important and responsible process, the result of which is an appropriate strategy.

In order to review existing SPTs of national enterprises and to identify problems in this area, the methodological principles was developed, based on evaluation tools and distribution capacity. The SPT is advisable to explore using adequate information about the features of SPT/ The information can be received from the managers of these enterprises. As a result of our research the elements of SPT analyzes were carried out. The main of them are: availability of strategic planning at the enterprise, its subject, object, the reason of conducting and results; centralization and automation level; the period for which strategic plans are developed; features and procedures of their development; strategic indicators; ability to change and to adopt to the enterprise environment; input basis for planning; strategic planning tools and etc. On the basis of practical materials analyses it has been founded that there are significant difficulties associated with the SPTs choice while entering European markets, connected with the necessity to take into account the peculiarities of a specific enterprise.

On the basis of publications on the SPT problem it can be argued that there is a large variety of strategic planning models. The main stage in the process of their formation

is to define the selection criteria of different kinds of strategies. The results of the criteria review of typical foreign strategic planning models lead to the conclusion that they are not concrete, not formalized and there are no clear boundaries, which complicates the possibility of their use in domestic business activity. Therefore, the practical use of foreign strategic planning models for Ukrainian enterprises is very problematic. During strategic planning of Ukrainian enterprises the specially designed models should be used. These models include relevant criteria that would allow selecting the priority strategy, taking into account peculiarities of the industry and the enterprise. The examples of such strategies are industrial, financial, investment, innovation and others.

The validity of the particular SPT selecting is determined with the list of factors. These factors include: stability of market conjuncture, enterprise scale, enterprise life cycle, level of the company strategic planning, peculiarities of the management organizational structure, level of management centralization and an enterprise diversification, personnel qualification and competence, automation and cybernation level and others.

The basic principles of SPTs formation and implementation include: principles of continuity, consistency, coordination, flexibility, participation, optimality, dynamic and adequacy. Introduction of strategic planning technologies will allow domestic enterprises to accelerate the European integration processes and to create effective cooperation with foreign partners.

While strategic planning of national enterprises conducting, managers should focus on indicators that are important for businesses in a particular area, reflect its problems and aim to solve acute problems and are not common and universal.

In this regard, based on the results of the research, a list of strategic by the Norton-Kaplan projections was suggested: finance, customers, business operations, training and development. The "finance" projection includes indicators such as profits, return on assets ratio of overall liquidity, financial stability. Such indicators as a company market share, rate of sales growth, competitiveness integral index represent the projection "consumers". The projection "business operations" includes strategic indicators such as capital productivity, labor and raw materials production, capital intensity, coefficient fixed assets. Projection "education" is represented with such indicators: productivity, coefficient of workers skills degree matching to their operations complexity, the rate of personnel turnover, costs on the innovation costs on training and retraining [1].

Conclusion

Results of the SPT study and the above mythology implementation reveals that:

– strategic planning is carried out on 72 % of investigated domestic engineering companies;

– only 46 % of surveyed companies have clear, delineated and declared mission.

– strategic planning in organizations is conducted by managers of all managerial levels;

– 80 % of investigated Ukrainian enterprises set long term targets in industrial, financial, investment and innovation activities;

– the majority of national enterprises plan in terms of 2 – 3 years;

– 62 % of the procedures for developing strategic plans are consistent;

– the majority of enterprises (73 %) carried out strategic planning from achieved indicators (the base of the results is input, the previous strategic plans and actual performance of the previous period);

– strategic planning objects are usually separate projects, programs and activities;

– results of the strategic planning is the basis for managers punishment or other employees incentives in only 20 % of companies surveyed.

It is also reviled and proved that there is a link between such nominal variables like:

– the presence of strategic planning in the organization and clearly defined and declared mission;

– the level of strategic planning centralization and SPT adaptability etc.

Strategic planning technologies is important part of Ukrainian enterprises effective development in terms of European cooperation.

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Three-dimensional model representation of investment attraction for company

Oleksiy Fedorchak

Management and International Business,
Lviv Polytechnic National University, UKRAINE,
Lviv, S. Bandery street 12, E-mail: atilla3@ukr.net

Abstract – Proposed mathematic tools for analyzing three parameters puzzle in economics. It is counted the nonlinear character of the dependences between the elements of the economic system and designed the model for the calculation marginal change volume of the attracted investments.

Key words – investments, attraction investments, the mechanisms of the attraction investments to the enterprise, mathematic model of the marginal change of volume attracted investments.

I. Introduction

The implementation process of attracting investments should be based on the implementation of a particular set of mechanisms to attract investment, the implementation of which may result in loss of time and money on the part of the recipient. Therefore, the definition of probable relationship between the volume of investments and spending time and money caused by the present process is one of the most important tasks facing the company, attracting investment. This problem can be solved by applying a mathematical model that accurately reflect the relationship between the studied parameters. Outlines issues explored many different scientists. Among them we can mention IA Bobkov [1], IA Blanc [2], NM Yermoshenko [3], Buharya NI, AF Gojko, PS Rogozhin, VG Fedorenko [4] and many others. However, none of them offered a mathematical model that would reflect the process of attracting investments in the three-dimensional plane, the volume of investments, duration and cost of the process. Before you present this model, it should be noted that the process of attracting investment to the enterprise can not be described by conventional linear methods of mathematical statistics.

II. Mathematic model marginal change of the volume of attracted investments in the space: cost and duration of the process of attraction investments

This is due to the fact that during the implementation of the process is not "automatic" or "mechanical" interaction of several subjects of the capital market. This interaction is determined not only by economic factors, but also the individual characteristics of its members: their experience, beliefs, reputation, perception and so on. And at the same time mathematical model proposed by the author can not resist the existing methods, the so-called nonlinear statistics, since they require a significant amount of historical data and does not always give an opportunity to present the study process in the three-dimensional plane. Therefore, the author determined the three-dimensional model representation of the process of attracting investments will again stay in nonlinear regression. To describe the main principle of the model output try to analyze what can be represented by a nonlinear function of investments dependence of the duration and cost of the process. Obviously, the simplest function with which you can solve this problem in a plane described above, it will be an exponential function. Then we can give the following system of equations:

$$\begin{cases} I(Q_m) = Q_m^{\delta}; \\ T(Q_m) = Q_m^{\varphi}; \\ V(Q_m) = Q_m^{\lambda}. \end{cases} \tag{1}$$

where $I(Q_m)$, $T(Q_m)$, $V(Q_m)$ - unctional relationships in accordance volume of investments, duration and cost of the process used on the number of instruments; δ, φ, λ – umbers some steel by the interval (0; ∞).

So obvious is the assumption that:

$$I^{\frac{1}{\delta}} = T^{\frac{1}{\varphi}} = V^{\frac{1}{\lambda}}. \tag{2}$$

As you can see, you can express the dependence of attracted investments on the duration and cost of the process:

$$I = T^{\frac{\delta}{\varphi}} = V^{\frac{\delta}{\lambda}}. \tag{3}$$

Equality (3) makes it impossible to judge how on investment affect the other two parameters simultaneously . Therefore, we transform equation (3) in terms of the usual linear regression, considering the non-linear nature of the studied variables through the use of powers:

$$I(T,V) = a_0 + a_1 T^{\frac{\delta}{\varphi}} + a_2 V^{\frac{\delta}{\lambda}} + e, \tag{4}$$

where a_0, a_1, a_2 - ome linear weights (can be obtained based on linear regression); e - errors of the model (4).

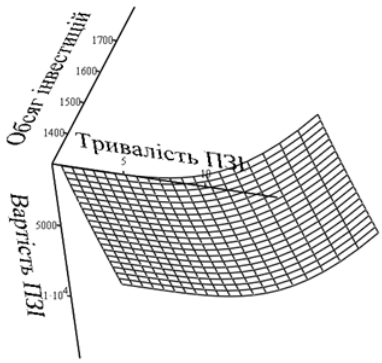
Owever, equation (4) does not solve the problem of three-dimensional presentation of the study depends, as a figure that describes the function (4) can be provided only in three dimensions, therefore the study of the function in terms of whether it is increasing or decreasing can be achieved only by analyzing volume change this figure (example shown in the figures. Fig. 1).

The definition of a generalized increase in the efficiency of attracting investments can be based on analysis of the dynamics of volume three-dimensional figures, an example of which is shown in Fig. 1 a. The volume of this figure can be calculated by the formula of double integral:

$$V_D = \iint_D \left(a_0 + a_1 T^{\frac{\delta}{\varphi}} + a_2 V^{\frac{\delta}{\lambda}} \right) dTdV \tag{5}$$

According to one of the properties of double integrals we obtain: (6) Integrating element of integration:

$$\begin{aligned} V_D &= \iint_D a_0 dTdV + \iint_D a_1 T^{\frac{\delta}{\varphi}} dTdV + \iint_D a_2 V^{\frac{\delta}{\lambda}} dTdV = \\ &= a_0 \iint_D dTdV + a_1 \iint_D T^{\frac{\delta}{\varphi}} dTdV + a_2 \iint_D V^{\frac{\delta}{\lambda}} dTdV. \end{aligned} \tag{6}$$



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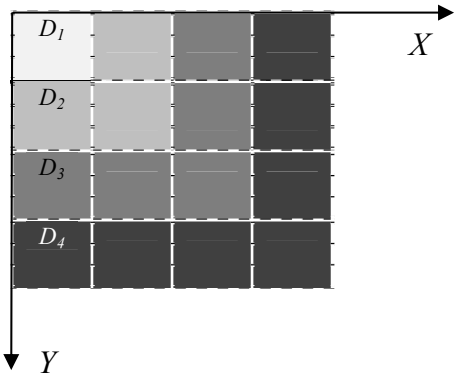

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Fig. 1. An example of the figure, which describe the volume change of the formula (7, 8) and schematic distribution range of values that analyze the dynamics of the studied volume figures

Notes: «PAI» -the process of investment attraction.

Integrating element of integration:

$$V_D = a_0 \iint_D dTdV + a_1 \iint_D T^{\frac{\delta}{\phi}} dTdV + a_2 \iint_D V^{\frac{\delta}{\lambda}} dTdV =$$

$$= a_0 \int_V dV \int_{T(V)} dT + a_1 \int_V dV \int_{T(V)} T^{\frac{\delta}{\phi}} dT + a_2 \int_V V^{\frac{\delta}{\lambda}} dV \int_{T(V)} dT.$$

$$T(V) = T \Rightarrow V_D = a_0 \int_V dV \int_T dT + a_1 \int_V dV \int_T T^{\frac{\delta}{\phi}} dT +$$

$$+ a_2 \int_V V^{\frac{\delta}{\lambda}} dV \int_T dT = \frac{a_0}{2} \int_V T^2 \Big|_{t_1}^{t_2} dV + a_1 \int_V \left. \frac{\phi T^{\frac{\delta}{\phi}+1}}{\delta + \phi} \right|_{t_1}^{t_2} dV +$$

$$+ a_2 \int_V \left. \frac{\lambda V^{\frac{\delta}{\lambda}+1}}{\delta + \lambda} \right|_{t_1}^{t_2} dT = \frac{a_0}{2} v \left(t_2^2 - t_1^2 \right) \Big|_{v_1}^{v_2} +$$

$$+ a_1 v \left(\left. \frac{\phi t_2^{\frac{\delta}{\phi}+1} - t_1^{\frac{\delta}{\phi}+1}}{\delta + \phi} \right) \right|_{v_1}^{v_2} + a_1 t \left(\left. \frac{\lambda v_2^{\frac{\delta}{\lambda}+1} - \lambda v_1^{\frac{\delta}{\lambda}+1}}{\delta + \lambda} \right) \right|_{t_1}^{t_2}. \quad (7)$$

$$T \in D; V \in D;$$

$$\left[t_1 \ldots t_{end} \right] \in T; \left[v_1 \ldots v_{end} \right] \in V.$$

$$E = \frac{V_{D_3} - V_{D_4}}{V_{D_2} - V_{D_1}}, \quad (8)$$

Conclusion

Thus, formulas (7, 8) reflect the ratio between the volume of investments and the duration and cost of the process.

Also they can be used to set the rate of change of the volume of investments adjustable length and cost of funds for the implementation of the process of attracting investments.

Therefore, the output value can be viewed as a model the three-dimensional representation of the process of attracting investments.

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Income tax on individuals as a tool impact population welfare

Oksana Khymych[1], Valentyna Shkilna[2]

[1]Ph.D. Senior Lecturer of the Department of Administrative and Financial Management, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: a_oksanka@ukr.net

[2]Assistant of the Department of Financial, Lviv Polytechnic National University, UKRAINE, Lviv, Gorbachevskogo street 18, E-mail: valytkashkilna@gmail.com

Abstract – Investigated the tax on personal income in Ukraine in modern conditions. Present briefly the major changes that occurred in the administration of personal income. Determined that there have been significant changes in the personal income tax. The study of changes in the personal income tax as a tool to influence the welfare of the population, we can conclude that the problem of raising living standards rise sharply in today's environment.

Key words – individual income tax, tax, tax administration, mechanism of levying tax, population welfare.

I. Introduction

The most important instrument of state regulation of personal income characteristic of any tax system is the individual income tax. Historically - is the oldest form of tax relations between the state and citizens from forced removal of the mandatory part of their income to create a centralized monetary fund state to perform its functions. The level of individual income tax individuals directly affects the real personal income much of the population, especially those who receive income in the form of basic salary, which requires a balanced approach to tax collection.

We can confidently assert that the tax on personal income (hereinafter - IT) is the main instrument of influence on the welfare of the population. And in terms of socio-economic crisis prevailing in the country today, the role of this instrument increases significantly. Formation and improvement IT occurred throughout the period of Ukraine's independence and is under transformation.

II. Page Setup

IT - is a direct federal tax levied on personal income and is governed by Section IV section of the Tax Code of Ukraine (hereinafter - TCU) [1].

Payers of personal income tax, according to the Tax Code, a physical person - resident who receives income as originating in Ukraine and foreign income and individual - non-resident who receives income from a source in Ukraine.

Tax agent of tax on personal income - a legal entity (its branch, department, another separated unit), self-employed persons, representative non-residents - legal persons, regardless of legal status, method of tax and other taxes and forms accrual of income (in cash or in-kind) must calculate, withhold and pay income tax to the budget on behalf of and at the expense of individual income paid to such a person, to tax accounting, file tax returns and be responsible for tax violations in the manner prescribed by the Tax Code Ukraine.

It is not a non-resident taxpayers who receive income from sources in Ukraine and have diplomatic privileges and immunities established by the international treaty of Ukraine on income they receive directly from the proceedings diplomatic or equivalents there to such international agreement activities.

The object of taxation of personal income tax, according to TCU, is acting resident total monthly (annual) taxable income, income originating in Ukraine, which finally taxed during their charges (payments provision), foreign income - income (profit) obtained from sources outside Ukraine. The object of taxation is a non-resident total monthly (annual) taxable income from sources in Ukraine, revenues originating in Ukraine, which finally taxed during their charges (payments provision).

The mechanism of the tax administration has undergone major reforms that are most observed, so to speak, with the introduction of the TCU 01 January 2011. [1] when introduced progressive taxation scale. However, a number of major legislative changes occurred with the adoption of the Law of Ukraine "On Amendments to the Tax Code of Ukraine and some other legislative acts of Ukraine on tax reform" [2].

Present briefly the major changes that have occurred in the administration of personal income tax:

1) tax on passive income increased from 15% to 20%. These passive income includes royalties and investment income. A proposed tax on dividends set at 5% for businesses that pay income tax on a common basis, and 20% for companies that do not pay income tax;

2) The salary of up to 10 minimum wages will be taxed at 15%, and more than 10 minimum wages (12,180 USD.) - 20% (of the excess amount);

3) tax on personal income will be taxed pensions larger than 3 minimum wage, that is 3654 USD. (15% of the excess amount);

4) at payment cash will have to pay a 2% tax to the Pension Fund, and for non-cash transactions - canceled. Recall today the purchase of foreign currency transactions (both cash and non-cash) will be charged a fee of 0.5% of the purchase price;

5) continued performance of military duty (1.5%) solution before the entry into force of the Verkhovna Rada of Ukraine to complete the reform of the Armed Forces of Ukraine and the tax base of this tax extends to all personal income;

6) introduced step-down ratio that can be applied to the rate of the single social contribution (hereinafter - Single Contribution) subject to compliance with the criteria;

7) Single Contribution of salaries of staff members - not less than the minimum premium news regarding payment of payroll Single Contribution to the overall system and self-employed persons.

Consequently, there have been significant changes in such areas as:

- Increased personal income tax rate. Instead of 17% - 20%. Rules of increased rates have not changed: if the base levy personal income tax for monthly taxable income does not exceed 10 times the minimum wage (hereinafter

- MW), in the amount established on 1 January of the year (in 2015 - 12 180 USD.), Apply a VAT rate of 15 %. If the taxation of personal income tax base determined considering p.164.4 TCU, exceeds the 10 MW, the excess amount is used to rate 20% (previously - 17%). (Changes to st.167.1 TCU). The use of a dual income tax rate (30%). Double the rate specified st.167.1 TCU (30%) applied to income accrued as winnings or prize (except for winnings, prizes in a lottery) for residents or non-residents. Among the exceptions is now no gain in public and private money and lottery winnings player (user) received from the organizer of the game. Wins in public and private money lottery subject to tax in the full amount at the rate of 15%. The rate of personal income tax of 10% for wages of miners lifted;

- Taxation of passive income. Thus, the tax rate on passive income in the tax base set at the following rates: 20% - for passive income, including accrued dividends on shares and / or investment certificates paid collective investment schemes; 5% - for income from dividends on shares and corporate rights accrued residents - payers of corporate income tax by 1 January 2015 (except income from dividends on shares, investment certificates paid to joint investment institutions);

- The taxation of dividend income tax. For dividends on shares and corporate rights accrued residents - payers of corporate income tax to 01/01/2015 was left at 5% (they are taxed at a rate of 5% if paid already in 2015); dividends on shares and corporate rights after 1.1.2015 p. are subject to personal income tax at 20%; dividends on preferred shares under p.170.5.3. TCU equal to the salary and benefits are subject to income tax at the rate of 15% (20%); dividends on shares and / or investment certificates paid by joint investment institutions, subject to personal income tax at 20% (pp.167.5.1 TCU);

- Taxation of pensions. The amounts of pensions over three minimum wages will be taxed according to the law, which operated before 1 January 2015, subject to taxation in the pension in excess of 10 thousand. UAH., Of such excess. From 1 January amended the century. 164 GCC and is now subject to tax pensions that exceed three minimum wages (3654 UAH.), In the part of such excess, at 15%. For example, if the pension is 4100 USD., Then subject only 446 USD. The part that exceeds the limit of 3654 USD. If the excess amount over three MW more than 10 times the minimum wage, the tax rate increases - to 20%. Taxation of pensions carried out by the Pension Fund of Ukraine (gave - PFC) automatically. Retirees do not need to deal with these issues in tax inspection or control PFC [1].

Also, taxation and military duties extended like a long time - "before the entry into force of the Verkhovna Rada of Ukraine of the completion of the reform of the Armed Forces of Ukraine." Tax rates were at the same level - 1.5% of the tax object defined by the claims. 1.2 p. 161 subsection 10 of section XX TCU [1]. The object of taxation from January 1, 2015 are revenues of a century. NKU 163, including total monthly (annual) taxable income of the taxpayer.

It should be noted that delayed administration: 100% of the tax benefits from 2015 to 2016, which will be available in an amount equal to 50% of the subsistence minimum for able-bodied persons (in 2015 - 609 USD) [2].

We must form new approaches to the selection of the rates of tax on personal income, which, unlike the existing ones, shall be based on indicators: ratio of social security and the tax burden, and reduces uneven income distribution in the form of wages and the tax burden on Individuals and increase revenue

The study of changes in the personal income tax as a tool to influence the welfare of the population, we can conclude that the problem of raising living standards rise sharply in today's environment. We consider unacceptable to tax pension benefits, because it is not the incomes and expenses that fell on the shoulders of the citizens and their employers throughout their lives spent at work.

Conclusion

It is safe to say that in 2015 in the taxation of natural persons has changed significantly and negatively affect the level of their welfare. These changes have led to a significant increase in tax liabilities of individuals, which is an unbearable burden for families with low incomes. After all, most people in the country is below the average standard of living. The impact of the tax burden on individuals and reinforces the significant increase utility rates and inflation. Also, when this was not implemented measures to support citizens from the crisis were in financial trouble. We can predict that declared changes adversely affect the socio-economic situation of the country.

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The Role of Educational Projects in Ensuring Youth Competitiveness in the Labor Market

Ihor Kulyniak[1], Olha Koshyk[2]

[1]Management of Organisations Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: igor.kuln@gmail.com

[2]Management of Organisations Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: olyakoshuk@i.ua

Abstract – In the article the role of educational projects in ensuring youth competitiveness in the labor market is revealed. Examples of different forms of educational projects, including certified online courses, trainings and webinars are given. Significant role of such structures as BritishCouncil, Victor Pinchuk Foundation, the European program Erasmus + and other programs in higher education is reviewed.

Key words – educational projects, online courses, trainings, webinars, BritishCouncil, Victor Pinchuk Foundation, Erasmus+.

I. Introduction

The outlook on the education in Ukraine is changing daily. Since last couple of years the educational system has changed its standard look. Increasing emphasis is put on self-education, private organizations that make appearance in the educational market, and various educational projects financed by foreign countries. Such an approach to education has become a chance for all students to turn into skilled professionals needed in the international labor market.

II. Main Results

Certified online courses, trainings and webinars are gaining popularity in the market for educational services. The majority of Internet users have become familiar with the two aforementioned concepts, however a webinar is the one that has recently been gaining momentum. Web conferencing may be used as an umbrella term for various types of online collaborative services including web seminars ("webinars"), webcasts, and peer-level web meetings. It may also be used in a more narrow sense to refer only to the peer-level web meeting context, in an attempt to disambiguate it from the other types of collaborative sessions [1]. A webinar is a way of organizing online meetings, and a format of seminar or workshop hosting, as well as conducting other events using the Internet.

One of the examples of certified online courses are those developed by the founders of the educational Internet platform called “Prometheus”. This is a public project for mass open online classes (MOOCs). MOOCs are created in collaboration with teachers from best Ukrainian universities and uploaded into own online platform. They provide a free opportunity to publish and share courses using this platform for both universities, organizations and leading businesses. “Prometheus” offers free online access to top university-level courses for everyone interested [2].

Other popular websites for undergoing online courses are:

- Coursera [3];
- SkillsAcademy [4].

There are many opportunities for obtaining additional education over the Internet, but they are often scattered across different organizations. Thus, there is a number of online resources where the information about such events is gathered. STUDWAY is the most popular among them.

“Studway” is an online magazine about student life. The goal of the project is to help youth live a brighter and more comfortable life, find motivation, plan own professional development and interesting trips. From Latin “studens” means the one who works hard, therefore “Studway” is not about having a student ID, but rather about the way of life and thinking [5].

Platfor.ma and Unistudy are very similar Internet resources. Platfor.ma talks about ways of working, things to learn and places to rest so that our country can become a true part of Europe and not only on a map [6].

BritishCouncil is actively participating in Ukraine, strengthening ties between Ukraine and the United Kingdom in the area of arts, English learning, higher education and social development. In teaching English, the Council collaborates with the Ministry of Education and constantly conducts internal trainings for teachers of educational institutions. Around 3,000 students pass through the Kyiv School annually, taking over 11,000 exams and tests.

In higher education BritishCouncil is establishing connections between the United Kingdom and Ukraine - in areas such as liaising between universities and employers as well as internationalization of higher education [7].

BritishCouncil also acts as the founder of the “Active Citizens” programme created for the youth in the field of intercultural dialogue and social development.

Likewise, actively engaged is the Victor Pinchuk Foundation, which owns two educational projects [8]:

- Scholarship programme “Zavtra.UA” which is the first private nationwide programme aimed to support talented youth. Its main goal is to promote formation and strengthening of the new generation of intellectual and business elite;
- Scholarship programme “Worldwide Studies” that provides Ukraine’s best and most talented students with an opportunity to get world-class education and utilize the acquired knowledge to the benefit of the country.

In 2014-2020 a new Erasmus+ programme will be operating in the EU. It will combine seven existing European programmes in the area of education, science and sports, including Erasmus and Erasmus Mundus.

More scholarships will be granted within Erasmus+. The programme will give funding to provide greater mobility, international partnerships and joint research projects, as well as for the empowerment and personnel development in partner countries around the world [9].

The National Erasmus+ Office assists the European Commission, the Education, Audiovisual and Culture Executive Agency (EACEA), the national authorities and higher education institutions in the implementation of the

ERASMUS+ Programme. The NEO follows closely the policy developments in Ukraine, particularly in the field of higher education but also at other levels of education, if required. Besides the EU Delegation, the NEO is a focal point in the country for all actors, potential applicants, beneficiaries and other stakeholders as regards the EU cooperation activities in (higher) education under the ERASMUS+ programme. The mandate of the National Erasmus+ Office under the ERASMUS+ programme covers all: supporting, promotion, monitoring and dissemination activities related to the Erasmus+ activities in higher education open to cooperation with partner countries (in Key Actions 1, 2 and 3) [9].

Jean Monnet Activities are designed to promote excellence in teaching and research in the field of European Union studies worldwide. The activities also foster the dialogue between the academic world and policy-makers, in particular with the aim of enhancing governance of EU policies. European Union studies comprise the study of Europe in its entirety with particular emphasis on the European integration process in both its internal and external aspects. The discipline also covers the role of the EU in a globalised world and in promoting an active European citizenship and dialogue between people and cultures [10].

Following Ukraine's attainment of independence in 1991, the country became much more open to international educational exchange programs. The Fulbright Program was opened in Ukraine at the beginning of 1992. Its goal was and remains to increase the mutual understanding between people of the United States and Ukraine through scholarly and research exchanges. Originally, the Fulbright Program was managed by the United States Information Agency (USIA) through the United States Embassy. Since the inception of the Fulbright Program in Ukraine, nearly 900 Ukrainian scholars, students, and professionals have traveled to the United States for research or study in U.S. institutions of higher education. During the same period, more than 530 U.S scholars, students, and professionals have participated in the Fulbright Program in Ukraine as university lecturers, researchers, and consultants. Fulbright alumni in the United States are active citizens and make up a significant lobby which doesn't let the U.S. Congress forget about supporting educational programs. Funding for the Fulbright Program is designated every year by the U.S. Congress as part of the annual budget [11].

Additionally, quite a few international organizations are actively taking part in the area of education (e.g., ENACTUS, Edu Active, CFA etc.).

ENACTUS is an international non-profit organization that connects students, teachers and businesses. This organisation use the power of entrepreneurial action and improve quality of life and living standards of people with different needs. All students of ENACTUS around the world implement projects to expand human capabilities. They act under the guidance of mentors from universities and business. This experience not only change their lives, but also develops talent [12].

Conclusion

To date, the increase in the level of youth education and the growing desire for self-education have become a positive trend. Additional training, participation in various educational programs is constantly contributing to successful employment. Hence, many educational programmes are being founded, public organizations are also being involved in creating conditions for additional education. A “first career step” educational programme has quite recently been introduced in Ukraine that allowed to undergo internships in local authorities. This programme is effectively working in Lviv as well. Furthermore, as part of the internship, young people have the opportunity to attend trainings from leading companies and develop in the direction of their choice.

It should be noted, however, that this tendency has become a prerequisite for strengthening Ukraine’s position in the global market and its economic growth, since the future level of development of Ukraine depends on the education level of young professionals in all possible aspects.

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Problems in the CSR Program Formation and Ways of Their Solution

Myroslava Muzhelyak

Finance Department, Lviv Polytechnic National University,
UKRAINE, Lviv, S. Bandery street 12,
E-mail: mira-mm@mail.ru

Abstract – The theses contain justification of CSR programs' benefits. Moreover on the one hand there are described the most common mistakes that enterprises allow in the formation of CSR programs, and on another hand – ways that enterprises can try to develop their own corporate social responsibility programs.

Key words – corporate social responsibility, CSR program, CSR program's benefits, CSR program formation.

I. Introduction

One of the famous management theory in the world is based on the corporate social responsibility (CSR) principles, because of CSR is playing a central role in helping enterprises to be seen as leaders. By the way, effectiveness of CSR management system depends on different factors, among which there are social investments, social partnership, standards, CSR programs etc. Despite Milton Friedman's opinion, wellknown economist and Nobel laureate, who referred to corporate social responsibility programs as "hypocritical window-dressing," and said that businesspeople inclined toward such programs "reveal a suicidal impulse", CSR program plays the most important role especially when enterprices start to plan their CSR activity. However enterprises that take an active role in promoting their corporate social responsibility programs are generally viewed more favorably than those that do not have highly visible programs.

II. The main material

The process of making CSR program is important for domestic enterprises. Introducing a corporate social responsibility program gives enterprises a good reason to examine and improve on their spending. By another way, there are 4 business benefits, which enterprises can expect from a CSR program:

- attract and retain employees;
- reduce your operating costs;
- improve your brand;
- maintain and improve your market share;
- reduce your risk;
- improve your access to bank financing.

But before enterprises start forming their own corporate social responsibility program remember:

1. The program must be implement strategically. Just giving a donation is not enough. The best corporate social responsibility programs are based on a two-way relationship with enterprises and each of the organisations they are involved with. This allows both parties to be challenged and grow together.

2. Corporate social responsibility commitments should be in line with the values of enterprise, customers and staff. Most importantly, they must be based on a genuine concern for people and the community [4].

Enterprises as a good corporate citizens are diligently implementing corporate social responsibility programs that address sustainability, philanthropy, community involvement, and other goodwill requirements. At the same time many of them make serious but avoidable mistakes that can overshadow well-intentioned CSR investments. The errors result in damage to the brand and to the "responsible" person's career. Among such mistakes are:

1. Misalignment of the cause with the business. It means that, for example, a company in the fast-food business probably has no real ability to fix the US educational system. However, most likely, the enterprise would be better served if the selected cause leveraged the skills, connections, and resources within it. There are o lot of good practices in this case. One of it is the FedEx's example. This company donates its transportation services to support emergency situations such as disaster relief and organ transplants. While simultaneously serving the sales and marketing messages, those causes reflect the business competency, and, as such, the programs make sense to investors, employees, and all partners involved. The unifying and memorable theme helps rally the company's available resources, which deliver something meaningful and have a real impact.

2. Focusing only on one aspect of CSR. It is good when companies are committed to giving money to local charities, but it is bad if they dump manufacturing waste into their community's water supply. So here we must remember that CSR is a very broad subject, and although every aspect is important, but much important to determine the price of realising every CSR initiative.

3. Reporting first. Rather than develop and execute a CSR strategy and handful of programs first, some enterprises opt to initiate their CSR program with a public report. That approach shows a lack of understanding of CSR and its impact on the brand, employees, future hiring, investors, and other stakeholders. Reporting first is a risky thing to do, since it implies a committed direction that may not be fully backed up by infrastructure and resources.

4. Not having a CSR road map. To effectively embrace CSR, it must be bring many pieces together, such as the branding, messaging, and strategy, as well as with affiliates, partners, and suppliers. Without a plan, it is impossible to coordinate the necessary company resources and have everyone committed to being good corporate citizens. CSR programs have many interdependencies and milestones to coordinate so without a road map, employees will be in motion but potentially heading to different destinations.

5. Assigning a CSR champion without committee support. Best practices across industries show that cross-functional teams are critical to baking CSR into a company's operations. Many companies also form a board-level CSR committee to ensure accountability throughout the organization.

6. One of the biggest challenges is getting internal people motivated and involved with CSR initiatives. Much of this shortcoming is due to lack of effective internal communications. Leading companies use repetitive "inreach"

via a multiplicity of channels, such as intranets, newsletters, posters, and emails, to let employees know about new volunteer opportunities, charitable drives, and other CSR initiatives. Cutting-edge companies are using means–such as paycheck statements, text-messaging, and broadcast voice mails–that can creatively reach the mixed demographics of the internal audience.

7. Poorly communicating externally. Communicating CSR to outside stakeholders requires a new way to market. As this art form is just coming of age, you can already see CSR presented on websites, advertisements, and annual reports.

8. Not taking advantage of employee volunteerism. Employee volunteerism is proven to increase employee leadership skills, create happier and healthier employees, and help boost a company's reportable giving contributions. Employee volunteerism is a great way to get the entire team into the CSR spirit with minimal investment or management.

9. Giving without any rules. Again, any company that donates cash or in-kind resources to a worthy charity should be commended. However, there are enterprises selected a charity because a senior manager or other power player has a personal connection or affinity or the company gives small donations to multiple charities. Without clear guidelines about how charitable donations are to be granted and to whom, there is a potential liability to the company and the person who is "making" those decisions. Whether those decisions are fair and support the anti-discriminatory ethics that the company supports also come into question.

10. Middle management isn't on board. In the process of making CSR programs must be enlisted managers of all levels of management system [3].

There are five ways that enterprises can try to develop their own corporate social responsibility programs:

1. Crowdsource ideas. A top-down, command-and-control type of enterprises hierarchy is a bad match for inspiring a truly vibrant corporate social responsibility program. That's why it's recommended to use digital tools to engage employees in the idea-generation process. Ask them what they want the company to take on to give back to the community. Then use those ideas to create a corporate social responsibility culture that is more inclusive, democratic and participatory.

2. Enlist customers. Customers expect enterprises to carry their weight when it comes to social responsibility. When a enterprise aligns its mission with corporate social responsibility, customers and business partners are much more likely to support it. In this case it's recommended to use social media, email newsletters and blog posts to generate interest and gather support.

3. Partner with other organizations. The partnership may generate more on-the-ground results and goodwill than a enterprise's corporate social responsibility program built from scratch.

4. Combine philanthropy and corporate training. Inject philanthropy into corporate events and training. Make it an integral part of how the enterprise operates, learns and grows.

5. Create something that lasts. Some corporate social programs have encountered skepticism and the perception that the efforts are one-offs. Because of this it is recommended to impress customers by creating a self-sustaining social responsibility program that is designed to make significant social change over an extended period of time [1].

Based on the foregoing, it is necessary to elaborate procedure of CSR program formation. In this case deserves attention results of Diana Corina GLIGOR's research. In particular, she has elaborated an implementation plan that could be used in the practical task of actually implementing a social responsibility program. This is an eight steps model that encompasses the logical scheme of the process of implementing a social responsibility program in a strategic approach:

STEP 1. Analyzing the internal state and the external competitive context regarding CSR initiatives for the business organization willing to implement a CSR program.

STEP 2. Selecting targeted stakeholders, the social cause to be supported by the business organization and the appropriate CSR type of program.

STEP 3. Deciding the desired level of involvement for the business organization.

STEP 4. Designing the plan for the actual implementation.

STEP 5. Designing the internal and external communication plan.

STEP 6. Deciding on the potential partners for implementing the CSR program.

STEP 7. Monitoring and evaluating the results of the implemented CSR program.

STEP 8. Analyzing the feedback on the implemented SR program as premises for further initiatives [2].

Conclusion

In summary CSR program formation will be effective if it takes into account the importance of internal and external factors.

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Ways of Improvement of Tax Administration on Real Estate Distinct from Plot of Land

Andriy Pelekhatyy

Department of Regional Financial Policy, SI "M. I. Dolishniy Institute of Regional Researches of NAS of Ukraine'',
UKRAINE, Lviv, Starojevrejska street 15/1,
E-mail: Pelechatyj_A@i.ua

Abstract* – *The article Identifies main benefits from collection of taxes on real property distinct from plot of land for local governments and taxpayers. The problems of the modern system of property taxation are analyzed. The main disadvantages of charging to local budgets in compliance with recent changes to the Tax Code of Ukraine from 12.28.2014 are identified. Proposals for improvement of budget legislation in the part of property taxation are made. Expediency to set the equal tax rate with privileges rejection for the payment of property tax is suggested.

Key words – real estate tax, distinct from plot of land, local budgets, territorial communities, financial capacity, budgetary and tax law.

I. Introduction

The main task of development of Ukraine today is ensuring of its efficiency as a guarantee of comfortable and safe living. Article 24 of the Constitution of Ukraine says that all citizens have equal constitutional rights and freedoms and are equal behind the law. That is, all citizens of the country regardless of the place of residence, ethnic or social origin, property status and other features are eligible for state-guaranteed services. Currently, the issue of financing of the development of local communities is characterized by inefficiency of budgetary support, complete dependence on the distribution of funds at the central level, the lack of interest of the community and their reluctance to participate in problem solving of human settlements development and ensuring its financial sustainability and inefficient allocation of responsibilities between local authorities and the central government.

II. Main Results

One of the main factors of development of the territory is the stability of revenue sources, i.e. the list of certainty of fixed income and standards governing deductions from income for different levels of government on a long term basis, to schedule local authorities' expenditure for the future

As immovable are characterized by the constancy of their location and their jurisdiction can be easily fixed, it is always possible to define the object of taxation, with peculiar features - permanent location and duration, that ensures unimpeded access to it for fiscal authorities. It is easy to establish the taxpayer, which could be a property owner and the leaser.

Property tax is actively investigated by modern Ukrainian economists, such as V. Vishnevskyy, V. Zagorskiy, V. Kravchenko, A. Lisovyy, I. Lunina, V. Melnyk, B. Rybalka, A. Sokolovska.

The aim of the study is to determine the main threats of property taxation at the local level and make proposals to improve budget legislation regarding property taxation.

Tax on immovable property other than land is attractive to local governments as a stable and financially significant source of revenue.

The main advantage of collecting this tax are:

- Direct dependence between taxpayers and recipients of services financed by revenues from this payment;
- Sustainability of a property tax base that eliminates the possibility of evading its payment;
- The principle of solvency through adjustment rates and establish tax benefits;
- Predictability amounts of tax revenue, that creates conditions for effective planning of their own activities.

In terms of financial autonomy of local budgets changes to Tax Code of Ukraine seemed to be reasonable (from 12.28.2014). In Art. 266 Tax on immovable property, other than land set taxes should be imposed on total subject's area (both residential and non-residential). Thus (according to p. 266.4.1) tax base of residential properties decreased in [1]:

- 60 square meters (for apartments);
- 120 square meters (for residential buildings);
- 180 square meters (for different types of real estate, simultaneous possession of flats and houses).

Cottages and garden homes were included in the list of objects that are not subject to tax till 01.01.2015, and since 2015, the owners pay property tax.

It should be noted that the legislator provided in addition to local councils the right to increase the maximum limit of residential property, which reduced the tax base, which generally can eliminate the payment of taxes, but these changes are one of the first steps to independence of local budgets.

The proposed tax changes achieve the mentioned goals once can be characterized as positive aspects and can carry risks and threats to the implementation of the budget process at the local level. We consider it is necessary to focus on the shortcomings of Article 266 of the Tax Code of Ukraine and to make proposals to address them.

Under the provisions of the Tax Code taxation fall only on commissioned homes, but in the settlements is a sufficient number of private houses, which are inhabited by people, but not commissioned or their owners do not have all necessary documents. This situation has arisen because of the complexity of the introduction of house in operation, is associated with significant costs time and money.

Thus, for the commissioning of a residential building are necessary:

- A document certifying the ownership of the land;
- A declaration of the beginning of construction work;
- Technical passport at home.

The biggest difficulty today in making citizens arising from ownership of the land, entered into article 24 of the Law of Ukraine "On regulation of urban development", according to which for the manufacture of ownership of the land than necessary master plan of the settlement also submit a detailed plan and zoning plan settlement. Today less than 50% of settlements have a new master plans and only about 5% have plans for zoning, which led at the

moment to stop any action on production of documents proving the ownership of the land within these settlements. The lack of official recognition of property rights leads to that of residential property (which is actually used for its intended purpose) can not be taxed.

In such situations the basis for such taxation may be houses product data object or owner books accounts maintained by local authorities and which spelled out all the necessary information to calculate the tax payment.

Therefore, we consider it is appropriate to supplement article 266, paragraph 3, subparagraph 4, be amended as follows:

"The tax base of residential and non-residential property, including their shares that are not registered in the State Register of real rights on real estate or are no documents on the ownership of individuals, calculated on the basis of the supervisory authority or technical passport, owners books, maintained by local authorities. Control of such objects is put on local governments. The decision to tax such objects put on the local council. "

In their work, village councils is governed mainly with owner accounting books, but according to instructions slave accounting data there are made on the basis of the documents or information provided by the head of the household that may significantly understate the real estate tax base.

Before the introduction of this tax would be appropriate to make an inventory of objects that are subjected to tax on immovable property other than land and urban cadastre form. Formation of the Property Registry for inventorying documentation should be put on the local government.

At the same time, the introduction of new sizes and order of calculation of property tax can be challenged in court, because the Tax novels have been violated basic principles of tax law, established art. 4 of the Tax Code of Ukraine. In particular, stability (changes to any element taxes and duties can not be made later than six months before the end of the fiscal period in which it will operate the new rules and rates. Taxes and fees, their rates and tax incentives can not be changed during fiscal year) and equality of taxpayers before the law, to prevent any acts of tax discrimination (ensure equal treatment of all taxpayers regardless of social, racial, national, religious affiliation, ownership entity, nationality natural person, the place of origin of capital).

In our view, changes in tax rates for residential and / or non-residential property owned by individuals and legal entities are necessary. In the early years of the introduction of property tax would be appropriate to set its minimum rate of 0.5 per cent of the minimum wage, set at 1 January of the reporting (tax) year, for 1 square meter tax base and eliminate all existing benefits for this payment. This will maximize the revenue of local governments and relieve social tension regarding this payment. In addition, during the transition period it will promote the formation of clear information base for property taxation objects and their characteristics.

On January 1, 2015 the minimum wage is 1218 grn., So if the proposals will be implemented in life, the average rural household (2.71 persons), with 75.2 m2 owned housing will have to pay to the local budget 457.97 grin for the year (1,218 x 0,005 x 75.2), i.e. 38.16 grn per month. It should also consider the fact that these funds should not pay one person and household, which can be two or three able-bodied person. Of course even such a small amount of tax would not be paid voluntarily. Therefore, local authorities should explain to the rural population that these funds will remain with the agriculture budget, and hence will be used for immediate needs of rural development, road repairs, street cleaning and lighting, maintenance of kindergartens, health posts and other facilities of rural social infrastructure.

Conclusion

Thus, the creation of an effective mechanism of real estate tax in Ukraine will create a financial base for building a financially independent communities. And our proposed changes will increase the potential of tax revenues to local budgets and will remove the social tension among the population in relation to the new tax payment.

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Evaluation conflicts in the enterprises activities

N. Podolchak[1], G. Kovalchuk[2]

[1]Department of administrative and financial management, Lviv Polytechnic National University, UKRAINE, Lviv, Stepana Bandery str., 28, nazar_podolchak@yahoo.com

[2]Department of administrative and financial management, Lviv Polytechnic National University, UKRAINE, Lviv, Stepana Bandery str., 28

Abstract. – It has been elaborated the method for quantitative evaluation of level and structure of the interpersonal management conflicts that prevail over the other conflicts in the machine-building enterprises functioning. According to the reasons of appearance investigated interpersonal management conflicts were divided into the following types: informational, behavioral, structural, conflicts of relationships and values.

Key words – interpersonal management conflicts, conflict identification, conflict evaluation.

I. Introduction

Dynamics of the environment, complexity of organization and communication structures, increase of the competition level, uncertainty in a number of market spheres, growth of the negative crisis outcomes, struggle between countries for markets and resources, active political confrontation especially in the developing countries are causing the general increase of conflicts quantity and conflicts levels. All the stated above factors of conflicts appearance lie beyond the limits of enterprises influence on them, which is why they require the constant monitoring and appropriate adjustment on the part of the organization. However, it is not less important to consider the subjective component of conflict appearance – lack of desire to see the mutual advantage of cooperation, possibility to avoid conflicts with minimal losses, confidence in the accuracy of ones objectives, principles and convictions, asymmetry and monocentricity of corporate culture, managers indifference towards the occurrence of conflict situations, which leads to irreversibility of negative effects and significant losses caused by conflicts activity.

II. Research materials

The problems of identification and quantitative evaluation of management conflicts in the enterprise functioning have been researched by both domestic and foreign scientists, including: A.J. Antsupov (2009), S.L. Boehm (1974), P.P. Gornostay (1997), S. Yerina (2002), H. Cornelius and C.Fair (1992), T.A. Polozova (2007), I. Sivchuk (2012), K. Smith (1993). All the methods of estimation process can be divided into usage of qualitative evaluation criteria and quantitative identification indicators and into determination of the conflicts level.

An interesting method of conflict identification that is called mapping was suggested by Australian scientists H. Cornelius and S. Fair (Cornelius and Fair, 1992: 250-268). The key point of this technique consists in the development of identifying map that contains the following elements: the parties of conflict management, their needs and concerns. According to the authors of this method such maps are very effective in preparation for ensuring negotiations and business contacts, negotiations that have no logical development, resources allocation, avoiding of tension inside of the team and personnel risk (in particular staff turnover), implementation of innovations and changes etc.

Before the development of conflicts identification and evaluation methods the structure of the conflicts should be determined. Thus, in relation to appearance reasons Lincoln suggests dividing all kinds of conflicts into informational, behavioral, structural, conflicts of relations and values.

To identify and evaluate conflicts it was proposed to apply the method of conjoint analysis. Sequence of conjoint analysis usage is shown in Figure 1.

Model for evaluation of the management conflict level and identification of its structure has the form (Malhotra, 2002):

$$K(x) = \sum_{i=1}^{m} \sum_{j=1}^{n_i} a_{ij} \cdot x_{ij} \ , \qquad (1)$$

where K(x) – integral evaluation of management conflict level at the enterprise; x_{ij} – evaluation of certain types of management conflict at the enterprise; a_{ij} – parameter of the independent variable that corresponds to the *j*-th level ($j \in \overline{1, n_i}$), *i*-th type of conflict; *n* – number of evaluation levels; m – number of management conflicts.

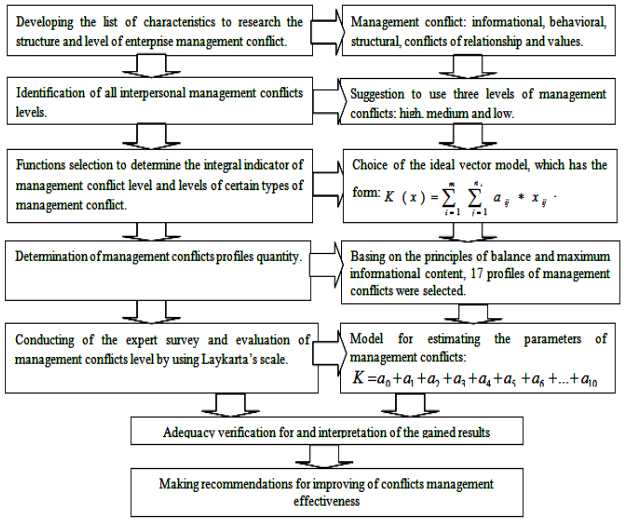

Fig.. 1. The sequence of conjoint analysis application to evaluate the level of interpersonal management conflicts

Note: elaborated by authors

To receive at most adequate and credible results of the management conflict level evaluation all possible profiles combinations should be determined. In practice, however, the amount of all profiles is limited on the basis of detection of correlative connections between the profiles by using orthogonal method. In our research it is

reasonable to evaluate 17 profiles that do not correlate with others; to be more specific, the correlation coefficient is minimal between the profiles.

Practically, we create a common multifactorial correlative-regressive model with fictitious variables that take the value of either 0 or 1. Calculation of equation parameters is carried out by using the method of the least squares, where the respondents evaluation is the dependent variable and formed combinations of management conflict are independent variables.

Therefore the calculated model for the joint venture "Sferos Electron" has the following form:

$$K_1 = 3.32312 + 2.03231x_1 + 0.89795x_2 - \\ -0.5493x_3 - 0.801x_4 + 0.21768x_5 - 0.1496x_6 - \\ -0.1564x_7 - 0.3027x_8 - 0.3486x_9 - 0.4132x_{10} \quad (2)$$

Furthermore, having considered the input data of LLC "Robitnia", it has been calculated the conjoint analysis models parameters for research of the interpersonal management conflicts structure and levels. The formula is the following:

$$K_2 = 2.48976 + 1.0536x_1 + 0.19196x_2 - 0.0138x_3 + \\ +0.42215x_4 + 0.44828x_5 + 0.07998x_6 - 0.215x_7 - \\ -0.3859x_8 - 0.389x_9 - 0.0354x_{10} \quad (3)$$

TABLE 1

AN AVERAGE VALUE OF INTERPERSONAL MANAGEMENT CONFLICTS PROFILES EVALUATION AT THE MACHINE-BUILDING ENTERPRISES

The average level of conflicts at the enterprises		Profiles of interpersonal management conflicts									
		Informational		Behavioral		Relationship		Values		Structural	
JV "Sferos Elektron"	LLC "Robitnia"	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
2	2.25	0	0	0	1	0	0	0	1	0	1
1.714286	2.375	0	0	1	0	0	1	0	1	0	1
2	3.375	0	0	0	1	1	0	0	1	0	1
3.142857	2.875	0	1	1	0	0	1	1	0	0	0
3.428571	2.875	0	1	0	1	1	0	1	0	0	0
2.714286	2.875	0	1	1	1	0	0	1	0	0	0
3.714286	3.5	1	0	0	1	1	0	1	0	1	0
4.571429	2.625	1	0	1	0	0	1	1	0	1	0
3.714286	3.5	1	0	0	1	0	0	1	0	1	0
2.571429	2.5	0	0	1	0	1	0	0	1	0	0
2	2.375	0	0	0	1	1	0	0	1	0	1
3	2.625	0	1	1	0	0	1	1	0	0	1
2.714286	2.25	0	1	0	1	0	1	1	0	1	0
4.142857	3.75	1	0	0	1	0	0	0	1	1	0
4.428571	2.75	1	0	1	0	0	0	0	1	0	0
3	2.875	0	0	1	0	1	0	1	0	0	0
3.142857	2	0	1	1	0	0	0	1	0	1	0

Note: generated on the basis of expert surveys

The received regressive models contain only the values of 10 levels of different management conflicts types. Therefore, we should find the values of the other 5 levels of management conflicts and identify the prevailing management conflicts in the structure of conflicts that arise in the machine-building enterprises functioning (Table 2).

TABLE 2

CHARACTERISTICS OF INTERPERSONAL MANAGEMENT CONFLICTS LEVELS AND PARTIAL WEIGHT OF THESE LEVELS

Management conflicts	Levels	Partial weights	
		JV "Sferos Elektron"	LLC "Robitnia"
Informational conflicts	High	1.05556	0.638464
	Medium	-0.07879	-0.223236
	Low	-0.97676	-0.4152
Behavioral conflicts	High	-0.09914	-0.149958
	Medium	-0.35085	0.286056
	Low	0.45017	-0.136098
Relationship conflicts	High	0.195012	0.27219
	Medium	-0.172335	-0.096105
	Low	-0.022675	-0.17609
Values conflicts	High	-0.0034	-0.0147
	Medium	-0.14964	-0.18563
	Low	0.15306	0.20033
Structural conflicts	High	-0.09467	-0.24755
	Medium	-0.1593	0.10605
	Low	0.25397	0.14149

Note: calculated by authors

Having applied the formulae for determining the fixed weight of management conflicts in the overall structure of interpersonal conflict at the machine-building enterprises, we have got the results which are settled up in Table 3.

TABLE 3

RESULTS OF THE FIXED WEIGHT OF MANAGEMENT CONFLICTS

Management conflicts	Relative fixed weights of management conflicts		Interpretation of received results	
	JV "Sferos Elektron"	LLC "Robitnia"	JV "Sferos Elektron"	LLC "Robitnia"
Informational conflicts	1	1	The most significant conflict	The most significant conflict
Behavioral conflicts	0.28811	0.074964	The second place in terms of conflict significance	The third place in terms of conflict significance
Relationship conflicts	0.184899	0.093335	The third place in terms of conflict significance	The second place in terms of conflict significance
Values conflicts	0	0	The least significant conflict	The least significant conflict
Structural conflicts	0.063927	0.004613	The forth place in terms of conflict significance	The forth place in terms of conflict significance

Note: calculated by authors on the basis of conjoint analysis

Conclusions

The structure of management conflicts in the functioning of companies is quite similar. The research has made it possible to detect that in the structure of management conflict the dominant ones are informational conflicts that are related to poor information support of companies' administrators. Hereby the level of informational conflicts is rather significant. Experts draw attention especially to the unsatisfactory level of information support of management decision-making process, lack of information about changes in the environment, asymmetry of information in the various stakeholder groups. Therefore, the main recommendation for elimination of the conflict's dysfunctional consequences for the company is the necessity to direct resources at the improvement of communication channels and to take measures regarding the management decision–making process information support development.

Further research should be focused on developing result-based methods that would help to reduce and avoid interpersonal management conflicts in the machine-building enterprises functioning.

Efficiency of management capacity

Lubov Prokopyshyn-Rashkevych[1], Veronika Karkovska[2]

[1]Management of Organisations Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12

[2]Administrative and Financial Management Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: Veronika.Y.Karkovska@lpnu.ua

Abstract. – The main components of the enterprise's management potential were defined and set up appropriate indicators for evaluation the development of professional qualifying and creative potentials, and organizational ability of coaching user.

Key words – coaching, coach, management potential, professional qualifying potential, creative potential, organizational ability, competence.

I. Introduction

The necessity of providing the functioning of the domestic business is related to the ability of managers, entrepreneurs to resist the challenges of fierce competition, to get important information objectively, to demonstrate business flexibility and to make effective management decisions. The correctness of the choice-making depends largely on the availability and implementation of management capacity, which should combine in himself a professional, innovative and intelligent, social and psychological competences. Professional competence can be received through studying, increasing the qualification, carrying out the training. However, innovation and creative competence and organizational skills are not always easily acquired and they need development tools through the use of coaching.

Researches on management are dedicated in works of domestic and foreign scholars, namely: W. heed E. Denisenko, VV Kulik, M. Nagar, I. Peter, A. Adler, W. Baumann , G. Gardner, J. Guilford, T. Galway, D. Goleman, M. Downey, M. Erickson, T. J. Leonard, V. Maximov, Maslow, A. Ohnyeyeva, M. Perret, Rogers , S. Rogachova and others. However, scientific researches do not comprise the main influence of coaching position to develop managerial capacity, criteria for evaluating the effectiveness of management capacity as a result of coaching, which causes the topicality of this matter.

II. Main part

The system of generating ideas with today's pace of business development is one of the key factors of success and company will only win its competitors, if her leaders are talented, ambitious and brave. It can't be talked about his effective functioning without competent, qualified management of enterprise. The effective development of enterprise and ensuring its competitive advantages depends largely on leaders who are the part of the team of happy and motivated people with common values, who are able to work on a positive result.

The team of talented leaders was, is and will be the key to success for any enterprise, which doesn't depend on the profile of its activities. But the time demands new requirements from the heads. The current leader simply must possess and effectively use all the management possibilities, it means on the basis of professionalism optimally use professional qualifying, creative potentials and organizational ability to achieve permanent and efficient functioning of the enterprise.

Professional qualifying potential is characterized by the potential ability of leaders to apply professional competence in terms of integrating their knowledge and skills in the performance of professional duties and creating the conditions for enterprise to improve and develop the competence of personnel.

III. Analysis

The main feature of creative potential lies in the potential ability of the management to acquire and to use intellectual and innovative competence to formulate and to solve new creative tasks, to create conditions for businesses to display these creative abilities and their implementation in order to achieve their goals.

Decisive for our time are changes in the nature of managerial activity of the heads of enterprises, which should have the organizational ability to be ambitious, communicative, to work in team, to be able to create a favorable climate in the team, quickly perceive information and make effective managerial decisions to be psychologically sustained, ready to stressful situations and to be able to go with them.[1, 2]

Anthony M. Grant gives a definition of coaching: "Coaching - is focused on solving, result oriented and systematic process of cooperation, during which the coach helps to improve the performance of the activity, increase life experience, self-learning and personal growth of people with normal (non-clinical) populations "[3, p. 27]. A founder of the school of transformational coaching P. Vritsa says that "coaching is an art - to promote the development of other people." Effective coach, in his opinion, helps others to realize their potential which they have already had, but it may not be shown yet [4, p. 18]. Thus, the concept of coaching is not monosemantic. Thus, diversity reigns in many definitions: "Supporting a customer during his life in all its manifestations", "mentoring", "Coaching", "Systematic process of cooperation", "instrument of personal and professional development." Coaching is very often identified with consultancy, because the basis of both processes is business consulting. But between the two there is a difference. Consultant comes from the fact that his client does not know how to solve the problem, and he needs a help with this, using their knowledge, experience and ideas. Couch is sure that the client knows the best solving of managerial problems and helps him only to find the most effective ways, while encouraging the development of creative and organizational potential. Moreover, coaching should not be equated with the training which is used for teaching new skills and abilities, that is what usually can and knows coach himself. However, the client

is always in the focus of coaching for which have to be chosen specific special methods and individual solutions.

Coaching is often perceived as a form of taking care of for subordinates. This is not entirely true. The task of coaching is to achieve maximum efficiency from employees in the process of performing their tasks, and from the heads of the enterprises – to make the most effective decisions. So coaching - a process of facilitating maximum of self-disclosure and the development of professional qualifying and creative potential, the tool of increasing the organizational ability of leaders, cooperation, which is focused on making the most effective managerial decisions to ensure competitive advantages of enterprise [6].

In accordance with that a coaching is a basic tool of all elements of managerial potential, we have proposed a system of indicators, which take into account the influence of coaching to develop potential possibilities of leaders and determine the effectiveness of its application.

Ideas should be realistic to implement. To realize new ideas their managers must have such trait as initiative. Initiative is needed not only to perform the task, but to feel the pleasure of it. The behavior of creative people is so, especially creative people that really know how to create the right atmosphere in the enterprise. It is felt immediately, because their initiative and energy is transferred, and the people who inspired her, too, want to do work with pleasure.

The task that confronts coaching is to manage this initiative, facilitating its spread and to display the creative abilities of the team [7]. The problem is that managers are faced with a kind of "energy barriers": the instability of the process of innovation (loss of enthusiasm, lack of funds and time, firing talented employees) distribution inventions into functional stages between different departments, many people, inspires them difficultly. To overcome these barriers, it is necessary to bring value to the company employees. Only one worker, who understands and accepts the value of the enterprise, will be able to give himself to work and to be truly happy.

Brilliant ideas almost always are created by people with courage for their implementation. That's why brave people play a huge role in creating innovations. Courage – isn't congenial characteristic. It is brought up, in which case the most important for each leader is to find themselves not only in producing ideas, but also actively implement them. Mostly just non- standard solutions allow solving the problem as quickly as possible when it is extremely necessary.

Special attention should be paid to the influence of coaching on development of organizational ability of the leader. To develop organizational ability is rather difficult, since it is impossible to explain how to achieve functional interaction, co-ordinate work between functional departments, how to ensure a certain level of communication skills, how to be strong-willed, how to believe in themselves and create a favorable climate in the organization. Such psychosocial competence can be demonstrated only by the example of coach – by his own behavior.

The head, forming a communication in the enterprise (in the subdivision) that (which) he heads must recognize the primacy of the human person; consider not only external indicators of work (performance, efficiency), but also the internal state of employee - permanent specific motivation to work effectively, a gradual self. This approach to the personality of the subordinate manager requires a high level of social maturity. The level of sociability is characterized by the ability to work with people to build good relationships in the team, namely to influence, persuade, explain, listen, lead.

The ability of the head to specially organized work allows to set the observance of legal documents, rationalization of managerial and manufacturing activities from the definition of common interests and goals of the team, construction incidents to a minimum and thus to resolve the conflict through confrontation to cooperation.

The leader's ability to defend the interests of the collective and each of his subordinates – is a good tool to conquest authority and combine workers into a single group. Credulity and distrust - is the most important qualities of a person that affects the climate in the team. Excessive, immoderate credulity distinguishes inexperienced people. It is difficult for them to become good leaders. But worst of all - suspiciousness to everybody because the leader's distrust almost always generates distrust subordinates. Demonstrating the signs of distrust to people, people almost always limits the possibility of understanding, and thus it means the effectiveness of collective actions. So, first of all, it is necessary to believe in yourself, trust your subordinates, but at the same time control the execution of their tasks.

Conclusion

Thus, providing the development of managerial potential of enterprises is a complex process that requires adequate time and effort. However, in the modern business environment it is necessary quickly and effectively to make managerial decisions which are associated with serious responsibility and a certain risk. It is needed a professional and psychological support from an experienced and impartial professional, when there are situations with making crucial decisions.

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Domestic labor market's modern development trends in terms of European integration

Iryna Anhelko

International Economics Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: anhelko@mail.ru

Abstract – The main trends of the domestic labor market in terms of European integration are considered. It is mentioned that the current development model of the domestic labor market is quite paradoxical and characterized by contradictions which make obstacles for effective integration. To remove the obstacles for effective integration of the domestic labor market in the European area was proposed to conduct numerous measures that should be aimed to protect domestic producers and employees, to stimulate its competitiveness, to strengthen the role of the state and public organizations in providing national priorities and its accordance with international standards.

Key words – labor market, development of the labor market, European integration, employment rate, welfare of population, shadow employment.

I. Introduction

Ukraine's participation in European integration is not just the international interaction of economies but especially is the process of penetration of the European Union institutions in the domestic economy. The main characteristics of this integration process are not only depth, but the complexity and duration, as well as the ambiguity of the impact on various aspects of social life, including development of the domestic labor market – the intersection area of employers and employees vital interests.

II. The main material of research

In the current economic conditions the development and functioning of the domestic labor market is highly important due to solving a number of socio-economic problems, such as increasing of employment, welfare and poverty overcoming. Focusing on the priority of the labor market is obvious, because the number of unemployed in Ukraine exceeds 1.5 mln. people despite of its annual decreasing (in 2012, the unemployed population (ILO) in the age of 15-70 was 1,589.8 ths. people, in 2013 – 1,510.4 ths. people, in 2014 – 1,847.6 ths. people). Thus, a quarter of mentioned unemployed receives unemployment benefits (according to the State Statistics Service of Ukraine on 01.01.2015, the number of registered unemployed was 512.2 thousand people (1.9% of the working age population), 408.4 thousand people of mentioned above (79.7%) receive unemployment benefits, the average amount of it is 1232 UAH per month) [1]. However, receiving benefits, as in general the salary in Ukraine, does not protect from poverty and low living standards.

In the European Union (EU) people are considered to be poor if their incomes are less than 60% of the average in the country, all social benefits are include as well. According to the State Statistics Service of Ukraine, in 2013 55% of Ukrainians received income less than 60% of the average in the country (in 2013 the average salary was 3265 UAH. (268.1% of the subsistence minimum for working aged people), 7.1% of Ukrainians received income more than average salary). Thus, 22.1% of Ukrainians had an average income 1560,1-1920,0 UAH. per month, 21.3% – 1200,1-1560,0 UAH. per month, 9.1% - 840,1-1200 UAH. per month, 2.3% - 480,1-840,0 UAH. per month, 0.1% – up to 480 UAH. per month [1]. Such «sad» statistics proves the increasing of poverty in Ukraine, low official salaries and different benefits.

The features of the domestic labor market development are its instability and significant shadow economy. According to ILO, the level of shadow employment in Ukraine is about 9%. According to the experts from the Institute of Economics and Forecasting, the share of employees in the "shadow" is 16.61% of all workers [2].

The high level of shadow employment in Ukraine is explained by the following reasons.

One of the main reasons of this increasing is the poverty problem. In economic practice it is believed that the poor are families in which the main item of expenditure, the value of which is several times higher than all others, is the cost of purchasing food. In Ukraine, according to research carried out on this item of expenditure accounts for nearly 60% of the family income, while in the European Union, this figure does not exceed 15-25%. The major food products in Ukraine are milk and dairy products, vegetables, bread and bakery products.

To survive in modern conditions, households are obliged to find extra sources of income, which are often from the shadow economy. Typically, such sources are from the private property, the accumulated capital, personal farm, individual and family employment, industrial and domestic services to households, unofficial and informal employment in trade and services, as well as the involvement of employees and the working population in another shadowed incomes in almost all sectors of the economy and especially in the sphere of circulation.

Another reason of the shadow employment spreading is the desire of employers to reduce expanses and to «hide» income from tax. In particular, in the official enterprises «fairly» earned salary is paid to workers against applicable wage order. So, actually paid salary, bonuses, benefits, etc. are much higher than officially recorded in the accounting documents.

Illegal enterprises, firms, factories, etc. without registration are made to omit taxes payment. Its production and financial flows are not recorded and salaries are paid to employees without official documentation.

It is counted that today approximately half of the Ukrainian wages are hidden so that due to STA, Ukraine annually loses about 10 billion UAH of taxes [3].

Due to experts, the payment of wages «in envelopes» are usually made in small and medium enterprises because of high charges on salary fund. Large companies don't pay social contributions because of insurance companies.

In general, according to unions, today the shadow wage in Ukraine is oriented 200 billion. UAH. [2].

Huge impact on the labor market development in Ukraine have labor migration and the tense political situation in the country.

The main reason that motivates people to leave their homes and go in search of a better life abroad, is a difference between life levels and economic opportunities in various regions of the world, particularly between developed countries and developing countries. In recent decades, this gap grew steadily, determining the prosperity of some and striking poverty of others. For example, if compare the minimum wage among countries of the European Union the highest is in Luxembourg – 1923 euro, and the lowest in Bulgaria – 184 euros [4]. In Ukraine, the minimum wage is about 54 euros (from September 1, 2015 the minimum wage is 1378 UAH.) [1].

In modern terms, according to various estimates, abroad is from 3 to 7 million. Ukrainian labor migrants. Given that in Ukraine on January 1, 2013 was 31,846.8 thousand. People economically active population of working age (15-64 years), we can talk about migration from Ukraine almost ¼ of active working age population [4]. However, definitive data on this phenomenon does not exist, because in some cases, migration is informal (illegal) nature.

Most Ukrainian workers going abroad for a period of 1 to 6 months. This so-called sezonnyky migrants, most of whom work abroad on those jobs that do not require skills that they have.

The main areas of employment migrant workers are: construction, agriculture, collective services (street cleaning and construction waste), transport and communication services, domestic workers (home cleaning, cooking, looking after children and infirm elderly people), industry (mainly the production of consumer goods - baked goods, clothing, shoes), trade and services (including Hospitality). This division of labor migrants by field of activity varies significantly depending on gender and country of residence.

Overall, the analysis of the current domestic labor development market model shows that it is quite paradoxical and characterized by contradictions which are obstacles to effective integration. Employment policy and remuneration policy are not coordinated, government and market regulators do not interact, made decisions, are the reaction to events but are not proactive, labor market is separated from the real estate, credit, investment, goods and services markets; state controls effectiveness of employers, but not their payments to employees; legislation is developing, but laws are usually broken.

To remove obstacles of the effective integration of the domestic labor market into the European area, it first of all must be reformed by:

- improving the system of remuneration;
- expanding opportunities to gain the main and additional official income;
- social support for certain groups of people;
- preventing the growth of unemployment by creating working places using various resources;
- increasing the quality and competitiveness of the workforce;
- increasing productivity by innovation technologies and improving of work places;
- using the experience of leading countries to enhance socio-economic development.

Reforming of the domestic labor market generally coincides with the measures necessary for the European integration of Ukraine's economy. In case of its implementation the conditions and the regulations of the labor market will be closer to European. However, it is necessary to remember that the European integration as well as any other process in the short term can cause considerable economic and social losses.

In general, the main advantages of European integration for the Ukrainian labor market and the economy in general are:

- changing of Ukrainian labor laws according to EU requirements;
- development of the system of working places in quantitative and qualitative dimensions;
- favorable investment climate and business environment;
- increasing of the productivity and competitiveness of the workforce;
- effective relocation of human resources;
- implementation of a new law and administrative culture in the relations between the subjects of the labor market;
- increasing of living standards.

The economic risks and threats of European integration include:

- dependence on external factors due to the enlarging of exports;
- dismissal of employees during enterprise restructuring; reduction in demand for domestic goods and services in the segment of uncompetitive working places;
- lack of investments to replace old technologies;
- lower quality of the national labor force in compare with foreign specialists, orientation of foreign investors not on innovation, but on the investment that quickly pays off and is less risky.

Conclusion

Overcoming the possible risks of European integration in the adaptation period, especially in its short phase, is possible only when they are considered and there are preventive and proactive measures of labor market regulation which must be aimed to protect domestic producers and employees, stimulate competitiveness, strengthen the role of the state and public organizations in ensuring national priorities and their compliance with international standards. Only the realization of all these measures will result in long term benefits of European integration changes in the domestic labor market development.

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The risk of appearance corrupt practices in the management of assets of private pension funds

Tetyana Kulinich[1], Illya Zhayvoronok[2]

[1]Management of Organization Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: tculia@gmail.com

[2]Management of Organization Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: illja134@mail.ru

Abstract – The article has been devoted to problems of pension reform in Ukraine. The sequence of implementation of pension reform in Ukraine has been described. Potential threats of pension reform have been analyzed. The detailed descriptions of threats of pension reform have been represented. The novelty of research is solutions which help to overcome threats based on corrupt practices in the management of assets of private pension funds.

Key words – Private pension fund, reform, threats, risks, management, solutions.

I. Introduction

During the last two years the legislative and executive branches of power in Ukraine have been implementing a great number of initiatives and reforms to improve the life of Ukrainians. Among them, there is pension reform. The main idea of pension reform is creation of an effective accumulative pension system.

This reform is represented in the government project (№2767) [1] and will be implemented in two stages:

1. From the January 1, 2016 a professional accumulative pension program funded for persons aged less than 35 years and employed in jobs with especially hazardous and harmful, especially heavy and difficult working conditions; local government officials, tax officials, customs officers, prosecutors, judges and academic and teaching staff is proposed to be introduced;
2. From 1 January 2017 the second level of the pension system reform is proposed to be introduced. The participants of accumulative pension system will be persons aged less than 35 years. However, the right to participate in this pension system is proposed to insured persons who are not older than 55 years. These persons will be given the opportunity to take part in accumulative pension system if they decide it till January 1, 2018 [2].

II. Threats based on realization of pension reform according to government project

Most of analytics defines two main threats based on realization of pension reform. One more treat (third) is defined by us.

The first threat is reduction of revenues to the Pension Fund of Ukraine after the start of accumulative pension reform [1].

The second one is that collected funds will not give desirable profit for the proper functioning of the pension system, which may lead to the discrediting of the idea of such pension insurance.

The third one is risk of speculation with investments of private pension funds by asset management companies.

Analytics thinks that part of the working population aged less than 35 years old will stop to transfer funds to the Government Pension Fund of Ukraine. This means that the deficit of the Pension Fund of Ukraine will increase by several times and it must be covered be the budget. The growth of budget expenditures on social services will reduce government investments in the real sector of Ukrainian economy.

Also, there is the problem of devaluation of funds invested in the accumulation pension system. This is due to the high level of inflation (39,5%), high interest rates and the devaluation of the National currency [1].

For example, there is the probability of situation when income from private pension fund investments will be lower than income from interest on bank deposit, and that will be disadvantage of the reform.

The last threat is directly related to the activity of private pension funds. According to the law, private pension fund does not operate independently and use the services of the administrator, custodian and asset management company (Fig.1).

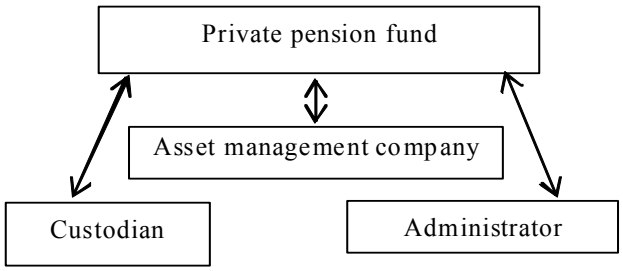

Fig. 1. Cooperation of Private pension fund with its main partners

III. Risks based on cooperation of private pension funds with asset management companies

Management of assets of private pension funds will be performed by asset management companies. These organizations are independent legal entities and carry out their activities independently. The model of cooperation of private pension fund with assets management company is represented in fig. 2.

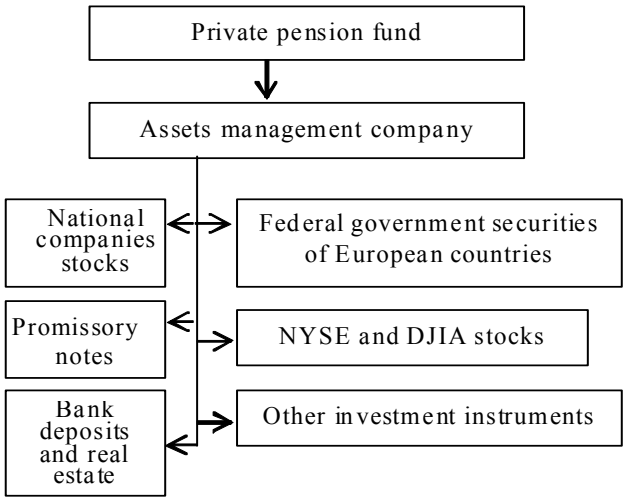

Fig. 2. The model of cooperation of private pension fund with asset management company

We consider there are two main threats in the work of these organizations:

1. There is a risk that fictitious asset management companies will arise. The creation of such organizations does not require large financial investments and great wastes of time for inspections by government authorities. Once the funds of private pension fund will be transferred to those fictitious organizations, its founders can use them for personal purposes and transfer them abroad. Similar cases have occurred in the Ukrainian economy and politics.

2. In addition, there are significant risks associated with the inappropriate use of assets of private pension funds. Assets management companies may unprofessionally diversify investment portfolio, investing a significant percentage of funds to non-profit projects. The reasons may be different: the incompetence of managers or plot with the owners of enterprises.

The problem is that currently our country does not have legislation that would make it impossible to occurrence of such threats. There are no laws about the responsibility for economic crimes [3].

There are no detailed requirements for the objectives of investments by asset management companies. Requirements on diversification of the investment portfolio of private pension funds have got a lot of inaccuracies [4,5].

Conclusion

According to defined threats pension reform in Ukraine must be performed more professionally. First of all legislative and executive branches of power in Ukraine need to do a complete legal base which will protect the interests of depositors of Private Pension Funds and create a favorable economic climate for the activity of investment institutions.

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Application of Basic Tools of Experimental Economy in Management Science

Izabela Joachimiak

Wroclaw University of Economics, Poland, Wroclaw,
e-mail: izabela.joachimiak@ue.wroc.pl

Abstract – In the times of rapid economic transformations taking place in the world markets, it is becoming more and more difficult to predict economic trends as well as people's behaviour. In order to do so, it is more common nowadays to adopt unorthodox approach apart from using traditional methods. Undoubtedly, experimental economy is a good example of such kind of approach. The basic tool used in experimental economy is an experiment and it will be the main subject of this study. In its first part, this article explains fundamental concepts and the essence of experimental theory basing on available literary resources. The second part presents lots of specific examples showing how to use experiments both in human resources management and quality management.

Key words – experiment, experimental economy, Kaizen, PDCA.

I. Introduction

According to the Polish dictionary, an experiment (lat. *Experimentum* – experience, research) is an attempt to implement an innovation idea or a scientific experience which is conducted to explore some kind of phenomenon [1]. In available literary resources it is also defined as: the study of a phenomenon, which consists in intentional causing this phenomenon or changing it and carrying out observations and measurements which allows to draw conclusions about its properties [2]. It is performed in order to confirm or falsify a specific theory. Note, however, that designing experiments is not easy, and a good experiment has to be as simple as possible in implementation and give the most unambiguous answer. However, very often in practice it happens that an apparently failed experiment (which got out of control and did not give a clear answer to a question established earlier), became the beginning of the development of a new discipline or brought a new discovery, e.g. penicillin or X-ray radiation [3]. The aim of this article is to present an experiment as a basic research tool in economics, as well as the use of it in management sciences, with particular emphasis on quality management.

II. Experiment in management sciences

According to Griffin, management is a set of actions aimed at human, financial, material and information resources in order to achieve pre-determined goals in an efficient and effective manner by the organization [4]. Management includes four basic functions (picture below presents interconnectedness between these functions):

- planning and making decisions – aims of the organization are formulated the way of their realization
- organizing –activities and resources are coordinated which allows for the realization the pre-determined aims
- leading (motivating and managing people) – a set of processes used to encourage people to work for the organization
- control – observing progress in terms of the pre-defined aims in the organization [5]

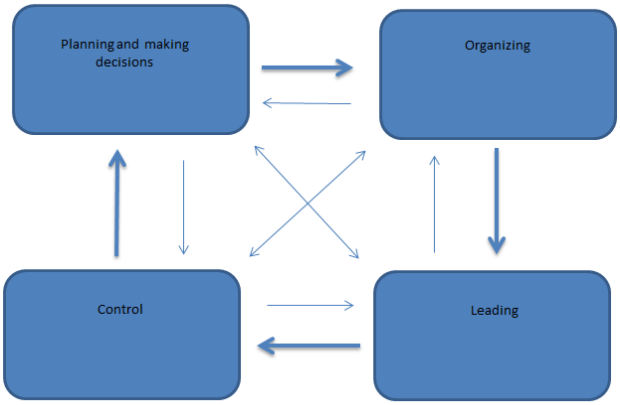

Fig. 1. Connections between management functions

Source: Griffin R.W. *Podstawy zarządzania organizacjami*, Wyd. Naukowe PWN, 1998, s. 40

Experiment in management is commonly used because of its broad application. An example of that are studies which were carried out in years 1972- 1932 in Western Electric company in Hawthorne by Elton Mayo with his associates. The first research was about changing the workplace illumination for a selected group of workers and comparing the results of implementation of that change. It seems that the performance of that group improved and curiously the performance also improved in group of workers who worked with unchanged illumination. Furthermore, this performance improvement stayed on the same level even after returning to the previous lighting conditions. Performance declined when illumination was reduced to a level similar to moon light [6]. The experiment in this case failed, because the main role in this research was played by supervision of researchers. Workers felt pressure so they worked harder to work than usually.

Another interesting experiment conducted in management was establishing a plan of piece-work incentive for a group of ten workers who were responsible for assembling parts for terminals of telephones. Mayo and his associates wanted to check the theory of management which claimed that employees always aim at maximizing their salary by producing as many units as possible. Researchers assuming that the group of workers will informally determine the appropriate level of production for its members. Some workers (who were called „naganiaczki") exceeded the internal norms, while others (who were called „dłubaczki") produced less. However, the latter tried to produce the establishment number of products, because they wanted to gain acceptance other workers – after producing the expected limits they slowed down [7]. In this case piece- work system did not work properly due to the fact that salary seems to be less important than the needs for social acceptance.

Another important experiment and also one of the most famous experiments in the world conducted in

management was carried out in a small Brazilian company Semco. Semler R. inherited his father's company, which produced high-quality industrial machines and provided specialised engineering services.

The first decision of the new owner was to dismiss two-thirds of the old board and to implement new rules: production workers had to determine on their own the starting and finishing hours of work, they had to strengthen the sense of honour and mutual trust (lack of internal audits), employees were able to choose their leaders in order to realize projects which really interested them, as well as deciding about matters in the company which are usually only in the competence of the company's board. The company initially employed about 90 people, but nowadays the number of employees is more than 3 000 people, and it consists of ten business units [8]. Additionally, Semco is one of the most desirable employers in Brazil with a group of dedicated and loyal employees [9].

On the basis of those examples above it can be seen that the basic tool of experimental economics is also used in other sciences. Below are some examples which show that experiment is also a useful tool in quality management.

In quality management there are a lot of tools, methods and systems which can be used to conduct an experiment. Here are some of them:

PDCA (Plan, Do, Check, Act) – it is an algorithm of gradual changes of the company's system; above all, the idea is to gradually and systematically make changes, which creates an opportunity to observe them. The experiment in this part consist in carrying out planned activities because there are totally new and in the second part the results are checked.

Kaizen – it is a kind of philosophy, which means a change for the better. It includes the involvement of all employees. It involves the gradual improving some kind of the company's activities (sometimes through minor corrections), which many lead to better productivity, efficiency and quality of products by the company. The aim is achieve long-term success by means of small steps [10]. Implementing Kaizen to European reality is extremely difficult because of cultural difference between Europeans and Japanese. This experiment does not always bring positive results in European enterprises because its success depends on the mentality of people (managers should develop cooperation with employees so that they are willing to share their ideas and suggestions without feeling any fear connected with lack of acceptance) [11]. Esselte Polska is an example of a company where the Kaizen philosophy was implemented. Initially this company generated high costs of storing final products. Thanks to arduous and long-term implementing Kaizen (analysis the whole process – putting on foil on specific machines and measuring the number of steps taken the machine's operator etc.), the company improved flexibility, efficiency and economic capacity.

Conclusion

The above examples can demonstrate that an experiment is a commonly used tool in experimental economics. Experiments can be conducted for different purposes and explore different kinds of relationships between dependent and independent variables (establish relations between causes and effects). This article proves that experiments are a useful tool in economics, human resources management (Semco company), quality management and in many different disciplines of social sciences.

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Tangible and intangible methods of motivation

Vitaliy Kruglov[1], Darina Kozyakova[2]

[1]Kharkiv Institute of Trade and Economy of Kiev National University of Trade and Economy, UKRAINE, Kharkiv, Otakar Jarosh lane 8, E-mail: kruvit@rambler.ru

[2]Kharkiv Institute of Trade and Economy of Kiev National University of Trade and Economy, UKRAINE, Kharkiv, Otakar Jarosh lane 8, E-mail: ya.darina@inbox.ru

Abstract – In the article tangible and intangible methods of motivation are given. It is argued that using of both methods by turns or in combination for better and more effective achievement the objectives of the organization will be more effective.

Key words: personnel motivation; method of motivating; tangible methods, intangible methods.

I. Introduction

"Company success depends on staff" – each company manager should implement such approach because company's profit strictly depends on employees or rather their fully dedication to work. It is reasonable to implement system of effective staff motivation for company success.

Successful and prosperity business requires that each employee feel own necessity for company, work enthusiastically and desire to work only for this company.

II. Main results

In modern conditions any system of administration works efficiently and with the highest possible results if it is based on a properly made incentive system. Incorrectly build system of work with stuff; particularly employees' motivation system often spoils company's work system, because the result of insufficient attention to employees' satisfaction is workplace and work discontent. Hence there is not very quality work of discontented people which don't have any desire to work on 100% of their abilities. And where one person is displeased there often can be whole displeased staff. As is generally known one unsatisfied employee is able to abet whole staff on his side against authorities. And it will leads to slowing of work or mass firing. Reasonable managers should avoid such scenarios.

How to prevent staff turnover? This question is often raised in publications. Often change of employees in itself is very harmful because company requires true professionals that able to bring their actions in accordance with the needs of this specific company with detailed features taking into account. And beginners, even if they are super professionals, surely spend some time for understanding of details of this specific work. Hence it is time losing and work slowing because all parts of company connect to each other. If one part of the company has a problem then all company has a problem. And this usually leads to money losses.

The problem of the staff motivation is one of the major management problems. At some point, business leaders face the challenge of employee motivation, aimed at productive performance of the employee duties. The key issue is to find the exact relation of moral and tangible incentives. Irrational use of tangible incentives, for example, can minimize employee commitment to development in his field. At reaching certain, individual "saturation threshold", further financial incentives do not motivate the employee desire for improvement of his productivity. Therefore, methods of intangible motivation (what is really important and interesting for each employee) are also important and necessary to improve the quality and productivity as tangible.[1].

Give an example of one of the basic approaches to definition of motivation – Maslow's pyramid. According to this theory human behavior based on needs (of something), that can be divided on five types: physiological needs, safety needs, social needs, esteem and recognition needs and needs of self-actualization or creative self-expression.

Tangible motivation (usually most cost-based for company) is naturally implemented on first two levels. First of all the salary motivation of employees only even very competitive is unprofitable for company because it leads to increasing of salary fund up to unjustified sizes and secondly, it is well known that salary increasing as a motivation measure will be effective only during few months.

Besides the first two types of motivation there are other types of motivations on company that may be considered and used as intangible motivation. Employees' managers which charged with stuff motivation know many methods and means of intangible motivation. They are based on main needs of employees and spent minimum means. The main part of intangible motivation is attention to employees, displaying of distinctive "appreciation" to employees for their work. Appreciation often may be just nominal. They must believe that they are the part of the company, full-fledged (on a par with authorities) part of the team, identify own interests and goals with corporate ones to properly assess this appreciation. It is obvious that active involving of stuff to company life has extremely positive effect on activities of any business.

Proper organization of the team of professionals (experts) working to achieve the objectives, and the creation of space for personal growth of employee is a cyclical process which includes lost of interest in execution of his duties or dismissal from the company. The main reason for this is shortage or total lack of motivation. Motivation is a tangible or intangible based method that aimed at increasing the interest of employees in field. [2].

It is not always right to compare importance or priority of the tangible and motivation. Despite the fact that the tangible interest of employees is a versatile tool in many cases, the encouragement of employees, based on their specific interests, is more effective. In some cases, employees prefer to intangible encouragement any monetary reward. With regard to the financial motivation, the most effective way is to increase wages. The work of employee will be more effective if the amount of wages is significant, otherwise it will cause a reluctance to carry out their duties.

All types of money rewards in companies considering tangible motivation can be divided on 2 big groups: compensatory payments and relative income. Compensatory payments include possible cash payment and social package that consist of services, benefits, insurance that company gives as addition to "cash". Relative income includes possibilities for progress, study, self-realization, realization of status etc. Usually compensatory payments system in most companies is more or less regulated because exists both law requirements and management necessity. But not any company has clear policy about relative income.

The most common methods of tangible motivation are monthly or quarterly bonuses, bonuses for length of service, etc. Also, method of financial motivation such a percentage from receipts is widelyuse in the area of trade and services. Its essence lies in the fact that monetary compensation is not specified. The amount of the reward depends on professional discharge emploee's duties. [1] There are also indirect forms of tangible incentives, such as the presence of the social package, the provision of service housing, partial or full reimbursement for meals, transportation, etc.

Intangible motivation is manifested in the fact that each individual team need to change specific standard rules. Non-standard, individual principles are used, in most cases, for effective implementation of intangible motivation. It is necessary to take into account the interests of each employee. For someone enough the encouragement from the authorities, some other wants the recognition of his good work. Also the important principle is encourage, praise and motivate of all employees but especially pay attention on the best: the bigger deal, high rates and other merits toward the company. Confirmation of desirable behavior impels to show excellent results again and again.

Most effective methods of employees' intangible motivation that can be used to increase efficiency of labour and employees loyalty are presented below. The main advantages of some of them is that their don't require any material costs and any concern for his staff manager may use it.

The methods of intangible motivation are:

– meetings holding where employees will be informed about company achievements and contribution of each one to this achievement, public praise and awarding of most distinguish employee;

– personal praise of employee for effective work, high productivity, fulfilment and overfulfilment of target or other work achievements;

– congratulation of employees with holidays, organization of holiday events on any level (from corporative holidays to modest celebration in staff);

– required help and sympathy in sorrow. Possibility of flexible work hours;

– assignment of membership cards for gyms, swimming pools, etc;

– polite treatment of employees;

– using of honour roll both visual (in company office) and virtual (on site);

– awarding of employees by letters of commendation, decorations, and keepsakes;

– providing of comfortable workplace with all required equipment.

However, for large companies it is not possible to implement an individual approach to motivating employees. Therefore, most managers are limited to generally accepted principles of motivation, based on the position and standing in team.[2]

Conclusion

To summarize, it is necessary to emphasize the importance of using the methods of tangible and intangible incentives for effective operation of any enterprise. The current arrangements, which are used for personnel motivation, are not perfect. But despite this, they are used every day in practice and contribute to achieving the goals. For example, European countries use a system of ratio indicators of tangible interest with the objectives of the organization and involve reward system based not on specific tasks but on a shared vision to enhance the efficiency of financial motivation. Based on the above, it is impossible to attach importance to only one method of motivating like tangible or intangible. Using of both methods by turns or in combination for better and more effective achievement the objectives of the organization will be more effective. [3]

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The peculiarity of thin border between people's chronotypes and the level of labour productivity

Anastasiia Novikova[1], Olena Bilyk[2]

[1]Department of Administrative and Financial Management, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: AnnaStasiya.91@rambler.ru

[2]Department of Administrative and Financial Management, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: olena.bilyk@gmail.com

Abstract – The peculiarity of thin border between people's chronotypes and the level of labour productivity is considered. The novelty of this article lies in the new term 'chronotypical discrimination' which is suggested and described. The article also analyzes how to improve the current state of management in Ukraine through labour productivity based on people's chronotypes.

Key words – biorhythm, chronotype, discrimination, labour productivity, schedule, 'lark', 'owl', 'dove', 'employee'.

I. Introduction

It would seem that our society is far advanced in terms of tolerance to dissimilar people. Nowadays, it is very popular to protect national and sexual minorities, to defend women's rights so that they're equal with men's. Furthermore, left-handers are not being retrained any more. There are more than hundreds of such examples. However, still a lot of issues remain unsolved. Meanwhile, all over the world many people are still discriminated - and no one beats the alarm.

In this article we want to represent the problem of chronotypical discrimination based on different biorhythms which influences on people's productivity at work.

II. The main material

The first thing that needs to be highlighted is such term as "biorhytms" in terms of our issue. A person's biorhythm is the propensity for the individual to sleep at a particular time during a 24-hour period. 'Eveningness' (delayed sleep period) and 'morningness' (advanced sleep period) are the two extremes with most individuals having some flexibility in the timing of their sleep period [1].

So, biorhythm is a cyclically recurring pattern of physiological states in an organism or organ, such as alpha rhythm or circadian rhythm; believed by some to affect physical and mental states and behaviour [2].

Biorhythms are the natural monthly fluctuations that govern physical, emotional and intellectual sides of person's development. On the peaks of these sides you will:

- feel physically fit to work on projects requiring physical strength and endurance;
- feel most creative, most loving and warm, and you are probably more open in your relationships;
- be at your most intellectually responsive;
- be open to accepting and understanding new ideas, theories and approaches.

The other side of the coin is, however, that after peaks we always come to the lowest points, when:

- you are likely to have less energy and less vitality. Be sure to follow this cycle if you require physical endurance for either sports or your work;
- you may be very irritated and negative about those things that occur in your everyday life;
- you are more inclined to be withdrawn and less cooperative;
- it is much more likely to have difficulty in grasping new ideas and concepts[3].

The scientists have found that at different and always individual location of biorhythms' peaks people are divided into three chronotypes. Everybody knows that people are divided into early risers, or "larks", and late risers, or "owls", depending on their biorhythms. Sometimes they are also divided into "owls", "larks" and "doves" – evening people, morning people and the intermediary type. If to believe world statistics, nowadays, about 40% of people are 'owls', 'larks' are about 25%, and all others – 'doves'. "Pure" types are only 3%, while the majority of people belong to the "mixed" type.

Genetic early birds will be naturally inclined to go to bed and wake up earlier. They make up roughly a third of the population. 16% of people are genetic night owls; they tend to have later bedtimes and wake times (about an hour after the early birds). And the middle ground have a tendency to wake up "between" the two extremes. It is undeniable that biorhythms can influence people's moods and career-making abilities. The latest studies prove that many mistakes can be avoided if we synchronize our plans to our biorhythms.

Must be said that this world is certainly made up for 'larks' because all living things on the Earth are subordinated to the rhythm of the Sun. People are not an exception. Since ancient times, people have defined their daily activities depending on the Sun. They simply could not afford to sleep in the most favorable time for working. There was, of course, a certain category of people who led an idle life, but we are talking about working class. 'Owls' have appeared recently, after the invention of electricity, and as people became less dependent on sunlight, their number increased.

As the 'lark' is a more natural chronotype, harmonious with the nature, it turns out that it is more beneficial. In addition, the world around us is also arranged under such people. After all, public institutions, shops and many other places start working in the morning, apparently it is based on those who rise early. And this is despite the fact that the majority of people are still 'owls'.

A chronotype is a sleep phenotype that influences people's wake and sleep time. People can affect their sleep habits by changing things like light exposure at day or night, caffeine intake, electronic media consumption, and so on, but the genetic chronotype won't change. It's the baseline, and recent psychological researches confirm this evidence [4].

In some case, people are slaves of their lives. Doubtless, most of us have no choice in our schedules at work. The biggest percent of modern offices are opened

from 8 a.m. to 5 p.m. HR-managers practically never pay attention on subordinate's chronotype. It means that nobody cares whether you are working hard or just attend your work. Despite the fact, that there are a lot of already created chronotype tests. That means that nobody has to invent anything new. It is enough just to use it as a part of habitual practice in companies.

The majority of great people is still required 7-8 hours sleep, albeit at different times of the day. For example, Honore de Balzac was very fond of coffee. He went to sleep at 6 p.m. and slept until 1 a.m. On the other hand, F.S.Fitzgerald was awake until 3:30 in the morning, and then slept until 11. The story goes that Albert Einstein liked to sleep 10 hours a night - unless he was working very hard on an idea; then it was 11. He claimed that his dreams helped him to invent. Also he felt that naps "refreshed the mind" and that they helped him to be more creative. These are just a few examples of some famous doers and their daily schedules [5]. As you can see, their achievements show us that the productivity can't be scheduled.

All processes inside a human body have their own rhythms. Every function, every action starting from the micro level and to the macro level is rhythmical. Biorhythms essentially influence our disposition, how we feel and how we work. For example, Japanese scientists have created special pocket computers that warn their owners of potential biorhythmic effects on their sense of wellbeing. Nevertheless, in our opinion, it is not enough. It makes no sense if you are 'a lark' and you have a night shift at work (they are usually like sleepy flies) or vice versa 'an owl' has to get up very early in the morning and start working.

To improve performance, efficiency of work and labour productivity - it is recommended to take into account chronotype individually for each employee, when planning the calendar, staff work schedules in enterprises – especially air traffic controllers, dispatchers, managers and operators. Moreover, it can significantly reduce the rate of accidents in manufacturing.

On the one hand, company may provide a semifree schedule. It means that everybody should be present at work, for example, since 11 a.m. till 3 p.m. and during the last part of the day employees can be at work whenever they want. The main point is to increase the labour productivity and the overall result of company's performance. The head may also appoint a deadline for the accomplishment of the tasks so that employees can allocate their own time, as they want, but to provide the results of their work on time.

On the other hand, people may solve this problem themselves. For example, they may find out to which type of chronotype they relate to and then try to look for the job according to it.

For 'larks' the best way is to find a job with a traditional schedule: early rise and early return home. This may be the position of a driver, a conductor, a civil servant, a teacher, a cook, a secretary, a baker, a janitor or any office employee.

If you are going to look for a job, being an 'owl' then it is better to choose the position with a free schedule or afternoon schedule - this is the best option. For example, the work of an administrator at a nightclub, a DJ, a waiter, a courier, a guard, a manager in a call center or an IT specialist.

Conclusion

To sum up, chronotypical discrimination is the unjust or prejudicial treatment of different categories of people, especially on the grounds of their chronotype. It is treatment or consideration of, or making a distinction in favor of or against, a person or thing based on the group, class, or category to which that person or thing is perceived to belong to rather than on individual merit. Nowadays, we see that the modern world is made up for 'larks'. That's why we offer to fight against it through 'clever' management. Here are our recommendations:

- to provide a semifree schedule;
- to check people's chronotypes;
- to choose a job according to the chronotype;
- to pay attention on labour productivity.

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The scopes of rational using of road and rail transport while delivering lime bricks in Ukraine

Maria Olkhova

Transport Systems and Logistics Department, O. M. Beketov National University of Urban Economy in Kharkiv, UKRAINE, Kharkiv, Revolyutsii Street 12, e-mail: olhovamv@gmail.com

Abstract* – *The challenge of transport mode choice is one of core logistics tasks. The plenty of solutions of this task is based on the main features of transport and can not be used for specific situations effectively. Researching of delivery variants of lime bricks is actual seeing rapid development and possibility of using diverse transport packaging.

Equivalent distance calculation allows to determine the scope of using rail and road transport. In contrast to the existing approaches of calculating of equivalent distance, this paper is proposed to use customer's cost as criterion of transport mode choice, including immobilisation cost while transporting goods.

Key words – Customer's cost, road, rail, equivalent distance.

I. Introduction

Each transport mode has its own advantages and disadvantages, as well as road and rail. However, as a rule, these features are common and do not allow to make a coherent decision on the transport mode choice. Factors identification, that influence the choice of road and rail transport modes, will improve the efficiency of the transportation process by choosing rational technology. Generally, cargo sort is the key factor during choosing the transport mode [1, 2]. Based on this revision of the factors of transport mode choice is advisable to carry out research for certain cargo type.

II. Research

Transportation of building materials, as well as any other materials are had its own features. These directly affect to the transport process technology. Simultaneously, timing of building works depend on directly the materials delivery timeliness. As a result of the rapid development of building materials, it is increasing the numbers of transport packaging that could be used for the transportation of these goods. As a consequence of it, there are increasing scopes of rational using of different transport mode, including road and rail. Selecting the rational transport mode will allow to optimize transport costs of transport services customers.

The aim of this paper is to investigate the factors of transport mode choice and to determine areas of rational using of road and rail transport while delivering lime bricks in Ukraine.

As a criterion for the efficiency of the transport mode choice are encouraged to use the customer's cost, which allows to take into account immobilization cost while transporting cargo.

Transportation time of rail as more as by road. Therefore, transportation time is an important one to considerate in the calculation of the customer's cost for cargo delivery. The inclusion immobilization costs will take into account the delivery duration by road and rail.

The objective function of the researched system is characterized by the following formula:

$$C_{cust} = C_{tran} + C_{Lo-Unlo} + C_{im} \rightarrow \min_{x \in \Omega \subset R^n} \quad (1)$$

$$\Omega : Q_f^{\ +} \le Q_f \le Q_f^{\ ++} \quad (2)$$

$$S_{cargo}^{\ +} \le S_{cargo} \le S_{cargo}^{\ ++} \quad (3)$$

$$T_{1km}^{\ +} \le T_{1km} \le T_{1km}^{\ ++} \quad (4)$$

$$l^{\ +} \le l \le l^{\ ++} \quad (5)$$

Where C_{cust} is customer's delivery expenditures, hrn; C_{tran} is transportation cost, hrn; $C_{Lo-Unlo}$ is load and unload operation cost, hrn; C_{im} is immobilization cost, hrn; Q_f is cargo amount, ton; S_{cargo} is cargo cost, hrn; T_{1km} is transportation rate, hrn/km; l is transportation distance, km.

Data of model had been formed by surveying experts and statistical data processing of Corporation "Kharkiv Building Material", which uses a road and rail transport while delivering lime bricks in Ukraine. For the calculation was used programme Microsoft Excel. Automation of calculation makes it possible to determine the value of the customer's cost, depending on the selected transport mode, as well as to carry out the monitoring of other factors model.

The experimental conditions were adopted by the following: transportation is provided within Ukraine, cargo transported into universal vehicles and wagons, the road and rail vehicles' capacity are 20 tons and 40 (60) tons in accordance. The rail wagons are owned by rail enterprises.

Expenditures while transporting cargo by road transport at the site from a rail station to consignee had been calculated based on transportation rate for a work hour.

As shown in Figs. 1 and Fig. 2, customer's cost depends on the transportation distance and changes from transport mode.

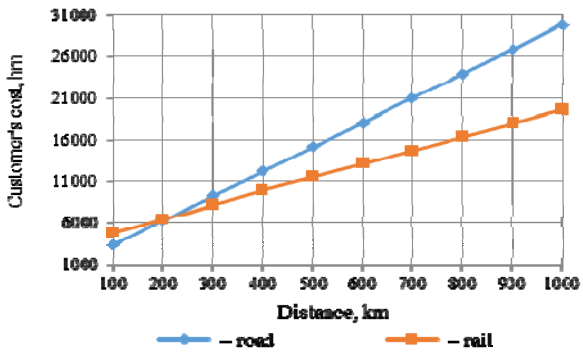

Fig. 1. Customer's costs while transporting cargo by road (A) and rail (Z) in Ukraine without consignee's rail siding, with the transportation distance (cargo amount 40 tons)

In addition to the results illustrated in Fig. 1, when transporting 40 tons of cargo over the distance of no more than 200 km it is appropriate to use road transport, but when transporting 60 tons of cargo it is better to use rail

transport for distance no more 160 km. If transportation distance is more, it is better to use rail transport for building materials transportation in Ukraine without consignee's rail siding.

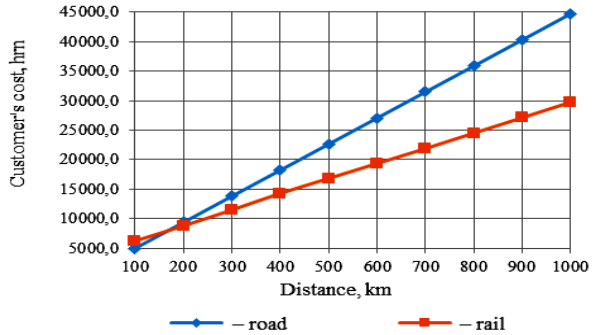

Fig. 2. Customer's costs while transporting cargo by road (A) and rail (Z) in Ukraine without consignee's rail siding, with the transportation distance (cargo amount 60 tons)

The intersection point of two lines indicates the same costs for the customer. This point can be called an equivalent distance point, it means that it is the same for enterprises either to use road or rail transport. As a result of received dependencies it is possible to determine an equivalent distance depending on various selection criteria of road and rail transport. There were made the experiments of the equivalent distance determination depending on different factors as such as cargo amount, transportation rate of road transport. Table 1 presents the equivalent distance values depending on the cargo amount.

TABLE 1

THE EQUIVALENT DISTANCE DEPENDING ON CARGO AMOUNT

Cargo amount, ton	Cargo cost, hrn	Transportation rate of road transport, hrn/km	The equivalent distance, km
with consignee's rail siding			
60	630	14	115
80	630	14	146
100	630	14	110
120	630	14	102
without consignee's rail siding			
60	630	14	160
80	630	14	165
100	630	14	195
120	630	14	180

If cargo amount is rising, the equivalent distance is reducing. That is the scope of rational using of road is falling. If a consignee has an own rail siding, equivalent distance is bigger than whilst consignee do not has own rail siding. Determinations of the equivalent distance depending on transportation rate of road transport are identified in Table 2. If transportation rate of road transport is rising, equivalent distance is reducing. The resulting numeric values can be used in industrial transport companies, who need to transport building materials in Ukraine.

TABLE 2

THE EQUIVALENT DISTANCE DEPENDING ON TRANSPORTATION RATE

Transportation rate of road transport, hrn/km	Cargo cost, hrn	Cargo amount, ton	The equivalent distance, km
with consignee's rail siding			
12	630	40	220
14	630	40	200
16	630	40	100
without consignee's rail siding			
12	630	40	360
14	630	40	280
16	630	40	170

This will select the appropriate transport mode for transportation of building materials based on the criterion of customer's cost, taking into account the costs associated with the funds immobilization during delivering.

Conclusion

The scopes of rational using of road and rail transport have been determined while delivering lime bricks in Ukraine for two variants: with consignee's rail siding and without consignee's rail siding. As a criterion of transport mode choice is proposed to use customer's cost and determined as a result the equivalent distance.

It is rational to use road transport, if transportation distance no more 200 km for average factors value of experiment and provided with consignee's rail siding. However, if consignee do not has own rail siding rail transport rationally to use for distance about 160 km.

The equivalent distance is reducing, when cargo amount and transportation rate of road transport is rising. Further research on the scopes of rational using of road and rail transport may extend factors that affect the equivalent distance.

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Problems and Prospects for Strengthening Technical and Economic Security of Agricultural Enterprises

Oksana Perkhach

Administrative and Financial Management Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: Oksana.L.Perkhach@lpnu.ua

Abstract – current state of technical and economic security of agricultural enterprises is explored in the article. The main directions for strengthening technical and economic security of agricultural enterprises are suggested.

Key words - technical and economic security, agricultural enterprises, physical capital, efficiency

I. Introduction

Current business development closely linked to the high level of its economic security. Because only in such conditions it is possible to provide effective strategic planning, efficient management and monitoring both internal and external business processes etc. New technologies and high quality physical capital play a crucial role in converting agriculture to an effective and competitive direction of the development ensuring technical and economic security. Technical and economic security means the providing of enterprise for the physical capital, its modernization and reconstruction in the purpose of achieving continuous process of production competitive products and receiving the profit. The sustainable agricultural production can be achieved only if the enterprise would react in time to changing market conditions.

II. The purpose of the article

The purpose of the article is studying the problems of technical and economic security of agricultural enterprises and displaying prospects of its solution.

III. The main material

Agriculture is the most important branch of economy in Ukraine. In 2014 it provided up to 11% of gross value added. The employment in this field of economy is more than 3 million people. There were almost 52.5 thousand of agricultural enterprises and entrepreneurs and they used 36.4 mln hectares of agricultural land [1].

Economic sustainability of agricultural enterprises depends on internal factors such as resource potential and its effective usage, technological equipment of production, economic and technological development of the enterprise ensuring a high level of profitability.

The residual value of physical capital in agriculture trends towards to increasing, because of capital investment increasing up to 62% in 2014 comparing to 2010 (Table I). The biggest share of these investments was made by agro-industrial holding companies [2]. They have access to "cheap" financial resources from International financial corporation and other organizations. That is why these kind of agricultural enterprises are well-provided for physical capital, than small-scale farms or households. However the rate of capital consumption was high and in 2014 it was about 38%.

TABLE 1

BASIC INDICATORS OF TECHNICAL AND ECONOMIC SECURITY IN AGRICULTURE OF UKRAINE

Indicators	2010	2013	2014	2014 to 2010, %
Residual value of physical capital, mln. UAH	63444,6	98134,8	103033,7	162, 4
Rate of capital consumption, %	...	35,4	38,4	x
Output per 100 UAH value of physical capital, UAH	307,18	257,66	244,04	79,4
Physical capital per 1 employee, thsd. UAH	98,01	168,56	195,62	199,6
Net profit per 100 UAH value of physical capital, UAH	27,19	15,21	19,67	72,3

Source: [1]

We can notice that physical capital usage was not effective, because in 2014 output per 100 UAH value of physical capital decreased by 21% comparing with 2010. Also net profit per 100 UAH value of physical capital decreased by 27% in the same period. Physical capital per 1 employee increased, because of decreasing of employees in agriculture. Also the main problem of technical and economic security of agricultural enterprises of Ukraine is that these enterprises mainly use the physical capital rented in the owners of property shares. Agreements of rent are conducted for a short-term period. Depreciation of fixed assets is counted by neither renters, nor holders. Thus one of the sources of physical capital renewal – depreciation – is lost. In such circumstances, it is difficult to form not only strategic, but also current development programs aimed at efficient use of assets, getting profit and ensuring the technical and economic security.

There is the tendency of gradual decrease of technique in agricultural enterprises (Table II). From this it follows that the loading per 1 tractor or 1 combine is increasing. In these conditions it is difficult to provide mechanized field work in time. Agrarian producers can not used 25-35% of tractors, combines and other machines due to technical problems and physical capital consumption. This leads to the extension of field work and loss of 20-30% of the harvest.

Also there is a situation, when one enterprise has more than it is necessary some kind of machinery and another enterprise hasn't needed quantities of this machinery. So, in this case it is advisable to organize the association of enterprises in the purpose of optimal machinery usage in such situations. Within the framework of association it would be possible to create and coordinate schedules of using machinery and the rent for them. Also it is advisable for small-scale enterprises to create service cooperatives in the purpose of buying new machinery for common use.

TABLE 2

AGRICULTURAL MACHINERY IN AGRICULTURAL ENTERPISES, AT THE END OF YEAR

Indicators	2010	2013	2014	2014 to 2010, %
Tractors, thsd. Pcs	151,3	146	130,8	86,5
per 1000 ha of arable land, pcs	*8*	*8*	*7*	*87,5*
Grain harvester combines, thsd. Pcs	32,8	30	27,2	82,9
per 1000 ha of grain sown area, pcs	*4*	*4*	*4*	*100,0*
Potato harvester combines, thsd. Pcs	1,7	1,5	1,3	76,5
per 1000 ha of potatoes sown area, pcs	*59*	*16*	*43*	*72,9*
Milking equipment thsd. Pcs	10,9	11,2	10,5	96,3

Source: [1]

Nowadays agricultural enterprises write off 2,6-6,5% existing machines annually, and buy only 2,3-4,6%. For normal reproduction of technical machines it is necessary to renew them by 18-20%. For example, now the Ukrainian agricultural producers use 2% of domestic grain harvesters, 20% of foreign grain harvesters and 78% of old constructive combines from Soviet times. The same situation is for other types of technique. Domestic technique and machinery are behind the world analogues in 2-3 generations. It is characterized as high power inputs, low productivity. Domestic technique demands more man-hours work. Low level of mechanization affects on the amount of production costs. For instance, in large-scale enterprises the technologies of crop production consists of 90-95% of mechanized work, and in small farms it consists of 65-75%.

Agricultural producers, particularly large-scale enterprises, start to invest in animal production (Table III). They build new construction for stock-raising farms and store houses using new technologies of agricultural production. We can see that stock-raising farms for cattle increased by almost 4 times in 2014 comparing to 2010. Also producers put money for conservation of vegetables, because they have the problem in this matter too.

TABLE 3

CONSTRUCTIONS FOR AGRICULTURAL PURPOSES THAT WERE PUT INTO OPERATION

Indicators	2010	2013	2014	2014 to 2010, %
Stock-raising farms, thsd. enclosure				
for cattle	3	8	11	366,7
for pigs	24	1	15	62,5
for poultry	7229	2754	11195	154,9
Poultry farms				
of egg direction, thsd. laying hens	1560	1546	2852	182,8
of meat direction, mln. heads per year	13,2	0,2	7,3	55,3
Store-houses for potatoes, vegetables and fruits, thsd. t of simultaneus storage	25,5	42,4	77,3	303,1

Source: [1]

Nowadays small-scale agricultural enterprises cannot make investments not only because of deficit of financial resources, but also for lack of clear guidelines for expedient trend of investment. So it is important to organize marketing service, which can explore and forecast agrarian market conditions, also circulate this information among producers of agricultural products.

It is complicated or sometimes impossible to use most of physical capital in agricultural enterprises in a different ways. Because of low business activity in rural areas it is difficult to sell some means of production, which are not used now or wouldn't be used in the future. The problem is strengthened by difficult and dynamic situation in the market of agricultural products. Producers of agricultural products are deprived of the information about expected market situation. Enterprises take decisions concerning reasonable ways of physical capital usage according to the information of previous market periods. As a rule, in the following year producers usually raise the output of such products, that were profitable in previous year. The supply of some agricultural products increases by joint action of many producers. Hereupon prices of those products decrease and farms cannot get planned profit. So it leads to ineffective physical capital usage and as a result low level of technical and economic security of agricultural enterprises.

Conclusion

Timely detection and removal of threats of technical and economic security will ensure the stable development of agricultural enterprises. For this purpose it is advisable:

- to create favorable conditions for investment from other sectors of the national economy and foreign direct investment on the formation of production potential of agricultural enterprises;
- to improve directions and methods of government support of physical capital renewal in small-scale agricultural enterprises;
- to provide information support to agricultural enterprises. This will allow them to change production specialization in time and to get the profit;
- to promote the expansion of technical services and common usage of agricultural machinery, including cooperatives, association and rent.

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Estimation of the tax potential as a part of budgetary potential

Roman Zhebchuk

Economic Department, Yuriy Fedkovych Chernivtsi National University, UKRAINE, Chernivtsi, Kotsubinsky street 2,
E-mail: r.zhebchuk@gmail.com

Abstract – The author describes the method calculating of tax potential in the process of budget planning as part of the budgetary potential.

Key words – budgetary potential, budget planning, public finance, fiscal potential, structure of budgetary potential.

I. Introduction

Today, budget planning of high quality is difficult to imagine without the estimation of the abilities of administrative and territorial unit to fill the budget, which together form its fiscal capacity.

The budgetary potential is the financial basis for social and economic development of the territory. The possibilities of realization of tasks for development of the administrative and territorial unit depend on the extent of budgetary potential and the level of its usage. It therefore determines the need for estimation of budgetary potential and its components in the process of budget planning in Ukraine.

II. Essence of budgetary potential

The review of current scientific literature and research of scientists' vision of the essence of the category of "budgetary potential" [1; 2; 3] state that today there is no single point of view with regards to this concept among scientists. At the same time, it is worth noting that the aforementioned research provides the opportunity to determine our own vision of this category. From our point of view, budgetary potential is a part of the financial capacity of an administrative and territorial unit (country, region, district, city, town, village), which comprises the total amount of funds that can be accumulated from all sources into the budget of the administrative-territorial entity for a specific period of time and under existing economic conditions.

The main components of the budgetary potential are tax potential and non-tax potential. Tax potential is a part of budgetary potential of administrative and territorial unit (country, region, district, city, town, village), namely the total amount of funds that can be accumulated through compulsory payments (section "tax revenue" of budget classification) into the local budget during the particular period of time and under existing economic conditions.

The non-tax potential is part of the budgetary potential of administrative and territorial unit (country, region, district, city, town, village) which is the total amount of funds that can be accumulated using tools, non-obligatory payments (all other sections of the budget classification of income except for the “tax revenue” section) into the local budget during a particular period of time and under existing economic conditions.

III. Estimation of fiscal potential

Based on international experience and the need for the evaluation of the budgetary potential, as well as the importance of using it within practice of budget planning in Ukraine we offer the following algorithm of estimating the tax potential.

In particular, according to results of our research and practice of levying of tax payments, not only the characteristics of the tax base must be considered while evaluating the tax potential, but debts to the budget system of each type of taxes and it’s repayment of previous years should also be taken into account. Thus, the tax potential of separate tax can portray the following formula:

$$ПП_{ij} = Н_{ij} + Д_{ij} + Нед_{ij} \quad (1)$$

where $ПП_{ij}$ – tax potential of the j-th obligatory payments in the i-th year.

$Н_{ij}$ – charges of the j- th mandatory payment at the end of the i-th year.

$Д_{ij}$ – additional charges on the j-th obligatory payment at the end of the i-th year as the result of the inspection of institutions which administer compulsory payments.

$Нед_{ij}$ – revenues that could come in at the end of the i-th year as repayment of arrears of previous years.

j – compulsory payment that is included in the section of the part «tax income» of budgetary classification [4].

i – year for which the calculation is made.

Taking this into the consideration, the total amount of tax potential of the territory in the i-th year ($ПП_i$) can be calculated based on the following equation which is proposed by us:

$$ПП_i = \Sigma\, ПП_{ij} \quad (2)$$

where $\Sigma\, ПП_{ij}$ - the sum of tax potential of all mandatory payments in the i-th year which add to the local budget.

According to the practice of executing local budgets by incomes in Ukraine, there is a discrepancy between the fact and planned income tax payments to the treasury of the local community. This reflects the level of filling of budget by taxes. In our view, this factor should be taken into account during the budget planning. We suggest to consider the effect of this factor by the coefficient of filling (Кн) which is useful during planning of separate item of tax revenues as well as overall. The algorithm of calculating of planned separate tax payment is proposed below:

$$ПНпл_j = ПНпр_j * Кн_j \quad (3)$$

where $ПНпл_j$ – income from the j-th obligatory payment which is planned for the next budget period.

$ПНпр_j$ – forecasted amount of revenues from the j-th obligatory payments of next budget period.

$Кн_j$ – coefficient of filling of the j-th obligatory payment.

While calculating $Кн_{ij}$ it is necessary, in our opinion, to take into account the actual level of income on obligatory payments and their comparison with the level of the potential revenue for each payment, i.e. with their potential (4). This comparison will reflect the capacity utilization rate of mandatory payments, or serve as a reflection of the level of taxes filling the budget.

$$Кн_{ij} = ПНф_{ij} / ПП_{ij} \quad (4)$$

where $Кн_{ij}$– coefficient of filling of the j-th obligatory payment in the i-th year. $ПНф_{ij}$ – fact revenues of the j-th obligatory payments in the i-th budget year/ $ППт_{ij}$ – tax potential of the j-th obligatory payments in the i-th budget year.

In order to improve the quality of budgetary planning we consider it appropriate to calculate the coefficient of filling by taxes for several periods and has its average value $\overline{Кн}$ taken into account when calculating the planned revenue next budget period. According to this, the average density factor taking into account the time factor can be counted as follows:

$$\overline{Кн}_j = \frac{\sum_{i}^{t} Кн_{ij}}{T} \quad (5)$$

where $\overline{Кн}_j$ – average rate of filling of the j-th obligatory payment for T years. $Кн_{ij}$ – coefficient of filling of the j-th obligatory payment in the i-th year. i, …, t – years, for which average coefficients filling of j-th obligatory payments are used in the calculation $\overline{Кн}_j$. T – number of periods (years) for which the average coefficient of filling is calculated.

The average coefficient of filling of obligatory payment which we analyzed (land tax) for the years 2010-2014 is 0,927.

As a result, the formula of planned revenue of the j-th obligatory payment, which combines tax potential and budget planning , transforms into the following:

$$ПНпл_j = ПНпр_j * \overline{Кн}_j \quad (6)$$

where $ПНпл_j$ – sum of incomes from the j-th obligatory payments planned for the next budget period. $ПНпр_j$ – forecasted revenues from the j-th obligatory payments in the next budget period. $\overline{Кн}_j$ – average rate of filling from the j-th obligatory payment for T years.

However, the total amount of planned revenues from the obligatory payments can be calculated as follows:

$$ПНпл = \sum_{j}^{k} ПНпл_j \quad (7)$$

where ПНпл – total revenues from mandatory payments planned for the next budget period.

$\sum ПНпл_j$ – the amount of planned revenues of all j-th mandatory payments that is planned for the next budget period and levied in the analyzed period.

j, …, k – all mandatory payments, which are used in calculating the coefficient of filling in the i-th year.

Conclusion

In brief, the author proposed method (1)-(7) of tax potential calculation which allows to determine its extent and, on the basis of these data, to calculate the amount of planned tax revenues. Further studies will focus on creating methods of calculating non-tax component of budgetary capacity.

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Actual trends of projects financing at early stages

Anastasia Roman'ko, Alexandra Ivanyuk, Olena Galushko
Finance and Marketing Department, State Higher Education Establishment "Pridneprovsk State Academy of Civil Engineering and Architecture",
UKRAINE, Dnipropetrovs'k, Chernyshevsky str. 24-A,
E-mail: anastasija-romanko@rambler.ru

Abstract* – *The paper is devoted to the current trends of financing small and medium-sized businesses at the early stages of development. Expected and real sources of financing are discussed. Internal and external problems of start-ups development are analysed.

Key words – innovative projects, financing, start-up, business incubator, "business angels", venture capital investments.

I. Introduction

In today's competitive environment all companies have to deal with innovations. However, investment activities are often faced with difficulties in finding the necessary investment. This is especially important for small and medium-sized businesses that do not have their own sources of funding and that is difficult for them to obtain bank loans.

II. Stages Start-up Financing

Start-up is a young, small company whose activities are connected with any innovative technology (the Internet, nanotechnology, medicine) [1]. Typically, these companies are in the stage of development or research perspective markets. The most important thing for them is to interest investors willing to finance. More details of the development of start-ups are shown in Fig. 1.

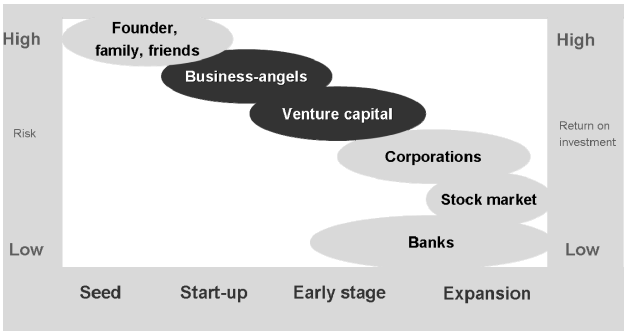

Fig. 1. Stages of business development and sources of financing.

The graph clearly shows that at the stage of initial capital, as a rule, it is not about profitability. Funding is provided by relatives, friends or business angels, who managed to get through. If the idea survives to the early stage, it can get into the incubator, then the accelerator, and then get venture funding [2].

A start-up project may require several rounds of financing before it can generate stable cash flow. The amounts and sources of financing could be different for and depend from company and industry. Companies need this finansing to provide such operations as product development, testing, tiral sales, administration and marketing.

Thereby the foreign practice allocate 5 main sources of financing for start-ups: the financing of their own funds team, 3F (family, friends, fools), private investors (business angels) and their associations, specialized venture capital fund [3].

1) Financing of their own funds team. This option is suitable only at an early stage in the creation of the company. As a rule, this is a very small amount of money to carry out ad hoc tasks: PR on the Internet, creating a portal for a project, the creation of legal. face and so on.

2) «3F» - is called « Family, Friends, Fools» because of very high risks of investment in the project at the idea stage.

3) Business incubators. Support for start-up projects by young entrepreneurs at all stages of development (from idea to its commercialization) engaged in business incubators.

This variant is typically used in step idea. Its advantage is that you will get a small monetary support and a startup gets a place in the incubator (office, sometimes office equipment, access to the infrastructure of the incubator) and a mentor who follows the development of the team and the project.

Business incubators have proved so successful form of support for a new business, that in recent years their number continues to grow not only in the US, where they are united in the National Association of Business Incubators, but also in other countries. In the world there are already more than 2,000 independently operating business incubators.

Recently, the services of business incubators available and for Ukrainian businessmen. In Ukraine today there are 7 business incubators: WannaBiz; Happy Farm; iHUB; EastLabs; GrowthUP; Polyteco; Founder Institute [4].

4) Business angels are individuals and legal entities who invest part of their own funds to startups in the very early stages of development. The purpose of "business angels" is to maximize the value of the company they grown and after a specified period of time (usually ranges from three to seven years) to sell its stake to do the following project that needs angel investment.

The number of active business angels in Europe is estimated at 125 thousand and the number of potential investors was estimated to be one million.

In the US, about 80% of the projects in the start-up stage was funded by business angels. In the UK, about 18 thousand. Business Angels invest about 500 million pounds to 3.5 thousand companies [5].

As for Ukraine, the relevant association consists of about 50 people, but according to experts, in fact, being an individual investor in Ukraine is much more popular.

5) Venture capital funds are a collective investment mechanism, based on the creation of the general fund by investors, and this fund, adhering to the policy of diversification of risk by creating its portfolio, is financing risky projects for profit above the market average.

The main part of professional market of venture capital investments are venture capital funds. For the majority of Ukrainian investors, funds of venture capital investments are unfamiliar instrument. While the rest of the world attraction such investment is a conventional method of business.

Venture Investment Program is successfully used in the United States, Finland, Singapore, Israel and the UK. According to recent studies in Europe and the United States, investment in venture capital investments are the most stable and profitable.

In Ukraine, venture capital investments are at an embryonic level. Since the past 10 years, venture capital start-ups attracted only foreign investors. Venture funds with Ukrainian capital have started to appear only since 2003.

III. Problems of Venture Capital Investment

According to Global Entrepreneurship Monitorthe sources of financig which entrepreneurs expect and which they really reach are quite different (several sources could be notified by respondents):

1) Sourses of financing expected by entrepreneurs:
   - 42.2% – banks and financial institutions;
   - 32.9% – family;
   - 9.7% – governmental grants;
   - 15.3% – friends and neightbors;
   - 14.7% – colleagues;
   - 14.5% – other relatives;
   - 19.6% – other.
2) Real sourses of start-ups financing:
   - 48.9% – family;
   - 26.4% – friends and neightbors;
   - 8.4% – other relatives;
   - 7.7% – colleagues;
   - 8.5% – other.

As we can see from statistics, friends and neightbors are underestimated factor in enterpreneurs' expectations regarding start-up financing.

Formal sector is formed by venture capital firms, funds of small innovative enterprises support and assistance, business investment companies, corporate investors (i.e. pension funds, insurance companies), non-financial corporations, industrial-financial groops, banks. Infrastructure of formal financial sector in Ukraine is well-developed but activity of such institutions in venture investments is very low.

Problems with start-ups financing are related not only to external conditions and venture capital market infrastructure, but caused by inner problems and mistakes. German Institute «Marktforschunginstitut Market Lab & Risikokapitalunternehmen Econa AG» analyzed more than 500 business-plans and came to next conclusions:

- 81,8% - superficial market analysis;
- 79,4% - mistakes in client orientation;
- 52,4% - overestimation of owns possibilities and unrealistic picture of expences;
- 42,5% - chance of «first idea right» is considered as guaranty of success;
- 72,2% - mistakes in SWAT analysis;

Deficit of qualified enterpreneur's education programs in Ukraine makes mentioned above problems much more significant and increases risks for investor.

It's very important that innovative project corresponds to the goals of investor, which could be:

1) Enhance - investment would strengthen current business position and protect from competetors.
2) Finance – investment of temporary free resources to get additional profit from business or to buy currently underestimated assets for future sale;
3) Information – to get access to new innovative technologies and products;
4) Protection – to set market barriers.

Conclusion

After analyzing the current trends of financing projects in the early stages of development in Europe, the USA and Ukraine, we can conclude that the investments of new and growing companies in the Ukraine, has not yet reached the level of European countries and the United States.

The main reasons for this are related to the problems of Ukraine's investment climate, underdeveloped capital market, the prevalence of low technological structures of the national economy, the imperfection of the legal system in the field of investment, low transparency of the business, a limited amount of real investment for attractive and innovative proposals.

However, it does not mean the lack of financing as such. Today the main investors in Ukraine - a single venture capital funds and investment companies, business incubators and accelerators, "business angels" and a serial entrepreneur.

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The Impact of Capital Base on the Financial Stability of the Banking System of Ukraine

O. Tkachenko

Banking Department, Ukrainian Academy of Banking,
PhD Researcher, UKRAINE, Sumy, Petropavlivska Street, 57.
E-mail: ckfm@ukr.net

Abstract. – The main factors influencing financial stability of the banking system of Ukraine are determined. Much attention is paid to investigation of capital base as a major factor that has a great influence on the banking system`s financial stability in Ukraine. Recent government regulations of capital base requirements adopted in Ukrainian practice are described.

Key words – financial stability, banking system, capital base, capital requirements, factors of financial stability.

I. Introduction

The support of financial stability of the banking system becomes one of the most important and ongoing problems of many countries including Ukraine. Most banking systems showed that they were not able to withstand the recent crisis. As a result many banks in Ukraine went bankrupt or insolvent. In this case there are a lot of factors influencing the financial stability of the country's banking system, but bank capital base nowadays is considered as the major one and the most discussed one among scientists and practitioners. That's why it is needed to research the problem of bank capital's impact on the banking system`s financial stability and interconnectedness between them in Ukraine.

II. Page Setup

Stability is the main characteristic of bank that maintains its dynamic development in competitive environment. Such concepts as stability and reliability determine bank`s ability to carry out functions on banking services market and in national economy. From one hand, reliability of bank characterizes it as a monetary and credit institution, which is able to effectively carry out appropriate functions, fulfill obligations to stockholders and clients. From other hand, bank stability is a fundamental characteristic of internal bank state, which allows withstanding the maximum level of unforeseen loses and saving the state of effective functioning. These concepts should be definitely considered in the context of financial issues as they are connected with financial resources flows, its features and conditions [1].

There are many approaches to define the concept of financial stability of the bank. Basing on existing definitions of different scientists [1-4] we can assume that financial stability of bank is such financial condition of bank, which depends on liquidity, profitability, solvency and describes the ability of bank to withstand negative internal and external factors. Talking about the financial stability of the whole banking system we can say that it is the ability of banking system to withstand financial shocks and disbalances and to carry out its functions in the national economy.

The factors influencing the financial stability of banking system can be divided into two groups: external and internal.

External factors of financial stability of banking system include:

- overall economic situation in the country;
- money demand and money supply;
- stability of national currency;
- level of inflation;
- tax policy;
- investment climate;
- balance of payment;
- interest rate, loan, currency policies of the central bank of the country;
- central bank reserves;
- government stability;
- social policy;
- unpredictable events et al.

Internal factors of financial stability are connected mostly with specifics, mechanisms and processes inside banks. These factors include: assets quality; deposit stability; capital base and adequacy of capital; banks` profitability; level of liquidity; following legal norms and requirements established by the central bank; bank marketing; bank strategy and policies; quality of management and others.

Meanwhile, the factor of bank capital base can be considered as both the external and internal factor of financial stability of the banking system.

From one side it can be examined as one of the characteristics of certain bank's policy and activity on the banking services market.

From the other side bank capitalization is connected with the policy of country's central bank regulations and requirements of international authorities in the sphere of banking regulation and supervision, Basel Committee in particular.

Another aspect of connectedness between financial stability and bank capital is the instrument that is used to estimate the level of financial stability in the banking system.

The generally accepted method of financial stability estimation is Z-statistic index, which is always used by scientists and representatives of the World Bank [6]. It is also published on continuing basis on the data website of this organization.

Z-statistic method is mainly used to analyze the stability of certain bank or the whole banking system through the aspects of various financial risks and factors that determine the conditions of financial institutions activity.

The positive side of this indicator is that it takes into account the main components that are directly related to the solvency of the bank or banking system. And along with assets and profits of the banking system, it is a bank capital. So we can observe a direct connection between capital base of banking system and the level of its financial stability.

The calculation of Z-statistic indicator is carried out with the help of the next formula:

$$Z = \frac{(\mu + k)}{\delta}, \qquad (1)$$

where μ – value of return on assets of the banking system for the period; k – ratio of equity (capital) to assets of the

banking system; δ- standard deviation of return on assets for the period.

Talking about Ukrainian practice, it should be noted that during the last ten years the size of bank capital has increased approximately in 8 times, but it didn't help to withstand the negative impact of crisis events in the banking system of Ukraine in 2008-2009. Also the capital adequacy ratio demonstrated some fluctuations during the analyzed period.

It should be noted that in this aspect the National Bank of Ukraine increased the minimum capital requirements for Ukrainian banks to 500 million grn. It pushed banks to actively increase the level of their capital to fulfill these requirements. Unfortunately not all of the banks have an opportunity to accomplish it. As a result, the financial stability of Ukrainian banking system remains on the low level that does not allow carrying out the redistribution of financial resources in the economy effectively and being competitive for Ukrainian banks on the international scene.

The mentioned above measure of the National Bank of Ukraine was adopted for new banks, which are willing to start working and providing banking services in Ukraine. For those banks, which had received banking license before 14 July 2014, the minimum amount of regulatory capital should be gradually increased by bank owners during the next terms:

- 120 million grn. – till 10 July 2017;
- 150 million grn. – from 11 July 2017;
- 200 million grn. – from 11 July 2018;
- 250 million grn. – from 11 July 2019;
- 300 million grn. – from 11 July 2020;
- 350 million grn. – from 11 July 2021;
- 400 million grn. – from 11 July 2022;
- 450 million grn. – from 11 July 2023;
- 500 million grn. – from 11 July 2024 [5].

It is supposed that such measures will induce banks to increase their capital. To solve the problem of low level of financial stability of banking system of Ukraine banks and government should organize joint procedures to increase the level of capital base in the banking system in the shortest period.

It should be noted that some steps have already been made by the government. For the last two years nearly 60 banks were closed because of the insolvency and inability to carry out banking activities.

Nowadays almost 40 banks have the size of capital that is lower than established requirements of the National Bank of Ukraine. So the government authorities advise them to find the sources to fulfill the requirements according to existing schedule, or organize mergers and acquisitions, or leave the market of banking services in Ukraine.

In this aspect some actions should be also organized to implement the regulations of Basel III into Ukrainian practice as far as it is one of the instruments to withstand financial and banking crises in future and ensure the high level of financial stability of the banking system of Ukraine.

Basel III is a comprehensive set of reform measures, developed by the Basel Committee on Banking Supervision, to strengthen the regulation, supervision and risk management of the banking sector.

The Basel Committee is raising the resilience of the banking sector by strengthening the regulatory capital framework, building on the three pillars of the Basel II framework. The reforms raise both the quality and quantity of the regulatory capital base and enhance the risk coverage of the capital framework [7].

Thus, we can see that the level of banking capital base is highly connected with the level of financial stability of the banking system. So banks and the government should identify the problem issues in the low level of banks' capital base in Ukraine and take some actions to form the directions to support and increase the financial stability of the banking system. Therefore, effective functioning of the banking system of Ukraine can have positive effects on the economy development and social sphere in the country.

Conclusion

In this paper the impact of capital base on the financial stability of the banking system of Ukraine is investigated, main government regulations of bank capital are presented.

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Financial Market Stabilization as a Component of Economic Security of Ukraine

Roman Tosko, Yuriy Blynda

Department of administrative and financial management
National University "Lviv Polytechnic", Ukraine, Lviv,
S. Bandery street 12, E-mail: Roman.R.Tosko@lpnu.ua.
blyndayura@gmail.com

Abstract. – The article deals with the essence of the problem of domestic and global financial market and presents a priority steps to stabilize and further development of the financial market of Ukraine.

Key words – the financial market, financial institution, financial sector.

I. Introduction

Nowadays the financial system of Ukraine is passing one of the biggest crises since independence. All the chronic problems that have been accumulated in recent years have emerged on the surface: lack of a clear interaction between state, market and people, the crisis of public confidence in financial institutions. Acute problems of management and supervision, resulting in a failure of financial institutions to pay its obligations.

The financial market of Ukraine is the object of attention of many domestic economists. In particular, you can call local scientists such as V. Bazylevych, A. Peresada, Fedosov V. Sheludko, St. George, A. Vasiliko, A. Hal'chyns'kyi, S. Hoffman, N. Kostin and other scientific works and Entries which are extremely important in the exploration of the domestic financial market and its structure.

Analysis of scientific works of domestic scientists aforementioned need for a deeper understanding of the nature and functionality of the financial market in social reproduction, as well as in terms of the institutional aspect of social life.

II. Main part

The development of Ukraine's financial market is a prerequisite for the development of other sectors of the economy of the state. A well-functioning insurance market, developed non-bank credit institutions, pension funds and other financial institutions contribute to the sustainable development of all economic processes in society. The financial sector is one of the most important part of the national economy.

Financial market - a special market, which traded a special product - money provided for use at the time in the form of loans or permanently [1].

According to V. Oparin "Financial Market" - a set of exchange-redistributive relations connected with the processes of buying and selling financial resources required for implementation of production and financial activities [2].

Financial market - a component of the financial system of a country that can successfully evolve and operate only in market conditions.

Today the financial market has the following components:

1. Markets of physical assets.
2. The securities markets.
3. Market of derivatives (futures, of forwards).
4. Market of mortgages.
5. The consumer credit market.
6. Market investment.
7. Market currency funds [1]

The main subjects of the financial market are the state, the public, professional market participants - financial institutions and infrastructure institutions, institutes of non-financial areas, as well as foreign market participants [3]

Most modern researchers describe financial stability as the ability of the financial system deal with various risks. However, the generally accepted definition of financial stability today does not exist. We will follow the approach proposed by Harry Skinazy [4].

According to H. Skinazy, a stable financial system is if it capable to perform the following three key functions:

- the distribution of economic resources in general and redistribution of resources the time between savings and investment in particular;
- accounting, assessment and prediction of financial risks;
- absorption (removals) of financial shakes and shocks emerging from the real economy.

In turn, factors that violate financial stability, can be divided into two groups: external (exogenous) and internal (endogenous).

The first group includes various macroeconomic imbalances in production and consumption, investment in real capital, international trade and investment flows.

The second group - factors associated with the most imperfect financial markets of age. A recent study by Kenneth Rogoff and Carmen Reinhart confirms that the current financial crisis are something regular and frequent, and financial markets characterized by instability [5].

Obviously, the cyclic mechanism of the current financial crisis is not fundamentally different from historically known mechanism of credit expansion of the change of the seasons "bubbles" and crashes. Market players rely on endless growth of prices of certain assets, whether real estate, stocks, commodities, derivatives, etc. Real income, generated by the asset (rent, profit or dividend) loses values in this case, and the dominant motive asset transactions is increasing its price. An asset that increases in value, has been used for providing loans, which go further purchase of the same asset. But there comes a time when growth rates slow down or stop, and cyclic mechanism worked at stirring up "bubble" began to work rapidly in reverse direction.

According to Dirk Heremansa, financial markets are imperfect in its nature, because it has the following special features:

- dealing with a particular commodity - money supply which is limited state monopoly;
- dealing with future cost and high risk uncertainty;
- assessment of good financial product or service much complicated and based on trust (credence goods);
- information asymmetry, strongly expressed agency problems and high moral risk as the unequal distribution of risks and benefits for the parties to the contract;;

- high interdependence and the risk of gregarious behavior of the behavior of market participants [6].

The banking system is dominant among other segments of the sector. As a result, 38 banks are in the process of liquidation, in 50 institutions introduced a temporary administration. The volume of deposits in foreign currency during 2014 decreased by 36.9% and amounted to 19.4 billion dollars. (in the national currency - by 15.4% more) in January-February 2015 decreased rate of up to 18 billion dollars.[7]

What the National Bank and the government In these conditions can do? The fact that in the past - "extinguish fires", primarily by administrative methods. While that our financial system is unstable and must act to prevent, much has been said before.

First of all, today should identify three global challenges of the market:

1) detachment of the financial markets to stimulate economic development, their focus on getting quick profits;;

2) lack of public confidence in financial institutions;

3) lack of effective borrower and the presence of "toxic" assets.

III. Recipes of of treatment

Algorithm of actions of the National Bank and the government in the present circumstances should be based on three areas:

1) stabilization of the currency market, reducing and keeping inflation at an acceptable level for the economy (not more than 10%);

2) stabilization of the financial sector, restore confidence in the financial institutions market;

3) formation of an effective system of redistribution of resources from their preferred direction for the implementation of economic development projects.

The question is what to do now and is it possible to avoid such situations in the future. The answer - in building an effective system of supervision of financial institutions and reorient the banking system to the real economy.

Financial market now in anticipation of the new economic and financial policy, which has stabilized the currency. In the short term, though trite as it sounds, are seen priority restrictive measures of an administrative nature, aimed at preventing speculative exchange rate fluctuations.

In the medium term, key measures should be: the discount rate, open market operations, regulation of bank liquidity and so on..

To stabilize financial market institutions one can use the five basic steps::

Step 1 - Permanent monitoring of financial institutions to ensure timely detection and appropriate solutions to eliminate them.

Step 2 - reorganization or liquidation of insolvent financial institutions. According to some estimates the number of financial institutions could be reduced by 50-60%. However, there is a logical question: where to get money for payments to individuals, since the budget of the Fund Deposit Guarantee is not "elastic"? It should also address the issue of restructuring of loans.

Step 3 -. Establishing a state "pad" to restore the financial system through the adoption of effective legislation that will, restore public confidence in financial institutions.

Step 4 - Stabilization, which requires the system to ensure effective supervision aimed at the prevention of threats, strengthening the system of protection of rights of investors and consumers.

Step 5 - efficiency. Its implementation should aim at raising the level of financial literacy, co-financing of major projects, implementation of risk management systems and safeguards to ensure guaranteed payments in the stock market, the efficiency of management. Restoring confidence in the banking system, which will increase the volume of its deposits, is only possible if economic falling will slow down and the welfare of Ukrainians will increase. So at this stage is especially important government support for financial sector development. One of the most effective tools can be a state development bank, through which you can direct the flow of public funds to support priority investment and innovative projects to provide access to long-term undertakings credit

Conclusion

The key of the stable development of the financial system of Ukraine is the development of the real economy, and vice versa. But all this should be based on a single vision of the ultimate goal of responsible authorities and the National Bank and the government implementing comprehensive measures aimed at stabilizing the financial sector and real action plan for economic recovery.

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Ecologistics Activities in Terms of Communal Waste in Poland

Anetta Zielińska

Wroclaw University of Economics, Faculty of Economy, Management and Tourism in Jelenia Gora, Poland, 58-500 Jelenia Gora, St. Nowowiejska 3, E-mail: anetta.zielinska@ue.wroc.pl

Abstract – The basic tasks of ecologistics concern such activities as : the collection, segregation, transport, disposal in chosen places and processing of waste. Ecologistics regarding waste processing in Poland faces the necessity to open to new technologies of recovery and recycling of raw materials. This will effectively influence state waste policy, contributing to efficient waste management, recognizing it as a valuable source of raw materials.

Key words – ecologistics, waste, waste management

I. Introduction

Upon the emergence of problems with one of the waste management issues to fight against the increasing amount of waste was ecologistics. Ekologistyka, the area of the oriented logistics on ecology.

The procedure of waste management is connected with ecologistics issues, that is ecological management of waste, control, and supervision of waste. The waste management means waste production and managing waste, while managing waste means collection, transport, processing waste, including supervision over such activities, as well as further handling of waste neutralization places and activities performed by a waste seller or a middleman in waste trade.[1]

In the management of waste, it is important for the proper hierarchy to deal with the waste, which will reduce the negative impact on the environment and optimal use of the substances contained in the waste.

The basic tasks of ecologistics concern such activities as: the collection, segregation, transport, disposal in chosen places and processing of waste.

II. Ecologistics activities

In managing waste it is important to keep the appropriate hierarchy of ways of waste handling, that is: preventing waste production, reducing the nuisance of waste for people and environment; recycling; other procedures of recovery; waste neutralization; waste disposal. Thus, ecologistics contributes to: making the system of waste management more tight at the source, reducing the amount of communal waste, creating a greater number of modern recovery facilities, the elimination of illegal landfills.

Implementing ecologistics in a company contributes to obtaining meaningful savings (for example, used-up or broken items instead of thrown away may be re-used though recycling, secondary purchase). Moreover, one needs to notice the market potential in waste, illustrated by the following prices of secondary raw materials per ton: scrap: 750-900 PLN [3], aluminum 3500 PLN [4], glass 200 PLN [5], PET: 800-1200 PLN [5], waste paper: 300 PLN [6].

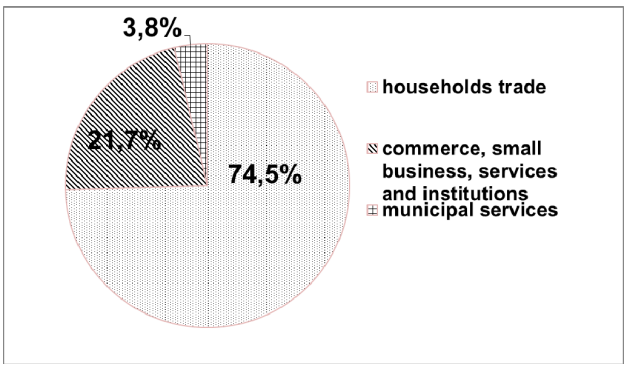

Fig. 1. The structure of the mixed municipal waste origin collected in Poland in 2013

Source: own elaboration based on the [2]

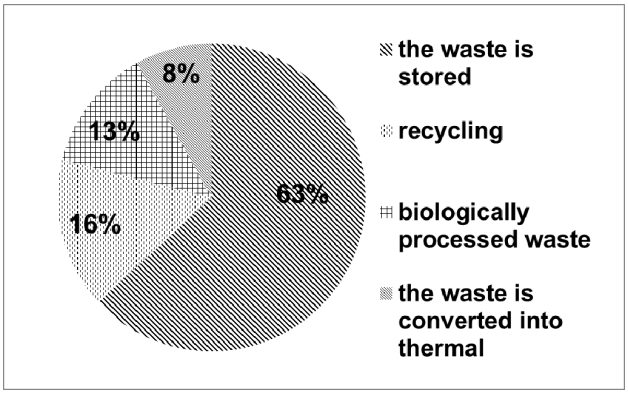

Fig. 2. Management of municipal waste in Poland in 2013

Source: own elaboration based on the [2]

Ecologistics in respect of a waste-incineration plant in Poland was a significant improvement from the entry into force of the new law on waste in 2013 Before making it happen ecologistics was extremely difficult, due to: adequately developed the necessary infrastructure (few of the incineration plant in 2013 - 8% of the waste heat of the transformed), 90% of municipal waste was exported to landfill (in 2013 fall to 63%), low levels of abstraction of secondary raw materials (2013-recycling of 16%).

Ecologistics activities are supported by the document in force „Krajowy Plan Gospodarki Odpadami 2014" (National Waste Management Plan) (KPGO)[1], which includes as the most important tasks in the forthcoming perspective till 2020 [8]:

- provision of a system of communal waste collection for all residents no later than 2015;
- provision of a system of selective communal waste collection for all residents no later than 2015;
- reduction of biodegradable communal waste, disposed at landfills, in such a way that in 2020 there shall be no more than 35% of waste amount produced in comparison with 1995;
- the reduction of disposed communal waste to max. 60% of those produced before 2014;

[1] National Waste Management Plan account shall be taken of the requirements of EU legislation in the field of waste management [7]

- preparation for re-use and recycling waste material, at least paper, metal, plastics and glass from households, and if possible waste of other origin similar to household waste at least at the level of 50% of its amount to 2020;
- achieving and maintaining (from 2014) the recovery of packaging at the level of 60 %;
- achieving and maintaining (from 2014) the recycling of all packaging at the level of 55 %.

Ekologistyka has an impact on waste management hierarchies using the principle of „four" (4R) [9]:

- Reduce.
- Reuse.
- Recycling.
- Rebuy.

Ecologistics focuses predominantly on the efficient collection of waste and then, their segregation and processing as well as effective transport, which should contribute to minimizing the waste in action – disposal at selected locations.

Conclusion

Ecologistics regarding waste processing in Poland faces the necessity to open to new technologies of recovery and recycling of raw materials. This will effectively influence state waste policy, contributing to efficient waste management, recognizing it as a valuable source of raw materials.

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EU Microintegration: Challenges, Opportunities, Milestones

Oleg Duma

Administrative and Financial Management Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: OlegDuma@lubin.in.ua

Abstract – Prospects, challenges, opportunities and milestones of entering European Union market have been described in the article. Different options of how to enter foreign market, peculiarities of cooperation and negotiations with foreign partners have been noted in the article as well.

Key words – foreign markets, international operations, EU market, foreign partners, microintegration, private label, international business, expanding business, international strategy.

I. Introduction

Expanding of business operations is one of the important priorities for management of every organization, regardless of industry, country or headquarters location. Board of directors tasks is always devoted to the issue of finding opportunities for further business growth. In Ukraine, with its traditional stagnation of the economy, outspread of business is possible through expanding operations to foreign markets.

II. Purpose of the article

The purpose of the article is systematization of consultancy experience and insight in shifting Ukrainian companies to the European Union markets.

III. Research results

European Union Association Agreement implementation has opened doors of opportunity for businesses in Ukraine. The adoption of the trade agreement, a unilateral implementation of EU preferences for Ukraine in 2014 has created favorable conditions for starting international operations for each company in Ukraine.

Decision about implementation of foreign economic activity and starting international operations abroad is related with two main challenges. First of the them is major motivation and understanding what for this operation is valuable for Ukrainian company and what problems could been resolved by such decision in present situation [1]. There could be defined several reasons of why international operations have to be launched: foreign markets gives opportunity to increase extensive sales and intensive as well (by selling goods at higher price in comparison with domestic market); cost reduction through achieving Economy of Scale (EoS) and, as a result, higher profitability will be obtained by the Ukrainian company; the opportunity of continuance the product life cycle by launching operations in the emerging markets where such product will be an innovation; reduction of risks by expanding operations to different markets which has more or less its own "rules" and connected with different factors and risks than domestic market; obtaining experience of entering foreign market which lead to expand new market faster and effectively with every new iteration; stay close with different types of customers to define their needs, motivation and demands which develops flexibility and ability to compete effectively both in foreign and domestic markets; increasing of Ukrainian company prestige and image in further international contracts and operations [2].

Process of business internationalization depends on position within domestic market, which could be described by two key factors [3]: degree of industry internationalization on which company operates and the degree of company internationalization as well. Industry internationalization degree could be characterized by the number and quality of international operations within the industry. If industry has deep international relations, export/import operations are connected with supply/distribution of the industry value-chain, so expanding business abroad in this industry is something like "must have" for companies. But, in the case of absence international operations within the industry, expanding foreign market for one single company in Ukraine could lead to obtaining leadership in domestic market and redirect additional cash flow to applying new technologies in production.

Before process of expanding company to foreign markets will begin one should make list of decisions about tactical solutions [4]. Expanding foreign markets means to start business in its core from the beginning, develop new business model which will solve the problems of potential customers in foreign market and will be competitive in comparison with present business models. There are many issues to consider, including:

- Export pricing strategies;
- Potential markets/sources/customers;
- Initial financing streams and anticipated revenues;
- Commercial policy for foreign market;
- Additional costs (e.g. marketing; shipping; inventory storage; storefront; travel);
- Legal, regulatory and licensure requirements;
- Potential partnership or investment opportunities.

Process of entering EU market should be started from study directives and EU regulations on certification and standardization of certain industry products. The next step is cooperation with companies that carry out certification. These step include obtaining such certificates as ISO, CE, Certificate of Origin and Certificate of Conformity etc. (list of certificates needed could be different depending on industry and type of product). Presence of such certificates simplifies the EU market entering for Ukrainian company.

The next step is development strategy of entering EU market. As part of this process is necessary to attract people who are familiar with the particular market and company profile, can convey hands-on experience in the market and bring information about the trade customs (trade traditions), way of how foreign market is organized, what is the market infrastructure in a particular country. However, taken in the account limited resources, work should start on the market of a single country what gives opportunity to accumulate experience of launching operations abroad and not to dissipate efforts of company internationalization.

In this context is also important to note that the development of the market of each country in the EU is associated with certain difficulties. They are:

- The non-competitiveness by price for Ukrainian goods. Despite the fluctuations of exchange rate toward the benefits of exporter and cheap labor forces, products of many branches in Ukraine is not competitive at the price of similar products sold in the EU. The reason is typically products made in China or other countries of Asia-Pacific region.
- Competition in the market. The more competitive is market of certain products the more stronger competitive advantages should possess Ukrainian producers. Because entering such market will lead to resistance from the present competitors on this market. In this case, Ukrainian companies should involve outside organizations or individual advisors which, by own insight and experience, brought the company to EU market with the lowest losses.
- High level of skepticism from the possible partners in EU (distributors, wholesalers, dealers etc). Products, which is not typical export product of Ukraine, is perceived by for example Polish companies decision makers rather skeptical. Non-typical is products which was never exported from Ukraine before. Ukrainian grain, sunflower oil and different kinds of vegetables are easy task to sell it in the EU market. Because producers of such goods are already successfully mastered the market of EU countries. When we cares about sophisticated technological products with a high added value, then European partner may have some doubts about the reliability of Ukrainian partner, the quality of the product or liability of Ukrainian company to respond for their agreement obligations. From the side of EU partners such doubts is connected not only with the image of Ukrainian business in Europe or some previous unsuccessful experience but also with evident events of political and military nature, taking place in Ukraine.

Same level of skepticism was provided by German partners toward Polish companies 15 years ago. But it was scattered after the first accomplished contract between German and Polish company. In our case recipe is the same. To overcome the skepticism and doubts of Polish, German or partner from any other country of EU one should be aware of Ukrainian business responsibility. After well completed contract with EU partner, appears some level of trust which will be inevitable asset in the following contracts. But, at the beginning, such doubts should be reduced by the business diplomacy during the contract preparation stage. Persuasion of EU partner to make test purchase, receive examples of products, visit production facilities in Ukraine, get confirmation from embassy that such company exist in Ukraine and so on. If Ukrainian companies want to start business operations in EU they should be ready to such kind of tests and verification. If Ukrainian company managed negotiation to this level, success is guaranteed for 50-60 %.

The key advantage of Ukrainian companies is ability to make delivery of products in time without any delay. This makes the opportunity to EU company make its business without warehousing stocks which require huge costs. This advantage comes to Ukrainian companies from the shortcomings of cooperation between EU companies and Chinese producers, which, by physical distance and huge amount of orders around the globe, may provide delays of supplies for 3-6 months what is unacceptable for business in EU.

Ukrainian company could use one of the following ways to enter EU market depending on goals and strategy*:

- Direct sales to foreign EU company which will sell Ukrainian products under own Private Label;
- Direct supply to wholesalers in EU country or specific region within a country. Wholesalers will be the link in the whole supply chain of the industry;
- Make agreement with distributors on the EU market which organize sales of Ukrainian products together with other product from the same category;
- Joint venture between Ukrainian and EU partners which is based on allocation of production facilities in Ukraine and distribution facilities in EU [5];
- Create own agency (affiliate company) in the foreign EU market which will take care about sales and distribution in particular country or region;

*Options of entering EU market was sorted from the less costly and easy to much expensive, but higher degree of control under business operations within EU market.

Joint venture option is a good idea when EU investor is founded. For EU partner such way means cost reduction by implementation cheap labor costs strategy, for Ukrainian partner it means all the distribution troubles in EU market will be cares by EU investor. In this case Ukrainian manufactured products will be sold under other brand name separately of Ukrainian products. But one of the major advantages of this mode of internationalization is opportunity of technology transfer from EU what could be done by foreign (EU) investor.

One of the best options for many companies will be search of distributor or EU company who will sell Ukrainian products under own Private Label. This simplifies the perception of products by the EU customers and shift the purchase decision making from “trusted or not trusted product” to “price/quality” decision. Private Labeling is a good start for own distribution system with own brand in the future. This approach could be kind of manipulation to overcome the stereotypes of Ukrainian products for the average EU buyer.

The last option is the most expensive and difficult way to enter EU market. In such case, Ukrainian company should start to build own supply chain in foreign market from zero point. But if company succeed in this direction after 3-5 years all the investments will be returned and company secures the control under own distribution chain. This option should be used in the cases if goods provided by Ukrainian partner has high quality and reliability, provides competitive price and technical characteristics. On the other hand, development of a complex system to supply foreign markets through the establishment a network of subsidiaries and representatives without preparation, evaluation market, practical market monitoring, feedback from potential

buyers and consumers, without test sales can be ineffective and all the effort will be vain. Involvement consulting company or private advisor are critical factor if the company only launches activities in foreign markets.

In the nearest future the most successful will be companies which start their international operations as fast as they can. Main arguments towards this thesis is that international operations provide earnings in foreign currency (USD or EUR; which reduces currency fluctuations risk) and provides higher margin per unit; EU is most secured market through different types of certificates and restrictions, so entering EU market provides extra guarantee and trust to company from partners allocated in other countries (US, Australia, Saudi Arabia, Qatar, UAE, Latin America, countries of Asia-Pacific region etc).

Expanding business to foreign market is an expensive process which requires relevant amount of capital investments, knowledge, experience, insight and time. It is connected as well with the ability to make business with foreign partners, understand processes on the foreign markets. Also, negotiations require frequent travel abroad, starting from meetings with potential partners who expressed interest to product or company till partners who, after negotiations, are ready to sign the contract.

Conclusion

Expanding business to foreign markets is very attractive and challenging process. It`s lasting and tough. And if it was started by the one single company, opportunities and benefits are obvious. We believe that effective planning, solid investigation and resourceful execution will lead Ukrainian companies to success in EU market place and in other foreign markets as well.

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The Effect of Vacuumization on the Photoluminescence and Photoresponse Decay of ZnO Nanostructures Grown by Different Methods

Yuriy Rudyk[1], Mykola Rudko[2], Borys Turko[2], Viktor Rudyk[2], Myron Panasiuk[2], Volodymyr Kapustianyk[1,2], Andriy Vaskiv[2]

[1]Solid State Physics Chair, Ivan Franko National University of Lviv, UKRAINE, Lviv, Universytetska street 1, E-mail: yurarudyk@ukr.net

[2]Scientific-Technical and Educational Center of Low Temperature Studies, Ivan Franko National University of Lviv, UKRAINE, Lviv, Dragomanova street 50, E-mail: rydko_mykol@ukr.net

Abstract* – *The effect of vacuumization on photoluminescence (PL) spectra and photoresponse decay of ZnO nanostructures fabricated by different methods was investigated. The visible band of photoluminescence and ultraviolet (UV) photosensitivity of the samples grown from the vapor phase was associated with the surface defects such as oxygen vacancies, and for the samples grown by hydrothermal method - with presence of the surface hydroxyl groups. The experimental results show that ZnO nanostructures grown from the vapor phase would be promising for producing of the low cost and effective UV detecting devices.

Key words – zinc oxide, nanostructures, photoluminescence, detectors of ultraviolet, defects.

I. Introduction

In recent years, extraordinary multifunctional properties of ZnO nanostructures were demonstrated. In particular this concerns transistors, nanogenerators, solar cells, light-emitting diodes, optically pumped lasers, chemical and biological sensors, detectors of ultraviolet and optical switches based on these materials. However, there is still no clear understanding of nature of the luminescence bands and the sensor parameters dependence on the type and number of defects in ZnO.

II. Experimental

ZnO nanostructures were grown on sapphire substrates with pre-deposited Au electrodes by two different methods. The distance between Au electrodes did not exceed 100 μm. ZnO nanowires (Fig. 1) were produced by the method of gas-transport reactions [1]. ZnO nanorods (Fig. 2) were grown by hydrothermal method [2]. Morphology of the samples was examined using REMMA-102-02 Scanning Electron Microscope-Analyzer. The room-temperature PL spectra were measured using automated monochromator/spectrograph M266 connected with CCD camera, based on Hamamatsu S7030-1006S sensor. The samples were excited by FQSS266-Q2 Nd:YAG laser (266 nm). The measurements of the current-voltage (*I-V*) characteristics were carried out using Keithley Model 2401 Low Voltage SourceMeter multimeter.

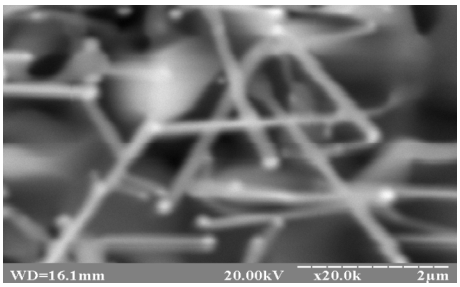

Fig. 1. Microphotographs of ZnO nanowires

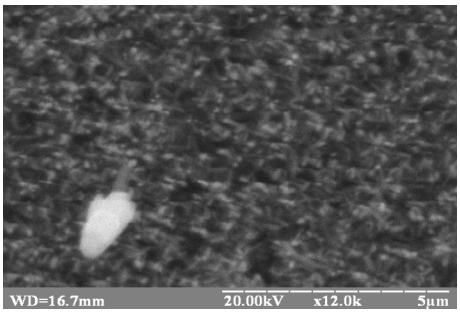

Fig. 2. Microphotographs of ZnO nanorods

The photoresponse decay was measured at 360-nm wavelength line obtained from a Xe lamp (1 kW) using the monochromator. All experimental measurements were made either in air and in vacuum at the pressure of 0.5 Pa.

III. Results and discussion

The morphology of ZnO nanowires and nanorods is shown in Figs. 1 and 2, respectively. ZnO nanowires were with diameter of 150-200 nm and a length of 5 μm. ZnO nanorods are characterised by an uniform length of about 1 μm with an average diameter of about 100 nm.

The room-temperature PL spectra of ZnO nanowires (Fig. 3) and nanorods (Fig. 4) obtained in vacuum and air consists of the two bands in the UV and visible regions.

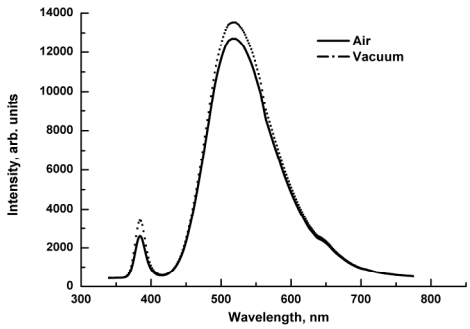

Fig. 3. PL spectra of the ZnO nanowires in vacuum and air

The band at 388 nm is typical for ZnO and arises due to recombination of free excitons, bound excitons and transitions in donor-acceptor pairs. The wide band from approximately 450 nm to 750 nm are caused by defects, first of all, by uncontrolled impurities and stoichiometry defects. For both types of samples after evacuating of air to the pressure of 0.5 Pa there occurred a slight increase of the ultraviolet band intensity, whereas the intensity of the visible band was changed in a different way. In the case of ZnO

nanowires in vacuum the integrated intensity of the visible band increased by about 6 %, whereas in the case of nanorods - vice versa, decreased by 17 %. On the basis of these data, one can conclude that the green peak around 520 nm for ZnO nanowires arises due to radiative recombination of a photogenerated hole with an electron attributed to an oxygen vacancy [3]. The emission peak near 600 nm for ZnO nanorods originates from the hydroxyl groups attached to the ZnO nanorods [4].These groups were also found to be removed upon evacuation, suggesting that there is a physical adsorption on the surface of the nanorods. When the PL spectrum was recorded again at the atmospheric condition, the intensity of the visible band is recovered almost to its original value. Since there is a substantial amount of water molecules in air, thay can be considered as source for the hydroxyl groups creation.

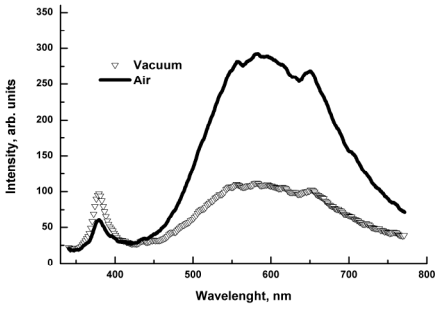

Fig. 4. PL spectra of the ZnO nanorods in vacuum and air

Fig. 5 presents the current-voltage (*I-V*) characteristics of the samples with ZnO nanowires and nanorods placed between two Au electrodes in darkness. A linear *I-V* characteristics indicate the ohmic nature of the contacts.

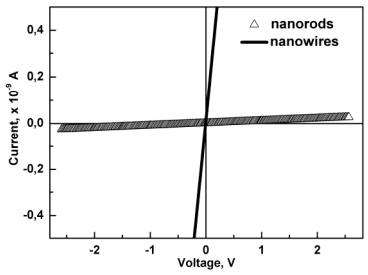

Fig. 5. *I-V* characteristics of Au-ZnO contacts in darkness

Photoresponse decay for the samples was measured under 5 V bias at room temperature in vacuum and air (Figs. 6 and 7). In the case of detecting of the ultraviolet radiation at the wavelength of 360 nm there was found that the recovery time of the sample with nanostructures grown by hydrothermal method is much higher then the recovery time of the sample with nanostructures grown from a vapor phase. After evaporating of air to the pressure of 0.5 Pa and switching off the Xe lamps the recovery time increased for the detector with ZnO nanowires and was not changed for the detector based on the nanorods. Filling with air had a little impact on the photocurrent relaxation time for the detector with nanorods, and led to a rapid decrease in the case of detector with ZnO nanowires. UV detector based on ZnO nanorods show a much higher rise time of photocurrent value upon illumination in comparison with the detector with ZnO nanowires. The high rise time indicates that the traps in the ZnO nanorods are involved into the photocurrent generation process.

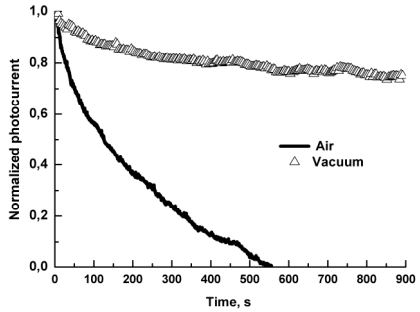

Fig. 6. Photoresponse decay of the sample with ZnO nanowires

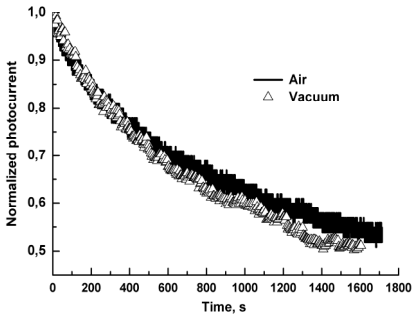

Fig. 7. Photoresponse decay of the sample with ZnO nanorods

Conclusion

We investigated the effect of vacuumization on the photoluminescence spectra and photoresponse decay of ZnO nanostructures fabricated by different methods. It was confirmed that the surface states play a crucial role in formation of PL spectra and UV detector properties of the nanomaterials. We associated a visible photoluminescence band and UV detecting properties of the samples grown from a vapor phase with the surface defects such as oxygen vacancies, and for the samples grown by hydrothermal method - with presence of the surface hydroxyl groups. Our results clearly show that ZnO nanostructures grown from the vapor phase would be promising for creation of the low cost and effective UV detecting devices.

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Thermo-kinetic Properties of the New Materials for Functional Layers of Flat Heating Elements

Taras Kovbasyuk, Yuliia Shapran

Applied Materials Science and Materials Engineering Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: felcproject@gmail.com.

Abstract – Thermokinetic properties of the dielectric coatings on the basis of glass-ceramic system PbO-ZnO-B_2O_3-SiO_2-Al_2O_3 (Sytal-Tsement) on a stainless steel substrate were studied. The advantages and disadvantages in comparison with modern functional layers of flat heating elements were analyzed.

Key words – flat heating element, surface engineering, dielectric coatings, glass crystalline material, thermal conductivity, thermal diffusivity, heat treatment.

I. Introduction

Applying of electric current as a source of thermal energy in the conditions of increasing scarcity of natural energy is becoming more important. The development of environmentally friendly electric heaters with low inertia for space heating, trains and municipal electric (cabins and carriages for trains, trams, trolley buses) is one of energy conservation problem. At present, the production technology of flat heaters is expensive and with low productivity. These technology is based on multiple screen printing method followed by complicated heat treatment. Moreover, for the production of dielectric and resistive pastes used precious metals. The principle scheme of a flat heating element structure shown in fig. 1.

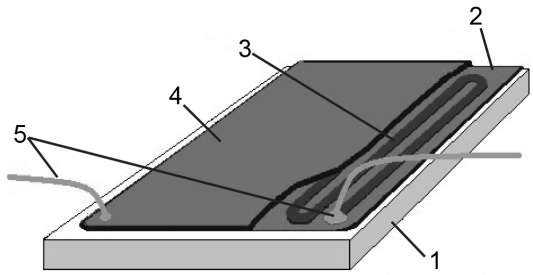

Fig. 1. Principle scheme of a flat heating element [1]:
1 – substrate; 2 – dielectric layer; 3 – resistive element;
4 – protective shell; 5 – contact electrodes

These work focuses on the development of alternative production technologies of dielectric layer (fig.1, term.2) for flat heating elements by methods of surface engineering with using new dielectric pastes based on glass ceramics system PbO-ZnO-B_2O_3-SiO_2-Al_2O_3 (sital-cement) with minimal proportion of precious metals or without its on substrate with stainless steel. The thermal conductivity and thermal diffusivity of the two glass-ceramic surfaces which manufactured from SC 90–1 and SC 100–1 powders, were investigated. The obtained results was compared with the properties of the substrate.

II. Experimental part

To obtaining of radically new dielectric layers on flat heating elements was chosen two brands of sytal-tsement powder: SC 90–1 and SC 100–1 (table. 1). Before applying to the surface of the substrate, the powder was added to 30 % of distilled water and 2% of acrylic varnish. After careful stirred during 3–4 hours the resulting slurry was applied to the surface of the stainless steel plate 15*15*2 mm. Obtained surface samples were dried in a furnace chamber at 70 ºC. The final step of the creation of dielectric coating was complex heat treatment during which crystallization occurs. The scheme of heat treatment mode for the crystallization of dielectric layer shown in fig. 2.

TABLE 1

THE CHEMICAL COMPOSITION OF INITIAL COATINGS WITHOUT HEAT TREATMENT

Oxide	Chemical composition, wt. % (± 0.2 %)	
	SC 100–1	SC 90–1
PbO	75.5	75.3
ZnO	12	11.6
B_2O_3	8.4	8.5
SiO_2	2.1	2.1
Al_2O_3	2	0.8
BaO	–	1.7

As a result of painstaking research, we found the optimum heat treatment mode of two sytal-tsements SC 90–1 and SC 100–1, which consists of two stages:

- the first stage of heat treatment – was annealing at t_1 = 400 °C during 45 minutes to forming of the crystallization centers. Heating from room temperature to 400 °C carried out at a speed of 4 °C/min. Temperature level was maintained by thermostat to within ± 5 °C;
- second stage heat treatment – was annealing at t_2 = 480 ° C, during which implemented the maximum speed of crystal growth. The duration of the second stage annealing corresponds to the required time for full volume crystallization of the glass layer. Increasing the temperature from 400 °C to 480 °C is carried out at a speed of 4 °C/min. At (480 ± 5) °C system "substrate - coating" aged by 60 min. Then the furnace was spontaneous cooling to 90 °C.

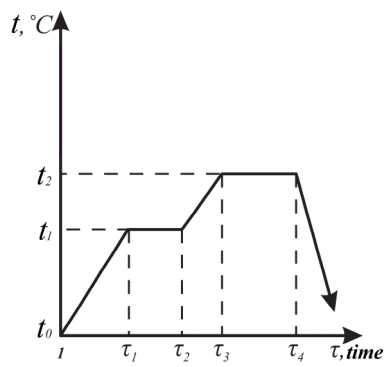

Fig. 2. Scheme of heat treatment mode for the crystallization of dielectric layer [2]

The thickness of the dielectric coating was determined by metallographic microscope METAM-R1. Research of thermo-kinetic properties of obtained dielectric coatings were carried out on Laser-Flash-Apparatus device - LFA 427.

III. Results and Their Discussion

In comparison with modern dielectric pastes used for the production of flat heating elements, our coatings based on glass-ceramic system $PbO-ZnO-B_2O_3-SiO_2-Al_2O_3$, notcontains incorporates precious metals and very easy to manufacture.

The cross-sectional microstructure of the SC 90–1 and SC 100–1 layers on a stainless steel substrate shown in fig. 3. The average thickness of the sytal-tsement coating was within 0.4–0.6 mm for SC 90–1 layer and 0.3–0.5 mm for SC 100–1 layer.

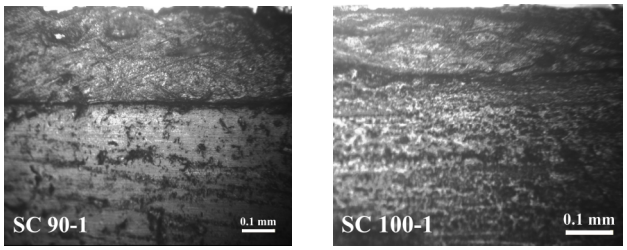

Fig. 3. The cross-sectional microstructure of the SC 90–1 and SC 100–1 layers on a stainless steel substrate

Crystallized coating which based on metal oxides have good dielectric properties [3,4]. To obtain the quality flat heating element, it's necessary that the physical properties of functional layers (dielectric and/or resistive) were close to the values of the properties of the substrate.

To evaluate the feasibility of using coatings based on $PbO-ZnO-B_2O_3-SiO_2-Al_2O_3$ system as a functional layer for flat heater, the thermal conductivity (fig.4) and thermal diffusivity (fig.5) of dielectric layers and substrate were investigated.

With increasing temperature, the thermal conductivity of both layers slowly increasing to the temperature 400 °C. The value of thermal conductivity of sytal-tsement layer SC 90–1 are almost identical to the properties of substrate taking into account the deviation.

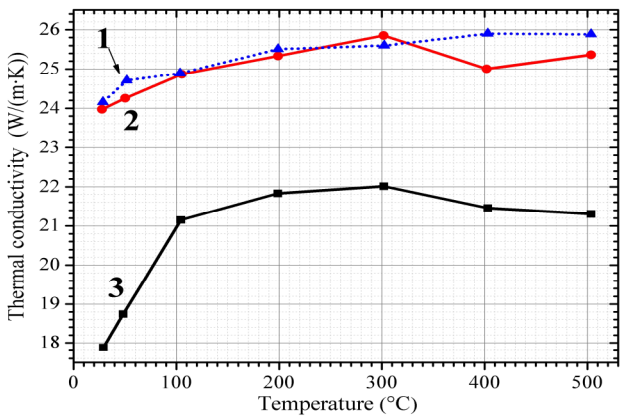

Fig. 4. Thermal conductivity of dielectric layers SC 90–1 (2) and SC 100–1 (3) on substrate with stainless steel 40X13 (1)

With increasing temperature, the thermal diffusion in metals and glass-ceramic materials were increasing. As a result the thermal diffusivity of substrate and both dielectric coatings are reduced. The value of thermal diffusivity of sytal-tsement layer SC 90–1 are almost identical to the properties of substrate taking into account the deviation.

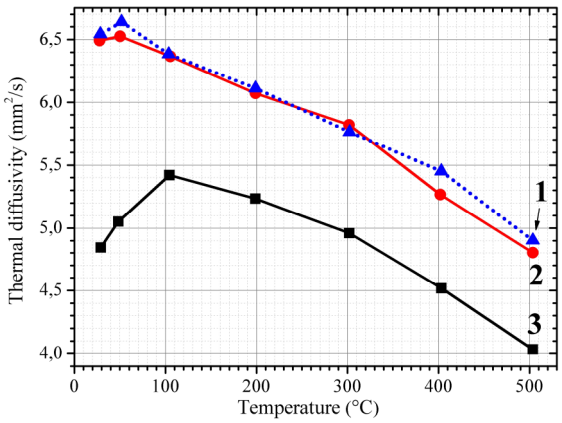

Fig. 5. Thermal diffusivity of dielectric layers SC 90–1 (2) and SC 100–1 (3) on substrate with stainless steel 40X13 (1)

Considering the all properties and published data the glass-ceramic system $PbO-ZnO-B_2O_3-SiO_2-Al_2O_3$ can be used as functional coatings in flat heaters. Considering the identity of thermo-kinetic properties of sytal-tsement SC 90–1 with properties of the substrate, a flat heating element based on these will have better performance properties.

Conclusion

The new materials based on glass-ceramic system $PbO-ZnO-B_2O_3-SiO_2-Al_2O_3$ for the functional layers of flat heating elements was investigated. Among the two studied materials for further research was chosen sytal-tsement SC 90–1 which thermokinetic properties was identical compared with the stainless steel substrate. The flat heating element based on system "stainless steel substrate - sytal-tsement SC 90–1 coating" will have better performance properties.

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Optimization of logistics management processes in transport nodes

Yana Litvinova
PhD student, Department of Transportation Management, State Higher Educational Institution "Nation Mining University", Dnipropetrovs'k, K.Marksa av., 19,
E-mail: litvinova_yuna87@mail.ru

Abstract – Theoretical bases of the effectiveness of logistics systems operation is analyzed. Conditions of quality improvement for cargo owners service are determined. Problem situations that arise in the process of clients' service are characterized together with the reasons of their occurrence. Directions of optimization of the processes of transport nodes operation from the view of logistics management are suggested together with the effectiveness criterion, which enables consideration of the inner-system characteristics.

Key words – technological process, transport node, logistics management, systems approach, optimization tasks, unproductive downtimes, cargo owners.

I. Introduction

Transport nodes belong to complex technical-economical subsystems, which make transport systems that, in turn, perform functions of cargo traffic processing during its transportation by different types of vehicle. Complex technological systems, as a rule, function in the conditions of great influence of stochastic environmental factors. Such situation is typical for transport nodes as well. Environmental influence on traffic nodes is described by probabilistic indices of material, financial and information flows as well as by the parameters of random variables, which characterize technological processes of of cargo processing.

II. Justification of directions of logistics management optimization

Increase of effectiveness of business entities service, especially in the sphere of cargo transportation, in the light of European integration processes of transport systems, is a very topical scientific-practical task.

Under the notion of logistics systems effectiveness in [1] the authors understand an index (or a system of indices), which characterizes the level of logistics system operation quality with the set level of total logistics expenses. Performance of a logistics system is characterized by such criteria, as agility, economic efficiency, consumer service quality, profitability and productivity.

In the work [2] the authors suggest to evaluate logistics systems effectiveness using two indices:

– percentage of perfectly realized orders;;

– cost of purchase.

Under the notion of perfect order's realization they understand punctual, unmistakable delivery of a product in a good condition (or a punctually and unmistakably provided service).

In the work [3] it is also stressed that in specific literature there does not exist a sole view over the question of defining the logistics systems operation effectiveness. Most commonly minimization of logistics expenses is supposed to be the main criterion of such effectiveness. Orientation on expenses minimization is actual, but provided that the required level of logistics service is achieved. Due to such ambiguity the multi-criteria evaluation of logistics systems operation effectiveness has recently become widespread.

The work [4] can be claimed as one of the first works dedicated to economic efficiency of the transport process and determination of criterion of the delivery system effectiveness. This work suggests to use cost of cargo delivery as a criterion.

With the help of cost and some physical indicators (labor input, energy consumption), suggested in the work [5], we can evaluate changes that happen in separate logistics subsystems as well as the effectiveness of the whole delivery system operation.

The analysis of existing effectiveness criteria has shown that in scientific works the most part of suggested effectiveness criteria consider interests of only one subject at the market (cargo owner or a carrier) or interests of two subjects (freight forwarder and carrier).

Improvement of conditions of cargo owners' service can be provided by increasing efficiency of their interaction at transport nodes, which is based on the terms of excluding unproductive downtimes for carriers, effective usage of warehouses spaces for transport nodes and reduction of expenses on cargo processing for cargo owners.

Operation of transport nodes as parts of the macro-logistics systems of transport services markets is characterized by the presence of a number of problems of technical and organizational character, which are reflected in the absence of sufficient number of free warehouse spaces, untimely processing of cargo at different stages, exceeding of the declared time and service cost, partial use of processing capacity, inability to arrange the direct cargo transshipment etc.

Problem situations, which arise in the process of clients service by means of transport nodes, can be referred to one of the following groups:

– problems, connected with the disparity of structure of production resources at a transport node to the parameters of environment of macro-logistics system of transport services market;

– problems, connected with the insufficient or too high capacity of production resources of a transport node at the production base with a correct structure;

– problems of organizational character: with the production resources that correspond to the market situation by structure and capacity, the accepted technology of their use does not provide the effective cargo processing.

These problems are caused by the following reasons:

– structure of production resources of the service system does not correspond the structure of demand on services, which are provided at the transport node by other subjects of transport services market (properly equipped fronts of direct processing for different pairs of vehicle are absent at a transport node, as well as sections of additional cargo processing etc.);

– capacities of production resources of a transport node do not correspond to the parameters of demand (processing capacity of cargo fronts does nor provide cargo service or is higher than required, roominess of warehouse space of transport nodes units does not correspond to the demand on intermediate storage etc.);

– processes of cargo service are not properly provided organizationally (schedule of vehicle delivery for their processing at cargo fronts are not coordinated with the schedules of operation of loading and offloading facilities; separate processes of cargo processing in the middle of a transport node are not coordinated with each other and that leads to inter-operational downtimes of mechanisms and to the increase of total processing time etc.).

The presented reasons of problem situations occurrence during the process of transport nodes operation is a consequence of partial or complete absence of system approach to controlling nodes as logistics systems.

Thus, taking into account the presented analysis of existing approaches to increasing the logistics management effectiveness and a number of highlighted problem situations, which arise in the process of cargo processing at transport nodes, as well as the stated reasons of their occurrence, it is reasonable to work out the following directions of processes of transport nodes operation from the position of logistics management:

– optimization of structure and capacity of production funds at transport nodes taking into consideration the parameters of demand and parameters of inter-system flows;

– development of methodology of working out the schedules of joint operation of vehicles and cargo fronts, which will consider the stochastic nature of parameters of material and information flows.

III. Formation of the target function for logistics management models

When solving the task of optimizing structure and capacity of production funds of transport nodes as elements of macro-logistics systems we offer to use the specific effectiveness index K_e [6], which is a ratio of total expenses E_Σ for clients service at a transport node to the cost of production resources C_R, which are used in the production process:

$$K_e = \frac{E_\Sigma}{C_R}. \quad (1)$$

These criterion contains the index (total service expenses), conventional in the practice of logistics management, but at the same time it allows to take into account the inter-system characteristic (production resources cost). We need to stress that total expenses functionally depend on demand parameters and parameters of inter-system material, financial and information flows.

Criterion (1) is also suggested to be used for the development of methodology of working out the schedules of joint operation of vehicles and cargo fronts at a transport node. It is necessary to highlight the fact that total time of vehicles or (and) service mechanisms downtimes is a conventional criterion in the models of optimization of processes of joint operation of different types of vehicles at service mechanisms. This index of effectiveness is suggested to be considered by determining the functional dependence of total expenses on service at a transport node on the time of mechanisms and vehicles downtime.

Conclusion

The absence of system approach to managing nodes as logistics systems is the main reason of problem situations occurrence in the process of transport nodes operation. To increase effectiveness of transport nodes operation processes from the position of logistics management it is necessary to optimize the structure and capacity of production funds of transport nodes as well as to develop the methodology of working out the schedules of joint operation of vehicles.

To solve the task of optimal management of transport nodes operation processes it is suggested to use the specific effectiveness index, which is a ratio of total expenses for clients service at a transport node to the cost of production resources that which are used in the production process.

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City's Parameters Influence on Transportation Servicing of Goods

Nataliya Fiyalko[1], Andrii Galkin[2]

[1]5th year student of the of the Faculty of Transport Systems and Technologies of O. M. Beketov National University of Urban Economy in Kharkiv, UKRAINE, Kharkiv, Revolution street 12,
E-mail: stairwaytoheaven1084@gmail.com

[2]Senior Lecturer of the department Transport Systems and Logistics of O. M. Beketov National University of Urban Economy in Kharkiv, UKRAINE, Kharkiv, Revolution street 12, E-mail: andrey__g@mail.ru

Abstract – Production delivery in the consumption sphere is one of the important trade functions that take place in the commercial companies. Rational management is important in goods distribution processes. Logistics tools are affecting on distribution channel delivery mechanism choice for different regions. The sales channels choice is one of the key decisions for the company.

The traditional concept of management is not excusing itself. Logistics activities of transportation servicing for various cities in the current market conditions, research not enough. Paper is aimed to improving existing models and approaches to urban transportation servicing of goods carriage.

Key words – logistics channel, material flow, transport planning cities, Automobilization level, retail network.

I. Introduction

The challenge in product's markets is carried out by different aspects. Logistics is no exception, it chose the best way to bring product - material flow from the suppler to client, with minimal price, time and maximum service level.

Increasing demands for transportation services caused by goods range and conditions of their carriage is increasing leads to necessity of improving transportation service approaches to material flows. Lot of markets of these goods makes to search best way to distribute them in different areas.

Choice of LC is influencing on distribution processes efficiency. The LC is linearly ordered characteristics participants that perform logistics operations which bring the MF from one participant to another or to the end user. LC consists of different participant's: manufacturers (seller), consumer (buyer) and logistics agents, storages, services organizations and others. An example of the LC is presented on fig. 1.

Channel's selection directly effects on speed, time, efficiency and safety of products movement during its delivery from producer to final consumer.

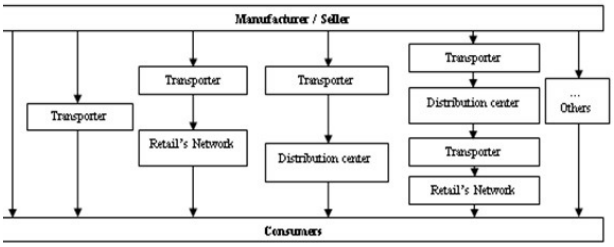


Fig. 1. Material flow's distribution channels scheme [1]

Channel's selection directly effects on speed, time, efficiency and safety of products movement during its delivery from producer to final consumer.

Existing general methods and models of logistics do not allow us to estimate the impact of a particular region, area or city on MF promotion processes. Therefore, the purpose of the article was chosen precisely evaluate the effect of various city's parameters on urban transportation servicing (TS). For this purpose the following tasks were performed: The city's characteristics analysis; analyzed and substantiated methods of transportation services; analyzed and substantiated methods of transportation planning of cities; Determined the influence of city's parameters on transport processes of goods carriage; Average transportation speed was determined in various Ukrainian cities.

II. City's characteristics analysis

Analysis of the sources of literature defines a large number of options the city, including the main can be considered: city area [2, 3], population [2, 3], city radius [4], Automobilization level [4, 5], the density of the road network [4-6], circuit city transport planning [2-6].

One of the main parameters is the city population [2, 3]. It directly affects the amount of territory planning structure, quantity and quality of life institutions, transport and engineering equipment and others. An important criterion for classification of a settlement to the status of the city is a population that is determined by:

- Small city: up to 10 thousand. - 50 thousand people;
- Medium: 50 - 250 thousand people;
- Big: 250 - 500 thousand people;
- Significant (large): 500 - 1000 thousand people;
- The most significant (the largest): over 1000 thousand people.

The category of the most significant in Ukraine are five cities: Kyiv (2,6 mln. people), Kharkiv (1.47 mln. people) Dnepropetrovsk (1,065 mln. people), Donetsk (1,016 mln. people), Odessa (1.05 mln. people), Lviv (0.9 mln. people).

Analysis of the sources of references defines eight fundamental geometrical schemes covering the diversity of urban planning structures [3-7]. Schematic representation of urban planning structures is presented in Table. 1.

It should be noted that in its pure form all the above schemes street network in modern major cities are small.

The density of the road network of the city is the ratio of the total length of the road network to the area of the city served. Too high density network has drawbacks, such as significant investments in network construction, major maintenance costs and low speed because of frequent traffic intersections. Under the current town-planning regulations mean density of transport networks in cities located within 1.0 - 2.5 km/km^2

The density of main street network in the village as a whole and its individual areas should be taken according to the Table 2 [6]. Value density transport network and walking areas in the city different areas preset in Table 3.

TABLE 1

DESCRIPTION OF THE TOWN PLANNING AGENCIES [4]

Name of scheme	Description	Coefficient	Source
free	The entire network consists of narrow crooked streets with variable width carriageway. For cities in Ukraine, this scheme is not applicable	-	[12-16]
radial	Complicated connections between peripheral regions, causing significant rerun and overload city center	>>1	[12, 13, 15, 16]
radial-ring	Has two fundamentally different types of highways - radial and ring	1,05 – 1,1	[12-16]
triangular	There is no clearly defined central core and the possibility of even distribution of transportation throughout the city	1,4-1,5	[12-16]
rectangular	It includes chord and diagonal streets, punched in the existing building on the busiest destinations	1,2-1,3	[12-14, 16]
hexagonal	The basis of the scheme is a combination of hexagons, excluded the formation of complex assemblies crossings on highways	-	[12, 13]

TABLE 2

DENSITY STREET NETWORK BACKBONE [4]

Groups of cities	The average density of main street network in the city, km / km^2	Including areas of cities		
		central	average	peripheral
The largest	2,0-2,5	4,0	2,2	1,4
large	1,8-2,1	3,4	1,6	1,2
Big	1,6-1,8	2,2	1,4	1,1
Medium	1,4-1,6	1,6	1,2	1,0
Small city	1,0-1,2	1,2	1,0	0,7

TABLE 3

TERRITORIAL DENSITY OF URBAN TRANSPORT NETWORK [4]

Qualitative characteristic density of the transport network	The density of urban transport network			
	In the city	In the city center	In the middle zone	At the periphery
Very small	Less than 1.6	Less than 3.0	Less than 1,6	Less than 1,35
Small	1,6-2,2	3,0-3,5	1,6-2,5	1,35-2,0
Moderate	2,2-2,75	3,5-4,0	2,5-3,5	2,0-2,42
Dense	2,75-3,25	4,0-5,0	3,5-4,5	2,42-2,75
Very dense	3,25-3,7	5,0-6,0	4,5-5,0	2,75-3,15
Extremely dense	Over 3.7	Over 6,0	Over 5,0	Over 3,15

The city area is the area bounded by the city limits, measured in square units. Area of the city, according to studies, affects the rate of dislocation density of consumers, and thus the distance between adjacent points.

According to the definition of the area, the city radius is the distance from the city center to the specified anywhere in the city. The radius of the city largely influences the speed connections. In this regard, is the value recommended speeds depending on the radius of the city [8].

TS are inextricably linked with the principles of urban planning and forecasting.

Solving problems TS can be obtained considering the parameters of the city. Therefore, it is possible to trace the influence of city planning structure parameters of LC.

III. Methods of transportation service

At the heart of the management of MF is processing information (technological, technical, economic) that aggregate information about the functioning of various objects that can capture, transfer, convert and use to perform management functions such as planning, accounting, analysis, management and others.

Given the fact that traffic volumes are directly related to the volume of material flows, determine the value of the last calculation in the horizon [7, 8, 9]. Average turnover time of vehicles is determined by:

$$\overline{T}_r^v = \frac{\bar{l}_m}{V_t^v} + t_{li} + t_{uli} \quad (1)$$

where $\bar{l}_m$ - The average route length in km; V_t^v - Technical vehicle speed in km / h.; t_{li} - Down time under load, h.; t_{uli} - Idle time during unloading to service retailers, h.

Adaptability streets of network to the requirements of modern urban traffic misalignment coefficient estimated - the ratio of the actual length of the path between two points to the length of the line between them [3]. Coefficient misalignment of RN calculated by the formula:

$$R = \frac{\sum_{i=1}^{n} l_{road}}{\sum_{i=1}^{n} l_{air}} \quad (2)$$

where l_{road} - The length between the points of roads, km; l_{air} - length between points "over the air", km; n - The number of plots.

It should be mentioned the approach takes into account the density of participants as retail network (RN) equidistant between them.

IV. Methods and models of City's transportation planning

Analysis of TS is procedure for the production, study and decision-making in the research process and the formation of a transport customer service, which allows a simple turn complex.

Systematic analysis of the activity of the motor company is to select the main elements of the structure and functions of the management system. It allows you to

create a mathematical model which is a tool location and describe the behavior of elements of the enterprise.

The formation of traffic is a result of the operation of transport systems biggest cities [9]. The transport flows consist of a set of correspondence of vehicles sold in the same ways, forming patterns which, subject to certain rules and can be formalized.

The need to understand patterns of transportation caused by the use of mathematical models in modeling traffic flows. In practice, modeling of traffic, there are several different approaches to the description of regularities of their formation.

Patterns of traffic formation based on a macroscopic approach found reflection in [10-14]. This approach is based on the fact that the relationship between the characteristics of the traffic flow can be established on the basis of experimental data, the analysis of boundary conditions and physical analogies [14].

Depending on the purpose of research can be used a variety of methods for determining the speed of traffic. In general, all methods can be divided into full-scale and modeling techniques.

The method of field research [15] is to obtain actual speed in a given space and within a specified period. This method is to conduct direct observations. Determining the speed of transportation can be done by modeling methods [12, 15, 16].

It should be noted that the benefits of field observations of traffic speed is their high accuracy, ease of use. The disadvantages are the complexity and high cost of material survey, especially when using special technical means and vehicles [15]. The use of this group of methods is possible on stage to collect the necessary statistical information. For example, when developing traffic models. However, given the material and technical possibilities, preference should be given direct counsel against transport network and the implementation of control gauging's when traveling in a car without special equipment.

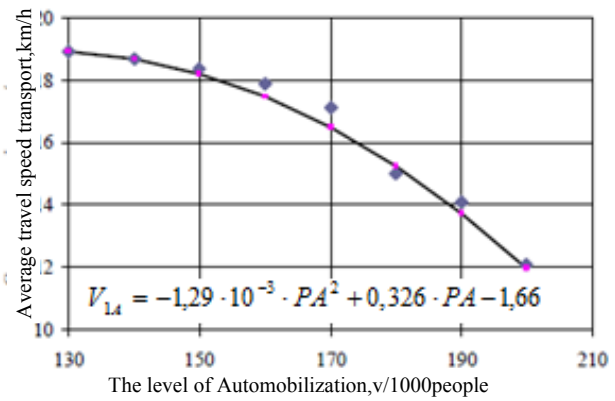


Fig. 2. Dependence of average travel speed network the level of Automobilization [17]

The second group of methods for determining the speed of traffic is to use traffic models. To establish a connection between the various pairs of the main characteristics of transport stream can be used [14, 16]:

- Experimental data and built on them functions;
- Conclusions reached in the analysis of boundary conditions;
- Physical analogy.

At this time developed several approaches to determining the speed of traffic in terms of urban transport networks. One of the approaches developed by C. Robinson [15], based on the assumption that the total impact of regulated and unregulated intersections, edge effects reduces the capacity of city streets by about 50%. In this approach, the dependence of traffic on its intensity has the form:

$$V = 55{,}82 - 6{,}92 \cdot 10^{-5} \cdot N_{1n}^2 , \qquad (3)$$

where N_{1n} – traffic, which accounts for an average of one lane city street, cars / hour.

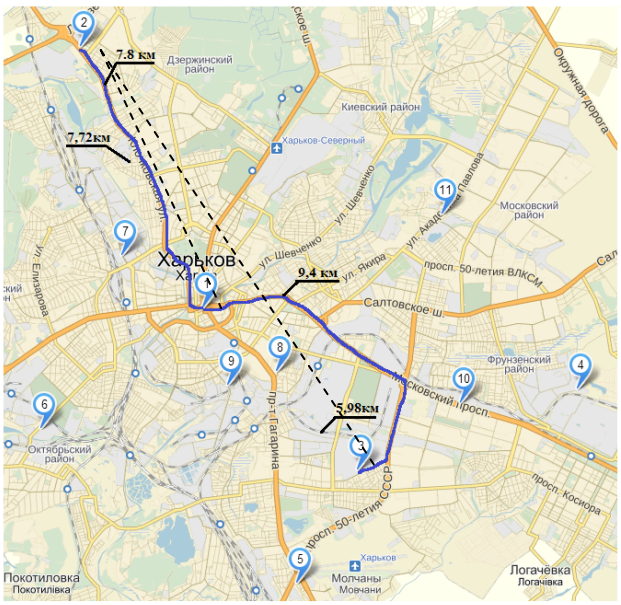
Model Eq. (3) is suitable for use in urban transport networks. But it is designed to determine the speed only a limited category of city streets - where free flow speed not exceeding 60 km/h. As imagined, this model will give significant errors in determining the speed of traffic on the streets of large (70-80 km / h) and low (30-40 km / h) speed of free movement. Univariate models of change in network [16].

Presented regression models change the speed of traffic in urban areas are adequate and suitable for use in solving problems increase the efficiency of transportation systems significant and largest cities. This proposed model is most appropriate for further calculations

V. Determination of city's parameters influence on average transportation speed

For the calculation of road network outline misalignment N sites (we have 10) measurement by determining the start and end points of the site. These points are located directly on the road.

For Kharkiv city was scheduled for the following 10 lots, similar to sections 1-2 and 1-3, centered in paragraph 1 Fig. 3.



where

- -length between points on road
- -length between points "over the air"

Fig. 3. Scheme of points for the calculation of road network for misalignment c. Kharkiv

It calculated the distance roads and "over the air" between the center and all areas. Similarly, it was planned and calculated the distance between the points for the three retailers of the city. For c. Kharkiv factor misalignment road network for RN 1 is:

$$R = \frac{72,1}{58,5} = 1,23.$$

For m c. Kyiv, c. Lviv and c. Dnepropetrovsk Calculation misalignment road networks perform similarly c. Kharkiv. The calculation results are summarized in the Table 4.

According to the obtained coefficient misalignment road network and Table 4 may identify each city planning scheme.

Thus, c. Kharkiv and c. Kyiv with a rectangular-diagonal scheme planning, and c. Lviv and c. Dnepropetrovsk – rectangular.

The closer this ratio is to unity, the better the draft transport network. Table 5 degree is misalignment network depending on the value coefficient.

TABLE 4

RESULTS OF CALCULATIONS FOR DIFFERENT COEFFICIENTS MISALIGNMENT RETAIL NETWORK [4]

Name of the City	Number s / n	Name of RN	Coefficient of misalignment	The average value of coefficient of misalignment	Number of participants RN
Kharkiv	1	household goods 1	1,23	1,2	10
	2	ATB	1,15		10
	3	ProStor	1,15		10
	4	Foxtrot	1,26		7
Kyiv	1	household goods 2	1,44	1,3	10
	2	ATB	1,29		10
	3	ProStor	1,28		8
	4	Foxtrot	1,36		9
Dnipropetrovsk	1	household goods 3	1,63	1,5	10
	2	ATB	1,55		10
	3	ProStor	1,48		10
	4	Foxtrot	1,47		5
Lviv	1	household goods 4	1,38	1,4	10
	2	household goods 5	1,45		10

To determine the average distance between two adjacent points on dependence Eq. (4). In the case of uneven distribution of dependence have the following form:

$$\overline{l}_d = \frac{\sqrt{\lambda_d^{-1}}}{R} \cdot \delta, \qquad (4)$$

where R - misalignment coefficient of the road network; λ_d - density deployment consumers, defined as: δ - dispersion, which in this case describes the deviation from the average in terms of length and is given by:

$$\delta = \frac{\sqrt{\sum (\overline{l}^{air} - l_{actual}^{airв})^2}}{n} \cdot 100\%, \qquad (5)$$

where $\overline{l}^{air}$ - the average value of length between points "over the air" km; l_{actual}^{airr} - the actual value of length between points "over the air", km.

TABLE 5

DEGREE OF MISALIGNMENT NETWORK [4]

Coefficient	Degree of misalignment network
Over 1.3	exceptionally high
1,25-1,3	very high
1,2-1,25	high
1,15-1,2	moderate
1,1-1,15	small
1,1	very small

The density of retail network in the city determined by the relationship:

$$\lambda_d = \frac{N_r}{S_m} \qquad (6)$$

where S_m - district service area (city square).

TABLE 6

RESULTS OF CALCULATION UNEVEN DISTRIBUTION OF PARTICIPANTS FOR VARIOUS RETAIL NETWORK

Name of the City	Number s / n	Name of RN	Coefficient of irregularity	The average value of irregularity coefficient	Number of participants RN
Kharkiv	1	household goods 1	0,46	0,5	10
	2	ATB	0,51		10
	3	ProStor	0,48		10
	4	Foxtrot	0,56		7
Kyiv	1	household goods 2	0,56	0,69	10
	2	ATB	0,79		10
	3	ProStor	0,72		8
	4	Foxtrot	0,69		9
Dnipropetrovsk	1	household goods 3	0,41	0,34	10
	2	ATB	0,29		10
	3	ProStor	0,32		10
	4	Foxtrot	0,35		5
Lviv	1	household goods 4	0,8	0,85	10
	2	household goods 5	0,89		10

According to Table 6 can conclude that within a city of irregularity coefficient did not differ significantly, which confirmed the existence of irregularity placement participants of RN. Further calculations of the average distance between two adjacent points using the dependence Eq. (5). For the city of Kharkov in the number of participants of retail network N_r =15 shall have the following meanings:

$$\delta = \frac{27,64}{55} = 0,5025 \cdot 100 = 50,25\%;$$

$$\lambda_d = \frac{15}{350} = 0,042;$$

$$\overline{l}_d = \frac{\sqrt{0,042^{-1}}}{1,2} \cdot 0,5 = 2,01 \text{ km};$$

Similarly perform the calculation for other cities. For the city of Kyiv will have the following values:

$$\delta = \frac{37,95}{55} = 0,69 \cdot 100 = 69\%;$$

$$\lambda_d = \frac{15}{840} = 0,017;$$

$$\overline{l}_d = \frac{\sqrt{0,017^{-1}}}{1,3} \cdot 0,69 = 3,97 \text{ km};$$

For the city of Dnepropetrovsk will have the following values:

$$\delta = \frac{18,74}{55} = 0,34 \cdot 100 = 34\%;$$

$$\lambda_d = \frac{15}{405} = 0,037;$$

$$\overline{l}_d = \frac{\sqrt{0,037^{-1}}}{1,5} \cdot 0,34 = 1,17 \text{ km};$$

For city of c. Lviv will have the following values:

$$\delta = \frac{46,75}{55} = 0,85 \cdot 100 = 85\%;$$

$$\lambda_d = \frac{15}{190} = 0,078;$$

$$\overline{l}_d = \frac{\sqrt{0,078^{-1}}}{1,4} \cdot 0,85 = 2,16 \text{ km}.$$

The data will be used in subsequent calculations to determine turnover time. Increasing of length of the route leads to an increase in the turnover time.

VI. Finding and results of speed calculations for different city's

According to statistics to the Automobilization level and specific density of the transport network for the cities of Kharkiv, Kyiv, Dnipropetrovsk and Lviv reduced to the Table 7.

TABLE 7

VALUES OF AUTOMOBILIZATION AND SPECIFIC DENSITY OF TRANSPORT NETWORKS FOR CITIES

City's Name	Indicators	
	The level of Automobilization, v/1000 people	Specific density of the transport network, km^2/ km^2 10^2
Kharkiv	143	1,97
Kyiv	200	1,5
Dnipropetrovsk	171	2,1
Lviv	187	1,8

According to Table 3 and Table 7 density values obtained for each characteristic quality of the city transport network density for Kharkiv - small, Kyiv - very small for Dnipropetrovsk and Lviv is also small.

Average travel speed network, depending on the specific density for cities [17] will be equal to:

$$V_{Kharkiv} = 17,4 \cdot 1,97 - 1,62 \cdot 1,97^2 - 10,56 = \\ = 17,4 km/h.;$$

$$V_{Kyiv} = 17,4 \cdot 1,5 - 1,62 \cdot 1,5^2 - 10,56 = 11,8 \text{ km/h.};$$

$$V_{Lviv} = 17,4 \cdot 1,8 - 1,62 \cdot 1,8^2 - 10,56 = 15,5 \text{ km/h.};$$

$$V_{Dnipropetrovsk} = 17,4 \cdot 2,1 - 1,62 \cdot 2,1^2 - 10,56 = \\ = 18,8 km/h.$$

Average travel speed network depending on Automobilization level for cities [19] will be equal to:

$$V_{Kharkiv} = -1,29 \cdot 10^{-3} + 143^2 + 0,326 \cdot 143 - 1,66 = \\ = 18,57 km/h.;$$

$$V_{Kyiv} = -1,29 \cdot 10^{-3} + 200^2 + 0,326 \cdot 200 - 1,66 = \\ = 11,9 km/h.;$$

$$V_{Lviv} = -1,29 \cdot 10^{-3} + 187^2 + 0,326 \cdot 187 - 1,66 = \\ = 14,2 \ km/h.;$$

$$V_{Dnipropetrovsk} = -1,29 \cdot 10^{-3} + 171^2 + 0,326 \cdot 171 - \\ -1,66 = 16,36 \ km/h.$$

The values of the cities' network speed depending on the specific density of the transport network and depending on the Automobilization level not significantly different, so the results can be used for calculation the required the turnover time (1) and the number of vehicles for a specific city.

Conclusion

As a result of research had found influence of city's parameters (Automobilization level, density of the transport network, degree of misalignment network) on elements of urban transportation servicing process (average transportation speed of vehicle and the length of the route). Calculations have shown that an increase in the Automobilization level and traffic misalignment coefficient increases turnaround time, increasing the density of the road network on the contrary decreases turnaround time.

Further research should focus on further investigation of the influence of the city's parameters on logistics technology choice in them.

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Welded Layers Microstructure Modification on the Basis of Powder Wire Cr10B4 with addition of Al, Mg

Andriy Voitovych, Roman Mykhalskyi, Roman Vlakh

Department of Welding, Hardware Diagnosis and Restoration, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12,
E-mail: andrsibox@gmail.com

***Abstract* – The welded layers formed of powder wires PW Cr10B4, PW Cr10B4Al2, PW Cr10B4AlMg were investigated in the course of work. It was defined that Al, Mg applications influence the microstructure grinding and rounding carboboride inclusions. Abrasive wear resistance of the weld materials under the condition of outwearing by a fixed abrasive, unfixed abrasive, as well as shock load, was detected. It was determined that wear resistance of the welded layers with PW Cr10B4AlMg at shock load was 3.5 time higher than that of other weld materials. Degradation mechanism of the welded layers PW Cr10B4AlMg is malleable.**

Key words – welded layers, microstructure modification, powder wire, wear-resistance, surface.

I. Introduction

The details that work on the condition of abrasive particle presence undergo outwearing [1]. Powder materials of the system Fe–Cr–B–C are widely used for outworn surface recovery [2]. The phase composition of the microstructure of the system Fe–Cr–B–C consists of: Fe/Cr carbides with hardness to 900 HV, as well as carboborides with hardness to 1300 HV and an eutectic matrix with hardness to 700 HV [3]. The welded layers of Fe–Cr–B–C material continue working several times longer on the condition of abrasive outwearing. A disadvantage of the wear-resistant material is dendritic axes that condition fracturing at shock load. The microstructure loses its capacity to resist outwearing and destroys fast because of microfissure creation [5]. The attempts of graphite rounding in high-strength cast irons are known. Mg_2Si modifier that influences graphite flakes well was used in the course of work [6]. But this modifier is hardly accessible and expensive, that is why the aim of this work is to study the influence of aluminium-magnesium powder PAM – (Al 60%, Mg 40%) and aluminium powder PA (Al 99.99) on the microstructure of the welded layers of powder wire PW Cr10B4.

II. Experiment method

Welding was conducted in the flux OCS 45м, with the automatic head ABS, powder wires PW Cr10B4, PW Cr10B4Al2, PW Cr10B4AlMg (Table 1), PW diameter is 1.6 mm, clad material is steel 1008, filling rate is 18%.

TABLE 1

PW BURDEN COMPOSITION

PW	Chemical elements, %				
	Cr	B	Mg	Al	Fe
Cr10B4	10	4	-	-	The rest
Cr10B4Al2	10	4	-	2	The rest
Cr10B4AlMg	10	4	1	1	The rest

For welded layers formation DC welding generator ПСО 500 was used. Welding current is 160–180 A, voltage is 28–30 V. Welding wire delivery rate is V_{wire} 142 m/h, welding rate is V_{weld} 13 m/h. The microstructure of the welded layers was examined on a transverse microsection using the electronic microscope EVO 40 XVP. Hardness measurement was made with a microhardness tester ПМТ-3, charge weight 200g.

Welded layers wear-resistance was investigated under different outwearing conditions. Abrasive outwearing with an unfixed abrasive was estimated according to GOST 23.208-79. Dry quartz sand with particle size 200...1000 μm was constantly delivered to the area of contact of the wiper and sample. Wiper turning speed was 25 (m/s), and strength of its pressing to the sample was 2.4 (kN). For estimation of outwearing with a fixed abrasive an abrasive wheel CM-2 on a ceramic bond was used. Line friction velocity was 0,4 (m/s), load in the area of line load was 1.5 (kN).

Shock outwearing was estimated according to striking force 12 KJ with a ball Ø25 mm made of steel ШХ 15 that was falling onto the surface with frequency 40 s^{-1}. Experiment duration was 3600 s. Sample weight loss was determined electronically with accuracy to 2×10^{-4}.

III. Result discussing

The microstructure of the welded layers PW Cr10B4 (Fig. 1 a) consists of dendritic axes, sizes reach from 10 to 15 μm in width and from 100 to 700 μm in length. Heat-resistant element content there constitutes Cr to 13 mass%. We can assume that these are carboborides FeCrB. Welded layers matrix contains ferrum Fe to 93 mass% and low-alloyed Cr is on the level to 3 mass%.

It was detected that additional alloyage with the powder PA, PAM PW burden influenced the microstructure. The microstructure of the welded layers of PW Cr10B4AlMg (Fig. 1 в) is altered in comparison with the microstructure of the welded layers mentioned above. A prolonged nature of the dendritic axes is changed into a roundish one, refinement takes place, the sizes of the inclusions decrease and become from 10 to 5 mkm in length and width.

It is conditioned by decrease of welding puddle temperature, with respect to exothermic reaction. But it leads to dissolution of Cr in average spectrum 3.1-5.3 mass% in two of the welded layers. A disadvantage of microstructure of the welded layers formed of PW Cr10B4Al2 is a high porosity.

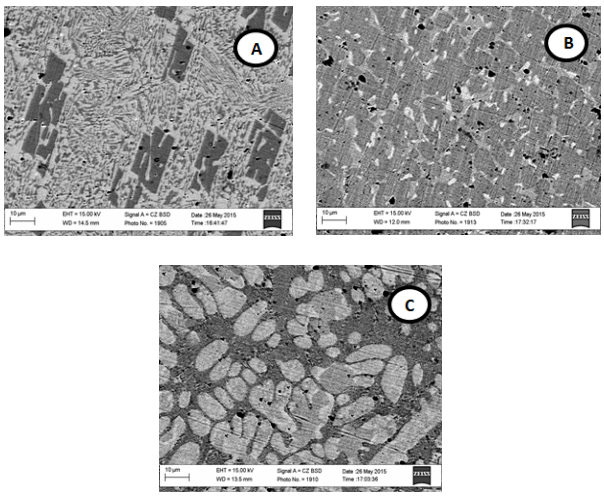

Fig. 1. Microstructure of welded layers:
a- welded layers of PW Cr10B4, b- welded layers
of PW Cr10B4Al2, c-welded layers of PW Cr10B4AlMg

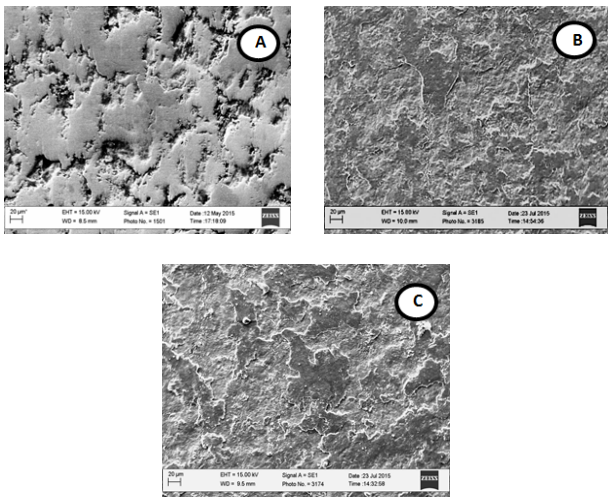

Fig. 2. Surface morphology after shock outwearing:
a-welded layers of PWCr10B4, b-welded layers
of PWCr10B4Al2, c-welded layers of PWCr10B4AlMg

It was detected that the welded layers of PW Cr10B4AlMg had finely divided phases with a complex chemical composition Fe(Cr Mn)Si; they are marked with black inclusions.

Small hardness of the welded layers of PW Cr10B4 is on the level of 650 HV. In the other welded layers of PW Cr10B4Al2 small hardness increases to 780 HV. But it decreases to 700 HV in the welded layers PW Cr10B4AlMg.

Wear-resistance of the welded layers (Table 2) under the condition of outwearing with a fixed abrasive is the smallest in the welded layers of PW Cr10B4Al2, loss weight constitutes 0.31g. It was defined that wear-resistance of the welded layers of PW Cr10B4AlMg is 1.5 times higher than that of PW Cr10B4.

TABLE 2

WEAR-RESISTANCE OF THE WELDED LAYERS

Material	PWCr10B4	PWCr10B4Al2	PWCr10B4AlMg
With a fixed abrasive	0.05	0.31	0.032
With an unfixed abrasive	0.02	0.01	0.02
Shock outwearing	0.0094	0.0048	0.0025

But under the condition of outwearing with an unfixed abrasive wear-resistance of the welded layers of PW Cr10B4Al2 is the highest, weight loss is 0.01g. The other welded layers PW Cr10B4, PW Cr10B4AlMg have equal weight loss 0.02g. At shock load weight loss is the lowest in the welded layers of PW Cr10B4AlMg – 0,0025g, this wear-resistance is 3.5 times higher in comparison with the welded layers PW Cr10B4.

The welded layers of PW Cr10B4 destroy in a brittle way, since hard carboboride inclusions fringe out and crumb. It is also confirmed with the heighest weight loss 0.0094g. The other welded layers of the wires PW Cr10B4Al2, PW Cr10B4AlMg, destroy in a malleable way.

Conclusion

1. The microstructure of the welded layers of powder wires PW Cr10B4, PW Cr10B4Al2, PW Cr10B4AlMg in the flux ОСЦ 45 was investigated. It was detected that additional alloyage with powder PA, PAM PW burden influences the microstructure grinding and rounding dendritic axes.

2. Wear-resistance of the welded layers of PW Cr10B4AlMg is 1.5 times higher on the conditions of outwearing with an unfixed abrasive and 3.5 times higher at shock load outwearing.

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Energy aspects of arene domain presence in the coal structure under the sorption process

Magda Ziółkowska[1], Grzegorz S. Jodłowski[1]

[1]AGH University of Science and Technology, Faculty of Energy and Fuels, POLAND, al. A. Mickiewicza 30, 30-059 Kraków, E-mail: magda.ziolkowska@agh.edu.pl

Abstract – This work presenst two way dissertation on energy aspects of arene domain presence in the coal substance and its interactions with sorbate molecules under the sorption process. Newly elaborated approach aimed at adsorption mechanism identification is discussed and the estimation procedure of energy profile of possible molecule location in the pores of graphite-like substance is presented. Wider view on the sorption process is included in the Multiple Sorption Model with regard to the absorption-adsorption character of the phenomena taking place under the location of sorbate molecules in the sorption system. Both approaches give us information on effect of arene domains and overall view on sorption process and coal structure.

Key words – coal structure, porosity, modeling, adsorption, absorption.

I. Introduction

The complexity of the coal structure (i.e. combination of multiple components) causes continuous need in the development of the material description and sorbate molecules interactions.

The statistical approach to the introduction of the coal structure components to the model is already used in Multiple Sorption Model (MSM). In MSM all compounds present in the coal mass are divided to the main groups of components and modeled together as a class of the physical objects with common properties of the segments of each object.

The novel attempt is to model the molecule behavior in the porous system of the component class – arene domain – qualified as quasi-graphite compositions. This attempt is developed in newly elaborated adsorption mechanism identification approach [1]. It enables to examine the effects of the adsorbent structure diversity on adsorbate molecule properties with special regard to the surface geometrical heterogeneity. More specifically, it draws information on the adsorbate volume, and hence applying *PVT* relationship for liquid bulk phase enables for estimation of energy profile [2].

In further considerations arene domains are the component of a total sorption system. Coal substance is composed by main components:

- Arene domains – quasi-crystalline formations of condensed benzene rings plates connected each-other by the relatively strong bonds;
- Linked chains (aliphatic, alicyclic and heterocyclic) connected each-other and with arene domains in nodes;
- Unlinked chains (aliphatic, alicyclic and heterocyclic) without connection in nodes;
- Pores present in coal surface and bulk (especially submicropores with diameter comparable to molecule size), understand as the constituent with connection to a vacuum if it is empty;
- Mineral admixtures with negligible sorption properties in comparison to coal matter porous system.

Two first components constitutes the limitedly rigid structure and is called macromolecular phase. Third component forms the elastic part of the coal substance and is called molecular phase [3], [4]. Special attention is taken on the arene domains and its behavior under the sorption process in this work.

Modeling of such complex system is burdened with uncertainty because of many parameters setting up in the starting point of simulation on the base of theoretical deliberations and earlier investigations (e.g. Hombach curve of cohesion energy density δ_c [5], [6] or results of optimization models of dual sorption). More detailed information on the excess energy of the molecules in the contact with arene domains porous system let to more precise modeling of the sorption phenomena in the hard coals.

II. Effects of adsorbate properties in graphite-like pores

Rigorous examination of surface diversity effects on adsorption phenomena may be performed for the discreetly represented graphite-like pores. Thus, it is required for the nanostructure of predefined shape (i.e. niche, cavity) to be formed by the carbon atoms at fixed positions. Such a representation enables to approximate the structure of the single coal arene domain as a graphite-like cavity (see Fig. 1), and hence to consider the individual adsorptive particle movement near the surface. More specifically, the individual particle mass center moving within free space is considered (the volume of space available for the particle). In a free space of volume V_{fi}, the molecule movement is limited by an equipotential surface $U_{bdry}(V_{fi})$. Moreover, at the boundary translation is limited to the surface and hence the movement accounts for two degrees of freedom. Therefore, kinetic energy represented by the temperature $k_B\tau_i$ is compensated by the decrease of, the corresponding to the volume V_{fi}, average potential $U_{avge}(V_{fi})$. Having in mind that the considerations are performed for the individual particle, $U_{bdry}(V_{fi})$ is the only component of the potential generated at the boundary, coming from solid-fluid adhesive forces. Hence, the kinematic equilibrium may be expressed in the following form:

$$\tau_i = \frac{U_m(V_{m_{pi}}) - U_{m_{adh}}(V_{m_{pi}})}{R} \tag{1}$$

where R is gas constant and $U_m(V_{m_{pi}})$, $U_{m_{adh}}(V_{m_{pi}})$ are $U_{bdry}(V_{fi})$ and $U_{avge}(V_{fi})$ related to the one mole of particles, respectively. The volume V_{fi} corresponding to the volume occupied by the molecule mass center is subsequently recalculated as a volume of the moving particle – more detailed see [1].

The analysis of the temperature τ_i and volume $V_{m_{pi}}$ relationship makes possible to gain information on the adsorption mechanisms, when compared to the liquid phase properties (i.e. following classical localized adsorption mechanism assumption - vaporous adsorbate is approximated by the liquid state properties).

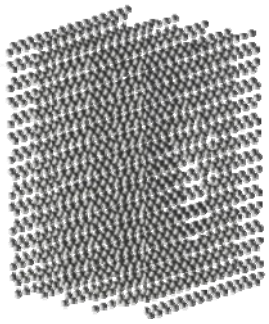

Fig. 1. Arene domain structure approximated by the graphite-like cavity model. The model is formed by the carbon atoms at fixed positions, and hence chemical heterogeneity is neglected. The cavity parameters are 0.7 nm depth and diameter: at the top layer 1.1-1.6 nm and at the second layer 0.8-1.9 nm [7]

The adsorption mechanism identification is a significant step in analysis, with special regard to the comparability of the dissertation on energy aspects of arene domain presence in the coal substance. As discussed in Sect. III MSM arbitrary assume localized adsorption mechanism, and hence it is necessary to define at first, the temperature range at which localized mechanism occurs. Subsequently, having in mind the volume additivity at the localized mechanism range and assuming that the excess energy evolved due to particle interaction with surface carbon atoms may be assumed to be withdrawn, in order to hold the constant temperature in isothermal adsorption, the system parameters may be averaged according to the Maxwell-Boltzmann distribution.

The Maxwell-Boltzmann averaging enables for evaluation of the system parameters, i.e. particular mechanism fractions and its ratio leading to the qualitative identification of the predominating mechanism or kinematic and thermodynamic temperatures. Finally, performed averaging leads to the key parameter in estimation of the energy effects of adsorbate molecules under the adsorption process – averaged molar adsorbate volume $\overline{V_{m_p}}$ at the temperature T (the temperature range may be freely selected). This volume may be seen as a realistic adsorbate molar volume in adsorption system of predominating localized mechanism. Originally it was exploited for calculations of surface texture parameter ζ, employed as a validation parameter when compared to the earlier studies performed in our team [8]. ζ describes possible contact of the adsorbate molecule with the adsorbent surface molecules, and hence may be seen as an effective contact ratio. Thus, it may be calculated taking the values for molar adhesion energy $\overline{E_{adh}}(\overline{V_{m_p}})$ and effective adhesion energy $\overline{U_{m_{adh}}}(\overline{V_{m_p}})$:

$$\zeta = \frac{\overline{U}_{m_{adh}}(\overline{V}_{m_p})}{\overline{E}_{adh}(\overline{V}_{m_p})} \tag{2}$$

In this paper, the application of ζ to the arene domain energy profile analysis is considered. In particular, the molar adhesion energy $\overline{E_{adh}}(\overline{V_{m_p}})$ may be of practical significance, and hence is evaluated applying Berthelot rule by combining adsorbate and adsorbent cohesion energies:

$$\overline{E}_{adh} = 2\delta_c\sqrt{E_{vap}\overline{V}_{m_p}} \tag{3}$$

where δ_c is the solubility parameter of adsorbent matter, E_{vap} is the adsorbate cohesion (evaporation) energy, both referring to the adsorbate reference state (for vaporous substances it is the liquid state).

The van Krevelen method [6] may be applied to calculate the solubility parameter δ_c . Nevertheless, it has to be taken into account that despite the modeled graphite-like cavity model is geometrically heterogeneous, it cannot be treated equivalently with the diverse coal structure. Hence, the value for δ_c was taken to be constant and $\delta_c = 30$ (i.e. it was assumed that graphite-like surface results in decrease of the carbon content). Subsequently, the adsorbate cohesion energy is evaluated with *PVT* relationship for liquid bulk phase [9].

Hence, newly elaborated approach aimed at adsorption mechanism identification provides interesting information on adsorbate properties, enabling to get an insight also in energy aspects for the model approximating arene domains.

III. Multiple Sorption Model

Model divides the sorption process into subprocesses: absorption where cohesion energy of the coal substance plays substantial role, expansion subsystems in which pores has size lower than molecule diameter and must be expanded together with location of the molecule, thus both cohesion energy of sorbent and adhesion energy of sorbates are in use and adsorption subsystem collecting molecules located on the surface of pores bigger than molecule diameter and adhesion forces are relevant to this interactions only. In the purpose of the calculations, system is divided to eleven subsystems, starting from absorption with pores relative radius $R = 0$ nine transitional subsystems $0 < R \leq 1$ related to expansion and adsorption with relative radius $R > 1$, see Fig. 2.

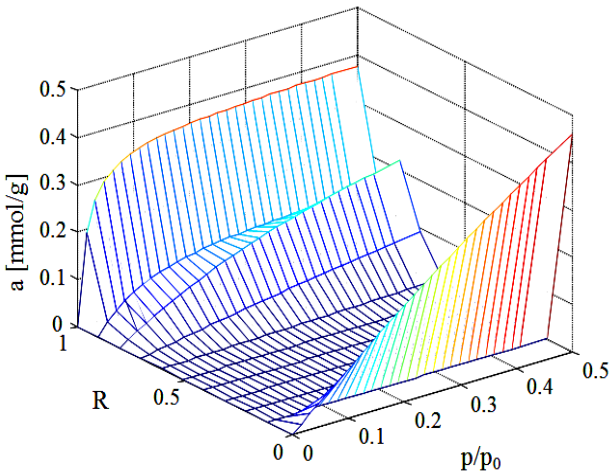

Fig. 2. Exemplary results of multisorption simulation for carbon dioxide and sample of coal

One could observe on the chart (Fig. 2) curves of absorption ($R = 0$) and adsorption ($R \geq 1$) and set of curves describing expansion in the transitional subsystems.

Finally, the adsorption in pores with bigger relative radius (micro-, meso- and macro-pores) is modeled by the formula elaborated for multilayer adsorption with limited

increase of the molecules quantity in the layer called LBET (i.e. clustering based approach aimed at microporous structure characterization) [10]. The model grants to evaluation of multilayer adsorption with aggregates different from BET theory. In such a case model becomes enhanced Langmuir or generalized BET equation dependently on the control parameter.

Polar effects of surface functional groups are taken into account and special coefficient describing possibility of specific interactions for polar sorbates is introduced to the model.

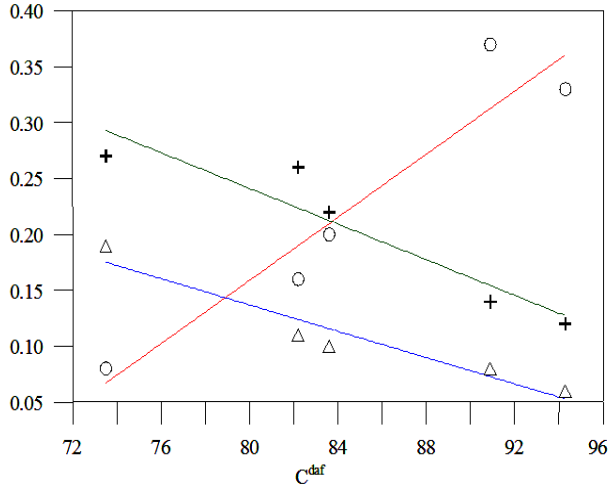

Fig. 3. Tendencies of components content in hard coals vs. carbon content; line description: red – arene domains, green – unconnected chains, blue – pores

In Fig. 3 the tendencies in the changeability of main components of hard coal structure are presented. Content of arene domains strongly increase with carbon content, while unconnected chains and pores decrease. Last one is not strong tendency because some cases of increasing content of pores in coal matter for higher carbon content (above 88% C^{daf}) are stated.

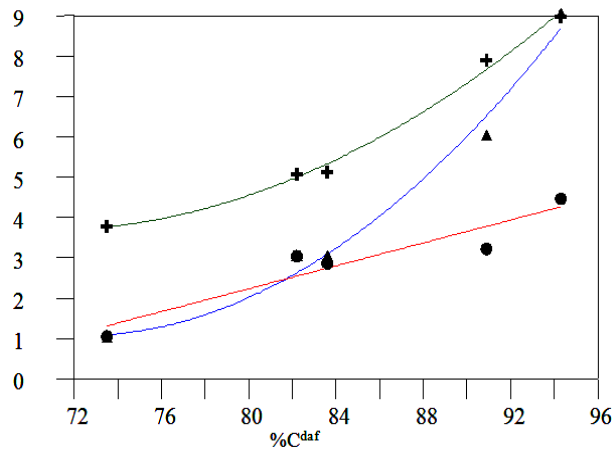

Fig. 4. Composition of arene domains in the coal samples of different carbon content; lines description: red – domain compactness, blue – number of plates in the domain, green – number of plates in the domain

All the parameters of the arene domain structure increase with increasing carbon content in the coal substance what results in growing importance of this component presence in coal structure. Both effects are taken into account in the detailed physicochemical analysis: the entropy of mixing decrease due to the limitation of space available for molecules and enthalpy effects due to the isolation of sorbate molecules in the subsystems.

Energetic parameters of the coal structure and sorption system are evaluated for different sorbates on the range of coal samples (Table 1).

TABLE 1

SELECTED ENERGETIC PARAMETERS OF THE SORPTION SYSTEM

C^{daf}	δ_c	δ_p	χ_A	δ_p	χ_A	δ_p	χ_A	δ_p	χ_A
		H_2O		CH_3OH		CO_2		CH_4	
75.16	28.40	46.4	1.87	28.8	4.81	-	-	-	-
80.88	24.00	46.4	-0.17	-	-	16.0	4.82	10.3	5.49
82.51	24.08	46.4	3.03	28.8	4.67	-	-	-	-
83.31	24.10	46.4	2.69	28.8	7.25	-	-	-	-
84.90	23.82	46.4	1.51	28.8	5.30	-	-	-	-
86.55	22.50	46.4	-1.90	-	-	16.0	3.66	10.3	4.17
86.85	22.80	46.4	3.35	28.8	5.37	-	-	-	-
88.95	22.53	46.4	2.40	28.8	5.22	-	-	-	-
91.49	22.58	46.4	1.98	28.8	6.83	-	-	-	-
92.40	22.86	46.4	1.51	28.8	7.09	-	-	-	-
92.41	23.00	46.4	-2.52	-	-	16.0	5.05	10.3	5.17

The tendency of irregular decrease of the cohesion energy density δ_c is observed up to carbon content 85% subsequently the little increase of this parameter is viewable. This fact has important influence on the sorption energy χ_A as it is an effect of the estimation from the Berthelot Rule:

$$\chi_A \approx \zeta_a \cdot 2\sqrt{\chi_{ph} \cdot \chi_{ch}} \qquad (4)$$

where: χ_A – energetic parameter of the sorption in the system, ζ – geometric parameter of molecule fitting to the pore together with specific interactions for polar sorbates, χ_{ph}, χ_{ch} – energetic parameters related to the cohesion energy density of sorbate δ_p and coal substance δ_c, respectively.

Thus, the cohesion energy of arene domains and molecules on its surface is important issue for the sorption modeling in hard coals and further development is necessary.

Conclusion

Development of the new methods of coal structure parameters estimation and sorption system description is in progress. In particular, the issue of more precise cohesion energy evaluation of sorbate for more complicated system like hard coal is under considerations. It is well understood that complex description of the diverse coal structure is almost virtually impossible. Nevertheless, on the basis of identified coal components parameters it is possible to improve the adsorption system analysis.

In particular it was shown that the formulas elaborated in approach aimed at adsorption mechanism identification may be of practical significance when applied to the MSM. On the basis of evaluated adsorbate properties more adequate insight into the modeling of multiple sorption of different sorbates may be obtained. This comes from the equivalent interpretation of the energy profiles, see. Eqs. (2), (3) and (4), in both presented approaches.

Despite less precise treatment of the coal structure diversity in adsorption mechanism identification approach, the discreet representation of the arene domain structure enable to get an insight into the adsorption mechanism. Hence, it may be found as a possible linking of the presented approaches, especially when analyzing the information gained in adsorption mechanism identification approach as an attempt to predict the particle behavior in more complex systems like hard coals.

Acknowledgements

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Numerical solution of parametric optimization of the resonant vibro-impact system with technological limitations

Volodymyr Gursky

Department of Mechanics and Automation Engineering (MAE), Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: vol.gursky@gmail.com

Abstract – The purpose of research: development of method of optimization of the resonance vibro-impact system stiffness parameters with technological limitations of kinematic and dynamic characteristics. The synthesis is based on a numerical dynamic analysis which uses methods of tackling nonlinear differential system of equations. The discrete algorithm of choice-based optimization of synthesized coefficients of asymmetric lump linear stiffness characteristic with limitations imposed on technological parameters and system frequency characteristics is proposed. Optimal parameters of a vibro-impact machine are determined by the maximum of power criteria, which is the ratio of maximum acceleration of the working mass to the current value of the power consumption of a mechanical system.

Key words – vibro-impact system, resonance, vibratory machine, optimization with limitations, stiffness characteristic.

I. Introduction

Vibrotechnologies are based on detailed analysis of complex nanoprocesses, is directly related to the study and introduction of the nonlinear effects in oscillatory systems, which have significant influence on complex physical and mechanical transformation in the technological structures of mediums. The result is the increase in use of the vibration systems in non-traditional production areas, and also the increase in technological effectiveness of the machines in traditional areas of their usage [1]. The considerable amount of researches are based on application of multi-frequency, especially high-frequency vibrations during surface and volumetric processing, concrete production, screening etc., which are caused by the usage of vibro-impact systems [2].

II. Problem statement

Inertial, stiffness-damping and power parameters of the system are in charge of vibro-impact mode formation, particularly there is a specific coordination between them. The definition of rational (optimal), stiffness and force parameters of vibro-impact systems should be based on an appropriate dynamic analysis. Regardless of considerable subject popularity of nonlinear equations, there are not integral techniques to synthesize appropriate modes and thus be a practical instrument during the development of vibro-impact system of a certain type which has additional limitations.

III. Analysis of the latest research

In particular, multi-frequency of vibro-impact systems is one of the most essential factors, which proves their efficiency. The dynamic features of lump and linear systems are discussed in various scientific works which initiate the dependency to form their frequency and kinematics characteristics [2, 3]. Recently, proper nonlinear systems have been introduced on the level of resonance schemes [4], including the machines with electromagnetic and electromechanical drive [5, 6]. Traditional resonance machines with electromagnetic drive have mild nonlinear properties, which are mainly caused by parametric connections between force and kinematics characteristics [7]. Therefore, there is a tendency to use nonlinear qualities in resonance modes.

IV. Purpose of the article

The article aims at a generalized approach to the synthesis of stiffness parameters of two-mass resonance vibration machine on the condition that a vibro-impact mode is being used. The accent is put on the frequency characteristics of nonlinear systems. In particular, a type of the system performance on synthesized resonance mode has been approved. Besides, meeting the requirements of the basic technological conditions (at which the machine runs), accordance with kinematic characteristics of vibro-impact mode and necessary technological resistance of the system (which works on a resonance mode providing a proper value of resonance zone width) is anticipated.

V. The main statement

The construction of system is structured into two-mass and determined by inertial characteristics of oscillatory masses – mass m_1 is working, mass m_2 is reactive. The masses are connected by an elastic-dissipative element. The system disturbance acquires an impulsive nature. Construction is based by vibro-insulator.

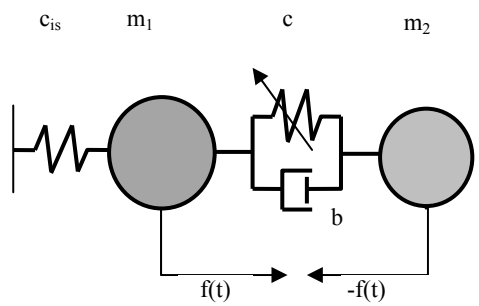


Fig. 1. Vibratory system's structural scheme

The proposed system is designed to mould products made of concrete at high-frequency (50 Hz and over), where one of the essential characteristic of vibro-impact machine mode is an asymmetry coefficient [2] of working mass acceleration:

$$k_a = \frac{a_{1max}}{|a_{1min}|},$$

a_{1max}, a_{1min} – maximal positive value and minimal negative value of working mass acceleration, the recommended value for this process is $k_a = 3...6$. Since the inertial parameters of both oscillatory masses m_1 and m_2 are known, a stiffness characteristic is determined by variable stiffness coefficient c. The bilinear stiffness characteristic will have the following form:

$$c = \begin{cases} c_1, & x \geq 0 \\ c_2, & x < 0 \end{cases}, \tag{1}$$

The synthesis of that stiffness parameters is carried out based on the grounds of the influence of the synthesized coefficients on the kinematic characteristics. Thus, motion equation of a mechanical oscillatory system has a view:

$$\begin{cases} m_1(1+k_{load})\ddot{x}_1(t) + c_{is}\cdot x_1(t) + b\cdot(\dot{x}_1(t)-\dot{x}_2(t)) + \\ + \begin{cases} c_1\cdot(x_1(t)-x_2(t)), \\ \text{if } x_1(t)-x_2(t)\geq 0 \\ c_2\cdot(x_1(t)-x_2(t)), \\ \text{if } x_1(t)-x_2(t)<0 \end{cases} = f(t); \\ m_2\ddot{x}_2(t) - b\cdot(\dot{x}_1(t)-\dot{x}_2(t)) - \\ \begin{cases} c_1\cdot(x_1(t)-x_2(t)), \\ \text{if } x_1(t)-x_2(t)\geq 0 \\ c_2\cdot(x_1(t)-x_2(t)), \\ \text{if } x_1(t)-x_2(t)<0 \end{cases} = -f(t). \end{cases} \tag{2}$$

where, k_{load} – coefficient of technological capacity [2]; $f(t) = F\sin\left(\frac{\omega t}{2}\right)^4$ – idealized law of impulsive electromagnetic system disturbance with an amplitude force value is carried out F (this law is based on imitating modeling); $b = 2\frac{m_1\cdot m_2}{m_1+m_2}\varsigma\omega$ – a coefficient of viscous friction; ς – damping parameters (nonmetric damping coefficient) of driven resonance system as a part of crippling damping for a given system; c_1, c_2 and c_{is} – stiffness parameters of the basic springs and isolators; ω – disturbance frequency.

Model's parameters numerical value are:

$$m_1 = 60\text{kg};\ m_2 = 10{,}5\text{kg};\ k_{load} = 0{,}25;$$

$$\varsigma = 0{,}2;\ F = 1{,}2\ \text{kN};\ c_{is} = 2\times 10^4\ \text{N/m};$$

$$\omega = 314\ \text{rad/s};\ b = 1{,}12\times 10^3\ \text{N}\cdot\text{s/m}.$$

Synthesized stiffness parameters are unknown and defined based on relations:

$$c_1 = \frac{m_1 m_2}{m_1+m_2}\cdot\omega_{01}{}^2, \qquad c_2 = \frac{m_1 m_2}{m_1+m_2}\cdot\omega_{02}{}^2, \tag{3}$$

where $\omega_{01} = \Theta\cdot\frac{\omega}{z}$; $\omega_{02} = \Lambda\cdot\omega_{01} = \Lambda\cdot\Theta\cdot\frac{\omega}{z}$ – proper oscillation frequency values by stiffness coefficients;
Θ – frequency coefficient;
Λ – proper frequency relations; z – resonance settings (takes $z = 1$). Based on this, unknown stiffness characteristics will be defined by the value of synthesized coefficients Θ and Λ:

$$c_1(\Theta) = \frac{m_1 m_2}{m_1+m_2}\cdot(\Theta\cdot\omega)^2, \qquad c_2(\Lambda,\Theta) = \frac{m_1 m_2}{m_1+m_2}\cdot(\Lambda\cdot\Theta\cdot\omega)^2. \tag{4}$$

It certainly simplifies the task in contrast to the synthesis by stiffness parameters, which are located in considerably much wider ranges.

The fixed value of proper oscillation frequency for gapless stiffness characteristic (Eq. (1)) is defined by appropriate synthesized parameters:

$$\Omega_0 = \frac{2\omega_{01}\omega_{02}}{\omega_{01}+\omega_{02}} = \frac{2\Theta\Lambda}{\Lambda+1}\omega. \tag{5}$$

Researched kinematic characteristics essentially depend on synthesis coefficients (fig. 2), accomplished in accordance with kinematic characteristics of a vibro-impact mode and fixed value of proper oscillation frequency (of a resonance zone width) in the appropriate range:

$$\left.\begin{array}{c} 10\text{m/s}^2 < |a_{1min}(\Theta,\Lambda)| < 15\text{m/s}^2, \\ 3 < k_a(\Theta,\Lambda) < 6, \\ \Omega_0\min < \Omega_0(\Theta,\Lambda) < \Omega_0\max, \end{array}\right\} \tag{6}$$

An algorithm for the selection of synthesized coefficient and the calculation of determinant parameters was carried out to tackle the problem (Eq. 6).

The feature of the given algorithms is to meet technological conditions and to search for the maximum of maximal value of working mass acceleration, low power and on the set frequency band. An objective function of the optimization has a view of specific energy acceleration-power criteria, which also depends on factors synthesis

$$\xi_a(\Theta,\Lambda) = \frac{a_{1max}(\Theta,\Lambda)}{p_d(\Theta,\Lambda)} \to \max. \tag{7}$$

$p_d = \text{stdev}[f(t)\cdot(v_1(t,\Theta,\Lambda)) - v_2(t,\Theta,\Lambda)]$ – power of mechanical oscillation system.

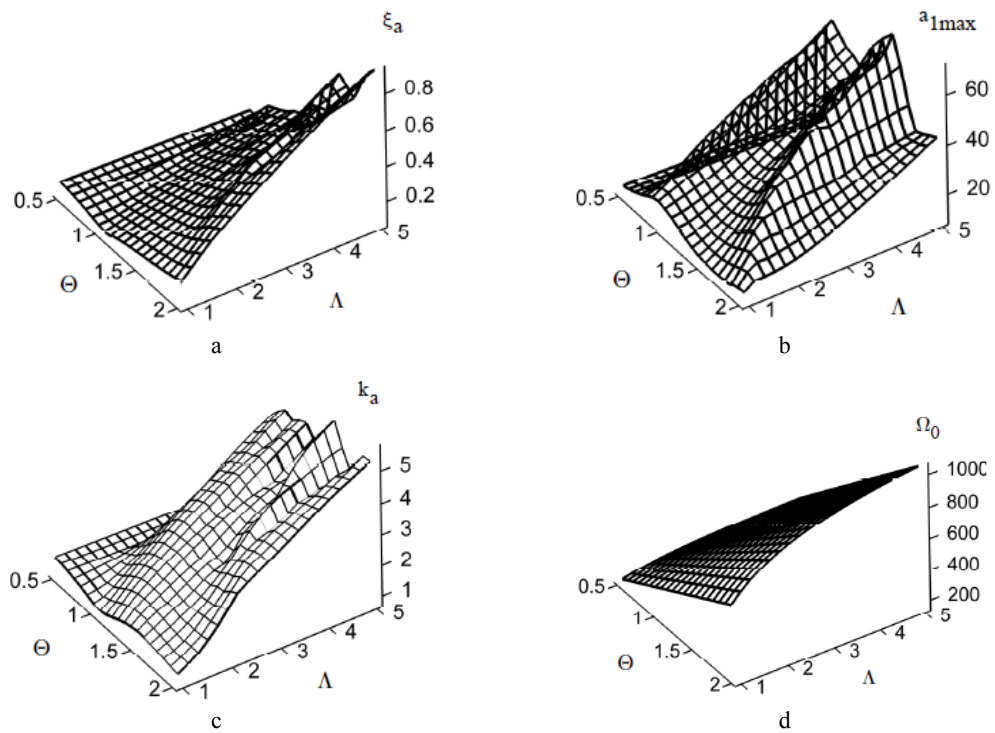


Fig. 2. An objective function (a) and technological limitation (b)-(d) and their dependence on factors synthesis

For solutions of optimization problem was developed the program in MathCAD (fig. 3). Synthesized factors Θ and Λ that provide relevant kinematic constraints are the main results of the program.

```
fstmin := | r ← rows(almax) − 1
          | c ← cols(almax) − 1
          | v ← ζa0,0
          | for m ∈ 0..r
          |   for n ∈ 0..c
          |     if | v < ζam,n
          |        | 3 < kam,n < 6 ∧ 10 < almin m,n < 15 ∧ 55 < Ω0m,n/2π < 70
          |        | v ← ζam,n
          |        | d ← kam,n
          |        | e ← almin m,n
          |        | f ← Θm
          |        | g ← Λn
          |        | h ← Ω0m,n/2π
          | (v d e f g h)
fstmin = (0.253  3.715  13.982  0.85  4.5  69.545)
```

Fig. 3. Program optimization problem of brute parameter's values

The vector of the parameters which are involved in the synthesis by program at the fig.3 in accordance with the main resonance near $50\,\text{Hz}$ within the possible residence of proper oscillation frequency $50\,\text{Hz} < \dfrac{\Omega_0(\Theta,\Lambda)}{2\pi} < 70\,\text{Hz}$ has the following form:

$$\mathbf{X} = \begin{pmatrix} \xi_a \\ k_a \\ a_{1min} \\ \Theta \\ \Lambda \\ \dfrac{\Omega_0}{2\pi} \end{pmatrix} = \begin{pmatrix} 0{,}253\left[\left(m/s^2\right)/W\right] \\ 3{,}715\left[-\right] \\ -13{,}982\left[m/s^2\right] \\ 0{,}85\left[-\right] \\ 4{,}5\left[-\right] \\ 69{,}55\left[\text{Hz}\right] \end{pmatrix}.$$

The main kinematics' characteristic in time – acceleration of working mass is at the fig. 4. It has a pronounced asymmetric view with calculated coefficient k_a.

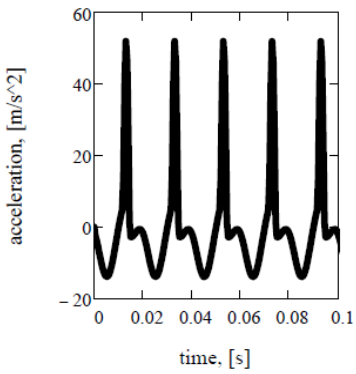
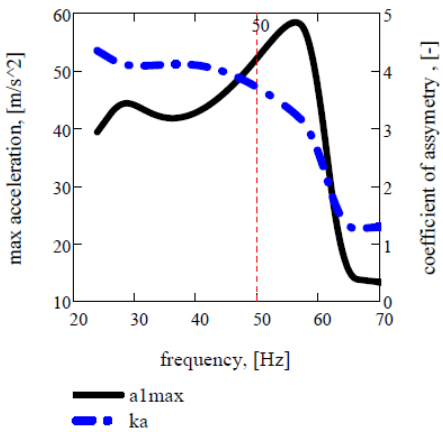
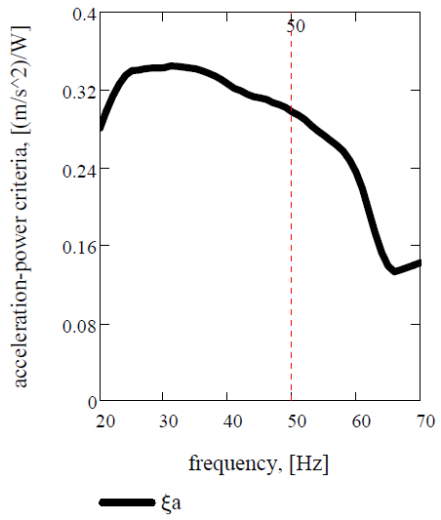


Fig. 4. Acceleration time dependence of the working mass

Frequency dependence of main kinematics and energy parameters are one of the most characteristic's of the resonance systems. The calculated kinematic constraints and power that depend on the frequency of disturbance are on the fig. 5. The chart for maximal value of acceleration (Fig.5, a) indicate near resonance mode, defined by high energy efficiency.



a



b

Fig. 5. Frequency dependence of technological limitations (a) and acceleration-power criteria of a system (b)

Conclusion

The parametric synthesis model of asymmetric lump-linear stiffness characteristic is proposed depending on introduced synthesis coefficients, which determine kinematic and dynamic (in particular frequency) features of vibro-impact system. Optimization problem based on energy criteria, allowing to operate main characteristics of the machine. The results obtained by numerical calculations of differential equations. Also used a program with the evaluation of limitations and the objective function for selection of parameters. The technique is useful for designing of process-type resonant vibration machines.

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Combined Mechanical Systems of Anti-Storm Protection of Horizontal-Axis Wind Turbines

Vitaliy Korendiy, Vitaliy Vergeles

Department of Mechanics and Automation in Mechanical Engineering, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: vitaliy.nulp@gmail.com

Abstract* – *The necessity of further improving of existent regulation mechanisms is motivated for the purpose of increasing of accuracy of power regulation, effectiveness and reliability of wind turbines functioning in wide range of wind speeds. The prospects of creation of combined mechanical systems are considered, where the possibilities of simultaneous blades turning and folding, blades turning (or folding) and wind-wheel deflection out of wind direction are provided.

Key words – wind turbine, anti-storm protection, mechanical system, power regulation, rotation frequency stabilization, blades turning mechanism, blades folding mechanism.

I. Introduction

Real independence of any country substantially depends on the state of its fuel and energy complex. As far as Ukraine is concerned, permanently increasing of electrical energy deficiency, depletion of environmental resources of organic fuels, ecological problems of nuclear and thermal (heat) power plants cause the arising of the chain of essential problems in its fuel and energy complex. Analyzing the experience of advanced countries, obviously, the priority in this problem is given to the application of power-saving technologies and alternative energy sources. And at the same time wind energy is considered as one of the most prospective, developed and ecologically clean power source.

Summary potential of airflows is approximately 50 times larger than total energy necessities of humanity. As to Ukraine, nowadays theoretical sources of wind (or total kinetic energy of airflows) within its territory exceed almost 150 times above electrical power production [1]. Nevertheless, wind sources of the mainland, which can be practically consumed at present stage of wind technique development, exceed almost twice above the amount of power consumption of Ukrainians. Furthermore, except wind energy on the territory of Ukraine it is possible to use highly efficient energy of solar radiation, develop hydropower and bioenergetics stations etc.

As regards the negative influences of wind-power energetics on the environment, noise factors are the most dangerous. The noise level directly near the wind turbine may vary from 32 to 56 dB, and the level of infrasonic pressure – from 96 to 106 dB [1]. Comparing these values with the noise of refrigerator – 40 dB, passenger car – 55 dB, sweeper – 80 dB, blender – 90 dB, we may ascertain the fact that wind turbines are not more dangerous than most of domestic appliances or transport vehicles [1]. All the more, the noise emission during the wind turbine operation doesn't go beyond several hundreds of meters from the basing place.

Thus, it may be stated that our country can completely provide itself with energy due to the use of alternative ecologically clean power sources (wind, sun, rivers and biological sources). And what is more, we might sell the excess of electrical energy and use the gained asserts for further development of alternative power energetics and electric transport and for application of energy-efficient technologies in industry and agriculture. In addition to this, the considered ways of development of Ukrainian fuel and energy complex might allow improving of ecological situation in our country, so far as several wind turbines with total power of 1 MW allow reducing of yearly atmospheric emission of 1800 tons of carbonic acid gas, 9 tons of Sulphur oxide, 4 tons of nitric oxide.

II. Mechanisms of power regulation, rotation frequency stabilization and anti-storm protection of horizontal-axis wind turbines

Wind speed time fickleness is one of unfavorable wind energy features. Wind speed can change few times more during several seconds. This situation negatively effects on characteristics of power, generated by wind turbine, and on strength parameters of its various parts (for example, blades) [2]. Most wind turbines are equipped with special regulation systems for ensuring effective and reliable functioning in conditions of changeable wind speed and load on drive shaft. These regulation systems mainly operate at the expense of blades turning and folding or wind-wheel deflection out of wind direction. Usually electric and hydraulic drives are used in regulation systems of wind turbines of middle and large power (more than 100 kW). Small wind turbines are equipped with mechanical regulation systems for the purpose of cost reduction of their constructions [2].

It is reasonable to equip low-speed multiblade wind turbines with systems of power regulation by means of wind turbine blow-off area control [2]. Multiblade wind turbines have large filling factor of blow-off area. This factor allows effective using of air flow ram pressure on blades surfaces as a driving force for blades folding mechanisms of systems of rotor getting out of wind direction. From the point of view of efficiency and accuracy of regulation it is reasonable to equip high-speed wind turbines (less than 6 blades) with mechanisms of blades turning [2]. However, from the point of view of structure cost reduction it is reasonable to equip high-speed wind turbines with mechanisms of rotor blow-off area control.

Thus, creation of combined mechanical systems, which unite mechanisms of blades turning and folding, blades turning (or folding) and rotor getting out of wind direction is one of priority tasks of further development of horizontal-axis wind turbines constructions. It is planned, that these combined systems will offers all advantages of each regulation method in the future.

Let's consider simplified kinematic diagrams of mechanisms of blades turning and folding of horizontal-axis wind turbine (fig. 1, a, b) [2; 3; 4]. Blades are pivotally connected with rotor hub, which is rotating

round horizontal axis. Blades turning into feather position is realized as a result of regulating slider H_1 movement along wind-wheel axis and changing of hinges C and K positions (fig. 1, a). The process of blades folding is realized by means of regulating slider H_2 movement along wind-wheel axis (fig. 1, b). This slider changes blades angular position relative to wind-wheel axis (rotor tapering or conicity) and wind turbine blow-off area by changing positions of hinges N and E .The force of ram pressure is driving force for blades turning and folding in case of passive regulation. When using inertial regulator, the centrifugal force of regulation weights can be used by way of driving force also [2; 3; 4].

Combined mechanical system of blades turning and folding (fig. 1, c) may be received by combining of the mechanism of blades folding (fig. 1, b) with the mechanism of blades turning round their own longitudinal axis (fig. 1, a). The presence of hinges B and D , which are placed on rotor hub when using combined mechanism, allows blades turning round two mutually perpendicular axes. Mentioned movements can be independent, when sliders H_1 and H_2 are not joined or are connected by spring elements. Also these movements can be dependent, when sliders H_1 and H_2 are immovably joined [2; 3; 4].

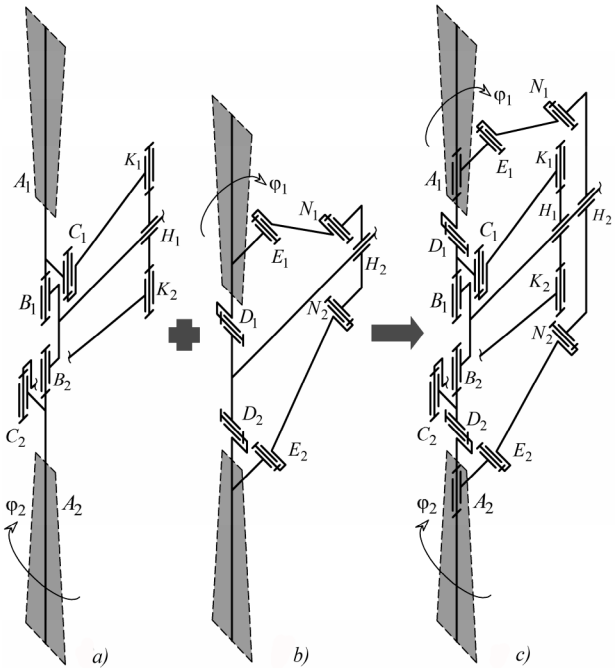

Fig. 1. Kinematic diagrams of the mechanism of blades turning (a), of the mechanism of blades folding (b) and of the combined mechanical system of blades simultaneous turning and folding (c)

When combining the blades turning (folding) system with the mechanism of wind-wheel getting out of wind direction tail-plane joins with nacelle by way of cylindrical hinge and interacts with nacelle through spring element [2]. Wind-wheel can be equipped with side blade, which is used for wind-wheel sideways turning relative to wind direction when wind speed rising over its nominal value. Similar effect can be achieved as a result of wind-wheel axis side-shift relative to tower axis or, in other words, when existing of eccentricity between wind-wheel and tower axes [2].

Conclusions

Each regulation method has its own advantages, faults and usage scopes (high-speed wind turbines with 2-3 blades or low-speed multiblade wind turbines). When analyzing transient modes of wind turbine operation (especially coherent or storm wind gusts), existent mechanical systems of power regulation are not sufficiently effective taking into consideration large detention lag of their actuation and problems of equipping by effective feedback systems. These problems appear when power regulating according to changing of wind speed or load moment on driving shaft. These problems mainly concern to the systems of wind-wheel getting out of wind direction and cause necessity of usage of extra (friction or electromagnetic) wind-wheel braking systems (blades turning or folding systems etc.). That's why, the expediency of combined usage of blades turning (folding) systems and systems wind-wheel getting out of wind direction is substantiated in the article. It is planned, that these combined regulation systems ensure effective and reliable wind turbines operating under conditions of coherent and storm wind gusts. At that, simplified kinematic scheme of the mechanism of blades simultaneous turning and folding is proposed and general principles of its functioning are analyzed.

Further investigations provide for creating of mathematical models of wind turbine aeromechanical system with proposed regulation mechanisms, derivation of analytical dependencies for determination of their inertial and rigidity parameters, realization of computer modelling of wind turbine operating in transient modes and substantiation of expediency of usage of proposed regulation mechanisms.

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Mobile Robotic Systems with Walking Movers and Mechanisms of Orientation

Vitaliy Korendiy, Oleksandr Bushko, Nazar Denderys

Department of Mechanics and Automation in Mechanical Engineering, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: vitaliy.nulp@gmail.com

Abstract* – *The expediency and areas of use of walking machines are substantiated. Three simplest diagrams of cyclic (lever) walking mechanisms (four-link, four-link with possibility of changing the position of the rocker arm rotation axis, six-link) are considered. Principal diagram of the lever mechanism of orientation of walking module with two cyclic movers is propounded and its operating features are analyzed.

Key words – mobile robotic system, walking mover, mechanism of orientation, principal diagram, operation features, motion parameters, mechanical trajectory of the pivot foot.

I. Introduction

Ground-based transport vehicles should be able to move in various operational conditions depending on their designated purpose. In the case when these conditions require vehicles operating at the territory with randomly located roadblocks, the usage of the machines with traditional movers (drives) may be essentially complicated.

The research of alternative movers for transportation vehicles and mobile technological complexes has been held since the time of wheel invention. The caterpillar and walking movers, created in the 19-th century, have steadfastly taken their places in modern technique [1; 2]. The research and development of walking movers and machines are being held in all advanced countries. At the same time because of structure complicity, dynamic unbalance and low power efficiency of walking movers, the introduction of walking machines and robots into industry and agriculture encounters dire difficulties [2; 3]. In spite of the fact that the number of established models of walking machines and robots may be estimated in several hundreds, the overwhelming majority of them are presented as laboratory mock-ups, which cannot be used in actual operating conditions and aren't adapted for real-time use.

The designing of walking machines and robots is hindered by the complexities of practical realization of optimal motion algorithm that meet certain criterions. First of all this problem is associated with difficulty of organization of the interaction between the components of the walking robot and also with the imperfection of the theory of optimal motion of walking machines. For using in various operation conditions and performing large range of tasks, which may be set for walking machines and robots, it is necessary to provide a number of important motion parameters: power efficiency, cross-country capability, roadblocks overcoming, maneuverability, limitation of maximal loads in the transmission, motion comfortableness (limitation of maximal accelerations of the machine body), shockless interaction between the pivot foot and the ground in predetermined positions etc. [1; 2; 3].

II. Cyclic walking movers and lever mechanism of orientation of mobile robotic systems

Over the last few years, a particular interest among researchers and engineers is caused by walking machines based on rigid lever systems, especially movers based on cyclic mechanisms (Fig. 1) [3; 4]. These movers guarantee predefined trajectory of support foot and are characterized as follows: as a walking mechanism they use willing mechanical converter or a new mechanism, synthesized on the chosen trajectory of support foot. The benefits of walking cyclic movers also include the simplicity and reliability of the design of legs (foots) and drives because such mechanisms usually require only one degree of freedom [3; 4].

Let's consider three simplest cyclic (lever) walking mechanisms: four-link, four-link with possibility of changing the position of the rocker arm rotation axis and six-link. Their principle diagrams are presented at Fig. 1.

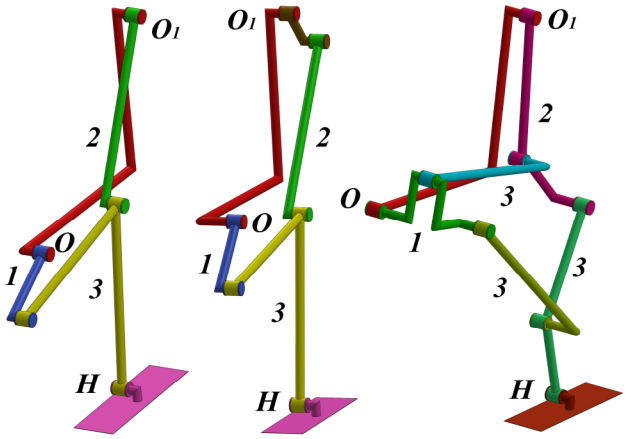

Fig. 1. Principal diagrams of cyclic (lever) walking mechanisms

The motion of all mechanisms occurs due to rotation of the link 1 (the crank). Joints O and O_1 are set on the machine frame (Fig. 1). Link 2 (rocker arm) performs reciprocating rotational (swinging) motion and carries out a role of the supporting element. Other links of the mechanisms are in planar motion and can be used to propel the foot and to provide the support of the machine. The foot is joined to the hinge H that interacts with a support surface, on which the walking machine is moving. The trajectory of the foot depends on the geometric parameters of the machine frame and elements of walking mover. Therefore, to ensure pre-defined parameters of motion (velocity, stride length, height of the foot lifting etc.) structural and kinematic analysis of each of the walking machine movers will be carried out in further stages of research.

In mobile robotic systems based on four or more cyclic walking mechanisms to ensure turning two basic methods are usually used. The first one is based on the difference between angular velocities of the movers on the left and right sides of walking machine. In the second method the additional lifting appliance is used, which raises the machine frame with walking movers above the supporting

surface, turns to the desired angle and puts down until the feet contact with the ground.

Talking about the walking machine with two cyclic movers, then the use of the first method of turning in this case is impossible because of the following necessity: walking machine movers must move simultaneously in opposite phase. The second method of turning is too difficult and expensive because it requires additional systems of lifting and turning the machine. Alternative variant in this case can be a lever steering walking mover, which schematic diagram is shown at Fig. 2.

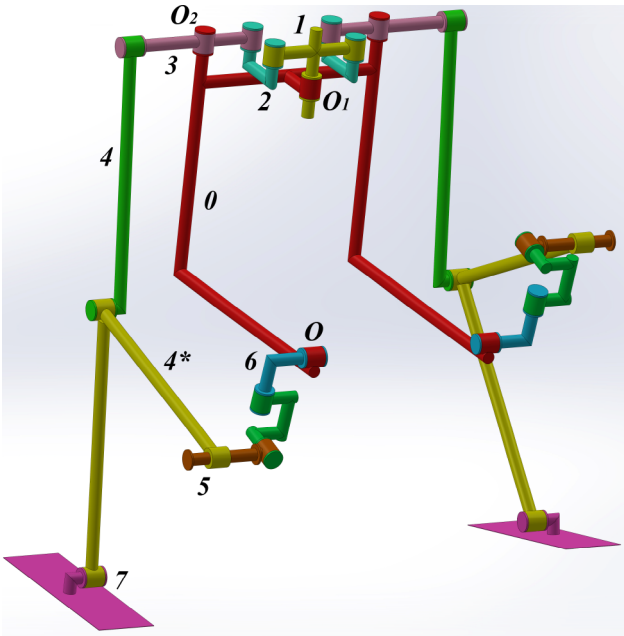

Fig. 2. Principal diagram of lever mechanism of turning of walking module based on two cyclic movers

Cyclic walking mover consists of the crank 6 and rocker arm 4 (Fig. 2), which are pivotally joined to the frame 0 at points O and O_2, respectively. The motion from the crank 6 to rocker arm 4 is transmitted through the floating link 4* designed as a curvilinear rod. In order to provide the opportunity of turning the walking mover the rod 4* joins with the crank 6 by using the slide 5, the directing rail of which can freely rotate around the axis of the crank 6. The axis of rocker arm 4 is set on the rotary shaft 3, the other end of which is connected to the four-link lever mechanism of turning (0-1-2-3). The drive mechanism for turning one link pivotally is joined to the frame 0 point. The drive link 1 of the turning mechanism is pivotally joined to the frame 0 at point O_1.

Lever mechanism of turning (Fig. 2) works as follows. The rotating motion from the crank 1 is transmitted through a system of levers 2 and 3 to the rocker arm 4 of the walking mover. The axis of rotation of the rocker arm 4 changes the angle of its position relative to the machine frame and through the floating link 4* changes the direction of the supporting foot 7. It should be noted that the rotation of the foot 7 is only possible at a time when it is not in contact with the supporting surface, that is in transferring phase. Thus, during the design process of the mechanism it is necessary to ensure alternate turning of the supporting feet on each side of walking machine.

Conclusions

The vast majority of ground-based transport vehicles have wheel or caterpillar movers. The necessity of their usage and further improvement is substantiated by relative simplicity of structure and high efficiency of operation. However, there are such operational situations where the usage of wheel or caterpillar movers is impractical, ineffective, and sometimes even impossible. So the research relating to the development of new types of movers which meet the requirements of high profile and ground permeability, environmental friendliness, mobility, etc. are continually conducted [1-4]. They particularly include walking machines.

The usage of walking method of motion allows qualitative improving of a number of basic indicators of transport vehicles in comparison with the wheel and track movers. In particular, there are more opportunities of adaptation to uneven supporting surface, the higher profile permeability and mobility, the ability of the machine motion in any direction and rotation in place, the ability to work on soils with low bearing capacity, controlling the supporting reactions and stabilizing body position while moving.

The vast majority of modern mobile (walking) robotic systems are equipped with various modifications of pantograph or insectomorphal movers. The main disadvantage of insectomorphal movers is increased power consumption due to the necessity of supporting of the machine weight. Disadvantages of pantograph walking mechanism consist in relatively large size of feet with two or more degrees of freedom, the complexity of structural implementing of legs due to the presence of translational kinematic pairs and the necessity of changing the orientation walking planes for orientation.

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Substantiation of Usage Expediency and Analysis of Exploitation Problems of Low-Power Wind Turbines

Vitaliy Korendiy, Vitaliy Vergeles

Department of Mechanics and Automatization in Mechanical Engineering, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: vitaliy.nulp@gmail.com

Abstract *– Wind energy is considered as one of the most perspective, developed and ecologically clean energy resource. Nevertheless, it is associated with several harmful factors which influence environment. That's why basic causes and zones of vibration initiation in wind turbines, as well as negative vibratory and acoustic factors of wind turbine influence on natural beings, are analyzed. In conclusion it is substantiated that the ecological problems of low-power wind turbines may be neglected and they should be widely used for economic development and energy independence improvement of our country.*

Key words – wind turbine, blades vibrations, acoustic influence, energy of air-flow, alternative energy sources, harmful factors, noise and vibrations.

I. Introduction

The growth of the usage scale of electrical energy, gradual exhaustion of traditional energy sources (oil, gas, coal etc.), aggravation of the problems of environment protection have intensified the search of ecologically clean methods of electrical energy production. Such directions of alternative and renewable power engineering as solar, wind, geothermal, biogas etc. that have practically inexhaustible supplies are actively developing.

Wind energy has weighty ecological preferences in comparison with other traditional and alternative sources. They consist in the absence of any environmental pollutant emission while energy producing, necessity of additional water cooling, requirements to special features of the power plant locating territory (presence of rivers, lakes, rich soils etc.). Unlike the heat power engineering, which is the main source of greenhouse gases and other unhealthy pollutants of the atmosphere wind turbines are much less harmful for environment. In itself output and processing of the coal, oil and gas cause pollution. Nuclear and heat electrical power stations require the presence of large lakes for cooling the power-generating units. Any other fuels which product the energy due to burning (firing) spend some part of the heat for environment warming and cause its heat pollution. And although wind-turbine electric plants occupy much larger areas than traditional power plants, nevertheless, 90% of the territories of wind farms locating can be used for the needs of agriculture or industry [1; 2].

In spite of the chain of preferences, airflow energy causes some harmful influences on the environment. Wind turbines may obstruct the radio wave propagation, influence the natural migrations of birds etc. However, the special attention should be payed to the noise and vibration pollution of the territories adjacent to wind turbines location [2; 3].

II. Vibration and acoustic influence of wind turbines on environment

Noise is one of the most dangerous and harmful forms of the wind turbines influence on environment. However, its emission is bounded by several hundreds meters from the place they are located (Fig. 1). If a man stays in direct nearness to the wind turbine for a long time (e.g. technician, engineer, maintenance man) the acoustic influence is wide-band [2]. The noise level against frequency may vary from 32 dB to 56 dB and the level of infrasound pressure – from 96 dB to 106 dB. In both cases the requirements of state sanitary norms are kept.

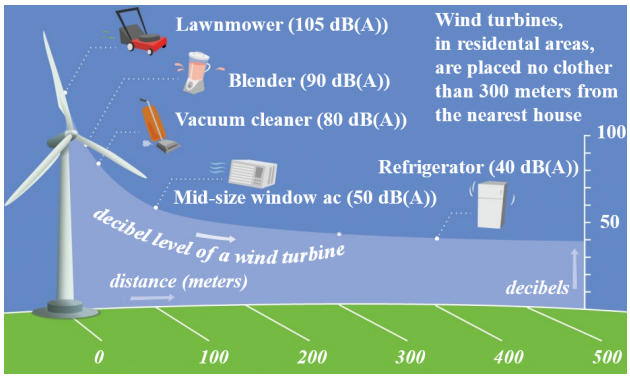

Fig. 1. The dependence of noise level on the distance between wind turbine and research object

Noise during the wind turbine operating may be provided by two main reasons: aerodynamic interaction between the blades and the airflow. It resembles the whistle when the air flows along blades surfaces; 2) mechanical friction between different parts of the plant, such as bearing box or electric generator [4].

Infrasound in wind turbines is weakly generated as a result of blades interaction with airflow. On the blades tips the air swirl appears caused by pressure differential on two opposite sides of a blade. This effect is called flow stall (Fig. 2) and essentially influences not only infrasound generating but also vibration emission, power reduction and decreasing of durability of wind turbine blades operating. The frequency of the infrasound may reach 6-7 Hz which is practically the same as natural rhythm of human brain and can influence his/her psychological state [3; 4]. Thus, these disadvantages are typical for wind turbines of megawatt class, whereas wind turbines of low and middle power in this case are much more undangerous and safer than railway transport, automotive vehicles, trams etc.

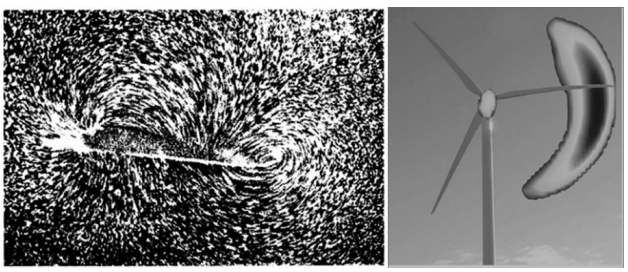

Fig. 2. The effect of flow stall and its acoustic influence

During the wind turbine operation aerodynamic, inertial and gravitational time-dependent loads act upon its elements and cause the vibrations of different parts (blades, nacelle, tower). These vibrations may be transmitted to the wind turbine foundation. Together with constrained oscillations caused by the action of external forces the vibrations may appear as a result of unbalanced masses of different parts of a wind turbine: windwheel with blades, step-up gear, generator etc.

To a considerable extent, airflow fluctuations and turbulence influence exactly the blades. Most of blades loads have time-dependent pattern and their amplitudes and frequencies steeply rise while increasing of the wind turbine overall sizes and worsening of weather conditions (sudden wind gusts with simultaneous changing of its speed and direction).

Dynamic vibrations appears in the majority of cases as a result of static disbalance of the windwheel, that is the displacement of its gravity center due to the difference between the blades masses. Vibrations may also appear as a result of nonuniform distribution of the snow or hitting the blades by other objects. Disbalance causes the vibrational displacements of different parts of a wind turbine, which harmfully influence its structure and may produce noise and infrasound. However, modern technologies of the windwheel balancing, installation of vibrated insulating and damping systems allow completely avoid static and reduce dynamic disbalance to the safe level [4].

Conclusions

One of the main arguments against wind turbines usage is noise. Wind turbines produce two types of noise: mechanical and aerodynamic. Mechanical noise is generally produced by the many different components of the wind turbine, such as the generator, the hydraulic systems or the gearbox. Various mechanical noise prevention strategies exist, such as vibration suppression, vibration isolation and fault detection techniques, which are described in the paper [4]. The noise value of modern wind turbines of middle power at the distance of 20 m reaches 34-45 dB. In comparison with wind turbines the noise level in a town at night approximately equals 20-40 dB, when driving a car on the block pavement road – 55 dB, while using a perforator – 95 dB [3]. That's why we may consider wind turbines as the same noise producers as the other domestic and customary technique (lawnmower, blender, vacuum cleaner, refrigerator etc.).

Infrasound and vibrations also harmfully influence the environment. During the wind turbine operating, on the blades tips the air swirl appears which is actually a source of infrasound. The larger wind turbine power and sizes are, the more harmful influence of these effects on environment is revealed. Strategies for reducing aerodynamic noise include adaptive solutions and wind turbine blade modification methods [4]. Adaptive noise reduction techniques include varying the speed of rotation of the blades and increasing the pitch angle. Although such strategies have been successfully implemented for noise reduction purposes, they can cause significant power loss [4]. Therefore, alternative adaptive solutions are sought. Blade modification methods such as adding serrations have proven to be beneficial in reducing noise without any power loss [4]. As for vibrations reducing, modern technologies of the windwheel balancing, installation of vibrated insulating and damping systems allow completely avoid static and reduce dynamic disbalance to the safe level.

Thus, these disadvantages are typical for wind turbines of megawatt class, whereas wind turbines of low and middle power in this case are much more undangerous and safer than railway transport, automotive vehicles, trams and other sources of infrasound with which people deal every day.

As for the advantages of the wind turbine usage, widespread application of wind turbines will positively influence the dynamic of the ozone layer reducing and, respectively, the intensity of the global warming. In addition, the stocks of water and traditional energy resources (coal, gas, oil etc.) will not reduce so quickly, because wind turbines in comparison with nuclear and heat power stations do not need cooling and do not cause the exhausting of the earth bowels.

Analyzing aforecited facts, we may confidently say that from the ecological point of view wind turbines of low and middle power do not cause essential harmful influence on environment. As a practical confirmation of this conclusion, we may take into consideration the fact that wind power engineering steeply develops in European Union, USA, China and other countries. In general, the energy of airflow can completely provide the increasing energy needs of humanity. Nowadays modern wind turbines produce more than 200 billion kilowatt-hours per year, which is approximately equal to 1.3% of the global world electrical energy producing. At the same time in some countries this rate reaches 40%.

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Simulation model of dynamic processes during friction hardening of the flat surfaces

Volodymyr Gurey[1], Petro Dmyterko[2]

[1]Mechanics and Automation Machine Building Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: vgurey@gmail.com

[2]Machine Building Technologies Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: dmyterko.petro@gmail.com

Abstract – Simulation model of dynamic processes during frictional hardening the flat surfaces of assembly parts was developed.

Key words – conference, conference proceedings, paper layout, paper sample, research paper, friction hardening, simulation modeling, dunamic processes.

I. Introduction

Urgent task of modern mechanical engineering is providing appropriate surface condition which determines the performance properties of machine parts. This led to forming of a new branch in mechanical engineering – the surface engineering. The development of surface engineering involves the development of new processes that modify the surface layer, drastically change its structure and properties. For modification of metals' surface, methods of surface processing with application of the concentrated flow of thermal energy are used. During the friction processing, an intense source of thermal power appears due to high-speed friction of the tool on the assembly part in the area of contact. There is also intense shear deformation of the surface layer of the metal. To increase the shear deformation a tool with transverse grooves cut in its working surface [1] is used. In the superficial layers of metal, reinforced nanocrystalline surface layers are formed. Intensive dynamic processes occur during friction hardening.

II. Analysis of Recent Research and Publications

Simulation modeling is a versatile method for studying dynamic systems, the behavior of which depends on random variables. Such factors when considering the dynamics of surface hardening during friction treatment may include disturbances that occur in the treatment zone. In the basis of simulation modeling lays statistical experiment, the implementation of which is impossible without the use of computer technology. Integration of one of the fastest matrix mathematical systems (MATLAB with Simulink package) opens up new possibilities of using different mathematical methods for solving problems of dynamic situational simulation of complex engineering systems, processes and devices. Package Simulink for simulation of dynamic systems is one of the best tools of modeling of dynamic systems [2].

The Simulink Package allows reducing the terms of design, improving the quality of technical systems development models and modeling processes that occur in these systems. The package Simulink fundamentally changed the nature of the requirements placed on mathematical software: to manage the whole course of the calculation process graphical modules used to create block diagrams of the systems are developed.

The process of frictional hardening of the working surfaces of machine parts is similar to the grinding process in kinematics. At the same time, in the formation of nanocrystalline hardened layer during friction hardening, the workflow is different from the process of grinding in force, temperature interactions that occur in the contact zone of the tool with the assembly part. In frictional enhancing there is virtually no surface layer cutting process, there occurs the process of high-speed friction in the contact zone of tool with the assembly part, there is intense shear deformation of the surface layer. Currently, the studies of dynamic processes during frictional hardening, including the interrupted hardening, are absent.

III. Body Part

Friction on the principle of strengthening its performance is similar to grinding. Therefore, for its implementation surface grinding machines, or OD grinding machines, or specially designed equipment can be used. Friction strengthening of flat surfaces was performed by upgraded surface grinding machine SPC-20a. To strengthen the necessary friction, linear velocity at the periphery of the tool shall be V_{tool} = 60-80 m/s, so the main machine component has been upgraded. Instead of abrasive wheel metal tool disc made of carbon structural steel 45 in normalized condition was set.

The metal disc was installed directly on the machine spindle cone to reduce its beating and therefore vibrations that are transmitted to the spindle hub. To increase the shear deformation in the surface layers of the assembly parts in the contact zone tool-detail during frictional strengthening, a tool with transverse grooves cut in the working part was used. The width of the groove was chosen from the condition of guaranteed full disengagement of the tool and assembly part.

The oscillating system of the machine is two-mass and shown in Fig. 1. For ease of analysis of the oscillatory processes, we will change the two-mass oscillating scheme to one-mass [2], in which the shown mass of the machine table will oscillate on spring-elastic elements with a present deflection rate relatively to the immovable center of the rotation tool (Fig. 2).

The interference between the assembly part and the tool (vertically) will be modeled by contact stiffness and damping power of local elastic-plastic deformation of the assembly part surface.

We write the differential equation that describes the forced oscillations of the table and the assembly part with respect to a fixed center of rotation of the tool in the vertical direction:

$$\frac{d^2 y_{table}}{dt^2} m^*_{table} + c_{contact}\left(y_{table} - y_{tool.}\right) + \\ + k_{contact}\left(\frac{dy_{table}}{dt} - \frac{dy_{tool}}{dt}\right) + c^*_{table-v}\, y_{table} + \\ + k^*_{table-v}\frac{dy_{table}}{dt} = 0 \qquad (1)$$

where: m^*_{table} – reduced weight of the table (kg);

$$\frac{1}{m^*_{table}} = \frac{1}{m_{table}} + \frac{1}{m^*_{spindle}} \qquad (2)$$

$m^*_{spindle}$ – brought to machine tool spindle weight (kg);

$$m^*_{spindle} = m_{tool} + \frac{1}{3} m_{spindle} \qquad (3)$$

m_{tool} – weight of the tool (kg); $m_{spindle}$ – weight of the machine spindle shaft (kg); $c_{contact}$ – contact stiffness between the tool and assembly part (N/m); $k_{contact}$ – damping coefficient between tool and assembly part (internal damping) (Ns/m); y_{tool} – vertical movement (coordinate) of the tool (m); $c^*_{table-v}$ – reduced vertical stiffness of the machine (N/m), $k^*_{table-v}$ – harmonized machine damping (Ns/m);

$$\frac{1}{c^*_{table-v}} = \frac{1}{c_{table-v}} + \frac{1}{c_{spindle-v}}, \\ \frac{1}{k^*_{table-v}} = \frac{1}{k_{table-v}} + \frac{1}{k_{spindle-v}}. \qquad (4)$$

$c_{table-v}$ – vertical stiffness of the machine; $c_{spindle-v}$ – vertical stiffness of the machine tool spindle; $k_{table-v}$ – vertical damping factor of the machine table; $k_{spindle-v}$ – vertical spindle machine damping coefficient.

Fluctuations in the horizontal plane of the machine table (Fig. 4) will be caused only by force of friction between the tool and the assembly part, since the transfer of momentum in the horizontal direction is necessary that the interference angle would be less than the angle of friction [3], which in this case is impossible.

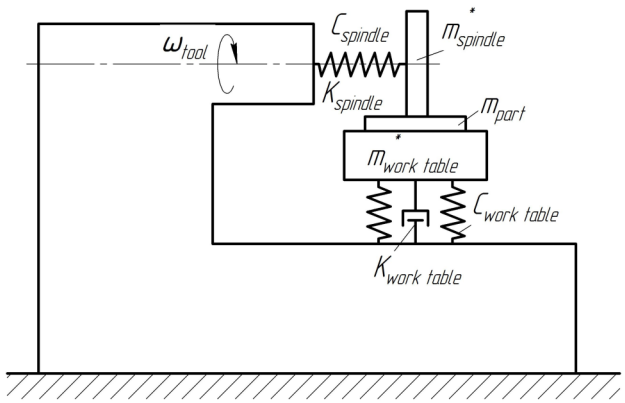

Fig. 1. Oscillating scheme of the machine

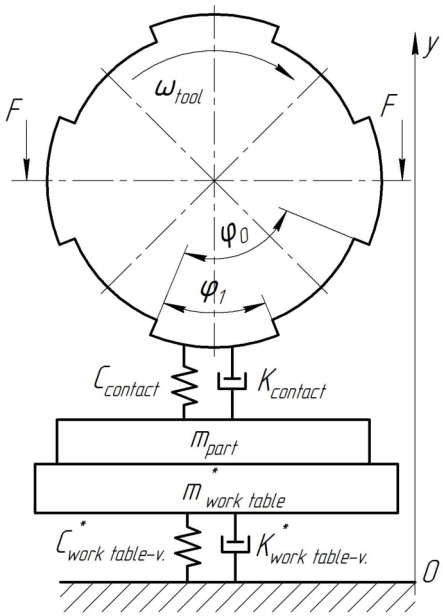

Fig. 2. Reduced to one-mass oscillating system with vertical fluctuations of the machine

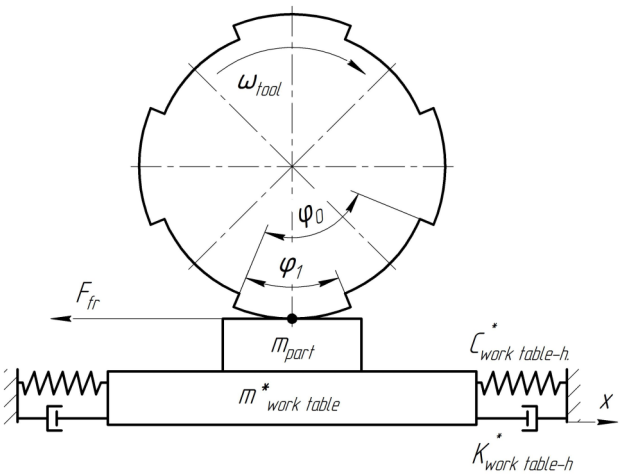

Fig. 3. Reduced to one-mass oscillating system with horizontal fluctuations of the machine

We construct a differential equation for the horizontal plane (axis) of the machine:

$$\frac{d^2 x_{table}}{dt^2} m^*_{table} - F_{fr} + \\ + c^*_{table-h}\, x_{table} + k^*_{table-h}\frac{dx_{table}}{dt} = 0 \qquad (5)$$

where: $c^*_{table-h}$ – reduced horizontal stiffness of the machine tabl; $k^*_{table-h}$ – harmonized horizontal machine damping;

$$\frac{1}{c^*_{table-h}} = \frac{1}{c_{table-h}} + \frac{1}{c_{spinde-h}}, \\ \frac{1}{k^*_{table-h}} = \frac{1}{k_{table-h}} + \frac{1}{k_{spindle-h}}; \qquad (6)$$

$c_{table-h}$ – horizontal stiffness of the machine table; $c_{spindle-h}$ – horizontal stiffness of the machine spindle; $k_{table-h}$ – horizontal machine damping coefficient; $k_{spindle-h}$ – horizontal machine spindle damping coefficient; $c^*_{table-h}$ – the friction between the tool and the surface of the assembly part (N); f - coefficient of friction between the materials of tool and the assembly part.

The friction between the assembly part and the tool will be determined by the equation:

$$F_{fr} = c_{contact}\left(y_{table} - y_{tool}\right) f \qquad (7)$$

where: $c_{contact}\left(y_{table} - y_{tool}\right)$ – the value of the normal reaction between the tool and the assembly part.

$$\left(y_{tool} - y_{table}\right) > 0 \text{ then } c_{contact} = 0;\ k_{contact} = 0 \qquad (8)$$

This condition implies the absence of contact stiffness in the absence of contact between the tool with the assembly part at the time of passage of the groove on the working surface of the tool over the zone of contact $c_{contact}\left(y_{table} - y_{tool}\right)$.

Numerical solutions of differential equations by the Runge-Kutta methods (1) (5) with the condition (8) for the actual experimentally determined parameters of the described above machine SPC-20a shown in Fig. 6–7. Tools of cut transverse grooves the number of which is equal to $n = 2$ for which the angle of the working segment is $\varphi_0 = \pi$, and the ratio of the working surface to the groove is $\varphi_1 = 0.5\varphi_0$. Tool radius $R = 0.1$ (m), it rotates with the angular velocity $\omega = 500$ (rad/s) and is pressed against the assembly part with force equal to 1,000 *N*.

To generate a signal which describes the rotation of the tool, we will use a tool from the library of Simulink – "Repeating Sequence". The diagram describing the rotation of the tool, i.e. a full rotation (2π) at a given angular velocity of ω, is shown in Figure 3.

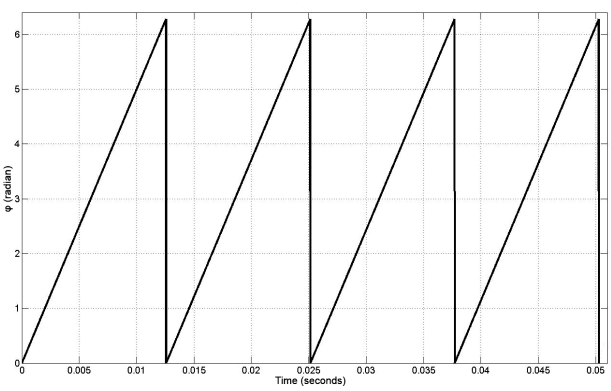

Fig. 4. Generation of a signal, which reflects the rotation of the tool

The mathematical model of interfering friction strengthening of flat parts is shown in Fig. 5. To display the block diagram of the model in general were applied power subsystems (Subsystem), which include: the rotation of the disk passing through the contact area and the smooth part of the groove, the solution of differential equations and the transfer of data via WorkSpace to Matlab. In the subsystem "Table oscillation in vertical direction" the equation of motion of the system in the vertical direction is represented by appropriate elements (Fig. 6), and in the subsystem "Table oscillation in horizontal direction" respectively in the horizontal direction (Fig. 7). To simulate contact of each smooth part and groove a cycle is used, i.e. "For Iterator Subsystem". This subsystem includes the checking of the position of the smooth and the groove as in the point of contact with the assembly part and check the conditions of contact with the mutual movement of the parts and the tool vertically. The constant "n", sets the number of cycles of the operator "For Iterator Subsystem". Since each test of the conditions of the contact provides relevant individual values with respect to time, then combining them into a single signal that goes to the output of this subsystem uses the block "Sum".

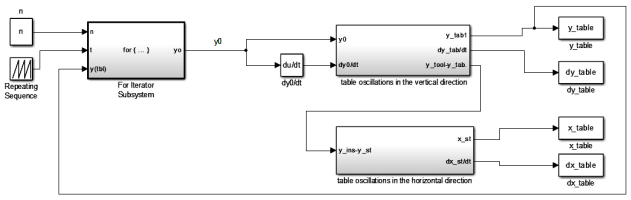

Fig. 5. Mathematical modeling of interfered friction strengthening of flat parts

With the help of the block "To WorkSpace", after the calculation of differential equations system, the results are written to the workspace of MATLAB. Using additional m-file we build needed graphs using the data workspace. In Fig. 6-7 graphs of movement of the machine table in the vertical and horizontal directions are shown.

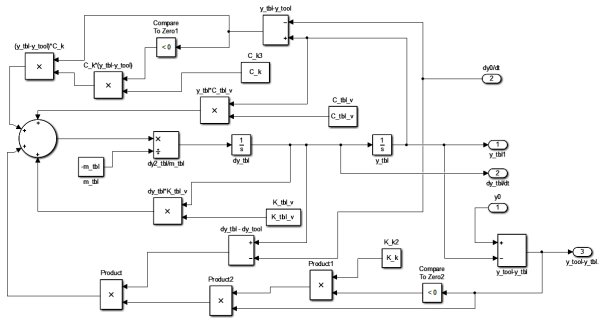

Fig. 6. Subsystem "Table oscillation in vertical direction"

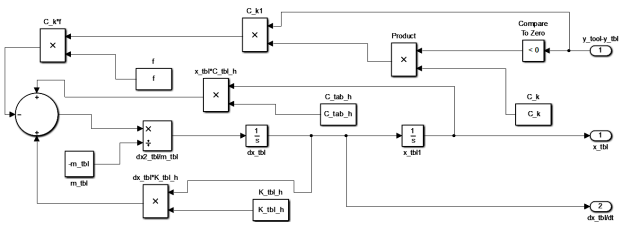

Fig. 7. Subsystem "Table oscillation in horizontal direction"

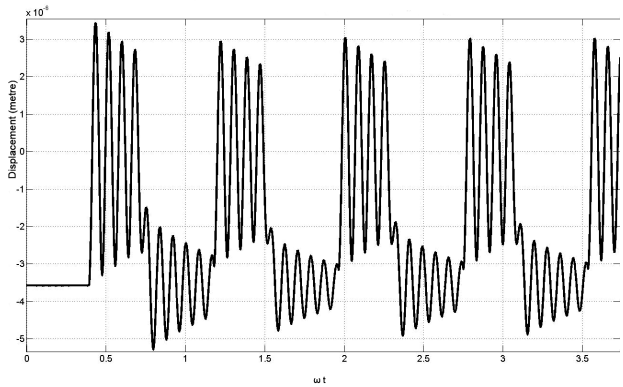

Fig. 8. The part displacement in vertical direction during frictional hardening

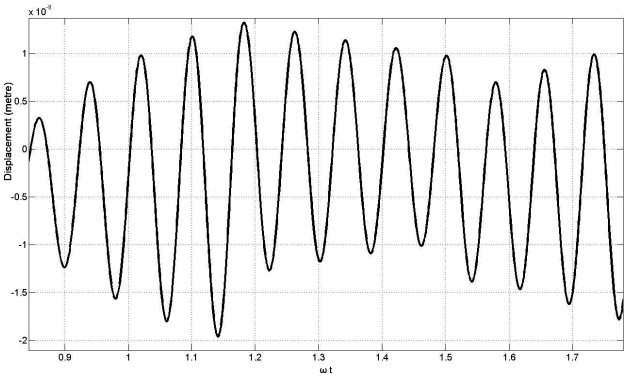

Fig. 9. The part displacement in horizontal direction during frictional hardening

Conclusion

The developed simulation model of the dynamic parameters of frictional strengthening allows exploring the processes that take place during frictional strengthening of machine assembly parts. Also it is possible to determine the influence of frictional strengthening process, the working part, the rigidity of the technological system's parameters on the behavior of dynamic characteristics of the machine.

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Features of Using the Structural Damping in Construction of Cutting Tools

Yurii Novitskyi

Department of Manufacturing Engineering,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: iurii.novitskyi@gmail.com

***Abstract* – The influence of internal friction parameters in the joints of structural elements on the machine for vibration amplitude of cutting tool and detail was analyzed. The possibility of effectively suppress the amplitude of oscillation of the cutting tool by selecting optimal parameters of frictional connection of the cutting blade was shown.**

Key words – structural damping, cutting tools, oscillations, amplitude, resonance, friction.

I. Introduction

As you know, oscillations that occur in the process of cutting metal, a negative impact on the quality of surface details, and the stability of the machine tool and resource. Because these oscillations occur in one of the resonant frequencies VPID system (usually at a very high frequency), then the decrease in amplitude oscillation damping uses [1], the impact of which is particularly effective for resonance and near the resonant frequencies. Effective damping is achieved through the use of internal friction in the joints still VPID elements of the system, known as structural damping [3] machine elements. The influence of structural damping of the amplitude fluctuations can be estimated by the following data. Logarithmic decrement damping of the lathe is 0.23 - 0.25 [4], while for ordinary steel its value is 0.02 - 0.04. It should be noted that the development of modern machine tools made toward reducing structural damping through the use of guide bearings. However, high value decrement is not a sufficient condition for oscillation absence, or smallness of their amplitudes. In [2] showed that it is link tool - detail is responsible for self-oscillation and the introduction of high damping in massive structural elements such as machine tool spindle and the caliper does not reduce the amplitude of oscillation of tools and parts. The most effective damping is the introduction of the least massive element, usually it's cutting tool and very rarely - detail. Therefore, designing instruments with high value of the logarithmic decrement zatuhan is an urgent task, especially for cutting hard materials.

II. Discussion

The scattering of energy in the oscillations fade, can be characterized Absorption [3], which is equal to

$$\psi = \frac{\Psi_n}{\Pi_n} = \frac{A_n^2 - A_{n+1}^2}{A_n^2} \approx \frac{k}{m} T \approx 2\delta \,, \qquad (1)$$

where Ψ_n – the energy dissipated during the n-th cycle fluctuations and Π_n - potential energy at the beginning of that cycle. In the case of cyclic loading strength thin plate αP_y, uniform pressure to squeeze to hard p basis for the length l (Fig. 1), the displacement of the plate relative fundamentals will not occur until the condition is performed:

$$P_y < fpbl \,, \qquad (2)$$

where f - coefficient. friction, b - width of the plate, α - dimensionless parameter load. At maximum load $\alpha = 1$, and at a minimum - $\alpha = r$, where $r = P_{y\,\min} / P_{y\,\max}$ - characteristic asymmetry of the cycle.

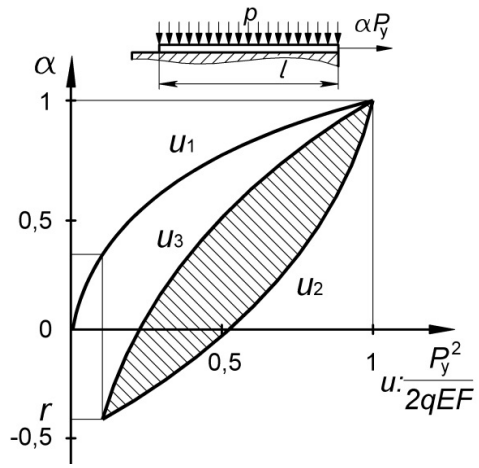

Fig. 1. Hysteresis loop Ψ

Fig. 1 shows the formation hysteresis loop between the thin plate and rigid base area which characterizes the energy dissipated during a cycle fluctuations. On the vertical axis delayed relative movement end plate from 0 to 1. This full shift plate relative to fundamentals impossible because of the condition (2), that shift will only occur in a certain length of the plate, and the greater the length of this shift, the greater the area hysteresis loop (Fig. 1), and hence the energy dissipation. The value of this energy can be calculated by the formula [3]

$$\Psi = \frac{P_y^3 (1-r)^3}{12qEF} \,, \qquad (3)$$

where $q = fpb$ – the threshold friction force (per unit length of the plate or cutter clamped in the tool carriers); E – modulus material plates (cutter body); F – cross-section area of the plate (the body of the tool).

From the analysis of Fig. 1 and (3) we can conclude that the pressure pressing plates (a cutter tool carriers) affects the energy dissipation in the connection. The less pressure, the greater the energy dissipation, but with decreasing pressure should come true condition (2). This is the tracker and shown in Fig. 2. solid curve 1. In order to prevent displacement of the tool in the tool carriers in achieving maximum energy dissipation, cutter should be fixed in stubborn resistance. This situation is reflected bar dotted curve in Fig. 2. Thus, as can be seen from Fig. 2, there is an optimal pressure value on the cutter, which corresponds to the maximum value of energy dissipation.

The scheme of fixing tool in the tool carriers shown in Fig. 3 Since the passing cutter fluctuate in a horizontal plane x - y, then it need additional support along the axis x, and it should be regulated. All this would require

structural changes to the machine tool carriers. Ideally it would not make changes to the design of tools, and to design appropriate instruments that would have sufficient energy dissipation to self-oscillation does not occur.

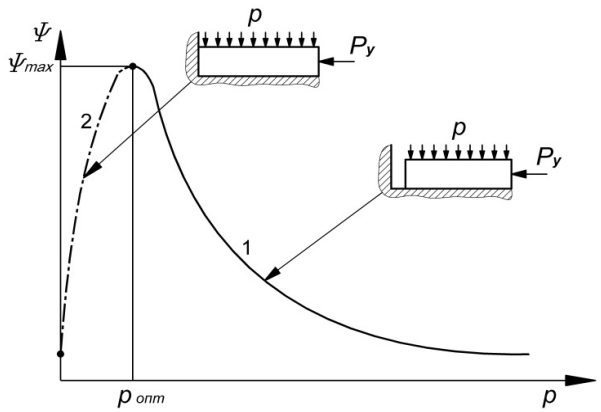

Fig. 2. Schedule dependencies $\Psi = f(p)$

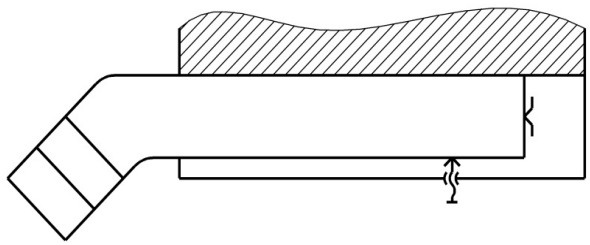

Fig. 3. The scheme of fixing tool in the tool carriers

Conclusion

So dissipation of vibrational energy at fixing tool, or in the instrument, can prevent the occurrence of oscillation in the process of cutting metal or significantly reduce their amplitude only optimal pressing the cutting blade.

In further research the system of differential equations which describe the motion of the four-mass vibrating system will be built. The vibrating system (Fig. 4) consists of caliper, cutter, detail and spindle, which are connected with machine carcass with elastic ties and dampers. This scheme corresponds to the scheme of classical lathe, the mass of the carcass of which is much greater than the mass of its individual units.

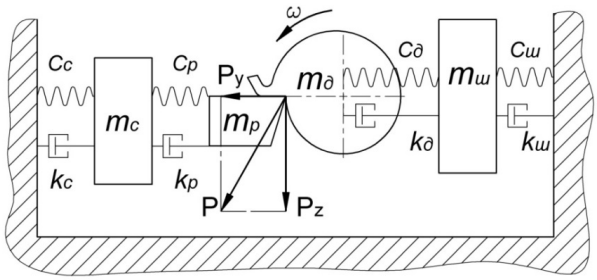

Fig. 4. The vibration scheme of the machine

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Structure and properties of diffusion boride layers on steels obtained at applying external magnetic field

Svitlana Chernega[1], Ihor Poliakov[1], Catherine Grinenko[1], Michael Krasovsky[2]

[1]Department of metal science and heat treatment, National Technical University of Ukraine "Kiev Polytechnic Institute", UKRAINE, Kiev, Polytechnic street, Bldg. 9, E-mail: smchernega@mail.ru; polykov_igor@mail.ru

[2]Frantsevich Institute for Problems of Materials Science NAS of Ukraine, UKRAINE, Kiev, Krzhizhanovsky 3, E-mail: michael_krasowski@yahoo.com

***Abstract* – Investigated the structure, phase composition, microhardness and wear resistance boride coatings obtained on carbon steels at complex saturation with boron and copper in various physical and chemical conditions, namely carrying satiation without application of an external magnetic field (EMF) and in its simultaneous imposition.**

Established that the application EMF on carbon steels formed a continuous, homogeneous boride layer, thickness is 2 times higher than the boriding without EMF.

Formation diffuse boride layers under the action EMF improves tribological characteristics and leads to an increase in wear resistance of 2.2 – 2.6 times.

Key words – boriding, boride layer, magnetic field, microstructure, micro hardness, wear resistance.

I. Introduction

Analysis of work, aimed at increasing productivity processes chemical and heat treatment, indicates that, along with traditional research in this field is the search in the direction of intensification of diffusion processes [1].

Boriding in an external magnetic field (EMF) – one of the new trends in physical materials. The external magnetic field is used to intensify the diffusion saturation working surfaces of metal products chemical elements (boron, carbon, silicon, etc.). At boriding in EMF significantly intensified diffusion processes, which in turn leads to a decrease the time necessary for saturation. Because considerable interest is the study of the effect of external magnetic field on the processes boriding.

The aim of this work was to study the structure and characteristics of complex diffuse boride coatings on iron-carbon steels obtained in powder boriding mixtures with the addition of copper containing compounds in various physical and chemical conditions, as well as the establishment impact of the saturating powder environment on the characteristics of the coating thickness, micro-hardness, crack resistance, stress spalling, wear resistance.

II. Materials and methods research

Complex boriding powder method performed in a special container under reduced pressure at a temperature of 975 °C for 4 hours using fusible shutters. The research was conducted on samples of carbon steel (steel 20 45, U8) [2].

Saturation alloys boron and copper performed in mixtures containing technical boron carbide B_4C and powders Cu_2O, Cu_3P. As the activator used fluoroplastic.

Heating the crucible and the subsequent isothermal holding was carried out in a laboratory oven type HSOL - 1.6,3 / 11. Electric furnace at a temperature of saturation placed in the solenoid, which served as the source of the magnetic field.

Polishing was performed on samples of diamond polishing circles paste grit from 28 to 1 micron, that provided to obtain high surface quality research. As a reagent for chemical etching using 3...5% – solution was nitric acid in ethanol; exposure – 30 - 90 sec. Also, carried out the thermal etching by heating the polished microsection in a box furnace to a temperature of 400 °C and held at this temperature during 30 minutes and cooling on air.

For measurement crack resistance monocrystals of solid crystalline material used method Evans – Charles [3 – 5]. In this case K_{1c} determined by the length of the radial cracks that formed around imprint of Vickers indenter, with semi-empirical relationship.

Test coatings for wear resistance was carried out on the friction machine M-22M as described in [6] and GOST 26614-85 (the method of determining the tribological properties).

III. Results and discussion

The mechanism of diffusion boriding powder technical boron carbide is described in [7]. According to this operation, boron carbide at the saturation temperature recovers to the lower boride anhydride boron oxide B_2O_2 by reaction:

$$B_4C + B_2O_3 \rightarrow B_2O_2 + B_mC_n \quad (1)$$

Vapor formed B_2O_2 carried transport of boron to the surface that is saturated. In this way, boron transporter is oxygen. Vapor B_2O_2 disproportionate on the surface that is saturated with formation of atomic boron and B_2O_3 by the reaction:

$$3B_2O_2 \rightarrow 2B + 2B_2O_3 \quad (2)$$

Atomic boron formed diffuses into the material to form the corresponding metal borides.

The surface that is saturated, covered with a film B_2O_3 in the molten state. The role of boron carbide is also that the point of contact with the surface of the particles is saturated, there is a restoration B_2O_3, thanks to the surface is cleaned by melting film. At this formed additional portions of B_2O_2 and is facilitated access to a vapor of B_2O_2 to the metal.

Steels St3 boriding in technical powder of boron carbide (2.13% B_2O_3) powder and boron carbide, boron anhydride purified by the same conditions (T = 1000 °C, and τ = 2 h). The thickness of the boride layer in the first case was 160 – 180 microns. At boriding in powder of boron carbide, of purified from anhydride, it fixed extremely low rate of saturation. The results of this experiment show boride anhydride participate in the formation of active boron atoms [8].

On the basis of the data obtained, we can conclude that the carrier is B_2O_3 with boron carbide, formed suboxides boron and carbon:

$$5B_2O_3 + B4C \rightarrow 7B_2O_2 + CO \qquad (3)$$

Since the temperature boriding high enough, evaporation takes place of boron oxide B_2O_3 and B_2O_3. Condensing on the products, the evaporation of oxides of boron formed melt system B_2O_3 – B_2O_3, containing ions of bivalent and trivalent boron.

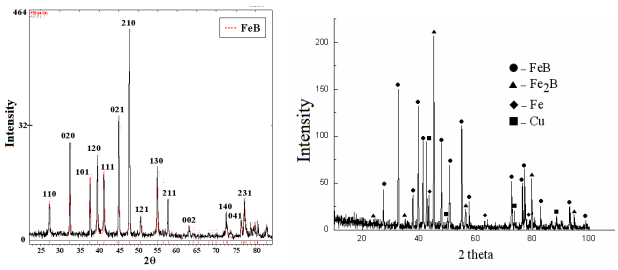
A necessary requirement diffusion layer formation is the presence of near surface saturable active atomic boron addition, temperature and duration of exposure should ensure the flow of atomic diffusion of boron in steel.

In the system Fe – B mass transfer elements is carried out mainly by diffusion of boron through the boride layer to the main reaction front, located at interfaces iron – Fe_2B borides and boride Fe_2B – borides FeB [9]. In forming a diffusion layer on the metal surface reaches saturation limit of the solid solution boron (γ) the germ arises first, and then the needle borides tetragonal Fe_2B (a = 5,109 Å, c = 4,249 Å and c\a = 0,832), containing 8,84 % B, a density of 7.336 g\cm3. These needles grow gradually becoming isolated in continuous layer of borides Fe_2B. Then, on the surface of boride layer having individual needle and then the second layer formed rhombic borides FeB, which has a density of 6.706 g\cm3 (a = 5,506Å, b = 4,061Å and c = 2,952Å), containing 16.25% B. Application of a magnetic field leads to an intensification of the diffusive penetration of the atoms in the crystalline lattice of γ-Fe [10].

To establish a relationship between the phase and structure, diffusion layers obtained after saturation with boron and copper, samples were subjected to X-ray analysis. Characteristic areas diffraction pattern shown on Fig. 1 – Fig. 2.

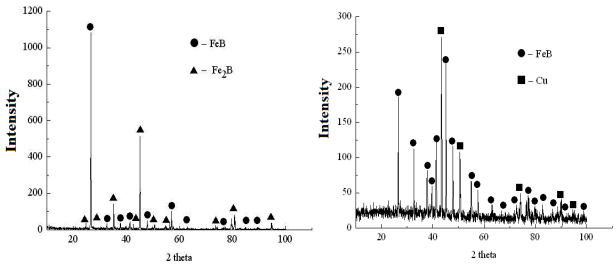
Diffraction patterns taken from the surface of boride coatings on steel 45 after boriding without EMF showed that in the surface layer up to 15 – 20 microns formed phase FeB (Fig.1, a), and at the complex saturated with boron and copper without action EMF – phase FeB, Fe_2B, Fe and Cu (Fig.1, b).

In the application of an external magnetic field observed redistribution boride phase. At using EMF in boride layers observed decrease volume phase FeB and on the diffraction patterns surface layers of boride coatings fixed presence phases FeB and Fe_2B (Fig. 2, a), and after the complex saturation boron and copper under conditions of external magnetic fields fixed phases FeB and Cu (Fig. 2, b).



a b

Fig. 1. Diffraction pattern taken from the surface steel 45 with boride coatings obtained after: a – boriding; b – boriding with adding powder Cu_2O, diffraction peaks of copper lines (111) (200) (220)



a b

Fig. 2. Diffraction pattern taken from the surface steel 45 with boride coatings obtained after: a – boriding at using EMF; b – boriding at using EMF and introduction to the saturating environment copper-containing powder Cu_2O, diffraction peaks of copper lines (111) (200) (220)

When applying EMF in boride layers observed the redistribution of the proportion of boride phases, changes in the crystal lattice period and a decrease volume of the unit lattice phase FeB (Table. 1).

TABLE 1

PARAMETERS CRYSTAL LATTICE PHASE AFTER BORIDING AND COMPLEX SATURATION WITH BORON AND COPPER IN DIFFERENT PHYSICAL - CHEMICAL CONDITIONS (1 – BORIDING WITHOUT EMF; 2 – BORIDING + EMF; 3 – COMPLEX SATURATION WITH BORON AND COPPER WITHOUT EMF; 4 – COMPLEX SATURATION WITH BORON AND COPPER + EMF)

The process of satura-tion	Name of the phase	Parameters of crystal lattice, Å			Volume (A^3)
		a	b	c	
1	FeB	4,0563	5,4973	2,9447	65,66
2	FeB	4,0481	5,4974	2,9433	64,50
	Fe_2B	5,1047	5,1047	4,2425	110,55
3	FeB	4,0527	5,4943	2,9423	65,52
	Fe_2B	5,0959	5,0959	4,2471	110,29
	Fe	2,9488	2,9488	2,9488	25,64
	Cu	3,6692	3,6692	3,6692	49,40
4	FeB	4,0540	5,4926	2,9421	65,51
	Cu	3,6065	3,6065	3,6065	46,91

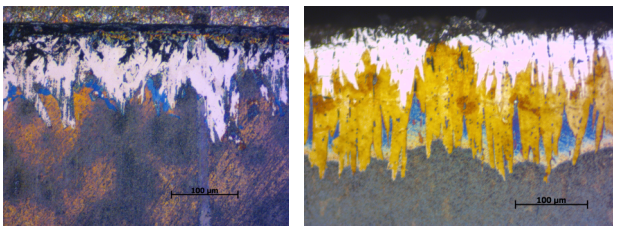
When the complex saturated with boron and copper steel 45 diffusion layer composed of the phases FeB, Fe_2B, Fe and Cu. Chemical heat treatment (CHT) with the simultaneous action of EMF leads to the formation of the diffusion zone phases FeB and Cu. When the complex saturated with boron and copper volume ratio of copper in the surface layer, the results of X-ray diffraction, volume was 4%, and at the CHT with the simultaneous action of EMF quantity of copper component in the surface phase FeB increased to 18.9% (Table. 2). Areas of coherent scattering in phase FeB, obtained by complex saturation with boron and copper with the simultaneous action of EMF, decreased to 38.3 nm as compared to 66.1 nm in the phase FeB, obtained without action EMF.

TABLE 2

QUANTITATIVE PHASE ANALYSIS OF BORIDE LAYERS AND LAYERS OBTAINED AFTER COMPLEX SATURATION WITH BORON AND COPPER IN DIFFERENT PHYSICAL - CHEMICAL CONDITIONS

The process of saturation	Name of the phase	Contents (%)
Boriding without EMF	FeB	100
Boriding + EMF	FeB	15,8
	Fe_2B	84,2
Complex saturation with boron and copper without EMF	FeB	62
	Fe_2B	30,5
	Fe	3,5
	Cu	4
Complex saturation with boron and copper + EMF	FeB	81,1
	Cu	18,9

Metallographic analysis established that obtained the powder technology coating after saturation with boron and copper have a structure with a clear boundary between the coating – base (Fig. 3). Diffusion layers are needle of iron borides, which are oriented perpendicularly to the sample surface and are wedged in the ferritic grains. In the near-surface zone boride phase FeB concentrate individual inclusions of copper, which are dropping form.



a b

Fig. 3. Microstructures complex boride coatings on steel 45 obtained in different physical – chemical conditions: a – boriding, duration saturation – 4 hours, x200; b – boriding + EMF, saturation duration – 2 hours, x200 (color high temperature etching at 400 °C).

Obtaining boron coating at simultaneous applying allows in 1.5 – 2 times to reduce the period saturation detail and get coatings with high hardness, wear resistance, crack resistance. At applying the EMF changing morphology boron layers, needles grains decreases sharply, disappear individually disappear sprouted grain borides in the matrix. Needles boron phases closely adjoin to each other and formed a continuous, homogeneous boron layer thickness is in 1.5 times higher than the boriding without EMF.

Investigation of the kinetics of growth of boride layers in a variety of physical - chemical conditions. It was established that after the diffusion saturation in boriding mixture for 4 hours without EMF obtain coating thickness of 125 – 150 microns, whereas when applied EMF formed coating thickness of 160 – 195 microns in 2 hours; at complex saturation with boron and copper at 4 hours without EMF formed coating thickness of 160 – 185 microns, whereas at after saturation with boron and copper the conditions in action EMF at 2 hours diffusion saturation obtained boride phase thickness to 200 – 230 microns.

Conducted research showed that microhardness boride phase after boriding was respectively – phase FeB – 19 – 20 GPa, and phase Fe_2B – 16,5 – 17,5 GPa. In the complex saturation with boron and copper using EMF get boride layers of microhardness – for phase (Fe, Cu)B – 17 – 18 GPa, and for phase $(Fe, Cu)_2B$ – 15 – 16 GPa. Thus, the complex saturation with boron and copper, observe a decrease of microhardness boride layers and increasing plasticity.

The calculated data crack resistance and stress spalling, which may occur in the boride phases, depending on physical - chemical conditions on the steel 45 is presented in Table 3.

The highest level of of crack resistance is achieved in the boride phases produced in powdered environments with copper powder when applying EMF, and accordingly is 2.23 MPa · $m^{0,5}$, wherein the spalling stress is 345,05 MPa. Then as at boriding without action EMF crack resistance – 1.12 MPa · $m^{0,5}$ and stress spalling – 163,21 MPa. Increase the value of spalling stress in layers obtained after complex saturation with boron and copper is caused the formation of higher viscosity phase, for which crack resistance K_{1C} 1.2 – 1.5 times higher than the output phase boride (FeB, Fe_2B).

TABLE 3

CRACK RESISTANCE AND SPALLING STRESS COATING OBTAINED IN DIFFERENT PHYSICAL – CHEMICAL CONDITIONS (PHASE Fe_2B): 1 – BORIDING WITHOUT EMF; 2 – COMPLEX SATURATION WITH BORON AND COPPER WITHOUT EMF; 3 – BORIDING + EMF; 4 – COMPLEX SATURATION WITH BORON AND COPPER + EMF

Physical – chemical conditions saturation	Coatings on steel	K_{1c} МПа·$м^{0,5}$	$\sigma_{сколювання}$ МПа
1	Steel 20	1,24	180,68
	Steel 45	1,15	167,57
	U10	1,12	163,21
2	Steel 20	1,67	243,34
	Steel 45	1,79	257,91
	U10	1,61	234,59
3	Steel 20	1,37	199,62
	Steel 45	1,45	211,31
	U10	1,52	221,48
4	Steel 20	2,23	345,05
	Steel 45	1,89	275,39
	U10	1,81	263,74

A study wear resistance of coatings of boride obtained in different physical - chemical conditions (Table 4). As counterbody used steel 45 after hardening and low tempering with hardness 50 HRC. It was established that the diffusion boride coating obtained by application of external magnetic fields have a higher tribological characteristics. Thus, the average linear wear boride coatings obtained in EMF is reduced by 2.4 times, and the friction coefficient is 0.63 compared to 0.66.

TABLE 4

TRIBOTECHNICAL CHARACTERISTICS BORIDE COATINGS OBTAINED IN DIFFERENT PHYSICAL – CHEMICAL CONDITIONS: 1 – BORIDING WITHOUT EMF; 2 – AFTER COMPLEX SATURATION WITH BORON AND COPPER WITHOUT EMF; 3 – BORIDING AT APPLYING EMF; 4 – AFTER COMPLEX SATURATION WITH BORON AND COPPER AT APPLYING EMF

Coating	Coef. of friction	Linear wear of the friction pair, I, um, The road friction (km)			Mass wear, I (mg/km)		Average linear wear of the friction pair, $I_{average}$, um/km	Spot of contact area on the sample, S (cm^2)
		1	2	3	sample	counter-body		
1	0,66	7	19,5	26	0,94	1,6	8,7	0,26
2	0,65	6,4	14,7	17,7	0,51	1,2	5,9	0,23
3	0,63	6,0	8,4	16,4	0,45	0,95	5,5	0,22
4	0,6	5,2	7,2	10,1	0,25	0,45	3,4	0,18

Complex saturation of carbon steels, boron and copper at using EMF improves the wear resistance of boride layers in 2.2 – 2.6 times compared with 1.4 – 1.5 times without the use of EMF, this is due to the formation of more perfect structure with a smaller quantity pores and higher crack resistance and spalling stress which grow up to 345,05 MPa as compared with 163,21 MPa for diffusion boride layers.

Conclusion

Application EMF with simultaneous deposition boride coating allows 1.5 – 2 times to decrease the duration of the saturation detail, and obtain a coating of high hardness, wear resistance.

When applying EMF in boride layers observed the redistribution of the proportion of boride phases, changes in the crystal lattice period and a decrease volume of the unit lattice phase FeB and change the morphology of boride layers. Observed a decrease needle-like grains, disappear individually disappear sprouted grain borides in the matrix. Needles boron phases closely adjoin to each other and formed a continuous, homogeneous boron layer thickness is in 1.5 times higher than the boriding without EMF.

Investigation of the kinetics of growth of boride layers in a variety of physical - chemical conditions. It was established that after the diffusion saturation in boriding mixture of carbon steels at simultaneous action EMF coating thickness increases, and the duration of the saturation decreases to 1.5 – 2 times.

Established that ehe highest level of of crack resistance is achieved in the boride phases produced in powdered environments with copper powder when applying EMF, and accordingly is 2.23 MPa · $m^{0,5}$, wherein the spalling stress is 345,05 MPa. Then as at boriding without action EMF crack resistance – 1.12 MPa · $m^{0,5}$ and stress spalling – 163,21 MPa. Increase the value of spalling stress in layers obtained after complex saturation with boron and copper is caused the formation of higher viscosity phase, for which crack resistance K_{1C} 1.2 – 1.5 times higher than the output phase boride (FeB, Fe_2B).

Formation diffuse boride layers under the action EMF improves tribological characteristics and leads to an increase in wear resistance of 2.2 – 2.6 times.

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Analysis of the traffic`s flow distribution by the types of drivers' temperament

Taras Postranskyy[1], Anna Sotnikova [2]

[1]Transport Technology Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: postranskyy@gmail.com

[2]Transport Technology Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: 20AnyutaS@gmail.com

Abstract – *This paper shows the results of the survey of determining the ratio of drivers by types of temperament in the transport flow that are necessary for further studies of driver's psychophysiology. Actuality of this issue consists in the necessity to take account of the driver's type of temperament as the main road traffic participants, which is one of the key factors of any behavior in difficult traffic situations.*

Key words – traffic flow, temperament, psychophysiological indicators, driver, functional state.

I. Introduction

Every year more and more acutely appears the question of road traffic safety. Technical and operational characteristics of highways improves, the level of active and passive vehicle safety increases but still "humen factor" remains the least understood and predictable. Arises the question to research and establish appropriate patterns of driver's psychophysiological indicators changes during his operation.

II. The driver as a part of the driver - vehicle – road system

In general, the transport process is the interaction between the subsystems of the "driver - vehicle - road" system. One of the components of this system is the traffic flow. The traffic flow is a part of the subsystem "traffic conditions - traffic flows". Properly organized management of this subsystem enables to reduce costs of transportation and improve traffic safety.

The transport flow is an organized movement of vehicles by transport network [1]. Its main indicators are the intensity, speed and density. The influence of these indicators on the driver's organism was investigated by various scientists. Increase of traffic`s volume and complication of traffic conditions instantaneously displaye on the nervous and mental state of the driver and his emotional stress [2]. This, in its turn, affects driver behavior in various traffic situations.

One of the main indicators of the driver's organizm is its functional state. It is the level of organizm's adaptation to external stimuluses [3, 4]. The results of studies of various scientists testify that due to driver's poor functional state malfunctions may occur in the man's work, as the operator of the transport process. As the N. U. Hiulyiev says, reliability and safety of the "driver - vehicle - road" system on 70-80% dependends on the driver's actions.

One of the characteristics that greatly affects the driver's behavior during driving is his temperament [3]. Temperament is an individual innate human quality that is shown in the psychic reaction rate to other people and circumstances. By type of temperament people are divided into sanguine, choleric, melancholic and phlegmatic persons. However, its explored that most people have a combination of two or even all four types [5].

As for drivers, depending on the type of temperament, their behavior in the same road situation may be different. For example, drivers-choleric are characterized by low culture of driving, non-observance of traffic rules, tend to exceed the normalized speeds. However, they react to situations that arise unexpectedly the most quickly. The opposite is the type of phlegmatic temperament that is extremely durable in long-distance runs, but somewhat delayed reaction can be expressed poorly in a crash situation. Sanguines are different by working capacity and vigor, but get tired of the monotony, so they are not too reliable for long distances. It is believed that the least fit for driving are melancholics because they can not control their emotions very good, they are characterized by doubt, fear, confusion. This can be a cause of errors while driving and in accordance cause accidents [3].

Researchers in [6] believe that the main component of temperament is an emotionalism, and its characteristic is the quality that predominate in humans. According to this characteristic scientists in [7] found that the most suitable to the driver's activity is a man with strong nervous system, the mobility of the nervous processes, the advantage of excitation over inhibition or balance of nerve processes.

The strength of the nervous system can act as one of the decisive factors of professional success of a driver [8]. Scientists on a base of statistics of traffic accidents determined that drivers with a weak nervous system do not allow the transition of the traffic situation from complicated into critical. Drivers with a strong nervous system allow this transition overestimating their capabilities.

To determine the temperament of the driver are used various kinds of tests. Often these methods of human physiological characteristics are used in professional selecting of candidates for drivers. This is because they allow to evaluate necessary assessment quickly and objectively and establish human individual peculiarities.

The most common test to determine the human temperament is "Eysenck questionnaire". It consists in providing concrete answers "yes" or "no" to 57 asked questions. According to the answer sheet form a value of extra-introversion and neuroticism of a man under examination. On this basis builds a graphical representation of test results that provide information about a proper type of temperament of experimental subject.

III. Research of driver`s temperament

To calculate the necessary amount of respondents was used a formula that takes into account the proportion of a given sampling error and amount of general totality, namely for what quantity research results would be distributed. In [9] is indicated that if the amount of the

general totality is more than 100.000, then this value can be neglected. This is because it does not significantly affect the increase of sample volume.

An indicator that is often used in sociological research is sampling error which is 5%, so, according to formula 1 sample size is 400 people that have to be interviewed [9].

$$n = 1 / \Delta^2 \quad (1)$$

Δ^2 – allowable error.

The survey participants were only people with valid driver's license. Graphically research results are represented in Fig. 1.

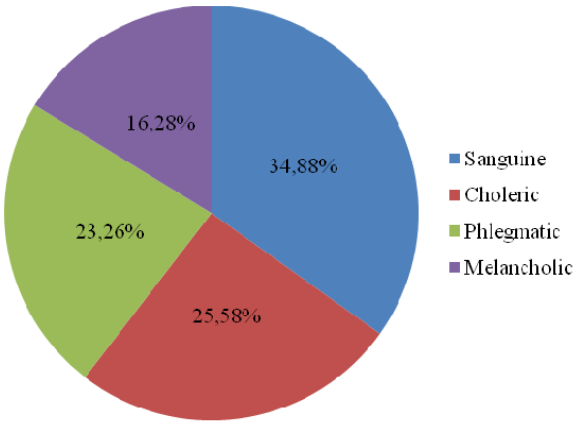

Fig. 1. Sorting of drivers by their temperament in traffic flow

After the survey was determined that in the traffic flow the predominant type of temperament is sanguine, its share is 34.88%; the following is choleric (25.58%), than phlegmatic (23.26%) and melancholic (16.28%).

Conclusion

According to the a survey results was determined that in traffic flow dominate drivers with this type of temperament - sanguine. These data have weighty scientific value. According to these data of statistical analysis of the distribution of traffic flow by the type of driver's temperament it is necessary to form samples with an appropriate correspondence. This will allow to establish corresponding regularities more accurately on the influence of different traffic conditions on psycho-physiological indicators of drivers.

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Methods of Rolled Copper Wire Properties Improvement

Zoya Duriagina, Khristyna Dvorianyn, Sergiy Shvachko, Eduard Pleshakov, Tetiana Tepla

Chair of applied materials science and treatment of materials
Lviv Polytechnic National University, 79040, UKRAINE,
Lviv, S. Bandery street 12, E-mail: kdvoryanyn@gmail.com

Abstract* – *Hot cracks of rolled copper are the most wide spread type of discards under continuous casting which are eliminated with difficulty. In industrial production of rolled copper wire at the plants of Ukraine the amount of oxygen in the obtained rods does not exceed the standard values. In this paper it is proposed to subject the melt to ultrasonic treatment to degassing process and the formation of homogeneous, dispersive sub dendrite structure of the rolled copper.

Key words – rolled copper, hydrogen, hot cracks, wire, pores.

I. Introduction

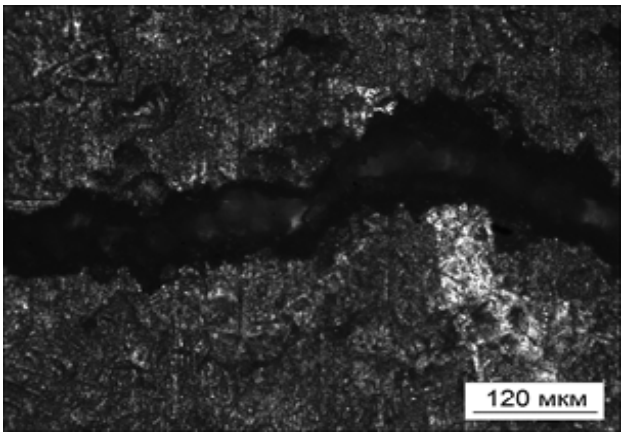
To ensure consumers' demands at the market of cable production the necessity of further investigation and improvement of the technology of copper electrotechnical wire and rolled copper wire production has arisen (Fig. 1).

a

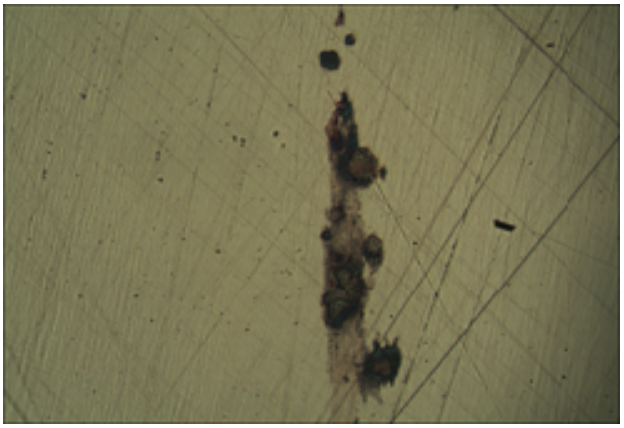
b

Fig. 1. Appearance (a) and fracture (b) of cable production of rolled copper

This is related with initiation of defects, in particular, of hot cracks under continuous casting and at the stage of rolled copper wire production (Fig. 2).



a



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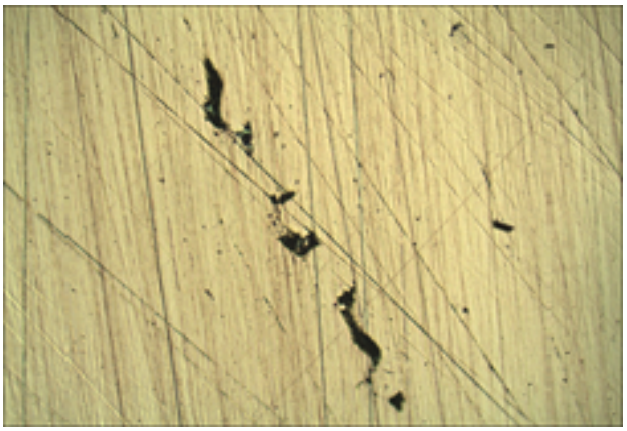

c

Fig.2. Microstructures of rolled cooper: hot cracks (a), non-metallic inclusions (b, c)

It is known that hot cracks are the most wide spread type of discards under continuous casting which are eliminated with difficulty. Hot brittleness depends on the parameters of recrystallization process, level of residual stresses and increased content of admixtures in the melt, especially of oxygen, which solubility in a liquid phase is much higher that in the solid one [1-2].

II. Discussion

In industrial production of rolled copper wire at the plants of Ukraine the amount of oxygen in the obtained rods does not exceed the standard values (Fig. 3).

But in this case hydrogen was present that has a negative effect on the operational properties of the finished product. Hydrogen solubility increases noticeably in the copper melt. In the process of recrystallization a "steam-like" porosity occurs by the reaction $Cu_2O + H_2 = 2Cu + H_2O$ that leads to the change of the cast bar mechanical properties [3]. So, one of the methods of hot cracks elimination in it is the decrease of hydrogen content at the expense of the oxygen concentration increase(according to Alex curve) [4]. It is well known that the increase of oxygen content in the copper melt to 0.06% took place simultaneously with oxidation of other harmful admixtures. Refining is another effective method of gaseous admixtures removal from the melt, however under such conditions the electric conductivity deteriorates.

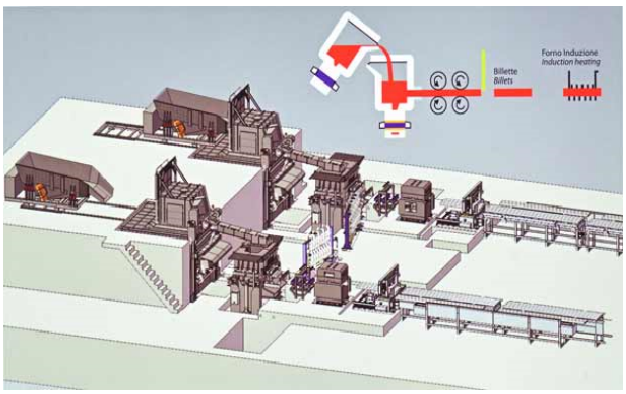

Fig. 3. Scheme of rolled copper production line by horizontal Continuous Casting Process

The significant effect of the structure formation character during crystallization on the rolled copper wire properties must be noted. In particular to remove the dendric inhomogeneity of the cast bar it is necessary to ensure the excess of crystallization centers before its development front. A structure of a real melt is not perfect: there are many submicron particles of oxides and other non-metallic phases, the so called "plankton". Usually it doesn't participate in hardening process. So it is possible to activate this process. For example, during active external action of cavitation treatment on the melt a microheterogeneity level can be decreased and thermodynamic stability of such system can be increased. In this case the main part of solid non-metallic inclusions are not wetted with the melt, since microdefects (pores, cracks) are filled with the gas phase [5].

In our paper it is proposed to subject the melt to ultrasonic treatment. Such an approach foresees a complex action. In particular, in this case the degassing process is more intensive, additional mixing of the melt occurs, thus preventing appearance of dendrite liquation and concentration of non-metallic inclusions along the grain boundaries. Besides, under crystallization this has a positive influence on the formation of homogeneous, dispersive subdendrite structure of the metal.

Conclusion

One of the methods of hot cracks elimination in it is the decrease of hydrogen content at the expense of the oxygen concentration increase. So, it is proposed to subject the melt to ultrasonic treatment. In this case the degassing process is more intensive, additional mixing of the melt occurs, thus preventing appearance of dendrite liquation and concentration of non-metallic inclusions along the grain boundaries.

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Modeling of Ni^{2+} exchange on the strong acid ion-exchange resin and the organic-inorganic ionite

Gennadiyy Afonin[1], Yuriy Beznosyk[2], Yuliyia Dzyazko[3]

[1]Department of Cybernetics of Chemical Technology Processes, National Technical University of Ukraine "Kyiv Polytechnic Institute", 37 Peremogy ave. Kyiv, Ukraine, 03056, E-mail: kaareel@yahoo.com

[2]Department of Cybernetics of Chemical Technology Processes, National Technical University of Ukraine "Kyiv Polytechnic Institute", 37 Peremogy ave., Kyiv, Ukraine, 03056, E-mail: yu_beznosyk@ukr.net

3. Department of sorption & membrane technologies and materials, Vernadsky Institute of general and inorganic chemistry of the Ukrainian National, Academy of Sciences, Pr. Vernadsky 32/34, 03680, Kyiv, E-mail: dzyazko@gmail.com

Abstract – In dynamic conditions extraction of ions of Ni^{2+} from the combined solution with using of acid ion-exchange gel pitch and the composite ionite on its basis containing units of nanoparticles of hydrophosphate of zirconium is investigated. The model allowing to define time for which capacity of Ni^{2+} ions is ful offered. The model assumes use only of empirical parameters reflecting concoction of ions in a firm phase.

Key words – Ion exchange treatment of water, the nickel ions, calcium, magnesium, dynamic model.

I. Introduction

Along with reverse osmosis, ion exchange, conventionally used for a wide range of practical problems, such as desalination of water [1], in particular, seawater [1, 2], an extract from the waste water of toxic and the ionic components [3, 4] cleaning liquid food products, the concentration of ions for subsequent analytical determination and many others. For the calculation of processes in ion-exchange columns is typically used bulky models that involve the use of such parameters as the diffusion coefficients of the ions in solution and ion exchanger, the exchange capacity of the latter, the coefficients of selectivity, the particle size of the resin layer and the height, the speed of solution. The greatest difficulty is the definition of the diffusion coefficient of exchanging ions in the ion exchanger, as this parameter varies with the degree of substitution of the resin and is very dependent on the presence of other ions in solution, which are absorbed by the ion exchanger as an exchange, and on nonexchange mechanism. When determining the ratio of selectivity also has problems if the solution contains several types of ions of the same sign of charge as well as the incomplete dissociation of the functional groups. In this regard, an actual problem is formalized model creation process in the dynamic mode, which minimizes the number of parameters, eliminating the diffusion coefficients and selectivities.

II. The experimental procedure

The purpose of research - the creation of a formalized model of ion exchange, only with empirical parameters. To achieve this goal it is necessary to solve such problems:

1. Ion-exchange extraction of Ni^{2+} ions from a solution also containing hardness ions, by ion exchange resins, and organic-inorganic ion exchanger.
2. To establish a correlation between the concentration of Ni^{2+} ions in solution and the exchange capacity of ion exchangers breakthrough.
3. Determine the empirical model parameters for different ion exchangers.

Investigated the strongly acidic gel anionite Dowex HCR-S (Dow Chemical) with the following characteristics: exchange capacity (Na^+) – 2.4 mmol cm^{-3}, the water content – 60% decrease in the translation of the H in the form of Na-substituted – 8%. Ion modified aggregates of nanoparticles of zirconium hydrogen phosphate, modification consisted of impregnation of the resin insoluble hydrogen zirconium and subsequent deposition in the polymer matrix of zirconium hydrogen phosphate (ZHP) solution H_3RO_4 similarly. As was established by using scanning and transmission microscopy, the size of the aggregates is prevailing several microns (Fig. 1) consisted of aggregates of nanoparticles (10-15 nm). The content of the modifier in the composite ion exchanger was 22 wt% water content – 58% on transfer-substituted form of Na^+ ion exchanger volume decreased 1.5 times.

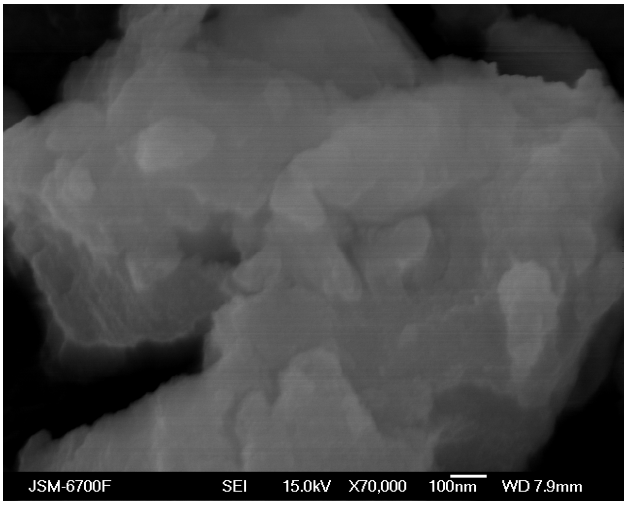

Fig. 1. Zirconium hydrogen phosphate

Ion content in the outlet of the column was determined by atomic absorption method using the device S9 Pye Unicam (Philips).

III. Results of the study

Fig. 2 illustrates a typical output curves ions Ni^{2+}, obtained for the polymer and organic-inorganic ion exchanger according – ion concentration at the column outlet from the volume of solution passed. The curves show the wide plateau and the rise of responsible container before breakthrough of the ion exchanger (mmol cm^{-3}) – this value, depending on the process conditions (composition of the solution and its

speed, the geometric parameters of the bulk layer) corresponds to a degree of substitution of the resin, in which the maximum degree extraction of certain ions from a solution is not implemented.

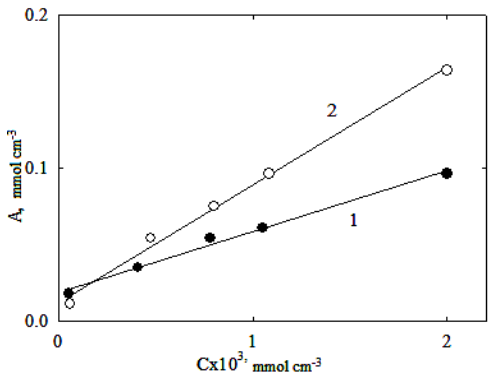

Fig. 2. The exchange capacity before breakthrough at cations Ni^{2+} cation exchange resin (1) and organic-inorganic ion exchanger (2) as a function of the initial content of these ions in solution

In other words, the introduction of inorganic modifier ZHF in strongly acidic ion exchanger resin enhances the ability to concentrate Ni^{2+} ions in the presence of hardness ions. Since the ion-exchange resins, modified nanoparticle aggregates ZHF, characterized by lower mobility of adsorbed ions and exchange capacity, improvement of the sorption capacity of the composites is obviously due to the peculiarities of ion exchange on the ZHF. Previously, it was found that the exchange of $Ni^{2+} \rightarrow H^{+}$ using ZHF accompanied by partial hydrolysis $Ni^{2+} \rightarrow NiOH^{+}$ ions sorbed directly into the ion exchanger phase (in a neutral solution forms $NiON^{+}$ content is very low). Ni^{2+} ions and $NiON^{+}$ form complexes with a phosphate functional groups. Probably complexes with these cations are more stable than the hardness ions, which causes preferential absorption of toxic ions composite.

Capacity before breakthrough was calculated by the formula:

$$A = \frac{(C - C_f)V}{v} \quad (1)$$

where C and C_f – ion concentration in the solution at the inlet and outlet of the column (mmol cm^{-3}), V – volume of the solution (cm^3), v – the amount of the resin (cm^3).

Dependences A of the initial concentration of Ni^{2+} described by linear polynomials:

$$A = a_1 C + a_0, \quad (2)$$

where a – empirical coefficients, a_0 – exchange capacity of the ion exchanger, achieved an infinitesimal ion content in solution (mol cm^{-3}), a_1 – factor reflecting the concentration of Ni^{2+} in the solid phase (dimensionless). Which a_1 can be regarded as analogous to the distribution coefficient, which is determined under static conditions. The coefficients a_0, obtained for unmodified and organic-inorganic ion exchangers, are very similar (0.018 and 0.012 mmol cm^{-3}, respectively), while the values of a_1 are 40 and 77 respectively.

For unmodified cation exchange resin model (A–V/υ) is inverse polynomial of the first order

$$A = \frac{b_1 v}{V} + b_0 \quad (3)$$

where b_0 – capacity of ion exchanger. For organic-inorganic ion exchanger:

$$A = \frac{b_2 v^2}{V^2} + \frac{b_1 v}{V} + b_0 \quad (4)$$

Equating the expressions (2) and (3), we obtain the relation in which the capacity will be reached before breakthrough unmodified ion exchanger:

$$\frac{V}{v} = \frac{b_1}{a_1 C + a_0 - b_o} \quad (5)$$

For organic-inorganic ion exchanger equating equations (2) and (4) provides:

$$\frac{b_2 v^2}{V^2} + \frac{b_1 v}{V} + b_o = a_1 C + a_0 \quad (6)$$

Solve the equation with respect to V/υ, we obtain:

$$\frac{V}{v} = \frac{-b_1 \pm \sqrt{b_1^2 - 4b_2(b_o - a_1 C - a_0)}}{2(b_o - a_1 C - a_0)} \quad (7)$$

Studies are an extension of our ongoing work, dedicated to the production of organic-inorganic ion-exchange materials and study their functional properties. In this study we compared the cation exchange resin and organic-inorganic ion exchanger resin based on this modified zirconium hydrogen phosphate. In the study of ion exchange extraction of Ni^{2+} from the combined solutions containing hardness ions, the mathematical model, varying the parameters of which are the concentration of extractable ions, as well as the ratio of the maximum volume of the solution, at which the capacity to slip, and the resin. Correlation equations to determine the capacity of the ion exchangers to slip without prior determination of the coefficients of selectivity and diffusion of adsorbed ions, as well as the mode of exchange. This model is advantageous because the mode determination process, and these characteristics of ion exchangers, requires a large array of experimental data that can not always be adequately interpreted, especially when removing ions from a multicomponent solution. The coefficients of correlation equations allow you to compare different resins.

The resulting model after verification, these additions in the future may be used for the calculation of ion exchange and sorption processes to extract from the combined solution of a component.

Conclution

This model involves the use of only empirical parameters obtained in the investigation of ion exchange in a dynamic mode and does not require a predetermined ratio of selectivity and the diffusion of sorbed ions, and the exchange mode.

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Modelling of Heterogeneous Systems in Microreactors

Yuliyia Miroshnychenko, Yuriy Beznosyk

Department of Cybernetics of Chemical Technology Processes, National Technical University of Ukraine "Kyiv Polytechnic Institute", 37 Peremogy ave., Kyiv, Ukraine, 03056, E-mail: ju1ianna@ukr.net

***Abstract* – In this paper an overview of approaches to the modelling of heterogeneous systems (liquid-liquid) in the microreactor was performed, mathematical models of various chemical reactions in microchannels published in the literature was considered and the comparison of theoretical and practical experiments was executed. Based on the generalized data, it has been proved the feasibility of microstructured reactor application for the process of silica surface functionalization in order to carry out the synthesis of innovative sorption materials. The next stage of this research is to develop a mathematical model of the process and its implementation by means of special software environment.**

Key words – microreactor, microchannel, process of functionalization, silica surface, CFD-modelling, heterogeneous system, miniaturization.

I. Introduction

Microreactors as a novel concept in chemical technology enable the introduction of new reaction procedures in chemistry, molecular biology and pharmaceutical chemistry. Microreactors offer several opportunities to optimize the reaction systems due to high specific interfacial area improving heat and mass transfer, the smaller working volumes, continuous mode of operation, efficient operation, low wastage of chemicals and intrinsic safety [1]. Potential advantages of microstructured reactors (MSR) allow successfully use them to complex processes for optimization and scale-up from the laboratory scope to production. These arguments give the background to discuss the realization of the functionalization process using the microreactor.

The process of silica surface functionalization is the effective approach to receive the silica-based adsorbents that are able to extract heavy metals such as mercury from water and, as a result, have the potential for reducing water pollution and protecting ecosystems [2, 3]. The solution of a wide range of issues related to the real experiment is achieved by modeling the test object with the help of special methods and tools. That is why, it is reasonable to perform computational studies of the microreactor system as well as the structural parameters of functionalized materials. Detailed simulation studies conducted in different operation conditions provide important insights to the reaction behavior in a microsystem environment. Comparison of performances in theoretical and practical experiments has been presented in the literature for different types of reactions, which suggests the adequacy of computing and credibility of the calculated data when integrated process in a laboratory or industrial scale. Thus, modeling of the functionalization process in the microreactor is an actual trend of chemical technology that provides opportunities for the synthesis of innovative materials with prescribed properties.

II. Purpose and objectives of the study

The key purpose of this paper is to explore new sorption materials as well as identifying new techniques for their preparation.

In accordance with the set goal the following research objectives are identified:

– to study the adsorptive properties of functionalized silica materials with different groups by means of quantum-chemical calculations. In this paper is presented an example of modeling the silica surface functionalized with thiourea-containing fragments;

– to investigate the approaches to the modeling of different reactions and processes in microreactors with the help of special software tools. The finite purpose of this task is to develop the mathematical model of the microreactor which could be effectively used for the synthesis of functionalized materials.

III. A general characteristic of functionalized silica-based materials

Back in the early 90s of last century, hybrid organic-inorganic materials which include functionalized organosilicon materials have received serious attention from many scientists due to the potential of properties combination for creating the novel structures [2]. In general, the class of hybrid organic-inorganic materials contains compounds that are composed of inorganic (according to our investigation, it is silicon dioxide) and organic (various radicals) components. This result can be achieved by: 1) impregnation of the inorganic part or introduction of the organic part into inorganic one in the absence of covalent bond between them; 2) formation of covalent bond between the components [3]. It should be noted that the latter type of materials is the most progressive in research and in the production scale as well.

IV. Methods of functionalized silica-based materials synthesis

A sol-gel method and a template method are the most promising approaches for obtaining functionalized silica materials. Materials received by means of the sol-gel technique are usually amorphous or have randomly arranged domains. The template synthesis method permits to obtain an ordered structure, but there are some difficulties regarding the intrinsic properties. Firstly, basic products and by-products of the reaction cannot be divided because of their covalent bonding with the silica surface. Secondly, the number of functional groups reduces significantly when the number of synthesis steps increases [3]. However, these (and other) shortcomings can be avoided by using the "direct" method of functionalization.

The core of the sol-gel method is the alkoxy-(or chlorine) silanes hydrolytic polycondensation reaction. In describing the process of transformation competing ways include: hydrolysis of bonds at the silicon atom with the formation of silanol, and polycondensation with the siloxane formation [2, 3]. But the key feature of the sol-gel synthesis is the ability to introduce different functional groups that are capable to interact selectively with the substances of various nature.

Therefore, the main goal of the functionalized silica materials synthesis is the combination of organic and inorganic components. For example, the inorganic

component can improve mechanical, thermal, structural stability of new compounds, while the organic component provides the specificity of the actions in these substances. In addition, the sol-gel process allows regulating the degree of interpenetration of organic and inorganic fragments at the molecular level to create the organic-inorganic hybrid materials with prescribed properties [3]. Further the influence on structural and adsorptive abilities as well as physical and chemical properties of the product can be carried out at all stages of the synthesis.

To provide the necessary physical, chemical, structural and adsorptive properties of the sample, it is possible to vary the nature and the value of output ingredients, catalyst, solvent, aging conditions and hydrogels washing and drying. A serious task is to regulate the concentration of ligand groups and their distribution on the silica surface. Furthermore, the essential aspect for the majority of applied problems is the opportunity to form both of the monolayer of molecules on the surface and polymolecular coverage. By virtue of requirements described above, it is reasonable to conduct computer calculations of the materials molecular structure by means of the quantum-chemical modeling. On the basis of the theoretical experiment result the process of silica functionalization can be simulated for determining the technological characteristics of the process in terms of sustainable development. The modeling provides clear guidance for sustainable chemical synthesis and production of new materials with useful properties.

V. Quantum-chemical modeling of the functionalized silica surface

Construction and previous optimization of structures was performed with a help of the molecular mechanics approximation methods using MM+ force field. The main task of this stage was to find the initial geometrical parameters of the molecules. Theoretical investigations of clusters were carried out by the approach “ab initio” (from first principles). In search of the optimal geometry of clusters there were placed no restrictions on symmetry and the main requirement was to achieve a minimum total energy and a stability of the cluster. For the calculations we used the method of density functional theory (DFT) B3LYP approximation with a local approximation of exchange-correlation potential (basis set 6-31 G(d, p)) [4].

VI. Implementation of the microreaction systems in chemical production

A large number of applications within the last decade have clearly demonstrated fundamental advantages for microreactors compared to the lab-scale equipment. Their main feature is to provide the intensification of mass and heat transfer due to the flow regime improvement. Moreover smaller devices require less space, materials, and energy and often have shorter response times.

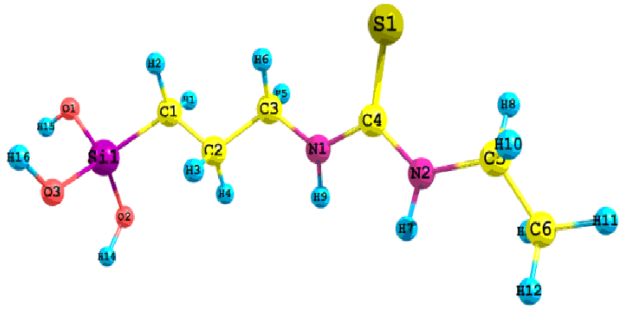
The key advantages of the microreactor are: Decrease of the linear dimensions, Increase of the surface-to-volume ratio, Improvement of the mass transfer, Increase of the number of units, Production flexibility, Safety and sustainability, Approaches to the modeling processes in the microreactor.

This system includes a set of equations of various types (from the linear to differential equations in partial derivatives) and requires special mathematical methods to solve the specific problems. It should be noted that the determination of boundary conditions and assumptions is the influential stage of modeling [5]. The theoretical calculations aimed at proving of this assumption and, thereby, reliable reproduction of the actual experiment by means of simulation. At present, there are a lot of successful commercial software packages for modeling complex chemical processes. The most popular of them are Aspen HYSYS, Aspen Plus, ANSYS, CHEMCAD, Pro II, Mathcad, COMSOL Multiphysics.

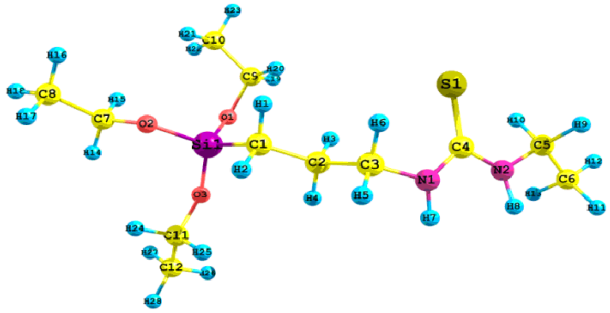
VII. Case study of quantum-chemical calculations of the silica surface functionalized with thiourea-containing groups

In order to analyze the process of functionalization in the microreactor firstly we investigated the parameters of structures with different functional groups. Here we presented the molecular structure of silica surface functionalized with thiourea-containing fragment as the case study. This choice is caused by the projected useful properties of such polysiloxane xerogels that are able to sorb ions of noble metals and heavy metals including such dangerous ions for the human as Hg2+ (mercury) [2, 3]. In our previous work, we have also described the results of the study on the behavior of nitrogen- and phosphorus-containing groups of functionalized silica surface.

Based on the quantum-chemical modeling of silica surface functionalized with thiourea groups [≡(CH2)3NHC(S)NHC2H5], it has been shown that hydrogen bonds can be formed between donor and silanol groups both in the presence and absence of the water molecule. Geometry was optimized (Fig. 1) and geometric parameters (Table 1) and spectra frequencies (IR and NMR) were calculated for these fragments.



a) E=-1261.3247 a.u.



b) E=-1497.1932 a.u.

Fig. 1. Optimized geometry of fragments of silica surface functionalized with thiourea group:
a – $(HO)_2Si(OH)(CH_2)_3NHC(S)NHC_2H_5$;
b – $(C_2H_5O)_3Si(CH_2)_3NHC(S)NHC_2H_5$
(where E is the total energy of the fragment)

TABLE 1

BASIC GEOMETRICAL PARAMETERS OF THE OPTIMIZED FRAGMENTS

Bridging	Length (Å)	Valence angle	Value (degree)
$(HO)_2Si(OH)\ (CH_2)_3NHC(S)NHC_2H_5$			
Si1-O3	1.666	O1-Si1-O2	111.5
Si1-C1	1.865	N2-C4-S1	123.0
S1=C4	1.684	C3-N1-C4	124.6
N1-C4	1.367	N1-C4-N2	113.5
$(C_2H_5O)_3Si(CH2)_3NHC(S)NHC_2H_5$			
Si1-O1	1.649	O1-Si1-C1	113.2
Si1-C1	1.874	C3-N1-C4	124.4
S1=C4	1.686	C4-N2-C5	124.1
N2-C4	1.364	N1-C4-N2	113.6
N1-C4	1.366		

As a result of the atomic relaxation, it was determined that an adsorption band of the hydrogen bond is slightly shifted to the lower frequencies, but it significantly increases with appearance of the water molecule (Fig. 2).

The theoretical analysis of the NMR spectra of studied fragments permits to identify the causes that determine the behavior of the modified silica surface layer. The values of the chemical shifts of shielding constant at nuclei 13C were found when forming the hydrogen bonds between the donor and silane groups. A comparison between the resonance frequencies of the theoretical NMR spectra with the similar experimental values revealed that computer fragments calculations of silica surface functionalized with thiourea groups are in good agreement with the data of synthesized adsorbents (Table 2) [3].

It should be noted that the lab synthesis of silica compounds with sulfur-containing functional groups has been carried out in the O. O. Chuiko Institute of Surface Chemistry. Yu. Zub reported the experimental results of the adsorption capacity of such materials in his doctoral thesis [3].

He examined the sorptive properties of mesoporous silica surface functionalized with thiourea ligand group regarding mercury ion (II). By virtue of the analysis of adsorption isotherms, it has been shown that the growth in the density of functional groups results in the increase of their inaccessibility when sorbing the metal ions. Consequently, the adsorption properties of mesoporous silica materials containing thiourea group on the surface layer depend on the content of the functional groups and the nature of the porous structure. The low density of ligand groups improves the extraction of mercury while the increase in density of functional groups leads to the impediment of the complexing process. These arguments confirm the necessity of the accurate process control to obtain materials with prescribed properties. Microreaction technology can help to carry out the synthesis under optimal conditions for producing highly selective sorbents that have the potential for water disinfection and purification.

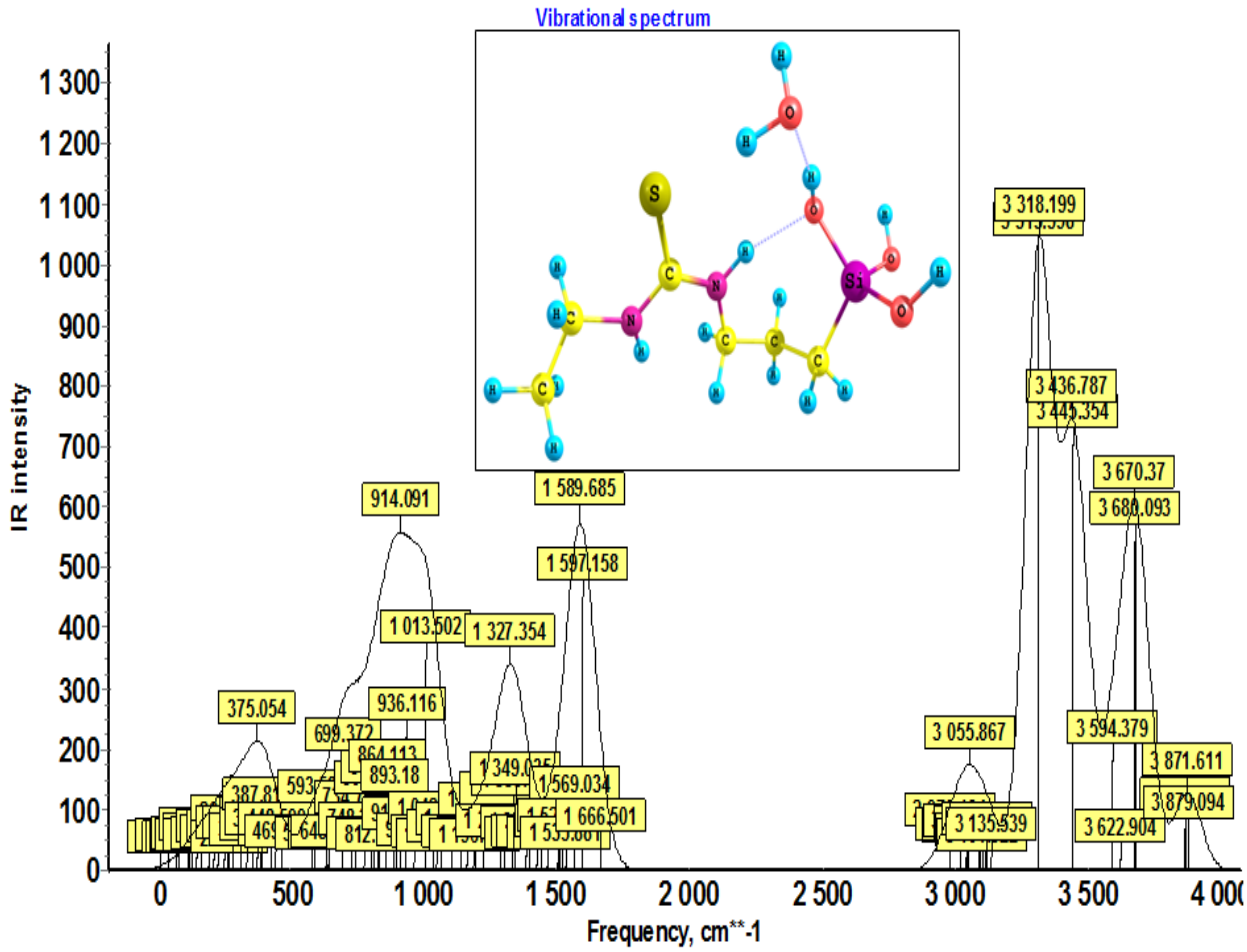


Fig. 2. IR vibration spectrum of the fragment functionalized with thiourea group in the presence of the water molecule

TABLE 2

EXPERIMENTAL AND CALCULATED VALUES OF THE CHEMICAL SHIFTS IN THE 13C NMR SPECTRA OF THIOUREA-CONTAINING FRAGMENTS

Type of the nucleus	[≡SiC1H2C2H2 C3H2NHC4(S)NH C5H2C6H3], ppm	[≡SiC1H2C2H2 C3H2NHC4(S)NH C5H2C6H3] (with intramolecular bond), ppm	[≡SiC1H2C2H2 C3H2NHC4(S)NH C5H2C6H3] (experimental values for mesoporous silica), ppm
^{13}C1	11.9 (7.40)[1]	12.0 (13.7)[2]	9.0
^{13}C2	26.8 (22.36)[1]	25.0 (24.1)[2]	23.1
^{13}C3	51.0 (46.15)[1]	50.0 (48.1)[2]	46.8
^{13}C4	192.5 (181.27)[1]	194.4 (189.5)[2]	181.4
^{13}C5	42.4 (39.20)[1]	42.5 (42.6)[2]	39.6
^{13}C6	14.6 (14.19)[1]	14.1 (13.7)[2]	12.8

[1] $(C_2H_5O)_3Si(CH_2)_3NHC(S)NHC_2H_5$
[2] $(C_2H_5O)_3Si(CH_2)_3NHC(S)NHC_2H_5+H_2O$

Conclusion

The adsorption properties of functionalized silica materials were approved in the context of water purification and the implementation of microreactors for the process of silica surface functionalization was discussed.

Quantum-chemical modeling of innovative silica-based materials that can be used for water treatment was performed. Thiourea-containing fragments were considered as the case study for identification of the theoretical experiment technique. The adequacy of the results of quantum-chemical modeling was confirmed by comparing the calculated values of IR and NMR spectra against the similar data of practical experience.

The analysis of approaches to modeling the process of functionalization in the flow microreactor was conducted. The simulation results of various technological operations were studied and the potential benefits of microdevices were confirmed in the context of sustainable manufacturing. The next step of this investigation will be the development of a mathematical model of the functionalized silica materials synthesis in the flow microreactor and its realization in the appropriate software environment. Ultimately, a clear guidance for sustainable chemical synthesis and large-scale production of functionalized sorbents will be provided and used for water treatment.

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Analysis of the Process of Obtaining Methyl Esters of Fatty Acids from Waste Vegetable Oils

Olena Kukushkina[1], Oleksandr Vasylkevich[2], Sergiy Bondarenko[3], Yuriy Beznosyk[4]

[1]Cybernetics of Chemical Technology Processes Department, Kyiv Politechnic Institute, UKRAINE, Kyiv, Peremogy ave. 37, E-mail: ok_post@mail.ru

[2]Cybernetics of Chemical Technology Processes Department, Kyiv Politechnic Institute, UKRAINE, Kyiv, Peremogy ave. 37

[3]Cybernetics of Chemical Technology Processes Department, Kyiv Politechnic Institute, UKRAINE, Kyiv, Peremogy ave.37

4 Cybernetics of Chemical Technology Processes Department, Kyiv Politechnic Institute, UKRAINE, Kyiv, Peremogy ave. 37

Abstract **– *the technological features of the process of obtaining the methyl esters of carboxylic acids from renewable materials were analyzed. The results showed that the waste vegetable oil can be used as raw material for biofuels production. However, to increase product yield and its quality technological scheme of obtaining the product correction is needed.***

Key words – methyl esters, catalyst, biodiesel, transesterification reaction, waste vegetable oil.

I. Introduction

The issue of global warming and greenhouse gas emission is becoming one of the major technological as well as social and political challenges. Increasing gap between the energy demand of the industrialized world and inability to replenish such needs are connected with the limited sources of energy such as fossil fuels and ever-increasing levels of greenhouse pollution from the combustion of fossil fuels. The problem leads to the perils of global warming and energy crisis. One quarter of the world`s CO2 emission are created by the transport sector which accounts for some 60% of the world`s total oil consumption. The greenhouse emission from widespread utilization of fossil fuels has a deleterious effect on climate temperature. There is a growing trend towards exploiting alternative, renewable and environmentally friendly fuels which are cost-wise competitive with fossil fuels.

Increasing the number of waste oils from catering facilities is a problem worldwide. Throwing out contaminated oil leads to problems of sewage treatment, pollution. Its reuse is a potential cause of health problems of people.

There are several options for disposal of these wastes, such as the manufacture of soap, thermal cracking [1], or biofuels. At the heart of the biodiesel production process is transesterification of a feedstock (Fig.1). The use of this fuel, which is a renewable resource, reduces pollution and leads to savings not renewable resources [2].

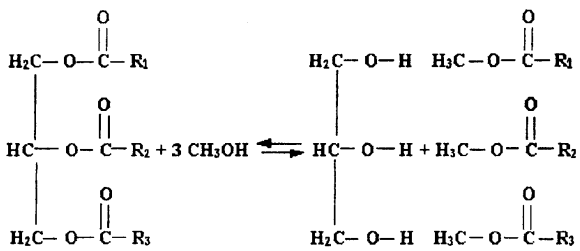

Fig. 1. Transesterification reaction

With the use of waste oil for biodiesel production, yield of methyl esters may differ from product yield compared with the case when the pure oil is used as a feedstock. Multiple heating and the presence of other substances in oil can significantly change its properties.

This circumstance requires additional experimental studies of transesterification reaction, when waste vegetable oil is used as a feedstock for biodiesel production.

II. Experimental part

In the biodiesel production as catalysts, the following substances are used: sulfuric, hydrochloric acid, sodium hydroxide or potassium. Overview of various methods of biodiesel production using different alcohols and catalysts are given in [3]. The alkaline catalyst is used in research because it has advantages over acidic catalyst due to the better speed of the reaction.

To analyze the process of obtaining biodiesel were conducted experimental studies of transesterification reaction of waste vegetable oil methyl alcohol. As feedstock used waste sunflower oil from fast food restaurants. A simplified flow-chart of the alkali-catalyst process for the transesterification of WCO is presented on Fig.2.

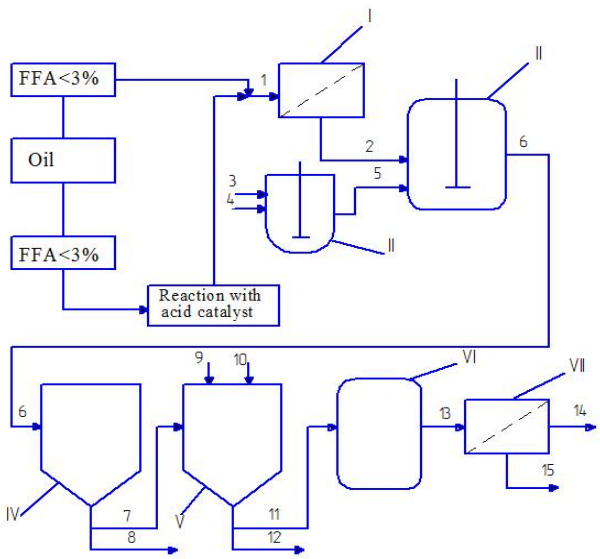

Fig. 2. The proposed scheme of biodiesel production: I – filter for oil; II – blender; III – transesterification stirring tank reactor; IV– decanter, V – separator; VI – tank reactor for biodiesel drying; VII – filtration unit. 1 – oil; 2 – treated oil; 3 – methanol; 4 – sodium hydroxide; 5 – methoxide solution; 6 – reaction products; 7 – biodiesel + methanol + impurities; 8 – glycerin; 9 – hot water; 10 – citric acid (0,4%); 11 – biodiesel+water; 12 – washing water; 13 – biodiesel with impurities; 14 – final biodiesel; 15 – impurities.

The experimental plant for biodiesel production is presented on Fig.3.

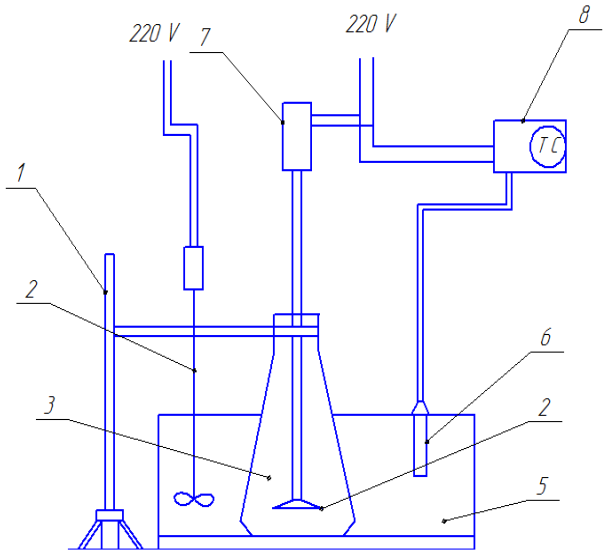

Fig. 3. Experimental plant for obtaining biodiesel
1 - tripod; 2 – mixing device; 3 – the reaction flask;
4 – mixing device; 5 – water bath; 6 – thermostat;
7 – engine of mixer; 8 – thermostat

In the first stage of processing to remove water from the feedstock, anhydrous sodium sulfate was used as dehumidifier. Then drained waste sunflower oil was filtered to remove food debris and other impurities from it.

For experiments with transesterification of waste vegetable oil has been produced reaction mixture, for which the following reagents are prepared: waste sunflower oil in an amount 100 ml and methyl alcohol in an amount of 12.5 ml. As a catalyst the potassium hydroxide in an amount of 0.8 g was used. These reagents have been added to the reaction flask 3 with stirrer 4. The flask was placed in a vessel with thermostat. The reaction begins in the two-phase system consisting of an alkaline solution of methanol and triglycerides. During the first few minutes of mixing, the system becomes a single-phase as a result of emulsification. After the formation of a significant amount of glycine the system again becomes a two-phase.

The reaction mixture, which consisted of waste oil, methanol and catalyst - potassium hydroxide, was mixed for 1.5 hours at 25 C. After stirring, the mixture was decanted for 16 hours. The result was formed two layers of liquids. The top layer is a lipophilic phase with a high content of methyl esters, and the bottom layer is a solution of methanol in glycerol

The top layer was separated and analyzed for the content of mono-, di-, and triglycerides and methyl esters of fatty acids. Depending on the materials used, the value of product yield was 62-71%.

Such relatively low yield is explained by repeated heating of oil and the presence of impurities in it, which significantly affect on its properties.

When oil is repeated heating to the boiling point, significant part of triglycerides forms a macromolecular products. Such reactions are determined by the presence of double bonds in the molecules of fatty acids that form the basis of triglycerides, which are part of the oil. Products, which are formed by polymerization have a large molecular weight and is not determined by chromatographic method. They have a boiling point higher than 360 ° C, so they can't be used as components of diesel fuel. According to accepted international standards, such products must be separated from the methyl esters of fatty acids.

This fact needs to be adjusted processing technology of vegetable oil for biodiesel. Before applying, the resulting product should be cleaned of contaminants (decomposition products, aldehydes, oxidation and polymerization products). The most appropriate method of separation - fractional distillation. In biodiesel must be used fraction with a boiling point not higher than 350 ° C.

Therefore, in technological scheme of the process should be used distillation column with vacuum stripping to separate the reaction by-products of the desired product.

Conclusion

The analysis of the of technological features of the transesterification process of the sunflower oil with methanol in the presence of potassium hydroxide allowed to choose a sequence of processes for biodiesel production.

Experimental studies of transesterification reaction of waste vegetable oil with methyl alcohol were conducted.

Based on the experimental results and their analysis, the correction of technological scheme for biodiesel process was proposed, which will provide a high enough yield the final product.

The introduction of this technology will reduce the environmental burden and get a quality product.

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Research of the hydrodynamic and thermodynamic modes of vortex granulator's operation for obtaining of porous ammonium nitrate

Artem Artyukhov, Volodymyr Vedmedera, Oleksandr Kremnyev

Processes and Equipment of Chemical and Petroleum-Refineries Department, Sumy State University, UKRAINE, Sumy, Rymskogo-Korsakova street 2, E-mail: artemijar@yandex.ua

***Abstract* – The work purpose – studying of regularities of distribution of the humidified granules of porous ammonium nitrate in working space of the vortex granulator and thermodynamic conditions of processing of granules in a vortex gas flow. We carried out analysis of the influence of the velocity components of the gas stream on a trajectory of its movement in the working space of the vortex granulator. Features of distribution of granules on device height are investigated. The analysis of results of measurement of temperature fields in the vortex granulator (single-phase and two-phase flow) is submitted. Received results of researches will allow to develop mechanisms to control the movement of granules in the working space of the vortex granulating equipment and kinetics of removal of moisture from them.**

Key words – porous ammonium nitrate, vortex granulator, hydro- and thermodynamics

I. Introduction

Currently search of new ways of receiving the granulated products with special characteristics, in particular, of porous ammonium nitrate for needs of the mining industry is conducted.

Receiving porous ammonium nitrate is carried out by the following methods:

1. Addition into the melt (solution) the pore-forming and modification additives.
2. Thermal treatment of granules.
3. Humidifying and drying of granules.

Each of these ways provides necessary absorbing and retentivity of granules in relation to diesel oil; thus ecological indicators of granules decrease (method 1), there is loss their durabilities (method 2), the scheme of production (method 3) becomes complicated.

It is necessary to have in basis porous ammonium nitrate from the granule which is evenly distributed on structure porosity which provides not only high ability to absorb oil, but also possesses high retentivity, thus keeping strength properties for receiving qualitative industrial explosive substances.

The perspective direction of development of chemical industry in this sector is creation of technological schemes of granulation with implementation of small-size vortex devices. When using vortex flows there is possibility of flight control of drop (granule) for providing conditions of lack of drop deformation in flight also the process of its secondary crushing.

Optimum hydrodynamic characteristics of continuous and disperse phases have to be matched for this purpose, trajectories of their movement should be calculated; the received results are compared with thermodynamic conditions of formation of granules of porous structure.

Advantages of way of receiving granules of porous structure in vortex flow:

– reduction of staying time of granules in the device volume and preservation of their strength characteristics;
– reduction of heat treatment cycles of granules;
– combination in one device of stages of moistening and drying of granules;
– possibility of classification of granules by the sizes;
– reduced equipment size.

The task of the work - studying of regularities of distribution of the humidified granules in working space of the vortex granulator and thermodynamic processing conditions of granules in vortex gas flow.

The procedure for conducting investigations:

– studying of process of granules classification by the sizes in working space of the vortex granulator;
– studying of trajectories of the movement of gas flow depending on value of its velocity components;
– studying of the temperature fields in the working space of the vortex granulator;
– development of algorithm to determine the required staying time of granules in a vortex granulator.

II. Study of hydrodynamic modes of the vortex granulator working

Classification of granules

The mathematical model [1] is the basis for the description of process of granules classification by the sizes.

Granulators with a constant area of cross section don't provide fully processes of classification of granules and separation of non-commodity fraction in volume of the granulator. It is explained that in working space of the vortex granulator the ascending speed of a gas flow keeps conststant, the corresponding working speed of the granule movement (or fractions of granules in the narrow range). It is possible to carry out processes of classification of granules in devices with a constant area of cross section in case of delivering of gas to the device by several streams with an arrangement of places of input on different elevation marks. This way of classification was rather power-intensive and not widely used.

Much more effective method of classification of a disperse phase is using of devices with a variable area of cross section of working space. Thanks to initiation in volume of the device of fields of velocity components of the gas flow movement on height of the granulator it is created various hydrodynamic conditions for the granules movement. On height of the device there is a distribution of granules on diameter (provided that granules from one material) or different weight (in the conditions of creation of granules of porous structure or multilayered granules are classified).

The calculated scheme of working space of the vortex granulator presented on Fig. 1.

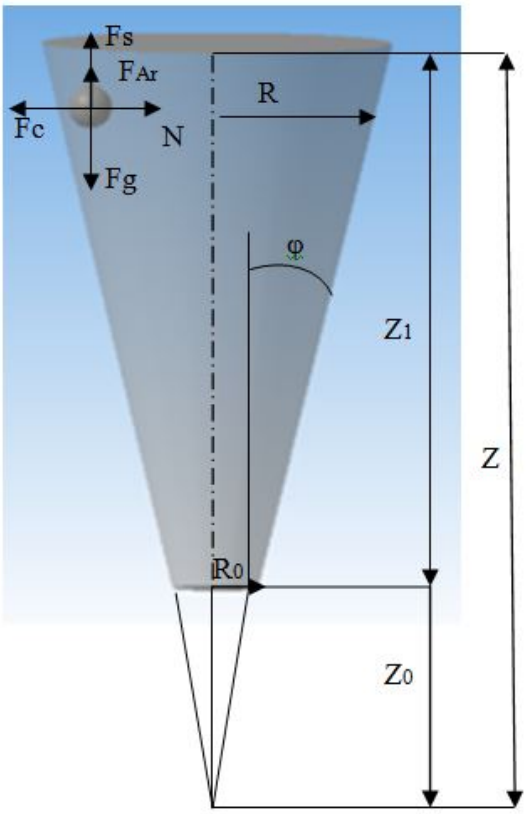

Fig. 1. The calculated scheme of working space of the vortex granulator [1]: Z – general height of a cone; Z_0 – installation height of gas distribution device; Z_1 – height of working space of the granulator; φ – half of a cone expansion angle; R_0 – radius of gas distribution device; R – the radius of the current workspace

Results of the gas flow rate calculating which corresponds to "hovering" of a humid granule and height of arrangement of a humid granule are presented in Figs. 2 and 3.

The received results allow to design the granulator for providing removal of granules of porous ammonium nitrate from necessary height depending on its moistness (weight).

Trajectories of the movement of gas flow.

At designing of small-sized vortex devices for creation of granules with special characteristics (in particular, porous structure) the special attention is paid to the hydrodynamic modes of the movement of granules in working space of the device under the influence of the twirled gas flow and to determination of their balance conditions [2, 3]. Depending on design features of the vortex device the choice of parameters of a gas stream which will allow a granule to stay necessary amount of time in a working volume of the device is made. Controlling the hydrodynamics of the movement of granules it is necessary to provide them with the set properties without collapse of their structure.

The basis of calculation of hydrodynamic vortex and highly turbulent flows are the classical hydrodynamics equations. Generally these equations are nonlinear and have not strict analytical solution without certain simplifications and assumptions. For implementation of simulation it is possible to solve them in number, finding instead of the continuous decision a discrete set of its values in certain points (or cells) spaces and for certain timepoints. Computer simulation - one of methods of the numerical solution of the equations of hydrodynamics. The ANSYS CFX software product (http://www.ansys.com) is used in this work.

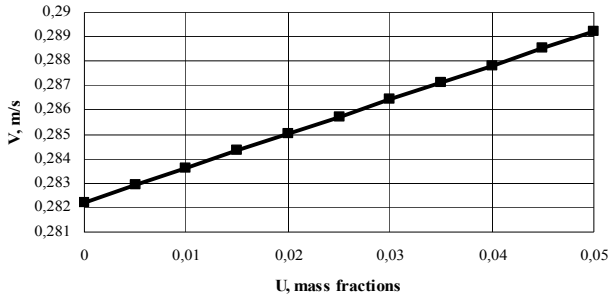

Fig. 2. The dependence of speed of a gas flow which corresponds to "hovering" of a granule from moistness of a granule (granule material – ammonium nitrate, diameter of a granule is 2 mm, temperature of a gas flow is 212 F)

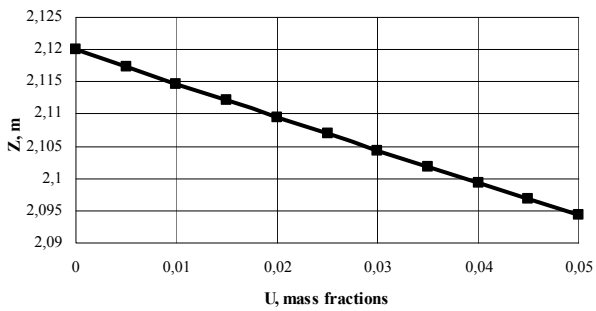

Fig. 3. The dependence of height of an arrangement of a granule on moistness of a granule (granule material – ammonium nitrate, diameter of a granule is 2 mm, temperature of a gas stream is 212 F)

Computer modeling of hydrodynamics of the movement of a gas stream in the vortex granulator allows to pick up its optimum design of working space already at the initial stage of researches before carrying the experiment out on a natural sample.

The analysis of simularion results which are presented on Fig. 4 showed:

– depending on the value velocity component of the gas stream it has a different configuration with a prevalence of one or other direction of motion;

– zone of the gas stream movement is narrowed with the prevalence of the axial component of the velocity;

– the increase on height of a zone of whirl of a gas stream is observed at the prevalence of the circumferential velocity component;

– movement of a gas stream to a wall of the vortex granulator is carried out more intensively at prevalence of a radial component of the velocity;

– under certain conditions intensity of an initial swirling of a gas stream doesn't influence a trajectory of its movement, and influences only value of total velocity of a gas stream;

– the axial component of speed gradually decreases in process of movement of gas flow on granulator height (it is connected with increase in cross section area of the granulator);

– the circumferential component of velocity is characterized by the maximum value at the exit point of the gas-distributing device;

– the radial component of velocity is characterized by the maximum value on device axis.

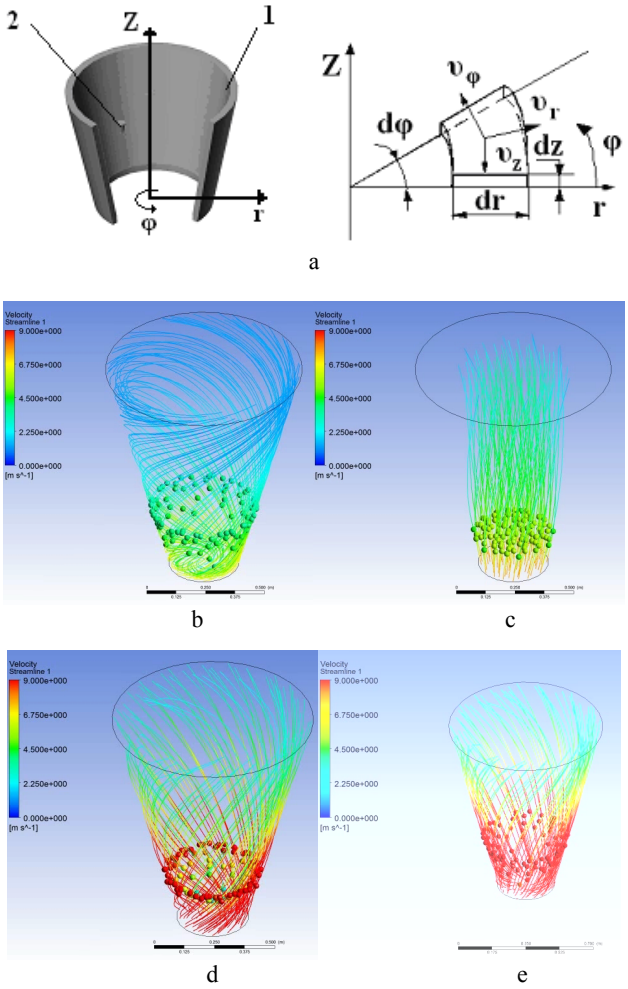

Fig. 4. Trajectories of the gas flow movement in working space of the vortex granulator at different values of components of total velocity: a – directions of components of total velocity (1 – the working space of the granulator; 2 – elementary volume of gas; dr, dφ, dz – elementary gains, Vz, Vr, Vφ, – axial, radial and circumferential velocity components of the gas flow, respectively); b – Vz=1 m/s,Vr=1 m/s, Vφ=8 m/s; c – Vz=8 m/s,Vr=1 m/s, Vφ=1 m/s; d – Vz=8 m/s,Vr=1 m/s, Vφ=8 m/s; e – Vz=8 m/s, Vr=15 m/s ,Vφ=8 m/s

III. Study of hydrodynamic modes of the vortex granulator working

Perspective method of receiving porous ammonium nitrate is the combination of method of heat treatment and moistening of granules in small-size vortex granulators [2]. Considering that each cycle of heat treatment leads to destruction of kernel of granules, the temperature range at which ammonium nitrate tests the minimum quantity of modification transformations is optimum. Temperature range 176-284 F was investigated, there the area of existence of modification of the II ammonium nitrate (183,2-255,2 F) is located. Heat treatment at temperature 284 F gives intensive release of ammonia in the atmosphere, at temperature below 176 F - final moisture content in granules of porous ammonium nitrate is higher than normative value.

Staying time of granules in flow of hot air has to provide removal of moisture to normative value.

Granules can be dried in the device in two ways:

– along with heating of the heat carrier;

– introduction for drying after full heating of the heat carrier and the subsequent heating.

In the first case warming up will be "soft" (gradual warming up of granule increases time of its drying, but protects from destruction of kernel). In the second case intensity of removal of moisture increases (sharp heating allows to reduce the period of warming up of granule, to increase intensity of removal of moisture), but thus destruction of kernel is possible. Selection of optimum thermodynamic operating mode of the granulator will allow to carry out full removal of moisture from granule with preservation of its durability and formation of porous surface layer. The second method of drying was used for research.

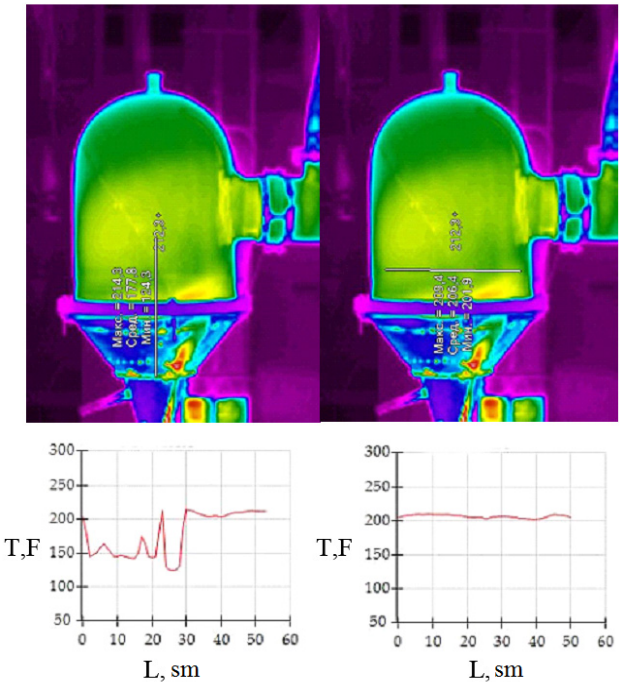

Fig. 5. Temperature field of gas flow in working space of the vortex granulator (operating time of 10 minutes)

The analysis of research results which are presented on Figs. 5-8, has shown that:

– change of temperature profile in working space of the vortex granulator in time is characterized by two extrema (the moment of input of granules in flow of the hot heat carrier and the moment of the beginning of simultaneous heating of granules and the hot heat carrier);

– warming up of working space of the vortex granulator in entering the operating mode is carried out unevenly with characteristic zones of the lowered temperature (eventually warming up becomes uniform);

– after loading of granules temperature in zone of the movement of granules sharply falls, intensity of further warming up of the granulator also decreases.

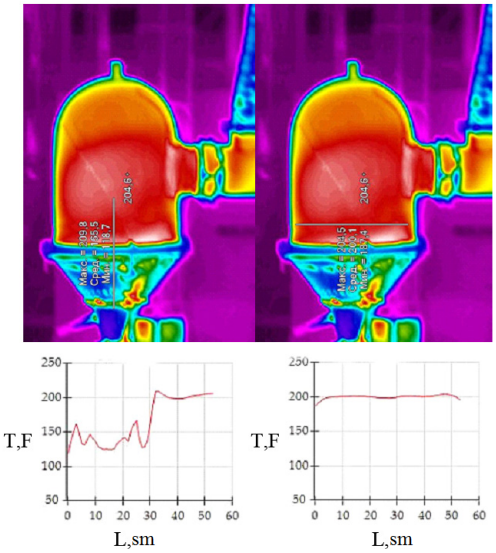

Fig. 6. Temperature field of two-phase flow in working space of the vortex granulator (operating time of 2 minutes from the moment of loading of granules)

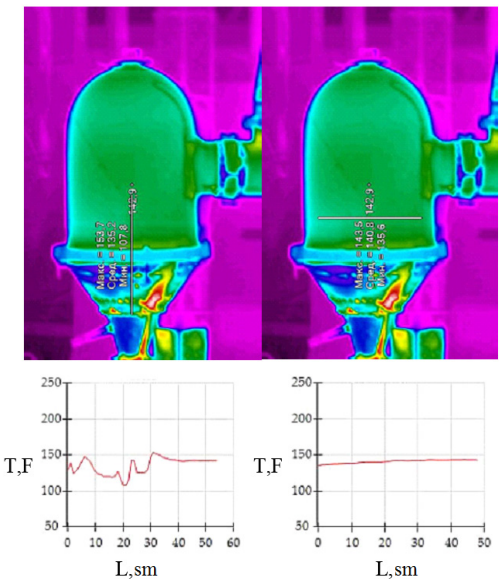

Fig. 7. Temperature field of two-phase flow in working space of the vortex granulator (operating time of 10 minutes from the moment of loading of granules)

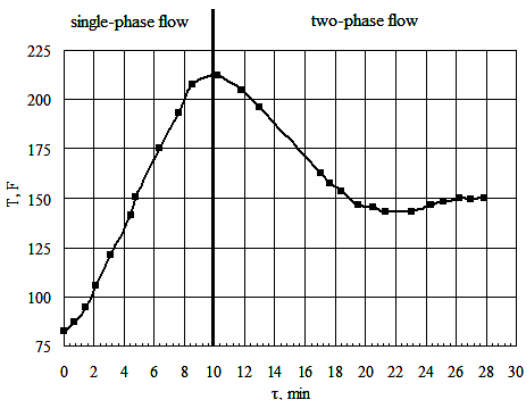

Fig. 8. Dynamics of warming up of working space of vortex granulator

Conclusion

Results of researches which are provided in this material, allow to develop algorithm of calculation of process of receiving porous surface layer on granule of ammonium nitrate. This algorithm is presented on Fig. 9.

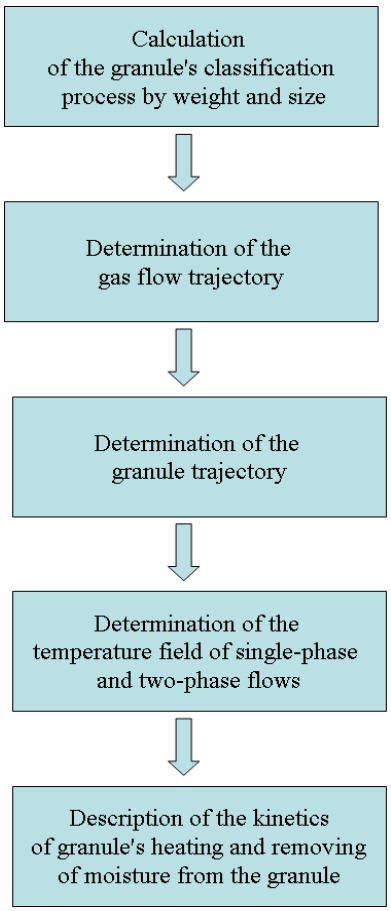

Fig. 9. Algorithm of calculation of process of receiving porous surface layer on granule of ammonium nitrate

The task of future researches – the description of the regularities of warming up of granule and removal of moisture from granules of porous ammonium nitrate in vortex flow of hot air (the last block of algorithm which is presented on Fig. 9).

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Formation of polymer microcapsules with encapsulated Fe_3O_4 magnetic nanoparticles

Roman Melnyk[1], Vitalii Serdiuk[2], Tetiana Kovalenko[3]

[1,2]Organic Chemistry Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12,
[1]E-mail: Melnykroma@yahoo.com
[2]E-mail: serdjuklvov@gmail.com

[3]Heat Engineering, Thermal and Nuclear Power Plants Department , Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12,
[3]E-mail: kovalenkotaniy@gmail.com

Abstract – Surface functionalized iron oxide magnetic nanoparticles (MNPs) are a kind of novel functional materials, which can be widely used in biotechnology and catalysis as magnetic separation systems. Therefore the goal of our work was to study preparation of encapsulated MNPs by elaborated extraction-coacervation technique using synthesized heterofunctional acrylate copolymer. Magnetite MNPs modified by oleic acid were synthesized and used in encapsulation process. Developed encapsulation technique allowed to obtain microcapsules with Fe_3O_4 nanoparticles encapsulated in paraffin core possessing magnetic properties and covered by heterofuntional copolymer shell.

Key words – heterofunctional acrylate copolymer, magnetite, magnetic nanoparticles, encapsulation, microcapsules.

I. Introduction

MNPs have many unique magnetic properties such as superparamagnetic, high coercivity, low Curie temperature, high magnetic susceptibility, etc. MNPs are of a great interest for researchers from a broad range of disciplines, including magnetic fluids, data storage, catalysis, and bioapplications [1–5]. Currently, MNPs are also used in important bioapplications, including magnetic bioseparation and detection of biological entities (cell, protein, nucleic acids, enzyme, bacterials, virus, etc.), clinic diagnosis and therapy (such as MRI (magnetic resonance image) and MFH (magnetic fluid hyperthermia)), targeted drug delivery and biological labels. However, it is crucial to choose the materials for the construction of nanostructure materials and devises with adjustable physical and chemical properties.

In the last decade, increased investigations with several types of iron oxides have been carried out in the field of MNPs. Magnetite (Fe_3O_4) and maghemite (γ-Fe_2O_3) are the very promising and popular candidates since it biocompatibility have already proven.

However, it is a technological challenge to control size, shape, stability, and dispersibility of MNPs in desired solvents. Iron oxide MNPs have a large surface-to-volume ratio and therefore possess high surface energies. Consequently, they tend to aggregate so as to minimize the surface energies. Moreover, the naked iron oxide MNPs have high chemical activity, and are easily oxidized in air (especially magnetite), generally resulting in loss of magnetism and dispersibility. Therefore, providing proper surface coating and developing some effective protection strategies to keep the stability of iron oxide MNPs is very important. These strategies comprise grafting of or coating with organic molecules, including small organic molecules or surfactants, polymers, and biomolecules.

Oleic acid (OA) is a commonly used surfactant to stabilize the magnetic nanoparticles with strong chemical bond between the carboxylic acid and the amorphous iron oxide nanoparticles [6]. Practically, it is worthy that in many cases the protecting shells not only stabilize iron oxide MNPs, but can also be used for stabilization during the encapsulation process.

Generally preparation of MNPs for biochemical applications as biocatalytic magnetic separation systems involved three steps. Firstly, the preparation of magnetic nanoparticles of required size, secondly, the encapsulation of the nanoparticles using suitable polymer with active functional groups and lastly attachment of a desired functional group such as anhydride which is suitable to bind a targeted active component such as enzyme for biochemical applications. In our work we studied two stages of magnetic separation system formation.

II. Results and Discussion

The main goal of this paper was to study the formation of MNPs encapsulated in paraffin core by developed "extraction-coacervation" technique in the presence of heterofunctional shell-forming copolymer.

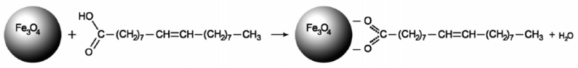
Our work was conventionally divided into two stages: 1. synthesis of modified by oleic acid Fe_3O_4 nanoparticles; 2. capsulation of modified Fe_3O_4 MNPs in paraffin core using synthesized heterofunctional acrylate copolymer under various conditions and studying the properties of the formed microcapsules (MCs).

Synthesis and modification of the Fe_3O_4 MNPs

The magnetite nanoparticles were prepared by a co-precipitation method [7] under optimal conditions. $FeCl_3{\cdot}6H_2O$ (about 0.046 mol) and $FeSO_4{\cdot}7H_2O$ (about 0.023 mol) were dissolved in deionized water in a 80 mL three-necked flask and heated to 318 K. The solution was bubbled with nitrogen gas to prevent unwanted oxidation. Then ammonium hydroxide (25%) was added quickly into the iron solution under vigorous stirring (800 rpm.)

$$2FeCl_3{\cdot}6H_2O + FeSO_4{\cdot}7H_2O + 8NH_4OH \rightarrow$$
$$Fe_3O_4 + 6NH_4Cl + (NH_4)_2SO_4 + 23H_2O$$

After 30 min oleic acid (OA, 3 mL) was added into the mixture to modify the Fe_3O_4 MNPs and the mixture was heated to 353 K.



After 1 h, the resulting Fe_3O_4 MNPs (black precipitate) were collected from the solution by magnetic separation and washed several times with deionized water and ethanol and then the suspension of the MNPs in ethyl acetate (EA) was prepared.

Encapsulation of Fe_3O_4 MNPs

Synthesized heterofunctional copolymer (HFC) of acrylonitrile (AN), butyl methacrylate (BMA), styrene

(ST), maleic anhydride (MA) with the composition AN:BMA:ST:MA = 50:28:14:8 mol% was used as dispersion stabilizer and shell-forming agent during microcapsule formation. Encapsulation of MNPs was carried out by developed "extraction-coacervation" technique [8].

Encapsulation was carried out in three-necked flask with propeller stirrer. The suspension of NMPs in solution of paraffin and HFC in ethyl acetate (Fe_3O_4:paraffin:HFC = 1:7:22 wt ratio) was added to the solution of EA in water with 1% polyvinyl alcohol (used as surfactant) at 313-323 K and different [organic phase]:[water] ratios under vigorous stirring (400, 450 rpm). After formation of stable dispersion, water was dropwise added and brown particles were formed. Formation of the microcapsules occured due to the process of phase separation that passes as a result of EA solvent extraction with gradually forming of the solids MC which are filled with hydrocarbon and MNPs.

After finishing of the encapsulation the reaction medium was reloaded into the glass and finely was washed with 400 mL of water for flushing particles from surfactant and EA. The resulting MCs with Fe_3O_4 MNPs were separated by filtration through a nylon sieve (sieve pore size was 10 microns) and repeatedly were washed with water. The resulting wet MCs were dried at room temperature and atmospheric pressure to constant weight.

As a result, we obtained spherical MCs with MNPs in paraffin core and polymer functional shell Fig. 1.

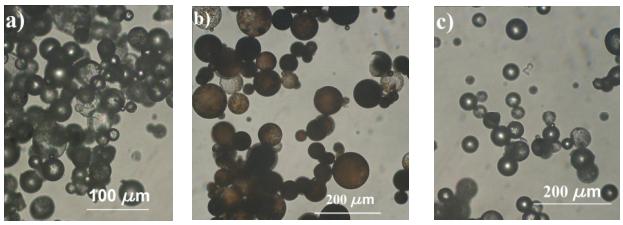


Fig. 1. Micrographs of MCs with encapsulated Fe_3O_4 MNPs of synthesis: a) №1; b) №3; c) №4

Formation conditions and size characteristics of synthesized MCs are presented in Table 1.

TABLE 1

CONDITIONS OF FORMATION AND CHARACTERISTICS OF MCS

No	Phase ratio	T, K	Stirring rate, rpm	d_n, μm	d_w, μm	k
1	1:15.6	323	450	24.4	32.3	1.32
2		313	400	68.7	110.2	1.60
3	1:15.8			54.8	84.4	1.54
4	1:16.7			38.1	56.6	1.48

In accordance to obtained results (Table. 1), the increasing of the stirring rate leads to formation of particles with smaller size and at the same time the polydispersity index also reduces. The increasing of surfactant amount in the system leads to decreasing number-average (d_n) and weight-average (d_w) diameter of MCs and reduces their coefficient polydispersity (k).

As it is shown in photos (Fig. 2) MCs with encapsulated Fe_3O_4 MCs possess magnetic properties (they are collected by neodymium magnet).

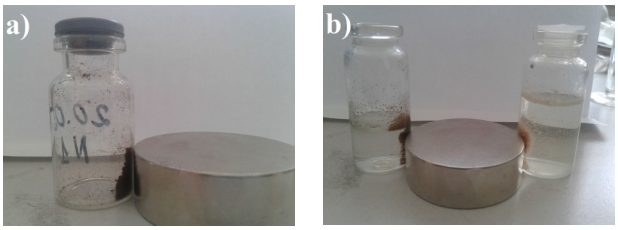


Fig. 2. MCs of synthesis №3 with encapsulated Fe_3O_4 MNPs: a) dried MCs after synthesis; b) MCs in water (left position) and MC in 1.5% water solution of HCl (right position)

It should be noted that obtained MCs are stable in solution of 1.5 % HCl and after 1 month MNPs still possess magnetic properties (see Fig 2b) that proves the encapsulation of magnetic particles in paraffin core.

Conclusion

Thus, the developed "extraction-coacervation" technique provides the encapsulation of Fe_3O_4 magnetic nanoparticles into paraffin microcapsules. Synthesized MCs possess magnetic properties and are covered with heterofunctional copolymer shell. Depending on formation conditions spherical MCs with size from 24 to 110 μm and polydispersity index 1.32-1.60 were synthesized. Obtained MCs possess magnetic properties after treatment by water solution of HCl during 1 month.

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Investigation the structures ZnS/HgS, HgS/ZnS

Martyn Sozanskyi[1], Pavlo Shapoval[1], Yosyp Yatchyshyn[1], Vitaliy Stadnik[1], Ruslana Chaykivska[2], Ruslana Guminilovych[1]

[1]Analytical Chemistry Department, Lviv Pol ytechnic National University, UKRAI NE, Lviv, S. Bandera Street 12, E-mail: sozanskyi.m@gmail.com

[2]Department of Technology of Organic Materials, Lviv Polytechnic National University, UKRAI NE, Lviv, St. Yura square 2, E-mail: Ruslana.chaikivska.xt.2013@lpnu.ua

Abstract – The process of synthesis ZnS and HgS thin films by a chemical bath deposition method (CBD) has been investigated. The phase composition, optical transmission, absorption spectra, surface morphology of films and structures based on ZnS and HgS films have been studied.

Key words – semiconductor films, chemical bath deposition, structure and morphology of thin films.

I. Introduction

Zinc sulfide (ZnS) films are important semiconducting materials with a wide-bandgap and n-type conductivity. They are promising for use in optoelectronic devices, such as photovoltaic cells, electroluminescent devices and solar cells [1]. Mercury sulfide (HgS) films have been used in solid-state solar cells, photoelectrochemical cells, storage cells, and photoconductors [2]. There is great interest in the physical properties of nanometer size semiconductor films, because their properties are often superior to those of conventional coarse-grained polycrystalline materials [3].

Development of ZnS/HgS heterostructures with different morphologies will provide new possibilities for wave function engineering and in tailoring optical and optoelectronic properties of semiconductor structures.

II. Experimental

The obtaining of ZnS and HgS semiconductor films is carried out by many methods. Technologically convenient way to their obtaining is the method of chemical bath deposition (CBD) [1]. Compared with the other it allows to pursue the deposition at temperatures below 100 °C on the large-sized substrates of different nature and use different combinations of starting substances.

The deposition of thin films of zinc sulfide (ZnS) was conducted with the initial working solution which consisted of zinc chloride ($ZnCl_2$), trisodium citrate ($Na_3C_6H_5O_7$), thiourea $CS(NH_2)_2$ and ammonium hydroxide (NH_4OH). The working solution which consisted of mercury nitrate ($Hg(NO_3)_2$), trisodium citrate and thiourea was used for the deposition of mercury sulphide thin films (HgS). The concentration of the solutions of zinc chloride was equal to 1.0 M; trisodium citrate – 0.5 M; .thiourea – 1.0 M; ammonium hydroxide – 14.28 M. Only freshly prepared reagents entered the working solutions for CBD of ZnS and HgS thin films. The deposition time was 80 min and the temperature 70°C for the ZnS films, 10 min and 80°C for the HgS films. The deposition has carried out on pre-prepared and thermostated glass substrates with an area of 3.24 cm^2. After the end of the reaction the substrates were eliminated; the surface was washed with a jet of distilled water to take off the remains of working solution and dried in air.

The investigation of surface morphology of the films was carried out using a raster electron microscope REM-106Y equipped with a system for microanalysis. Absorption-transmittance optical spectra of ZnS and HgS films and structures ZnS/HgS, HgS/ZnS on their base were obtained with a spectrophotometer Lambda 25 (Perkin-Elmer). A comparative signal was passed through glass substrates identical to the substrates, used for the investigated films. The phase composition of the ZnS and HgS films and ZnS/HgS and HgS/ZnS structures was investigated by X-ray powder diffraction (diffractometer DRON-3.0, CuKα-radiation). Primary processing of the experimental diffraction data in order to identify the phases was made using the PowderCell program [4]. Optimum exposure for each of the samples was selected.

III. Results and discussion

The structural analysis of ZnS and HgS films on glass substrates has been held. Peaks that corresponded to the cubic phase of ZnS (sphalerite) and hexagonal phase of HgS (Fig. 1 and Fig. 2) on all diffractograms can be identified. The lines of theoretical diffractograms of phases, mentioned above are shown for comparison.

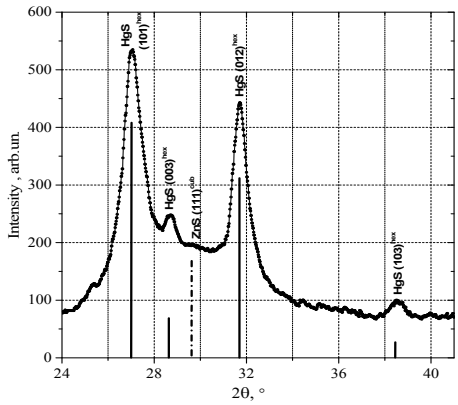

Fig. 1. X-ray diffractogram of ZnS/HgS structure

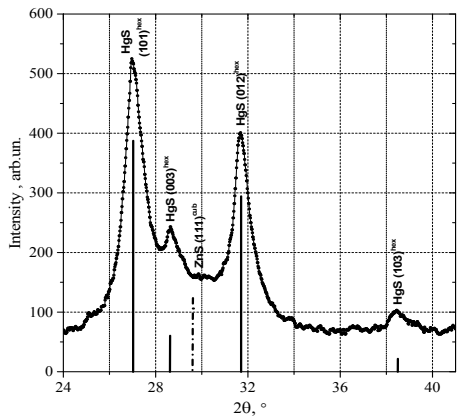

Fig. 2. X-ray diffractogram of HgS/ZnS structure

The optical transmission spectra T(λ) of ZnS/HgS and HgS/ZnS structures were investigated for wavelengths from 200 to 1000 nm (Fig. 3). A rapid increase of the light transmission can be seen at wavelengths 300 nm and. 350 nm, indicating a mixture of zinc sulfide and mercury sulfide, which confirms the results of the phase analysis by X-ray diffraction. The spectral dependences of the absorption of the ZnS/HgS and HgS/ZnS structures in $(\alpha \cdot h\nu)^2$ vs. hν coordinates allow determining the fundamental absorption edges. The optical band gaps of the films are localized in the ranges 3.54-3.68 eV and 3.00-3.06 eV, which is in good agreement with literature data for films of zinc sulfide and mercury sulfide, deposited by chemical methods [5-7].

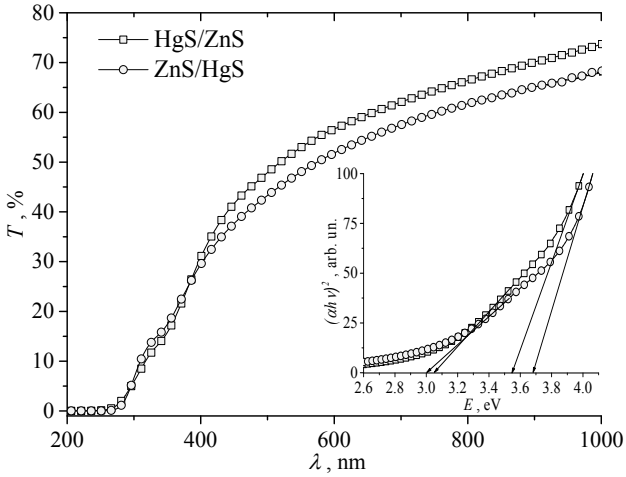

Fig. 3. The spectral dependences of optical transmission of ZnS and HgS films in the ZnS/HgS and HgS/ZnS structures.

Investigation of structures surface morphology (Fig. 4 and Fig. 5) showed that the previous layer of film is completely covered by the top layer, with small amounts of surface defects.

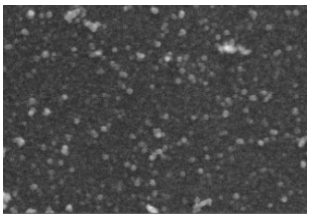

Fig. 4. Surface morphology of the ZnS/HgS structure

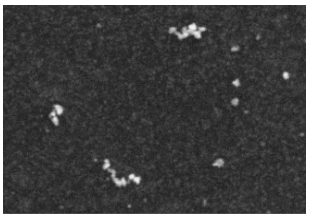

Fig. 5. Surface morphology of the HgS/ZnS structure

On the surface of ZnS/HgS structure there are seen the formation of microcrystals of zinc sulfide. The microanalysis of the surface of the ZnS and HgS films shows nearly stoichiometric zinc to sulfur and mercury to sulfur atomic ratios, with a slight excess of zinc atoms for the ZnS films and a slight excess of sulfur atoms for the HgS films. The microanalysis of the ZnS/HgS, HgS/ZnS structures shows that they consist of approximately of half of sulfur atoms and of half of a mixture of zinc and mercury atoms. It can be seen that the content of zinc atoms in the HgS/ZnS structure is considerably lower than in the ZnS/HgS structure, despite the fact that each layer of zinc sulfide and mercury sulfide in the structures was synthesized under the same conditions.

Conclusion

The ZnS and HgS thin films were synthesized by the chemical bath deposition method. The possibility of creating a double layer structure in the form of ZnS/HgS and HgS/ZnS combinations was shown. The phase composition of the samples was determined. Optical transmission and absorption spectra, surface morphology of ZnS/HgS, HgS/ZnS structures were investigated. According to the results of microanalysis the elemental composition of ZnS, HgS films and of ZnS/HgS, HgS/ZnS structures were studied. The positive research results of obtained ZnS/HgS and HgS/ZnS double layers allows assuming that the chemical bath deposition method can be used to produce not only double structures, but also multilayer coatings and heterocomposites [8].

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Effect of the Reactants Molar Ratio on the Kinetics of Cycloaddition of 2,3-Dimethylbuta-1,3-diene to allylmethacrylate

I. Kostiv[1], G. Marshalok[1], O. Marshalok

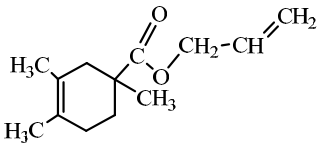
[1]National University "Lviv Polytechnic," st. Bandery 12, Lviv, 79013 Ukraine
E-mail: kostiv.irina@gmail.com

Abstract* – *The cycloaddition reaction between 2,3-dimethylbuta-1,3-diene and allylmethacrylate proceeds by the second order kinetics. The rate constants increase with the increase in the excess of one of the reactants. The change in the effective rate constants is described by the Michaelis–Menten equation indicating that the reaction proceeds through the initial equilibrium stage of formation of an intermediate complex which then transforms into the product. The effective rate constants, the equilibrium constants of formation of the intermediate complex, and the rate constant of its transformation into the reaction product were determined, as well as the thermodynamic parameters of the formation of the intermediate complex and the activation parameters of the transformation of the intermediate complex into the product. The limiting stage of the reaction is established and its mechanism is suggested.

Key words – 2,3-dimethylbuta-1,3-diene, allylmethacrylate, allyl-1,3,4-trimethylcyclohex-3-ene-1-carboxylate, cycloaddition reaction, Michaelis–Menten equation, effective rate constants, intermediate complex, limiting stage.

I. Introduction

Alkylcyclohexene carboxylates are starting materials for drugs, as well as modifiers, plasticizers, epoxyresins, and co-monomers [1]. They are used to create lotions, body emulsions, shampoos, day and night creams, perfumes, and food flavors [2]. In this work we studied the kinetics of interaction between 2,3-dimethylbuta-1,3-diene (DMB) with allylmethacrylate (AMA) to optimize the process of producing allyl-1,3,4-trimethylcyclohex-3-ene-1-carboxylate (1).



(1)

II. Experiment

Kinetic studies were performed in temperature-controlled sealed glass ampules according to the method described in [3], in the temperature range 403-433K. To the 10 cm^3 ampules were charged allylmethacrylate and 2,3-dimethylbuta-1,3-diene in the molar ratios from 1:1 to 1:1.75 and some hydroquinone, the ampules were sealed and placed in a thermostat. At regular intervals, an ampule was removed from the thermostat, quickly cooled, opened, and the reaction mixture was analyzed by gas–liquid chromatography on a SELMI CHROM-1 apparatus. The quantitative analysis was performed with internal normalization. The accuracy of chromatographic analysis in multiple parallel determinations did not exceed 3% [4].

The investigated reaction proceeds according to the second-order kinetics. The values of effective rate constants are listed in Table 1. We found that the values of the effective secondorder constants increase with the increasing ratio 2,3-dimethylbuta-1,3-diene : allylmethacrylate. The difference is more pronounced at higher temperatures. It was appropriate to examine in more detail the mechanism of this reaction. Note that the mechanism of the [4 +2]-cycloaddition reaction today is still controversial [5].

Two concerted mechanism are suggested: a single-step (sinchronous) and a two-step, in which the first step is the limiting one [6]. The Arrhenius equation described satisfactorily the dependence of the effective rate constants on temperature for different ratios (Fig. 1), which allowed us the calculation of the formal activation energy and other activation parameters of the overall process (Table 1).

TABLE 1

EFFECTIVE RATE CONSTANTS AND ACTIVATION PARAMETERS OF THE CYCLOADDITION REACTION BETWEEN 2,3-DIMETHYLBUTA-1,3-DIENE AND ALLYLMETHACRYLATE

AMA : DMB	$(k_{eff}\pm\Delta k)\times10^6$, l mol^{-1} s^{-1}				E_{eff}, kJ mol^{-1}	ΔH_{eff}, kJ mol^{-1}	ΔS_{eff}, J mol^{-1} K^{-1}
	403K	413K	423K	433K			
1 : 1	2.0±0.1	3.6±0.1	5.6±0.2	8.9±0.3	71.4	67.9	-187.6
1 : 1.25	2.4±0.1	4.6±0.1	7.3±0.2	10.6±0.3	715	68.0	-185.6
1 : 1.4	2.7±0.1	5.8±0.2	8.9±0.3	12.5±0.4	73.2	69.7	-180.2
1 : 1.5	3.0±0.1	6.7±0.2	10.9±0.3	14.7±0.5	76.6	73.1	-170.8
1 : 1.6	3.4±0.1	7.9±0.2	12.6±0.4	17.3±0.5	77.9	74.4	-166.3
1 : 1.75	4.2±0.2	9.9±0.3	16.5±0.5	23.5±0.7	82.7	79.2	-152.8

The correlation coefficient was satisfactory in all cases (R^2 > 0.95). The analysis of the parameters maid it possible to establish that upon increase in the 2,3-dimethylbuta-1,3-diene excess and the accompanying increase in the values of k_{eff} a systematic increase was observed in the effective energy (ΔE_{eff}) and the effective activation enthalpy (ΔH_{eff}). Simultaneously, the value of the effective activation entropy ($-\Delta S_{eff}$) also increased.

For all ratios of reagents an isokinetic relationship was observed with a high degree of correlation (R^2 = 0.99) between the effective entropy and enthalpy of reaction, which allowed the calculation of the isokinetic temperature T_{iso} = 332 K (Fig. 2) that was far from the

investigated temperature range. The correlation coefficient was satisfactory in all cases ($R^2 > 0.95$). The analysis of the parameters maid it possible to establish that upon increase in the 2,3-dimethylbuta-1,3-diene excess and the accompanying increase in the values of k_{eff} a systematic increase was observed in the effective energy (ΔE_{eff}) and the effective activation enthalpy (ΔH_{eff}). Simultaneously, the value of the effective activation entropy ($-\Delta S_{eff}$) also increased.

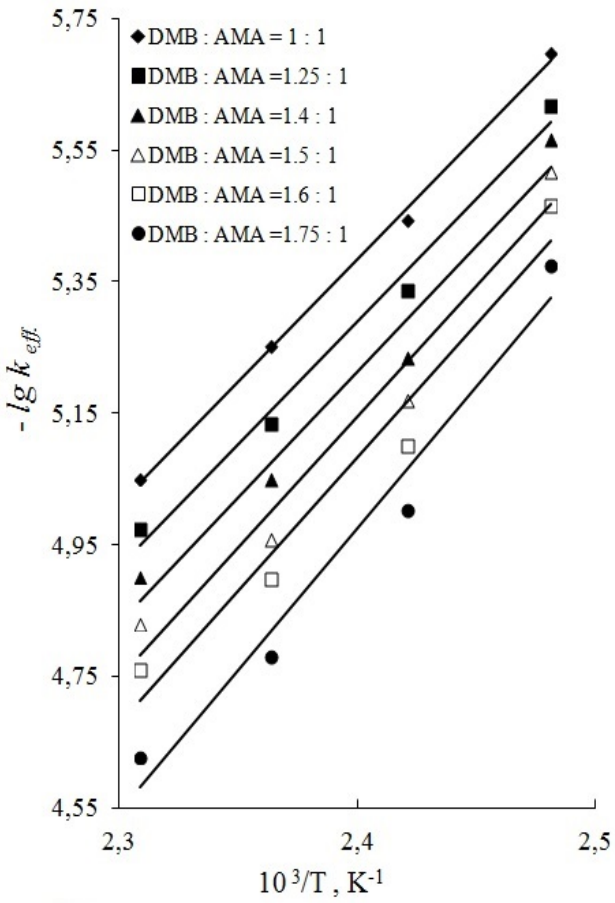


Fig. 1. Dependence of the effective rate constant of cycloaddition between 2,3-dimethylbuta-1,3-diene and allylmethacrylate on temperature for different ratios of reactants: 2,3-dimethylbuta-1,3-diene : allylmethacrylate

The increase in E_{eff} and ΔHe_{ff} with increasing excess of 2,3-dimethylbuta-1,3-diene and a simultaneous increase in ΔS_{eff} indicate the increasing steric hindrances in the reaction course. This finding suggests also that the reaction mechanism is unique in the studied range of the reagents ratio. Such a systematic change in the rate constants with an increase in excess of one of the reactants is typical of the reactions that include the formation of the charge transfer complex (CTC by the reagents) [7, 8]. A similar reaction course has been proved also for several cases, including the alcoholysis of alcohols [9, 10], where the formation of charge-transfer complexes was confirmed by the methods of physicochemical and spectral analyses.

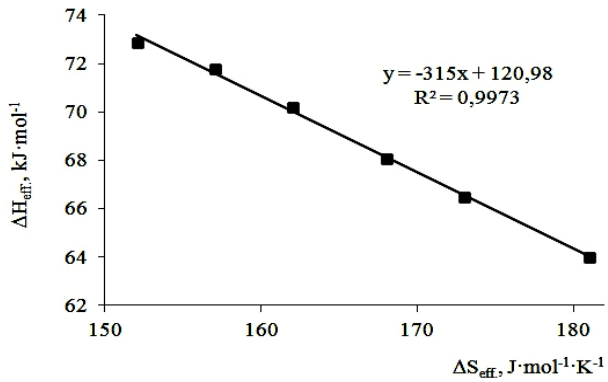


Fig. 2. Dependence of the effective activation entropy on the effective activation enthalpy of the cycloaddition between 2,3-dimethylbuta-1,3-diene and allylmethacrylate

For these reactions the effective second-order rate constant does not remain constant at the change in the reagent ratio, and the kinetics of the process is described by the Michaelis–Menten equation:

$$A + B \underset{}{\overset{K_{eq}}{\rightleftharpoons}} [A : B] \xrightarrow{k_{conv}} \text{Product}$$

$$\frac{1}{k_{eff}} = \frac{1}{k_{conv}} + \frac{K_{eq} C_A}{k_{conv}} \qquad (2)$$

where k_{eff} is experimentally determined effective second order rate constant (l mol^{-1} s^{-1}) for each reagent ratio,

K_{eq} is the equilibrium constant (l mol^{-1}) for the intermediate complex formation,

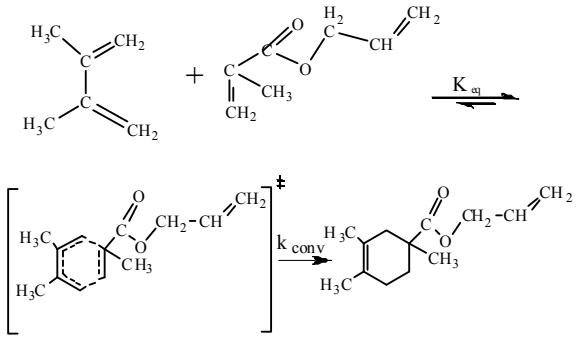
k_{conv} is the rate constant (s^{-1}) of the intermediate complex conversion into the reaction product,

C_A is the molar concentration (M) of the substance taken in excess.

III. Results and Discussion

In our case, the change in the effective rate constants of the 2,3-dimethylbuta-1,3-diene cycloaddition to allylmethacrylate as a dependence on the ratio of reactants is also satisfactorily described by the Michaelis–Menten equation (2). This fact suggests that the cycloaddition reaction between 2,3-dimethylbuta-1,3-diene and allylmethacrylate proceeds through a stage of equilibrium with the formation of an intermediate complex followed by its conversion into the reaction product [Eq. (3)].

From the dependences shown in Fig. 3 for four temperatures, we obtained the following linear equations:



(3)

403K: $1/k_{eff.} = -340146C_A+838510$, (R^2=0.998) (4)
413K: $1/k_{eff.} = -244294C_A+520041$, (R^2=0.991) (5)
423K: $1/k_{eff.} = -161490C_A+338760$, (R^2=0.994) (6)
433K: $1/k_{eff.} = -94241C_A+209279$, (R^2=0.992) (7)

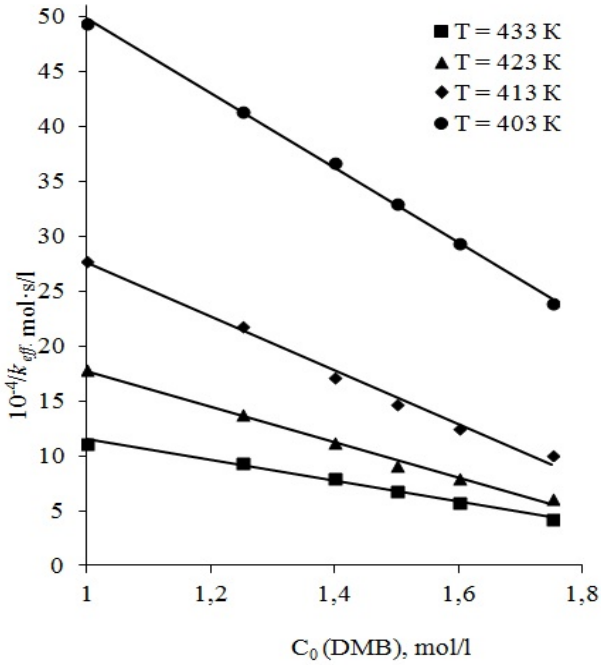


Fig. 3. Dependence of the effective rate constant of cycloaddition between 2,3-dimethylbuta-1,3-diene and allylmethacrylate on the molar ratio of reagents in the temperature range 403-433K

The slope of the obtained straight lines gives the rate constants of the conversion of the intermediate complex in the reaction product (k_{conv}). The values of the intercepts on the ordinate axis give the equilibrium constants of the complex formation (Table 2) according to the expression $K_{eq} = 1/(k_{eff}\, k_{conv})$.

The dependence of the equilibrium constant (K_{eq}) of the intermediate complex formation is described by the isobar (Fig. 4, $R^2 = 0.993$). The dependence of the rate constants of conversion (k_{conv}) on temperature is described by the Arrhenius equation (Fig. 5, $R^2 = 0.999$), which allows the calculation of the activation parameters of the intermediate complex conversion in the reaction product (Table 2).

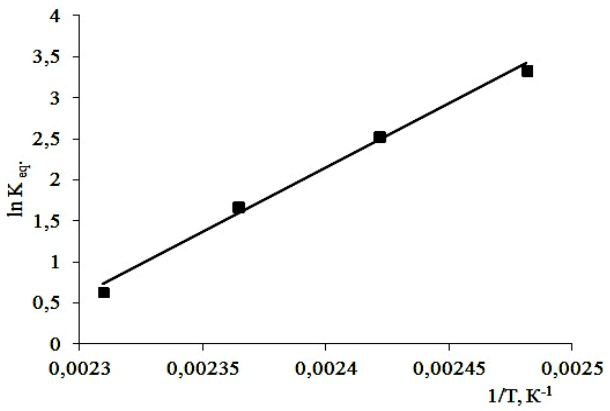


Fig. 4. Dependence of the equilibrium constant of the formation of intermediate complex on the temperature

TABLE 2.

EQUILIBRIUM CONSTANTS (K_{EQ}) AND THERMODYNAMIC PARAMETERS OF FORMATION OF THE INTERMEDIATE COMPLEX, THE RATE CONSTANTS (K_{CONV}) AND ACTIVATION PARAMETERS OF ITS TRANSFORMATION INTO A PRODUCT OF THE REACTION

Constants	403K	413K	423K	433K	ΔH_{eq}, kJ mol^{-1}	ΔS_{eq}, J mol^{-1} K^{-1}	ΔG_{eq}, kJ mol^{-1}
$K_{eq}\cdot 10^{10}$, л·моль$^{-1}$	9.59	10.01	10.40	10.93	2.8	-260.1	112.8
					E_{conv}, kJ mol^{-1}	$\Delta H^{\#}_{conv}$, kJ mol^{-1}	$\Delta S^{\#}_{conv}$, J mol^{-1} K^{-1}
$K_{conv}\cdot 10^6$, c^{-1}	1.19	1.92	2.95	4.78	66.7	63.2	-203.9

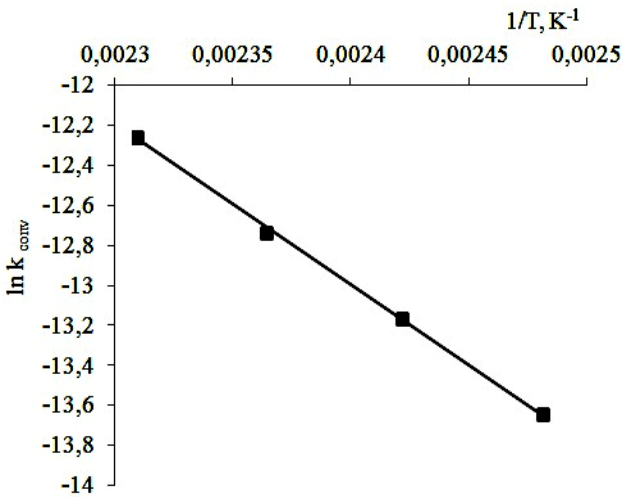


Fig. 5. Dependence of the rate constants of conversion of the intermediate complex in the reaction product on the temperature

The found positive ΔG_{eq} and negative ΔS_{eq} values indicate the energy advantage of the intermediate complex formation. At the same time a relatively fast decomposition of the intermediate complex suggests that its formation is the limiting stage of the process. Thus, we established for the first time that the kinetics of the investigated process obeyed Michaelis– Menten equation, which was valid in the case of the reaction course through the stage of the associative equilibrium. It is an argument in favor of this reaction to proceed by the mechanism of concerted cycloaddition. However, the nature of the interaction of the components should be studied in more detail.

It is known that the addition of a diene molecule to the dienophile double bond originates from a certain deficiency of the electron density on this double bond due to its interactions with the other active groups, and the stronger conjugation with them, the easier the diene

addition. Indeed, when k_{eff} of 2,3-dimethylbuta-1,3-diene interaction with allyllmethacrylate at 353K is 0.74×10^{-6} mol l^{-1} s^{-1} (determined graphically), the k_{eff} for the interaction of 2,3-dimethylbuta-1,3-diene with 1,4-naphthoquinone, where the π-bond interacts with two C=O groups, is 0.14×10^{-5} mol l^{-1} s^{-1} (in hexane) [11], and with its 5-substituted derivatives it is even two orders of magnitude higher, 1.5×10^{-3} mol l^{-1} s^{-1} [12]. The accelerating effect of electronegative substituents, like cyano group or halogen, on the cycloaddition reaction is even more pronounced. Thus, in the interaction of cyclopentadiene with methyl acrylate at 303K in dioxane k_{eff} is 2.8×10^{-5} mol l^{-1} s^{-1}, with fumaric acid dinitrile, 155×10^{-5} mol l^{-1} s^{-1}, and with tetracyanoethylene, 10200×10^{-5} mol l^{-1} s^{-1}. In such cases it is reasonable to assume that a relatively strong donor–acceptor bond arises between the reagents [13].

Conclusion

The results of the study of kinetic regularities in the process of synthesis of allyl-1,3,4-trimethylcyclohexa-3-ene-1-carboxylate and the study of the mechanism of this reaction showing its corresondence to the Michaelis–Menten equation confirm the formation of an intermediate complex between the reagents, 2,3-dimethylbuta-1,3-diene and allylmethacrylate. The study of thermodynamic parameters of formation of the intermediate complex suggests that the limiting stage is the slow formation of an intermediate complex, the activation parameters of the transformation of the intermediate complex in the product indicates that the conversion of the intermediate complex in the product occurs rapidly and spontaneously.

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CFD-modeling of gas combustion process in the industrial cyclone-calciner furnace

Roman Benko[1], Roman Havryliv[2], Volodymyr Maystruk[3]

[1]Department of chemical engineering, Lviv Polytechnic National University, UKRAINE, Lviv, St. Yura square, 9, E-mail: 96tej96@gmail.com

[2]Department of chemical engineering, Lviv Polytechnic National University, UKRAINE, Lviv, St. Yura square, 9, E-mail:romanhavriliv@gmail.com

[3]Department of design and operatin of machines, National University, UKRAINE, Lviv, Profesorska str., 1, E-mail:vmaistruk@gmail.com

Abstract – The computer model that enables to investigate the work of cyclone-calciner furnace for the heating up regime has been developed. Simulation carried out in ANSYS FLUENT 15.0. The temperature field and species concentration were obtained. The work results provide important data to further study the efficiency of the limestone thermal decomposition chemical reactions and optimizing furnace design and operation modes.

Key words – CFD-modeling, cyclone-calciner furnace, heating up regime of furnace

I. Introduction

High temperature processes are the basis for a number of industrial productions in chemical technology. This is especially true for limestone calcination processes to lime production. This process occurs in industrial furnaces of various designs. One type of these furnaces is the cyclone-calciner furnace. Furnaces of this type are universal and used in many industrial processes for processing and preparation of dispersed materials.

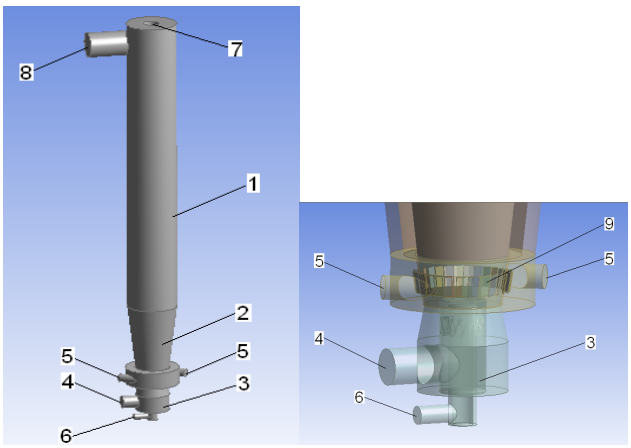
Exploitation of these manufacturing facilities are linked with the consumption of large amount of fuel for the thermal decomposition chemical reactions of limestone.

In addition, complex physical and chemical processes such as movement and heating of dispersed particles, combustion of fuel and interaction between particles and gas flows take place in the apparatus. Understanding these processes will make it possible to control the furnace and improve its efficiency, reduce fuel consumption and optimize modes of operation.

The most effective way to study the processes that take place in the cyclone calciner furnace and efficiency of work is the use of numerical simulations that can significantly reduce the costs of experimental and industrial research.

II. Boundary conditions for numerical simulation

For numerical simulation of combustion process fuel in calciner furnace the industrial testing data were used. Geometric dimensions and design of the furnace were described in [1]. The modeled cyclone-calciner furnace is shown in Fig. 1, a, b. In this type of furnace, the burner "ГГВ-МГП-200" is used.



a b

Fig. 1. Cyclone-calciner furnace geometry:
a - general view of furnace; b - burner location
1 - cylindrical section; 2 - conical section; 3 - burner;
4 - air inlet pipe; 5 - additional air inlet pipe; 6 - fuel (methane) pipe; 7 - inlet solids pipe; 8 - outlet pipe; 9-blades

Operation modes of the furnace is presented in table 1. All the geometric data and the initial and boundary conditions were supplied by "Pustomyty lime plant", Ukraine.

TABLE 1

OPERATION MODES OF THE FURNACE

Operation modes	Main regime	Additional air flow
Inlet air, m/s	17-22	13-20
Inlet gas, m/s	7	7
Inlet additional air, m/s	0	5
Temperature wall, K	1000	1000

Numerical simulation of combustion was carried out using software complex Ansys Fluent 15. The computational mesh was built using mesh generation ANSYS Meshing CFD and consisted near the 2 mln. cell. The qualities of the created mesh had checked to avoid error from occur.

For the CFD modeling the Realizable k-e turbulence model, the Discrete Ordinates (DO) radiation model and Non-Premixed combustion model were used. In the numerical procedure the 3-D, steady-state, Navier–Stokes equations, energy equation and single mixture fraction probability function (PDF) were used.

The fuel composition in mole fractions of the species CH_4, C_2H_6, C_3H_8, C_4H_{10}, and CO_2 is presented in table 2. For all inlet flows temperature was set as 300K.

TABLE 2

THE FUEL COMPOSITION

Species	Mole fraction
CH_4	0.965
C_2H_6	0.017
C_3H_8	0.001
C_4H_{10}	0.001
CO_2	0.003
N_2	0.013

The oxidizer (air) consists of 21%O_2 and 79% N_2 by volume.

To setting up the calculation module used the following assumptions:

1. The working volume of the furnace is a mixture of gases (oxygen, nitrogen, fuel, waste products);
2. The heat exchange between the environment and the wall is missing (the walls are “adiabatic”)
3. The thermal radiation from the wall in the volume of gas simulated by the model of discrete ordinate at a constant temperature of 1000 K.

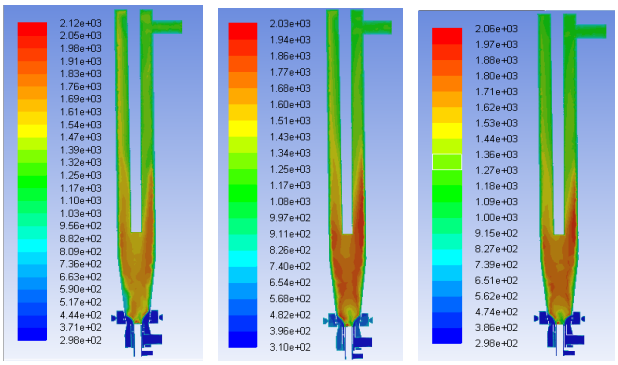
A finite volume method was chosen since most of fuel combustion simulations applied this type of method. SIMPLE-based approach was used for pressure-velocity coupling scheme. The solution was simulated until convergence is achieved. Approximately 3500 iterations was performed for each cases.

III. Results modeling

Simulation of the furnace was carried out for various technological modes, which correspond to different ratio of the primary and secondary air flow and fuel (gas methane) and described in [1].

The thermal fields results from the numerical modeling are demonstrated in Figs. 2 and 3, respectively. Figures displays the thermal fields according to the two operating conditions: case 1 - with different ratio of main air flow and gas flow; case 2 - with different ratio of main and additional air flow and gas flow.

From Fig. 3, the maximum temperature ranges from 1700K to 2000K and the temperature color scale is the same for all three cases.



a b c

Fig. 2. The temperature field for a vertical plane (case 1)
a) inlet air 17 m/s; inlet gas 7 m/s;
b) inlet air 20 m/s; inlet gas 7 m/s;
c) inlet air 22 m/s; inlet gas 7 m/s

When the gas and air enter the furnace and mixed in burner, combustion was occurs due to high velocity.

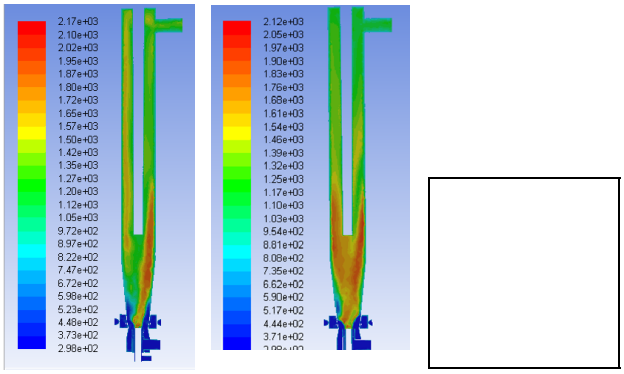
The central vortex created by the tangential blades of the burners is visible at the center of the conical section furnace.

One can notice that the highest temperature is located between the central pipe and wall of the furnace in conical section, were the stoichiometric condition is obtained. After that, the temperature was increased until reach maximum temperature.

As the flow moves to the outlet heat is exchanged with the furnace walls and central tube, creating the temperature gradient shown in the Figs. 2 and 3.

At the higher levels in cylindrical section of the furnace general temperature distribution shows lower values than at the lower levels. This is important since the particles calcination time decreases with non-uniform temperature distribution.

Fig.3 showing the effect of varying the amount of combustion air flowing to the burner according to case 2 (with additional air flow).



a b c

Fig. 3. The temperature field for a vertical plane (case 2)
a) inlet air 13 m/s; inlet gas 7 m/s; inlet additional air 5m/s;
b) inlet air 17 m/s; inlet gas 7 m/s; inlet additional air 5m/s;
c) inlet air 20 m/s; inlet gas 7 m/s; inlet additional air 5m/s

For case 2a (Fig.3.a) additional air flow velocity is low, so the peak flame outside of the conical section, meaning the combustion is poor in the furnace. In 2b and 2c cases (Figs.2b and 2c), the combustion is improved by using the additional air and the combustion flame is kept in the main combustion chamber.

One can conclude that the the high ratio of main air flow and additional air flow to the burner provides more uniform temperature field. For this cases the areas of local overheating are absent, and the maximum temperature in the working area is 2000K.

The flame is longer and characterised by a slightly higher temperature than that predicted for the air-fired case.

Probably the most efficient calcination of limestone can be arranged on the circuit with additional air flow. The answer to this question will be obtained after the particles calcination process simulation in the furnace according to cases 2b and 2c.

Conclusion

The combustion modeling provides some promising results to better understand the complex processes occurring within the furnace and can be a baseline for future modeling of pollutant emissions and limestone calcination processes.

The results make it possible to evaluate 3-D field of temperatures in the reaction zone and in the whole system volume, concentration species distribution, determine the length of the torch and choose the best operation mode for heating regime of furnace.

The experimental data are in good agreement with the field tests results of the device.

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Influence of surface-active additieves on processes of alkylaromatic catalytic oxidation

Volodymyr Reutskyy[1], Yurii Hrynchuk[2]

[1]Department of general chemistry, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: gib1986@gmail.com

[2]Department of general chemistry, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: yura_gym@ukr.net

***Abstract* – The process of ethylbenzene oxidation in the presence of catalytic systems, that consists fromsalt of variable valence metal and organic additives, was explored. Suggestion about the influence mechanism of additives on the ethylbenzene oxidation process were made.**

Key words – oxidation, alkylaromatic, ethylbenzene, additieve, surface active matter, radical, catalysis, catalytic system.

I. Introduction

Over a past decade chemical industry was going through some tough challenges: such as high price of reagents (mainly oil), decrease of production and increase of production standards. But due to rapid decrease of oil prices today situation changed and many economic specialist are predicting new outburst of chemical production all over the world (mainly in large industrial economics (USA, China, Germany etc.) and traditionally oil-countries (Saudi Arabia, UAE etc.)). In such economical situation manufacturer needs to stay on the "edge" providing more quality products for lower price. This task can be achieved in several ways. One of them is search for new technology, creation of new technological schemes based on new data and researches. However this way needs major investments and often means building new production facilities "from the ground". Taking all this into account we can say that this way is more suitable for creation of new productions. However major "players" on the chemical market usually have not only long history but also long-time working factories and plants based on older technological schemes. Such facilities are still making money for their respective owners but in comparison with newer plants can lose parts of the markets leading to their shutdowns. This leads us to another way of improvement – "evolution" of existing technology. Such way of improvement needs much less investments. Basically you need to make changes in few most "crucial" and/or" control-able" points of process and this can lead to major changes in process productivity, quality and time of production. Also such changes can help to fit into new production regulations because often higher productivity means less sewage (and this makes even out-of-date process "greener"). Also it needs to be noted that usually for "speeding" of processes were used temperature and/or pressure, but despite the fact that such changes can increase productivity or change selectivity of the process , their applying will lead to increase in process cost and as a result will lower the possible income. In our opinion the best way to make "older" technological process more productive and relevant is search, development and improvement (some kind of "evolution") of catalytic systems used in such processes.

II. Problem statement

Radical oxidation processes are one of the best ways to show how improved catalytic systems can change outcome of "out-of-date" industrial chemical process. Every industrial radical process is a "two edged sword" situation. At one hand you have a process that needs just a "little push" at the start (creation of free radicals) and later it becomes self-catalyzing[1]. On other – the further you go in terms of conversion the poorer would be selectivity of aim products (basically in the end you will receive mixture of products further processing of which would be a nightmare). Therefore most of radical processes (and almost all radical oxidation processes) are characterized by low conversions and huge recycle of raw materials. For example conversion of cyclohexane (CH) during oxidation to cyclohexanole (CHL) and cyclohexanone (CHN) (processes of obtaining adipic acid and caprolactane) is from 2% to 4%[3]. 20% conversion of ethylbenzene (EB) during process of hydroperoxide of ethylbenzene (HPEB) obtaining is reached due to use of 4 connected oxidation reactors (therefore conversion in 1 reactor is about 4-5%)[4, 5]. Relatively high selectivity on aim products in those processes is achieved with help of catalysts which are organic salts of Cobalt (cobalt naphtenate(CN), cobalt acetate (CA), etc.). Our previous studies showed that during oxidation Cobalt in form of Co^{3+} forms an active catalytic complex with raw material and organic substrate. Further decomposition of this complex provides high selectivity for aim products[5]. However effect of catalyst is limited and "deeper" oxidation still causes shifts of selectivity. Search for other salts of variable valence metal (SVVM) that could be used as catalyst for these processes is not relevant due to relatively low price of cobalt salts, their proven efficiency and accessibility. More logic way of solving productivity problem would be improvement of catalytic system by additives of different nature. This would create new catalytic systems based on industrially used catalysts.

Oxidation of cyclohexane in the presence of catalytic systems, along with variablevalence metal salt containing organic additives of electron-donor or electron-acceptor nature, has shown high efficiency of their applyence. Using the above mentioned additives allowed to change the ratio between the target product, to improve selectivity for the target products and increase the conversion of cyclohexane [1, 2, 6]. However, for cyclohexane oxidation process it is difficult to determine impact of organic additives on the elementary stages of the process. For this purpose it is expedient to use a model substance, which is characterized by a smaller number of stages of oxidation and a smaller number of products formed by oxidation. Substance of such a model can be ethylbenzene.Investigation of the process of oxidation of ethylbenzene in the presence of catalytic systems of different nature allows to set the mechanism of influence of these systems at the elementary stage of oxidation.

III. Experimental

Research was carried out in a steel reactor at temperatures 130 C and pressure 0.4 Mpa. As a basic component of the catalyst was used naftenat of cobalt. As catalytic additives were used poliglikol (PG), chromoksane and tcianethyl ether (TCEE). The concentration of cobalt naftenate was 0.003 mol / liter. Molar ratio of cobalt naftenate /organic additive was 1 / 1. The concentration of ethylbenzene hydroperoxide (HPEB) was determined tytrymaticlly, concentration of atcetofenone - by gas-liquid chromatography.

IV. Results and discussion

Obtained results revealed that in the presence of catalytic system naftenat Co – PG HPEB formation rate increases, indicating that the presence of PG increases the amount of dissolved oxygen in the system. However, considering that the influence of catalytic systems for oxidation is smaller than the total impact of naftenate of Co and PG, you can assume that in the reaction mixture is present the reaction of complexation between Co naftenate and PG, and oxidation catalyst in this case is not an individual compound but the complex between variable valence metal salt and organic additive. The highest growth of rate of accumulation HPEB was observed when we used the catalytic system naftenat Co - hromoksan. We can assume that hromoksan affects the ratio of Co^{+2} / Co^{+3}, increasing amount of the last in the system. Results obtained by using the system naftenat Co - TCEE also responds to the literature data (Fig. 1), as TCEE contains triple connection, and by its structure is an inhibitor of oxidation process.

The results of oxidation of ethylbenzene in the presence of catalytic systems containing organic additives such as PG and chromoksan show results opposite to those obtained in oxidation of ethylbenzene in the presence of individual compounds [5].

These results and data on the impact of ethylbenzene oxidation ratio of oxidized and reduced forms of cobalt Co^{+2}/Co^{+3} shows that the impact of PG is related to its surface-active properties and the effect of X and E in complex with their participation and thus different effects on the ratio of Co^{+2}/Co^{+3} in the reaction system – electronaceptor chromoksan shifts ratio towards $Co^{+3,}$ and TCEE,that has electrondonor properties, forms more stable intermediate complexes and thereby has inhibiting effect on the process of oxidation. These results confirm that the effect of organic additives is largely due to the chelation of salt of variable valency metal.

Other aspect of obtained data is obvious existing of synergetic effect of organic additives on reaction mixture. In both cases – alkyl-aromatic oxidation and oxidation of CH – raw materials could be looked on as non-polar solvents and all studied organic additives are surface-active matters (SAM) of different nature (ionic and non-ionic). Such nature of additives and raw materials would most definitely influence changes in surface tension (leading to changes of oxygen consumption and solubility, which is one of the most crucial points in oxidation processes) and also changes in micelles creation in reaction mixture. Structure of those micelles would influence structure of created active catalytic complexes and next stage of research should be finding of dependences of complex structure from nature of used SAM. Also it is worth mentioning that concedering miccelous-creation in raction mixture allows us to research oxidation process from the point of view of nano-catalytic systems as well as “classic” homogeneous catalysis.

Conclusion

Thus, the researches found that the nature of additives significantly affects the efficiency of the catalytic system in the process of oxidation of ethylbenzene. However,for a more detailed understanding of the influence of the studied catalytic systems it is necessary to explore a wider range of organic additives of different nature.

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Dispersion cooligomerisation of mixture of C_9 fraction unsaturated hydrocarbons

Oksana Orobchuk, Ulyana Fuch, Roman Subtelnyy, Bohdan Dzinyak

Department of Technology of organic products, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: or_oksana@ukr.net

***Abstract* – Improving the technology for producing cooligomers (syntheticlow molecular petroleum resins), which are obtained from chaep petrochemical raw materials – hydrocarbon fractions of liquid by-products of pyrolysis (LBPP) or cracking of oil, refining products or gas was discussed in the paper.**

The imperfections of industrial methods of initiated oligomerization are high reaction temperature , high reaction time, complexity of the selection of target products, high enough color. З метою усунення недоліків, властивих виробничим процесам, запропоновано проводити процес дисперсійної коолігомеризації To eliminate the shortcomings inherent in the production process to carry out the process of dispersion oligomerization is proposed.

A technological two-stages scheme of process of cooligomers obtaining by dispersion methods with next solution cooligomerization of unreacted hydrocarbons of C_9 fraction has been designed.

Results are of practical interest in refining by-products of pyrolysis of diesel fuel.

Key words: liquid pyrolysis products, dispersion cooligomerization, C_9 fraction, the initiator, cooligomer.

I. Introduction

In today's industrial development question of qualified use of by-products appears as ethylene production amount increases annually, leading to increasing of the amount of liquid by-products of pyrolysis (LBPP). The rational way of LBPP recycling is obtaining cooligomers on their basis [1].

The features of industrial methods of initiated oligomerization: high reaction temperature (453 ... 473 K), high reaction time (6 ... 8 hrs.), complexity of the selection of target products, high enough color (40 ... 100 mg I_2/100 ml) which significantly affects not only properties, but also the cost oligomer. Co-olihomers obtaining process (by initiated oligomerization) implemented in industry has a number of drawbacks. We offer to remove them partially by carrying out C_9 fraction co-oligomerization at dispersion system. Dispersion co-oligomerization of unsaturated hydrocarbons of C_9 fraction is a technologically initiated oligomerization in drops of monomer, dispersed in an aqueous medium mostly [2].

As a dispersion medium is water, oligomerization is carried out on temperatures up to 373 K [3]. In this temperature range the main component that makes styrene resin is partially viniltoluols. Most of the saturated hydrocarbon fraction C_9 is xylenes and benzene derivatives. Thus we obtain a system of monomer – solvent [4]. We get oligomer of large molecular weight hydrocarbons in solution, which do not participate in the reaction [5].

II. Experiments

As raw material for oligomerization (dispersion phase) fraction C_9 of liquid by-products of pyrolysis diesel is used: density - 925 kg/m^3; bromine number – 68 g Br_2/100 g, molecular weight - 102, the content of unsaturated compounds to 45% including styrene 170,85% viniltoluols 6,99%, 18,00% dicyclopentadiene, indene 1,25 %. The dispersion medium is water.

Initiators:

1) for suspension cooligomerization - benzoyl peroxide (PB) soluble in C_9 fraction, technical production "MERCK" (Germany), containing the main product of at least 76.2%, thermolysis temperature – 380 K).

2) for emulsion cooligomerization - potassium persulfate (PP) soluble in water containing the main product of at least 99.0%.

Suspension stabilizer - polyvinyl alcohol (PVA) $(C_2H_4O)n$, synthetic water-soluble polymer having hydroxyl groups and refers to vinyl acetate polymers and copolymers; emulsifier – (E-30) is a mixture of line alkansulfonates. general formula R-SO3Na, where R - corresponds with an average carbon chain length of C_{15}.

Oligomerization initiator is benzoyl peroxide (PB) by technical production "MERCK" (Germany), containing the main product of at least 76,2%, temperature of thermolysis is 380 K.

Synthesis of oligomers by dispersion oligomerization was carried out in three-neck flask with stirrer. Raw materials (C_9 fraction, and dispersion medium) proportions were served in a flask. The calculated amount of initiator solution and a suspension stabilizer were added in a flask. After loading the reagents rapidly stirred while heated to the desired temperature. The mixture was precipitated, filtered and dried in a vacuum oven at a temperature of 343 K. For oligomers yield (in terms of fraction C_9) and physic-chemical properties: unsaturation (bromine number), the rate of color iodometric scale (YMSH) molecular weight and softening temperature were determined.

III. Results and Discussion

The comparative evaluation of emulsion, suspension and industrial (solution oligomerization). methods of coooligomers obtaining have been made

Solution cooligomerization (similar to the industrial process), using lauryl peroxide initiator (PL) 1.0% by weight, was carried out at a temperature of 373 K for 6 h.

Dispersion cooligomerization (suspension and emulsion) was carried out at a temperature of 333 K, the process duration - 3 hours, the concentration of the initiators potassium persulfate (PP) and benzoyl peroxide (PB) - 1.0% wt. Emulsifier (E-30) concentration - 0.7% by weight, the concentration of suspension stabilizer polyvinyl alcohol (PVA) - 0,1% wt., volume ratio [C9 fraction: water] = [1: 2].

The research results are presented in Table. 1.

TABLE 1

DEPENDENCE OF THE YIELD AND PHYSICAL AND CHEMICAL CHARACTERISTICS ON WAYS OF COOLIGOMERIZATION

Characteristics	Suspension cooligomerization ($T = 333$ K, $C_I = 1{,}0\%$ мас., $C_{PVA} = 0{,}1$ % wt., $\tau = 3$ hours)	Solution cooligomerization ($T = 373$ K, $C_{BP} = 1{,}0$ % wt., $\tau = 6$ hours)	Emulsion cooligomerization ($T = 323$ K, $C_{PP} = 1{,}0$ % wt., $C_{E\text{-}30} = 0{,}7$ % wt., $\tau = 3$ hours)
The yield, wt%.	16,5	16,0	17,8
Bromine number, g Br_2/100 g	30,3	24,6	33,3
The average molecu-lar weight	490	900	695
Softening temperature, K	350	333	358
Color, mg I_2/100 ml	30	60	20-30

Each methods has both advantages and disadvantages. At almost the same output product (within 16.0 ... 17.8% wt.), The benefits of suspension and emulsion cooligomerizatin compared to solution cooligomerizatin, is a low temperature of the process that makes it possible to obtain cooligomers with low color number. The mechanism that is specific to emulsion cooligomerizatin provides high speed response time throughout the study. The resulting cooligomers characterized by slightly higher yield (17.8% wt.), higher molecular weight (810) and the softening temperature (358 K) compared with the characteristics of the suspension cooligomers.

Chromatography, infrared spectroscopic and chemical analyzes have been made. Have been established that products resulting dispersion cooligomerization (emulsion, suspension) containing composed mainly styrene units and viniltoluenu.

In the process of dispersion cooligomerization of unsaturated hydrocarbons of fraction C_9 mainly react styrene and its homologues. Dicyclopentadiene`s conversion is insignificant. Therefore, it is appropriate event initiated solution cooligomerization of unreacted hydrocarbons.

Conclusion

The suspension and emulsion methods of oligomerization process of unsaturated hydrocarbons of fraction C_9 have been conducted.

The dependence of the yield and physical and chemical characteristics of cooligomers on the cooligomerization method have been established.

A technological scheme of two-stages process of cooligomers obtaining by dispersion methods with next solution cooligomerization of unreacted hydrocarbons of C_9 fraction have been designed.

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Simultaneous Methyl Methacrylate and Methacrylic Acid Obtaining over Zirconium-containing Catalysts

Yuliia Nebesna, Roman Nebesnyi, Volodymyr Ivasiv, Nazarii Lapychak

Technology of Organic Products Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: yulia_lemberg@ukr.net

Abstract* – Methyl methacrylate and methacrylic acid are widely used monomers. The aldol condensation of methyl propionate and formaldehyde is perspective process for simultaneous obtaining of this methacrylate monomers. It was found that zirconium-containing catalysts are active in this process. The effect of zirconium content in the catalyst on methyl propionate conversion and yield of methyl methacrylate and methacrylic acid has been determined. The best catalyst for methyl propionate condensation with formaldehyde has been found.

Key words – methyl methacrylate, methacrylic acid, aldol condensation, methacrylates, catalyst, zirconium oxide.

I. Introduction

Methyl methacrylate (MMA) and methacrylic acid (MAA) are important monomers in industrial organic chemistry. Polymeric materials, made of MMA and MAA, have good transparency, lightness, UV light and weather resistance. Methacrylates are widely used in the production of organic glass, electronic and semiconductor devices, fiber optic cables, lighting equipment, paints, lacquers and other coatings, in medicine and so on. Demand for MMA and MAA has grown year-on-year over decades, so it is an actual task to improve these monomers obtaining methods or find alternatives.

One of the promising methods of methacrylate monomers producing is gas phase aldol condensation of carbonyl compounds [1]. This method has substantial advantages, such as small number of process steps and possibility to use by-products as commercial products [2]. Methacrylic acid and methyl methacrylate can be obtained simultaneously in one process, through aldol condensation reaction of methyl propionate (MP) and formaldehyde (FA) in the gas phase over heterogeneous catalysts. In our previous studies it was found that acid type catalysts containing oxides of boron and phosphorus and promoted by tungsten oxide are active in this process [3, 4]. These catalysts provide high conversion of methyl propionate (up to 99 %), but MMA and MAA selectivity is low [3].

As is known from the literature [5, 6], basic type catalysts which contain compounds of alkali and alkaline earth metals are active in the aldol condensation of MP with FA. One of such catalysts is based on cesium oxide or hydroxide deposited on silica gel [5]. These catalysts show high total MMA and MAA selectivity (up to 86 %), but due to low conversion of MP yield of unsaturated products was only 12.0 %. In order to increase selectivity of our B-P-O_x/SiO_2, we added basic oxides to this catalyst instead of acidic tungsten oxide, but this replacement did not have positive effect on catalyst activity and selectivity [7].

Recent publications show that zirconium oxide is effective promoter to the catalysts for condensation of MP with FA [8, 9]. In particular, the addition of zirconium increased MMA selectivity [8]. The aim of this paper is to study the effect of zirconium oxide addition to the catalyst based on boron and phosphorus oxides deposited on silica gel in aldol condensation of MP and FA.

II. Results and Discussions

Catalysts B_2O_3–P_2O_5–ZrO_2/SiO_2 were prepared for the study. The total amount of active components in the catalyst was 20 % by weight. Molar ratio of B_2O_3 and P_2O_5 oxides in each catalyst was 3:1 respectively. Zirconium oxide content in the catalyst was changed so that ZrO_2/P_2O_5 molar ratio in the catalyst was 0.1; 0.3; 0.6 and 1.0. The activity of these catalytic systems was studied in flow reactor with impulse feeding of the reactants and fixed-bed catalyst.

The reaction mixture of MP and FA with their equimolar ration was used for the research. Temperature was changed in the range of 563 ÷ 683 K, contact time was 12 s. The reaction products were analyzed by gas chromatography. Methanol and propionic acid (products of methyl propionate hydrolysis) also formed during the process, and diethylketone is another product, which can be separated and used as a commercial product.

The results show that in the presence of B_2O_3-P_2O_5-ZrO_2/SiO_2 catalytic systems MP conversion increases with temperature increasing over all studied catalysts (Fig. 1). The highest MP conversion was over the catalyst with ZrO_2/P_2O_5 molar ratio of 0.3 at all temperatures, e.g., 84.7 % at 563 K and 99.6 % at 683 K.

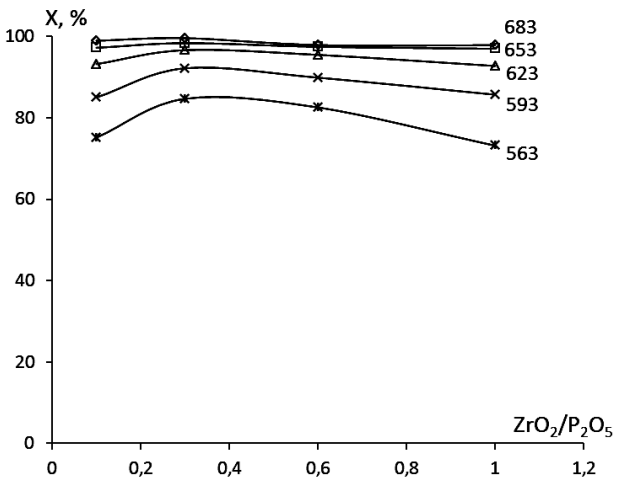

Fig. 1. Methyl propionate conversion dependence on zirconium oxide content in the catalyst in the temperature range 563 – 683 K

The total MMA and MAA selectivity increases with zirconium content increasing until molar ratio of ZrO_2/P_2O_5 is 0,3, and then slightly decreases. The highest selectivities were at 623 K over all studied catalysts,

because at temperatures over 623 K side reactions occurs actively, particularly, diethylketone formation. The maximum methacrylates selectivity (65.4 %) was at 623 K over the catalyst with zirconium oxide content of 0.3, and at 683 K over the catalyst with zirconium oxide content of 0.1 the selectivity was only 13.7 %.

The highest total yield of methacrylate monomers was over the catalyst in which molar ratio of ZrO_2/P_2O_5 is 0.3, at all studied temperatures of the process (Fig. 2). Also methacrylate yield increases with temperature increasing up to 623 K, then yield decreases. At 683 K yield was 13.4 % over the catalyst with zirconium oxide content 1.0 and 23.3 % over the catalyst with zirconium oxide content 0.3 At 623 K over the same catalysts MAA and MMA yield was 50.3 % and 63.3 % respestively, and at 563 K – 19.0 % and 31.5 % respectively.

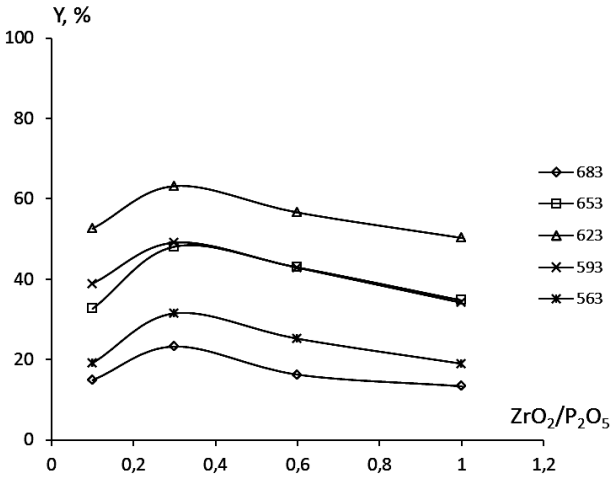

Fig. 2. The effect of zirconium oxide content in the catalyst on total methyl methacrylate and methacrylic acid yield at 563 – 683 K

As the yield of target products is a criterion for choosing the best catalyst for the process, the optimum catalyst for methyl propionate condensation process with formaldehyde is catalyst in which the molar ratio of ZrO_2/P_2O_5 is 0.3, as at 623 K this catalyst provides the highest total yield of methacrylates (63.2 %).

The experiments showed that B_2O_3-P_2O_5-ZrO_2/SiO_2 catalysts are active in methyl propionate aldol condensation with formaldehyde in the gas phase. Compared to the previously studied catalysts promoted by tungsten oxide and basic oxides, zirconium-containing catalysts provide significantly higher methyl methacrylate and methacrylic acid selectivity. Particularly in the presence of B_2O_3-P_2O_5-WO_3/SiO_2 catalyst the highest selectivity was 49.1 % at 653 K [4]; potassium-containing catalyst provided selectivity up to 42.4 % at 653 K [7], and in the presence of B_2O_3-P_2O_5-ZrO_2/SiO_2 catalyst the highest selectivity (65.4 %) was achieved at lower temperature – 623 K. So, adding zirconium oxide to B-P-O_x/SiO_2 catalytic system allowed to increase the selectivity of the process by 16.3% and to reduce optimum temperature of the process by 30 K.

Conclusion

It was found that zirconium-containing catalysts based on boron and phosphorus oxides are active in the process of methyl methacrylate and methacrylic acid simultaneous obtaining by aldol condensation of methyl propionate and formaldehyde. It was determined, that catalyst which has molar ratio of ZrO_2/P_2O_5 of 0.3 provides the highest methyl propionate conversion, methacrylate monomers selectivity and yield. Also this catalyst allows to reduces optimum temperature of the process by 30 K, which is positive for the economical aspect of this process.

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Characteristics of spray drying process of nanocolloidal silica as a method of production of nanostructural powders potentially applicable in inhalation therapy

Katarzyna Jabłczyńska*, Michał Wojnarowicz, Tomasz R. Sosnowski

Faculty of Chemical and Process Engineering, Warsaw University of Technology, POLAND, Warsaw, Waryńskiego Str. 1, *E-mail:k.jablczynska@ichip.pw.edu.pl

Abstract – The research was focused on investigations of the impact of spray-drying (SD) conditions on the morphology and aerosol performance of powders produced from nanocolloidal silica.Microsized nanostructiral particles were characterized by SEM, aerosol spectrometry and pharmaceutical impactor. Results show that proper adjusting of SD process parameters and precursor composition allows to obtain powders of different morphologies: solid or hollow particles with different wall thickness, or particles with a microporous structure with spherical or nonspherical shape. Obtained results indicate that silica nanoagreggates have characteristics suitable for their effective delivery to the lungs via inhalation.

Key words – spray drying, nanostructural powder, particles engineering, silica particles, inhalation therapy.

I. Introduction

In recent years nanoparticles gained a lot of interest in pulmonary drug delivery field due to the rapid advance in nanotechnology [1]. Their unique features, such as very high surface to volume ratio, give them properties different to the ones of bulk form of the same substance, for example a higher dissolution rate and better absorption in the organism. The size of nanoparticles is responsible for their specific interactions with tissues such as enhanced permeability and retention effect in the area of the tumor [2]. In addition, small area for opsonin binding allows nanoparticles to avoid phagocytosis [3]. All mentioned features increase the bioavailability of the active substance administered in the form of nanoparticles in comparison to the micronized drug. Nanoparticles can consist of the crystalline or amorphous form of active pharmaceutical ingredients or can be designed as polymer or liposomal carriers of encapsulated drug.

Another type of biocompatible nanocarriers of drugs with attractive physicochemical characteristics is silica nanoparticles [4]. After proper surface modification silica nanoparticles can serve as gene delivery vectors and carriers of anticancer or antimicrobial agents [5]. In powder formulations silica nanoparticles can be used to improve aerosolisation efficiency of inhaled drugs. They can act also as drying adjuvant in formulations of thermally sensitive drugs [5].

The lung offers large surface area (greater than 100 m^2) and very thin air-blood barrier (approximately 0.1 μm) for the mass transfer [1]. This fact makes inhalation very efficient and rapid way for drug delivery to the systemic circulation. Additionally, absorbed drug avoids so called 'first-pass' effect which significantly reduces its concentration in blood as a result of the metabolism in the liver [3]. Aerosol therapy is also the best method for the local administration of the drug in case of the pulmonary diseases. High concentration of the active substance can be reached exactly at the site of action with simultaneous reduction of the overall dose administered the body.

The size of inhaled particles has a major impact on their regional deposition in the respiratory system. Particles with aerodynamic diameter greater than 5 μm do not reach the lower (respiratory) airways. In contrast, particles smaller than 1μm are expected to be mostly exhaled without almost no deposition due to their low inertia. Therefore, nanoparticles cannot be efficiently delivered by inhalation to the bronchial tree and the alveoli, where they should deposit to gain a therapeutic effect. Additionally, nanopowders have a strong tendency to agglomerate, what makes their aerosolization very difficult [6].

The strategy adopted to overcome these limitations is to formulate nanoparticles into micron scale structures with the aerodynamic diameter of 1-5 μm [7]. These structures, after deposition on the wet surface of the lung, are expected to break up back into the nanoparticles [8]. The required type of nanoaggregates can be produced by means of spray-drying technique [6,8].

In this paper we study the influence on drying conditions on the preparation of micro-scale particles within inhalable size range, which might be used as carriers of functionalized silica nanoparticles

II. Experimental

Colloidal silica Ludox TM-40 (in the size range of 20±10 nm) [9] and Ludox AS-30 (bimodal size of 5 and 50 nm) purchased from Sigma Aldrich (USA) was used for the production of the nanostructrures. Colloidal silica suspensions were diluted using water purified by reverse osmosis (Puricom, USA) to gain the silica concentration of 1% w/v. Each precursor nanosuspension was prepared directly before spray drying.

Powder was obtained by spray drying of silica suspensions in Mini Spray Dryer B-290 (Büchi, Switzerland). Precursor was pumped at volumetric rate of 3 mL/min to the atomizing nozzle (diameter 0.7 mm) at volumetric rate of 3.6 mL/min fed by compressed air with rate of 6 L/min or 12 L/min depending on the variant of the experiment. The inlet temperature of drying air was set at 100°C or 200°C. Drying air flow through the dryer with the rate of 20 or 38 m3/h. Produced powders were separated in the high performance cyclone and collected in the product container. All combinations of aforementioned values of process parameters were tested with both silica preparations.

Basing on the morphologies of obtained particles three of them were selected for further analysis as the most distinctive. Process parameters used for the production of those powders are shown in Table I.

TABLE I

SELECTED PROCESS PARAMETERS

Sample	Compressed air flow	Drying air flow	Inlet temp.	Outlet temp.
	[l/min]	[m3/h]	[oC]	[oC]
A	6	38	200	113
B	12	20	100	39
C	12	38	200	99

Additionally, the experiment with water and ethanol (Sigma Aldrich, USA) in the 30:70 ratio (v/v) was held. Water-ethanol mixture was used as the silica dispersant to speed up solvent evaporation from the droplet. In this case silica concentration of 1% or 0.2% w/v was used.

Obtained dry particles were characterized in scanning electron microscope (SEM, model TM1000, Hitachi, Japan) after coating with 20 nm layer of gold (K550x Sputter Coater, Quorum Technologies, UK).

The first method used for determination of powder particles size distribution was based on the analysis of SEM images using Fiji open source software [10]. The distribution was found from three micrographs of the powder assuming a spherical particle shape. The volumetric median diameter Dv(50) was derived to characterize the particle size.

Size distribution of aerosolized powder particles was determined with two techniques. Optical diameter of aerosol particles was measured using Spraytec diffraction spectrometer (Malvern Instruments, UK) after dispersion of the 50 mg of powder in the commercial inhaler (Aerolizer, Novartis, Switzerland). The spectrometer was connected to the Inhalation Chamber (Malvern Instruments, UK) and the vacuum pump. Aerosol generation was obtained by drawing the airflow at the rate of 80 L/min. The measurements were time-averaged (measuring period: 500 ms, sampling rate: 1 kHz) and triplicated for each type of powder. Again the volumetric median diameter Dv(50) was derived to characterize the particle size.

Next Generation Impactor (NGI - Copley Scientific, UK) was applied for determination of aerodynamic diameter of aerosol particles. It is a standard method used in characterization of inhalation medical products. Powder was loaded into capsules as 50 mg aliquots and converted into aerosol in Aerolizer inhaler (airflow rate: 80 L/min). The aerosol was directed to the NGI and the mass of powder collected at particular stages corresponding to certain aerodynamic particle size limits was found (balance precision: 0.1 mg – Radwag, Poland). Five capsules were used in each run to obtain detectable mass of powder at each stage. The measurement was repeated three times for each powder sample and the results were averaged. Based on the mass distribution, the volumetric median diameter Dv(50) was evaluated.

The specific surface area, the average pore size and the microporous surface of three produced powders was measured using 3FLEX apparatus (Micromeritics, USA) after sample degassing in Smart VacPrep (Micromeritics, USA). Surface characteristics was made based on BET adsorption isotherm.

III. Results and discussion

Sample SEM pictures of obtained nanostructural particles are presented in Fig. 1, 2 and 3. The significant differences in particle morphology are visible as a result of drying conditions. In case of powder A, low flow rate of atomizing air results in larger size of droplets formed from the prescursor colloid and, accordingly, in larger size of powder particles. Higher rates of drying, as a consequence of high temperature of the process, results in formation of hollow and corrugated particles.

In case of powders B and C, initial droplets are smaller due to higher flowrate of the atomizing air, so the final particles are also finer. Differences in the morphology of particles B and C result from different drying temperatures. For powder B, solvent evaporation is slow enough to allow nanoparticles to diffuse to the center during droplet evaporation (shrinking). This explains why compact, spherical particles are formed.

A

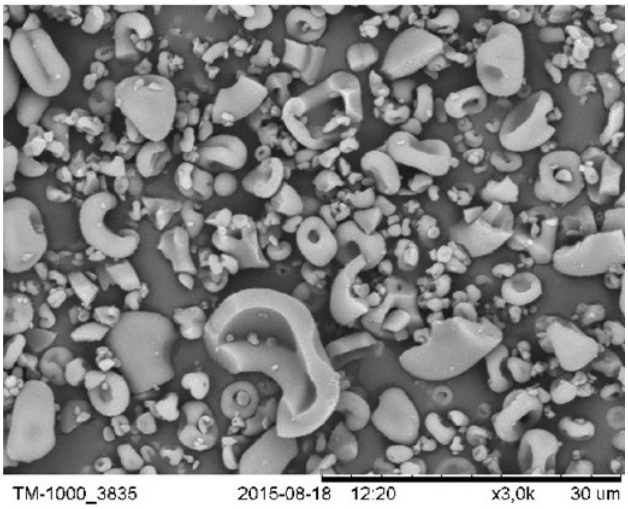

Fig. 1. SEM micrographs of powder particles obtained from colloidal silica Ludox TM-40 – Sample A (scale bar: 30 μm)

B

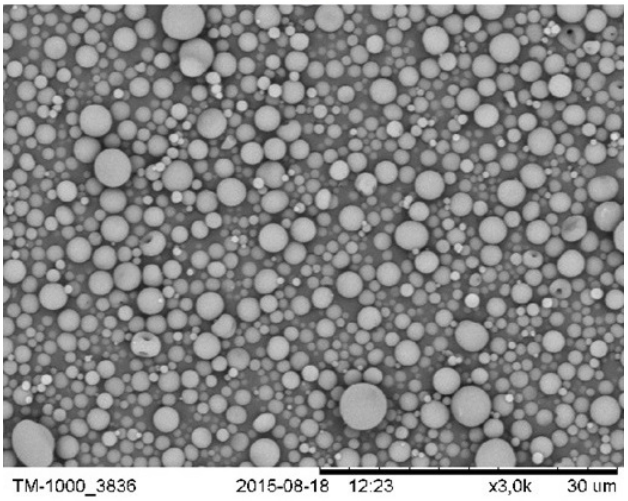

Fig. 2. SEM micrographs of powder particles obtained from colloidal silica Ludox TM-40 – Sample B (scale bar: 30 μm)

C

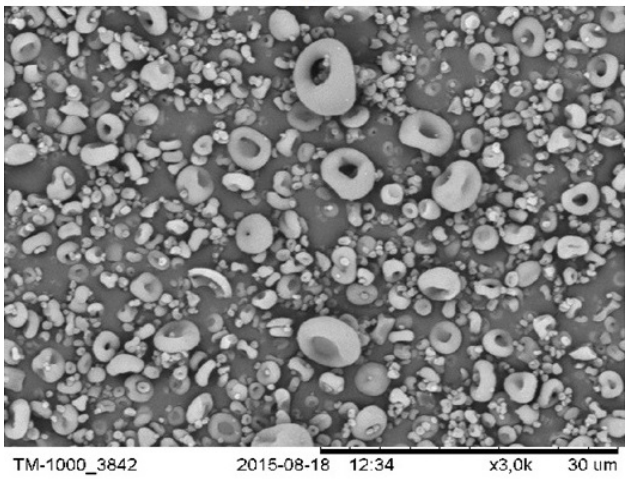

Fig. 3. SEM micrographs of powder particles obtained from colloidal silica Ludox TM-40 – Sample C (scale bar: 30 µm)

Particles of powder C are also much smaller than of powder A but, in contrary to powder B, cavities can be seen at their surface. Again this kind of morphology is a consequence of solid crust formation at the early stage of drying when solvent evaporation and surface reduction of droplets is faster than nanoparticles transfer (diffusion) towards the droplet center. The importance of the motion of droplet surface due to evaporation and the rate of nanoparticles diffusion within the droplet can be conveniently characterized by dimesionless Peclet number [11] which remains low in the process of formation of powder B but is increased during production of powder C.

Example SEM micrographs of particles obtained from the colloidal silica dispersed in 30:70 (v/v) water-ethanol mixture in concentration of 1% (w/v) are presented in the Fig. 4 and 5. The appearance of particles is not very different from the ones obtained in analogical drying conditions from aqueous suspension. Particles D are larger, corrugated and empty inside, while E particles are fine with concave deformations of the surface.

D

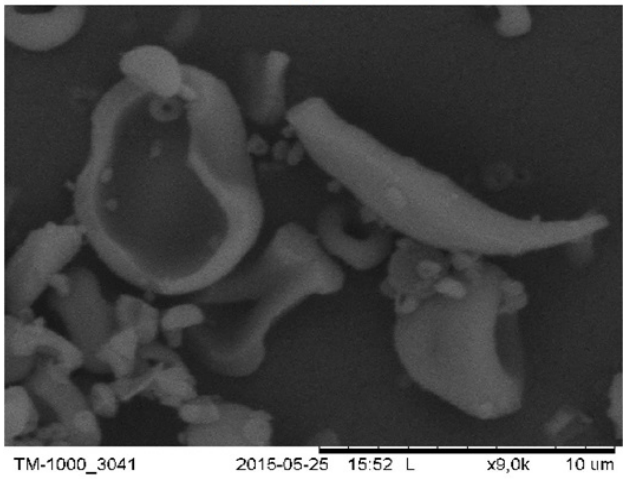

Fig. 4. SEM micrographs of the powder D particles obtained from colloidal silica Ludox AS-30 in water-ethanol mixture (1% w/v, process parameters as for samples A from Table I, T_{outD}=114°C) scale bar: 10 µm

E

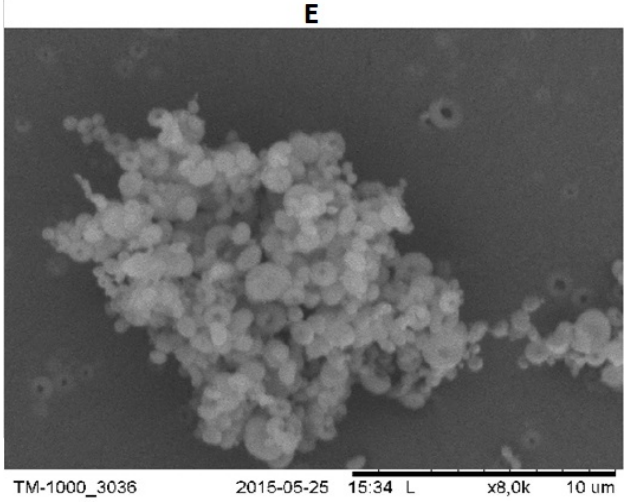

Fig. 5. SEM micrographs of the powder E particles obtained from colloidal silica Ludox AS-30 in water-ethanol mixture (1% w/v, process parameters as for samples C from Table I, T_{outE}= 100°C) scale bar: 10 µm.

The most interesting morphologies of particles obtained from the suspensions containing ethanol are shown in Fig. 6 and 7. The prelevance of large particles over small is visible. The use of silica in the concentration 0.2% allowed the formation of particles with very thin shell of the nanometric thickness. Holes in this shell are caused by solvent vapors escaping from the interior.

Some other unique particles can be seen in Fig. 6. Those particles (indicated by arrows) have the spongy structure with a numerous pores at the surface. This can be a result of local boiling of the ethanol i.e. rapid generation of vapor bubbles which left the empty spaces in the hardening shell of the particle.

Powders A, B and C where characterized in terms of particles size distribution by three different methods. Samples D, E, F and G were not investigated further due to the safety factors related to the necessity of larger powder quantities production and the lack of the appropriate dryer accessories required during the work with organic solvents.

F

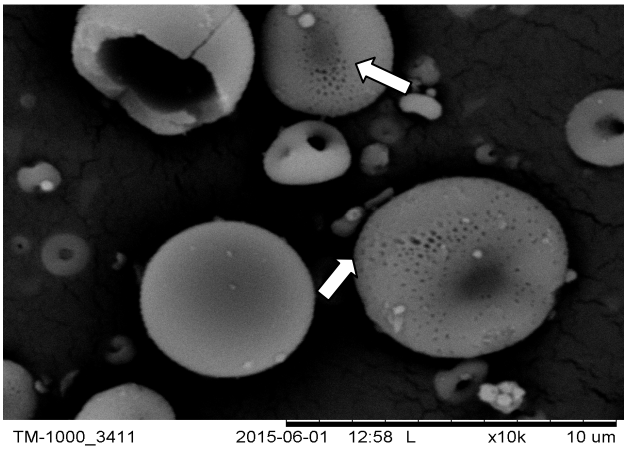

Fig. 6. SEM micrographs of the powder particles obtained from colloidal silica Ludox AS-30 dispersed in water-ethanol mixture (0,2% w/v, air flows as for sample A, T_{inF}=120°C, T_{outF}=66°C) scale bar: 10 µm

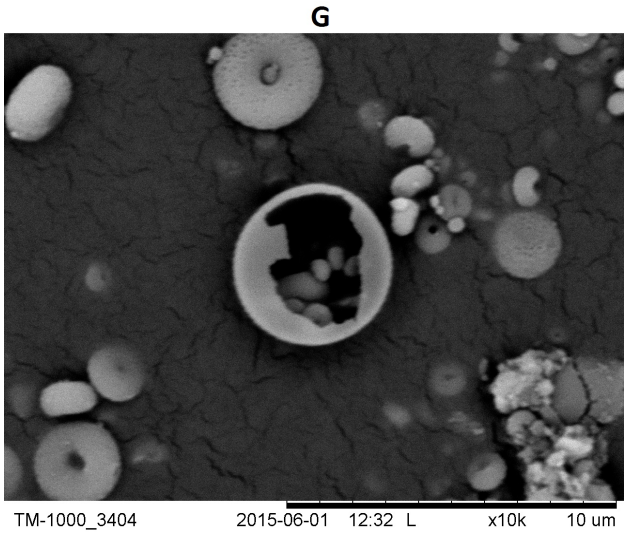

Fig.7 SEM micrographs of the powder particles obtained from colloidal silica Ludox AS-30 dispersed in water-ethanol mixture (0,2% w/v, air flows as for sample A, T_{inG}= 140°C, T_{outG}= 77°C) scale bar: 10 µm.

Histograms obtained by SEM image processing for the samples of powders A, B and C are shown in Fig. 8. This method allows for evaluation of the equivalent geometrical diameter. Powder A is characterized by the broadest particle size distribution and the highest particle diameters (2.5 – 12 µm). Powders B and C contain particles within the size range of 0,5 to 3 µm, however the contribution of smaller particles is greater in powder B.

The volumetric size distributions of aerosolized powder particles obtained from Spraytec sepctrometer are presented in Fig. 9. These data indicate the ability of produced powder to disperse to form aerosol, which is key factor in the assessment of the quality of obtained powders in the view of their potential use in the aerosol therapy.

Histograms depicted in Fig 9. show the same trends as found in the previous method, however the upper limit of the particles size ranges is higher. Powder A is characterized by particle size 0.4 - 25 µm. The majority of particles B and C are within the range of 0.1-12 µm, but additional small peak at approximately 30-50 µm was found for B particles.

It indicates that particle aggregates had been formed and were not dispersed in the inhaled. It can be concluded that spherical particles characterized by smooth surface have a weaker capability of aerosolization than deformed particles with corrugated surface.

Size distribution of aerosolized powders obtained in NGI are presented in Fig. 10. This method allows to determine the aerodynamic equivalent diameter which is the diameter of a unit density sphere with the settling velocity identical to the given particle. Being the preferential method medical powders characterization, it allows a direct prediction of deposition of inhaled particles in the respiratory system.

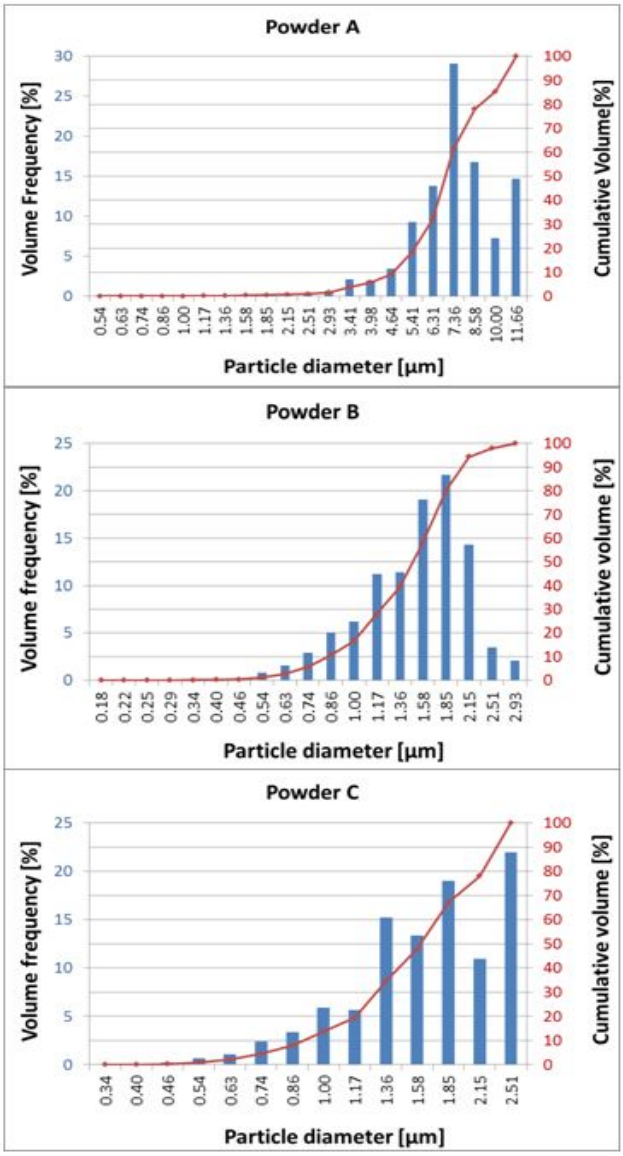

Fig. 8. Particle size distributions for powders A, B, and C derived from SEM images

Histograms presented in the Fig. 10 show again, that the largest particles are present in powder A, where the mass fraction contained in particles larger than 6.9 µm is approximately 17%. This fraction for powders B and C is 7% and 5%, respectively.

Table II contains the comparison of two quantitative parameters of the size distribution obtained with all measuring methods: the volumetric median diameter (VMD = Dv50) and the percentage of particles smaller than 4.7 µm (known as the fine particle fraction: FPF).

TABLE 2

SUMMARY OF THE STATISTICAL PARAMETERS OF THE SIZE DISTRIBUTIONS OBTAINED BY THREE MEASUREMENT METHODS

	Dv50 [µm]			FPF [%]		
Sample	I	II	III	I	II	III
A	7.0	3.9	3.9	13.4	61.8	61.8
B	1.5	1.6	2.8	100	84.6	80.4
C	1.6	1.3	2.5	100	93.4	86.4

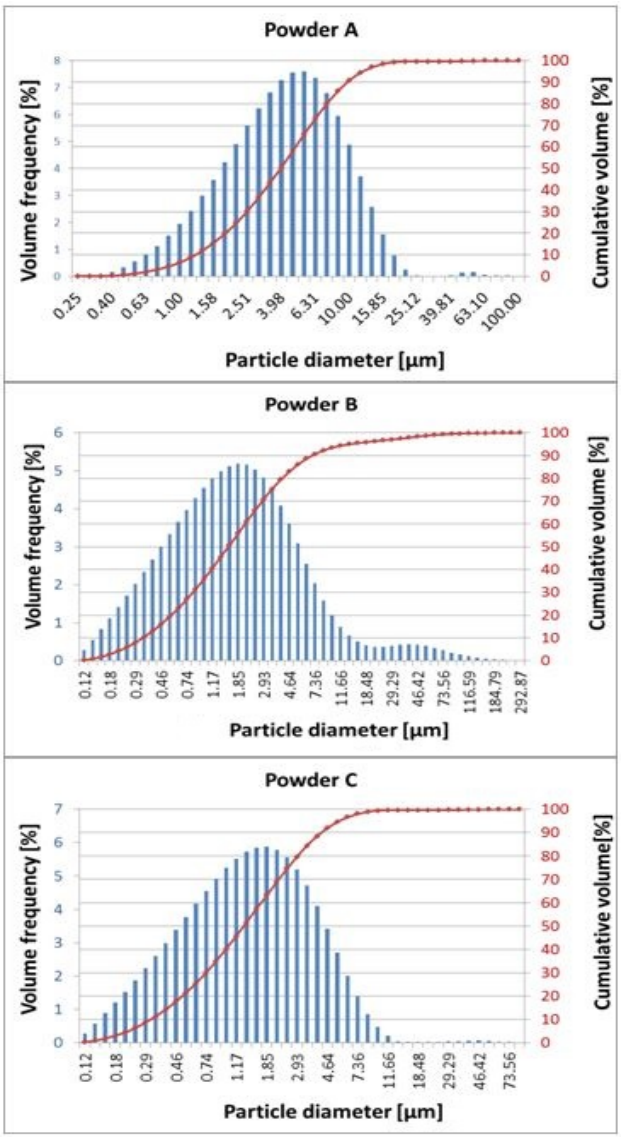

Fig. 9. Particle size distributions for aersolized powders A, B, and C obtained from diffraction spectrometer measurements

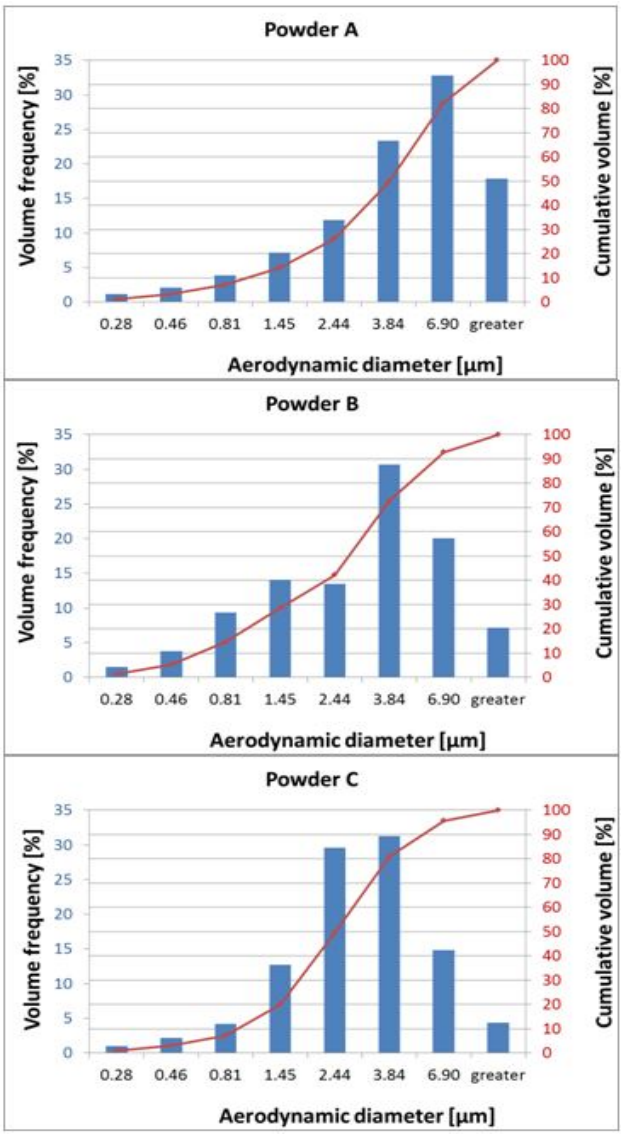

Fig. 10. Aerosol particles size distributions for the powders A, B, and C obtained from NGI measurements

In case of powder A, the highest value of Dv50 diameter was obtained from SEM images processing. Since the typical particle shape deviates from sphericity, the applied algorithm used to determine the particle size distribution could not work well for this powder. Non-sphericity of particles also explains why optical (II) and aerodynamic (III) Dv50 values are identical.

The shape of B and C particles is more spherical so the values of their geometric (I) and optical (II) average diameters are similar. High values of aerodynamic diameter result from particle compactness, i.e. high density (silica).

TABLE 3

PARTICLES SURFACE CHARACTERISTICS BASED ON ADSORPTION ISOTHERM MEASUREMENT

	Average pore size [Å]	Specific surface area [m^2/g]	Microporous surface [m^2/g]	Mesoporous surface [m^2/g]
A	7.535	108.14	2.151	105.99
B	7.548	109.91	1.558	108.36
C	7.529	108.48	2.399	106.08

Obtained results of surface properties measurement are presented in Table 3. Specific surface area is very similar for all powders and is about 108 m^2/g. Only sample B containing spherical particles obtained in the mildest drying conditions, shows a slightly larger surface area of almost 110 m^2/g. At the same time the particles of this powder have a minimum microporous surface. Although the spherical particles have the smallest surface area to volume ratio, due to the absence of large particles and the smallest median diameter, the building material is most fragmented in this case and therefore mesoporous surface is greatest. No corrugation of the surface of the particles causes lower microporosity than in other cases.

Nearly identical results were obtained for the average pore size. This value for all three samples is of about 7.5 Å, independent of the drying conditions employed.

Conclusions

Spray drying process performed in strictly controlled conditions was demonstrated to be a convenient method

of production of nanostructural powders with the required properties to consider them as potential carriers in inhalation therapy. Obtained nanostructural silica particles have different morphology depending on the drying parameters. By adjusting these parameters it is possible to obtain solid spherical particles, but also hollow particles with different wall thickness (including the nanometric shell) or particles with a microporous structure.

The paper also compares three methods of determination of the particle size distribution of powders and aerosols. It was indicated that geometrically smallest powder particles form also the smallest aerosols (with a low aerodynamic diameter), although this obvious trend can be changed in case of substantial powder aggregation.

The smallest value of aerodynamic Dv50 and highest value of FPF were observed for powder C, which was produced from the finest droplets of precursor and at the highest drying rate. This aerosol characteristics results from enhanced ability of aerosolisation than for powder composed of perfectly spherical particles. However, for both powders B and C, the value of fine particles fraction exceeds 80%, what suggest that almost the whole mass of powder emitted from the inhaler have the potential to be carried into distal parts of the respiratory system and be deposited there.

Comparison of the geometrical diameter of powder particles with the optical and aerodynamic diameters of aerosol particles allows to conclude, that for dense, nearly spherical particles the geometrical and optical diameters are lower than the aerodynamic diameter. In spite of that, diffraction spectrometry, as the least laborious technique for size distribution determination, can be used for preliminary assessment of the suitability of powders for inhalation administration.

It was also found that drying conditions have a negligible impact on the value of specific surface area, average pore size and microporous surface area of the analyzed powders. This suggests that conditions applied during powder production probably will not affect particles behavior (e.g. bioavailability) after their deposition in the lungs.

Acknowledgment

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Cultural features of microorganisms

Iryna Koval, Liliya Shevchuk

[1]General Chemistry Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: irynazk@gmail.com

[2]Department of Technology of Organic Products, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12

Abstract* – *Microorganisms' identification from different water media has been carried out. Cultural features of microorganisms are presented including studies some characteristics of colonies' growth in the Petri dishes.

Key words – microorganisms, pure cultures of microorganisms, colonies, cultural features, nutrient medium, Bacillus cereus, Diplococcus, Sarcina lutea, Pseudomonas fluorescens, Saccharomyces cerevisiae.

I. Introduction

Our previous investigations has established an intensification effect under the simultaneous action of gases of different nature and cavitation on the destruction of microorganisms in the natural water and sewage [1], relative rows of their effective extinction, dependence of microbial cells' disappearance rate of their concentration, mechanical cells' damage [2, 3]. Given experimental results are related to the studying cultural features of various types of microorganisms thich were previously identified in the water media. The next step of our investigations will be studying morphological (including coloration colonies of microorganisms by Gram, their sizes) and physiological (response to oxygen i.e. an intensity of growth, sowing by injection into solid medium in vitro and sowing by injection into melted medium in vitro) features of microorganisms that lead to the depth understanding mechanisms of cells dectruction under some additional factors.

II. Experimental Section

The investigated water objects were originating from natural water from different sources and wastewater from brewing production for microorganisms identification of in dominant amounts. Samples of sonicated water (1 cm^3) were poured out in Petri dishes into nutrient medium. Composition of nutrient agar medium for bacteria – meat water (1 dm^3), pepton (10g), agar (15g) and for yeast – malty mash (1dm^3) containing solids (6-8%) and agar (2%). Petri dishes were placed in TS-80M-3 thermostate at the temperature of 37°C for 48 h (for bacterial cells) and 30°C for 96 h (for yeast cells).

III. Results and Discussion

In investigated water objects were identified such microorganisms in dominant amounts: *Diplococcus, Sarcina lutea, Bacillus cereus, Pseudomonas fluorescens* among bacteria types and *Saccharomyces cerevisiae* among yeast). Therefore, as test-organisms should be used these five different types of microorganisms and have been selected to study of its cultural features.

TABLE

CULTURAL FEATURES OF MICROORGANISMS

Investigated microobjects	Characteristics of colonies growth in a Petri dish						
	shape and profile	**size, millimeters**	**color**	**surface**	**shine and transpa-rency**	**structure and texture**	**border**
Bacillus cereus	compact, fold, hilly; curved profile	□1; 1÷4	white	wrinkled with folded center	opaque, matt, moist	finely granular (farina-ceous); mucous texture	wavy, winding
Diplococcus	compact, round; convex or flat profile	□1; 1÷3	peachy; produce orange pigment	smooth	opaque, brilliant, moist	homoge-neous; soft texture	smooth, flat
Sarcina lutea	compact, round; convex or flat profile	□1; 1÷3	citric; produce yellow pigment	smooth	opaque, brilliant, moist	homoge-neous; soft texture	smooth, flat
Pseudomonas fluorescens	compact, round; convex or flat profile	□1; 1÷2	grayish (dirty white) or without color; produce green-yellow fluorescent pigment	smooth	opaque, brilliant, moist	homoge-neous; soft texture	smooth, flat
Saccharomyces cerevisiae	round; colonies in the deep have borders like crosses, which burst an agar; curved profile	1÷5	gray-white	hilly or slightly wrinkled	opaque, bright, sometimes matte	homoge-neous; texture is oily (pasty) and thick	flat, some-times wavy

The investigated pure cultures of microorganisms for the research were grown under the laboratory conditions in vitro on the nutrient agar medium with subsequent storage of cultures.

Cultural features of investigated colonies have been shown in Table, means character of colonies growth in Petri dishes on a nutrient medium.

Conclusion

In this paper cultural features (characters of colony growth on the nutrient medium in the Petri dishes: colony form and profile, size, color, surface, shine and transparency, structure and consistency) of *Bacillus cereus, Diplococcus, Sarcina lutea, Pseudomonas fluorescens, Saccharomyces cerevisiae* are given.

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"Green" Technology for Nitric Acid Production: Is it Real?

Roman N. Fedotov, Ayodeji A. Ijagbuji

Tehnological Institute, East Ukranian National University
named after Vladimir Dahl', Ukraine,
Severodonetsk, Soviet avenue 59-a,
E-mail: deadweasel@mail.ru, dejiijagbuji@yahoo.com

***Abstract* – This paper is intended to solve the problem of creating environmentally friendly technology for the nitric acid production. On the basis of existing production the analysis of produced waste and methods of disposal was carry out. The new technological solutions for the chemical industry that will achieve a low or non-waste technology is a cavitation of HOOH. Thus, due to the intensification of the absorption step, it is possible to increase the yield of the final product (HNO_3) by 20 % and reduce emissions of gaseous wastes to levels appropriate sanitary norm without further purification. In our opinion, this technological approach can be quite useful for the present chemical industry which completely rules out the catalytic-purification stage.**

Key words – nitric acid, chemical industry, absorption, waste gases, waste materials, intensification, nitrogen oxides, hydroxyl radicals, ecologically pure technology.

I. Introduction

In modern time nitric acid, undoubtedly, is the 2nd largest most widely produced inorganic compounds, which is also utilized as a raw material for inorganic synthesis in the chemical industry to produce fertilizers and explosive [1]. The production of nitric-acid involves large-tonnage technology, also employs highly toxic compounds (NH_3 and NO_x) and that's poses an hazardous effect on the environment. Therefore an effective management and modernization of nitric acid production is one of the most important theoretical and practical problems faced by chemical engineers.

Currently, all nitric acid industry production methods are based on the catalytic oxidation of synthetic ammonia using platinum-rhodium catalyst (Oswald process). The reaction product of ammonia oxidation – nitrogen monoxide NO is further oxidized to nitrogen dioxide NO_2 (it should be noted, that the process occurs spontaneously and it intensification cannot be carry out). The resulting gases (a mixture of nitrogen oxides) undergo absorption by water. The production can be represented by following chemical reactions [2]:

$$4NH_3 + 5O_2\ (\text{cat.} - \text{Pt}) \rightarrow 4NO + 6H_2O \quad (1)$$

$$2NO + O_2 \rightarrow 2NO_2 \quad (2)$$

$$2NO_2 + H_2O \rightarrow HNO_3 + HNO_2 \quad (3)$$

After analyses of all these processes it is investigated that the waste materials and gases inevitably are generated in great quantity, and to demonstrate the results we designed a flow-scheme that shows all the paths of wastes produced during nitric acid production (see Fig.1). Fig. 1 shows the "Raw materials" which include compounds such as NH_3, O_2, N_2 (inert), water (with varying degree of purity), catalysts (Pt-Rh - for ammonia oxidation, Al_2O_3-V_2O_5 - for catalytic purification), CH_4 - for heating flows.

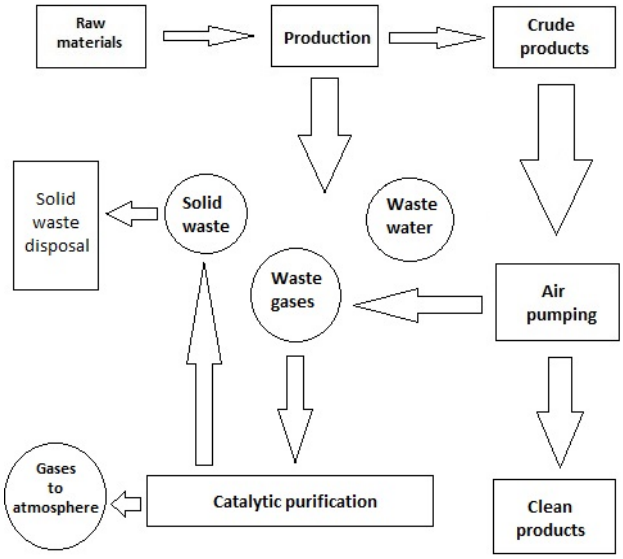

Fig. 1. Producing paths of waste and products in nitric acid technology

After acid formation process (Eq 1-3) we have two different flows. The first flow-path is the crude products - they undergo the air pumping process because it is necessary to separate NO_x gases from HNO_3. Clean products are stored in the warehouse to be sold. Extracted nitrogen oxides mixed with another's waste gases. The second flow-path include three types of waste materials. Waste gases contains: NH_3, NO_x, N_2O, CH_4, CO_2, H_2O. The nitrogen oxides undergo catalytic purification. In present time, the chemical-industries use a large-amount of catalysts ($Pt>MnO_2>V_2O_5>CuO>Fe_2O$) [3]. In our case the plant use a catalytic-mixture Al_2O_3-V_2O_5 [4]. The solid-wastes obtained from nitric acid production needs to be deactivated or taken-away from the flows. Water after condensation (can contain NH_3, NO_x and some amount of HNO_3) while the steam with waste-gases flow forms the waste water.

II. Waste Gases

Waste gases constitute massive waste at the nitric acid plants. They are formed as a result of the nitrogen-dioxide absorption process (Eq.3), unreacted ammonia, production of burning methane and unreacted CH_4 and unreacted gas-reluctant (CH_4 or NH_3) after catalytic purification. In our opinion, the most difficult problem is the purification from NO_x. Therefore, we decided to look carefully at the absorption process so as to intensify the conventional method, and develop a low or non-waste technology [5].

In recent years, a large number of scientists have been inclined to think that the reaction of nitrogen dioxide with water occurs via the N_2O_4 dimer. In studies [2], it has been explicitly demonstrated that NO_2 does not directly participate in the reaction with water, but only subjects its dimer (N_2O_4) to hydrolysis. Under normal conditions, NO_2 exists in equilibrium with its dimer, dinitrogen tetroxide (N_2O_4) ($\Delta H_{\text{dim}} = -57.3$ kJ/mol). Composition of the mixture $NO_2 \leftrightarrow N_2O_4$ depends on the temperature and

pressure. With increasing temperature, the equilibrium shifts to favor nitrogen dioxide, while the liquefied N_2O_4 turns brown. By increasing the pressure at constant temperature, the degree of N_2O_4 dissociation decreases almost completely dissociated at 140° C [1].

Recently, studies by Finlayson-Pitts et al. [6] was first suggested that the absorption of NO_2 with water undergoes prior dimerization of $\bullet NO_2$ radicals to form asymmetric dimer ONO–NO_2 with the highest dipole moment, which is shown in Eq. (4):

$$N_2O_4 + H_2O \rightarrow HNO_3 + HNO_2 \quad (4)$$

The structure of the transitions state of Eq. (4) calculated by the Density functional theory (DFT) method is shown in Fig. 2. Quantum chemical calculations have revealed that the asymmetrical structure with the trans-isomer configuration (see Fig. 2) has the highest dipole moment (μ = 2.6 D).

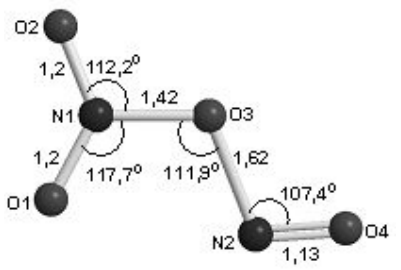

Fig. 2. Trans-isomer configuration of ONO–NO_2.Bond lengths are in Armstrong (Å). N_2O_4 is considered important surface specie in the reaction

According to the authors [6], the formation of asymmetric dinitrogen tetroxide ONO-NO_2 occurs on the surface of a thin film of water (a process we refer to as *the surface mechanism*). In the presence of highly polar water molecules (μ ≈ 1,8 D) is auto-ionization of dinitrogen tetroxide to form nitrate nitrozonium $NO^+NO_3^-$, which is a key intermediate in the process of nitric acid [7]:

$$2NO_2\,(gas) \rightarrow N_2O_4\,(gas) \quad (4a)$$

$$N_2O_4\,(gas) \rightarrow N_2O_4\,(surface) \quad (4b)$$

$$N_2O_4\,(surface) \rightarrow ONO–NO_2\,(surface) \quad (4c)$$

$$ONO–NO_2\,(surface) \rightarrow NO^+NO_3^-\,(surface) \quad (4d)$$

$$NO^+NO_3^- + H_2O \rightarrow HNO_3\,(surface) + HNO_2\,(gas) \quad (4e)$$

We calculated, by the DFT energy profiles (Eq. 4) in the gas phase, without dimerization of NO_2 and prior dimerization of NO_2, as well as the process of acid formation in the presence of water molecules. To simulate the process of *the surface mechanism*, we calculated aqua-complexes reactants and reaction products of acid formation water clusters $(H_2O)_m$, with m = 2 – 4:

$$NO_2(H_2O)_2 + NO_2(H_2O)_2 \rightarrow NO^+NO_3^-(H_2O)_4 \rightarrow HNO_3(H_2O)_3HNO_2 \quad (4f)$$

From the quantum chemical calculations, acid formation without the prior NO_2 dimerization has a higher activation energy (E_a=130.8 kJ/mol) than the reaction proceeding through prior formation of the asymmetric trans-isomer ONO–NO_2 (E_a= 80.1 kJ/mol).Therefore, one of the main requirements imposed on the absorption equipment in the production of nitric acid - the creation of a highly developed surface absorption, from our point of view, would be deemed a technological boom, confirming the mechanism [6], the mechanism of acid formation. The presence of thin films of water in the absorption column is realized by establishing a large number of plates as quantity of absorbed nitrogen oxides depends on the contact surface between gas and liquid.

Based on the above, it follows that the modernization of this stage production of nitric acid should be carried out in several directions. Firstly, in order to absorb nitrogen dioxides more actively, the absorption process has to be intensified, and secondly, to speed up the oxidation of NO to NO_2.

From our point of view, the modernization process of acid formation HNO_3 should be seen not only through the optimization of liquid-phase absorption of NO_2, but also through the possibility of acid formation in the gas phase. After the second product (Eq.3) - the nitrous acid is formed only in the gas phase and immediately decomposes to water and nitrogen monoxide NO.

Intensification of nitric acid formation. To deal with NO_x and disapprove of the catalytic cleaning of gases, we present a new method for the intensification of nitric-acid formation [5, 8].

In contrast to the absorption stage, where the hydrolysis of NO_2 occurs via surface mechanism on a thin film of water, we present nitric acid formation process entirely through the gas-phase by the interaction of nitrogen oxides with hydroxyl radical (•OH) and hydroperoxyl radical (•OOH):

$$NO + \bullet OOH + M \rightarrow HNO_3 + M^* \quad (5)$$

$$NO_2 + \bullet OH + M \rightarrow HNO_3 + M^* \quad (6)$$

It should be noted, that in our opinion, N_2O_4 does not react with these radicals which are generated by dynamic cavitation of hydrogen peroxide solution (HOOH) [5].

What exactly does cavitation means? Cavitation is the generation, subsequent growth and implosive collapse of gas or vapor-filled bubbles in liquids when subjected to rapid changes of pressure and temperature [9].

Under title cavitation, in liquid, realize the formation of steam and gas filled cavities or bubbles in the local fluid pressure decreases to the vapor pressure (i.e. in the process of boiling cavities). The system, tends to homeostasis, trying to balance the pressure between the two phases. As a result, the pressure in the bubbles, rising slowly and the reverse of boiling - condensation on the walls of the cavity. During this time, the cavity is formed in technical vacuum. The surrounding liquid phase , trying to fill the "void", creates forces which are directed along the normal to the center of the cavity. During the collapse of the bubbles is a "micro-explosion" of the cavitation cavity, which is formed in the center of the high pressure and high temperature (in the hundreds or thousands of times higher than the standard condition).

Hence, the energy release when bubbles collapse is sufficient for excitation, ionization and dissociation of molecular substances in the cavitation bubble.

During cavitation bubbles in the solution of moving the radicals •H, •OH ions and low energy electrons generated during the decomposition of substances in the cavitation bubble and the metastable excited states of molecules.

As previously indicated, hydrodynamic cavitation is the more energy-viable option in chemical engineering [5]. Subsequently, the means of generating radicals from hydrogen peroxide under the influence of hydrodynamic cavitation are shown:

$$H_2O_2 \rightarrow 2\ \bullet OH \quad (8)$$

$$H_2O_2 + \bullet OH \rightarrow H_2O + \bullet OOH \quad (9)$$

Because of their high reactivity radicals may interact with themselves and corrode the walls of the reactor [5]:

$$\bullet OH + \bullet OH \rightarrow H_2O_2 \quad (10)$$

$$\bullet OH + \bullet OOH \rightarrow H_2O + O_2 \quad (11)$$

$$\bullet OOH + \bullet OOH \rightarrow H_2O_2 + O_2 \quad (12)$$

Therefore, as a material for the reactor, we use a glass.

It is well known that hydroxyl radicals because of its high reactivity and short lifetime ($\tau \approx 10^{-8}$ c) can only interact with reagents entourage. From our point of view, the presence of water promotes the transfer of the radicals throughout and increases the lifetime τ [5]:

$$\bullet OH + H_2O \rightarrow HO\text{--}H\text{--}OH \rightarrow H_2O + \bullet OH \quad (13)$$

The mechanism of this "spillover" on the reaction volume, we characterize as a spillover •OH radicals in the aquatic environment. The term spillover first proposed by M. Boudart [10] for the transport process (diffusion) of adsorbed hydrogen on the surface of the catalyst.

Based on these ideas, we carried out a B3LYP/6-311++G(3df,3pd) calculation of TS of process (13): •OH radicals spillover in the gas phase with water vapor. The calculation results yield very low activation energy (E_a = 14.7 kJ) of process (13), which indicates a real possibility to the OH radicals transfer over the reaction volume.

Experimental part. In the experimental part, we were faced with the following objectives: to confirm that the formation of nitric acid without surface mechanism is no possible; synthesizing HNO_3 without absorption NO_2 by water; intensification for nitric acid formation by dynamic cavitation. . In Fig. 3, the laboratory unit to carry out the experiments for nitric acid formation is shown.

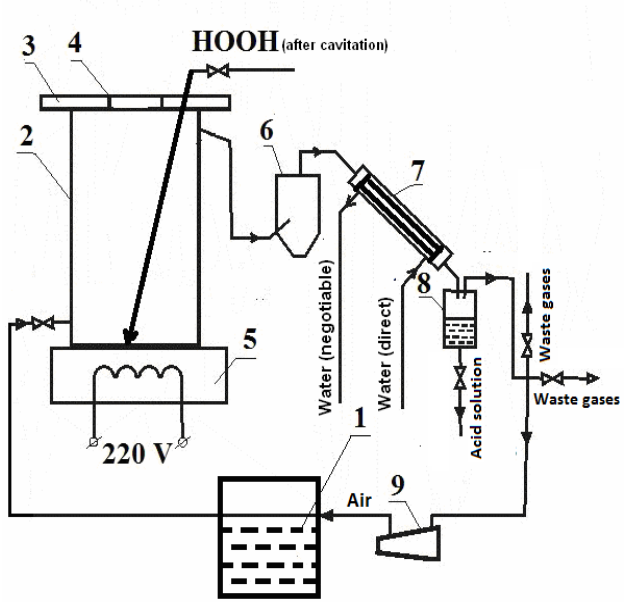

Fig. 3. Laboratory unit scheme for nitric acid formation: (1) NO_x generator, (2) Reactor, (3) Lid, (4) Quartz glass, (5) Electric oven, (6) Refrigerator condenser, (7) Heat exchanger, (8) Container for analysis, (9) Compressor

Hydrogen peroxide after ultrasonic cavitation was dripped into the reactor where at a temperature was over 100° C and generated •OH and •OOH radicals (see Eqs. 8–9) are interacted with NO_x (by Eqs. 5–6). The oxides of nitrogen (generated by Kipp's apparatus) were pumped through the reactor with the help of the compressor. The resulting liquid-gas mixture was pre-heated by allowing it flow through the heat exchanger so as to efficiently transfer heat from one medium to another, which is then finally fed into a measuring vessel for analysis.

The experimental time was ~ 30 min. During this period, iron, whose synergistic effect mainly is the production of additional •OH radicals, was completely dissolved. The concentration of acid decreased from 56 % to 34 %. The quantity of nitric acid formed in the experiment using hydrogen peroxide corresponds to ~ 14.5 % of the quantity of the trapped NO_x. Therefore, the cavitation-procedure can increase nitric acid formation to ≈ 20 %, the calculated error in the experimental data was 5 % [5].

Based on this result, we present an industrial approach as illustrated in scheme (Fig. 4) [11].

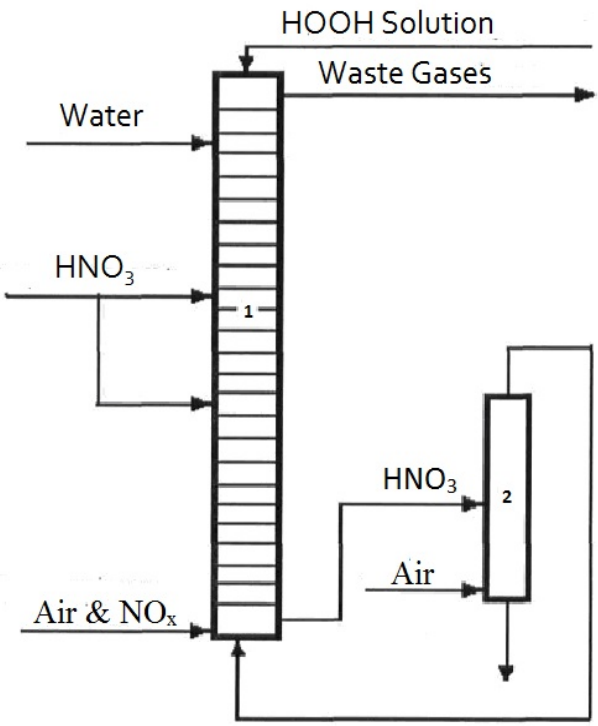

Fig. 4 Industry unit scheme for nitric acid formation: (1) Absorption Towe, (2) Pumping Tower

In our opinion, this technological approach can be quite useful for the present chemical industry which completely rules out the catalytic-purification stage.

III. Waste Materials

As stated above that solid-wastes during nitric-acid production contains deactivated catalysts, they can however, be utilized at the solid-wastes disposal. Further, some of them may be sent to the recycle to obtain coast compounds from catalyst. But unfortunately, it has not

quite been a successful technique. From our view-point, this calls for a catalyst-replacement, and carefully use energy from hydrocarbons more because during the ammonia-oxidation step at the plant, heating the flow to 900° C [4] is an absolute waste of energy.

We, therefore, propose a more-efficient method for the oxidation of ammonia [12] which is based on electrically conducting catalyst (ECC). In contrast to convectional technology, this method does not require heating through-out the whole-phase. ECC heats only itself and the reaction space around. Also, ECC does not need any precious or rare metals. It can use metals with high degree of electrical-resistance. We, therefore, recommend for this type of catalyst a mixture of nickel (Ni) and chrome (Cr) [12]. In Fig. 5, a laboratory unit to carry out experiments with an ECC is shown.

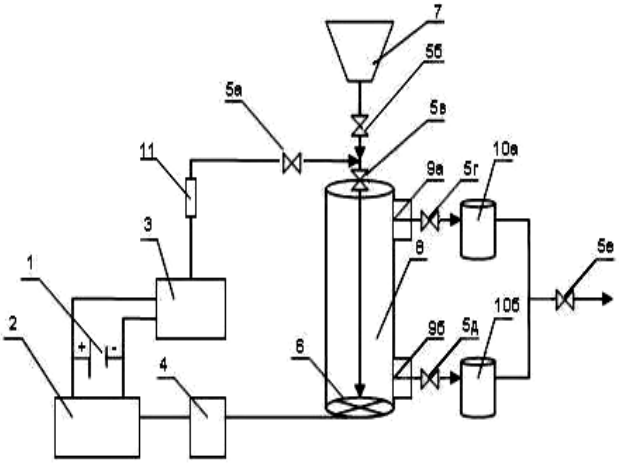

Fig. 5. laboratory unit to carry out experiments with ECC: (1) AC power supply, (2) laboratory autotransformer (LATR), (3) the compressor, (4) Ammeter, (5a-e) cranes, (6) ECC, (7) tank for ammonia solution, (8) reactor made of quartz glass, (9) analytical point, (10) tanks for sampling, (11) flowmeter

Unfortunately in this moment we could not present an experimental data, but we still work in this field

Conclusion

This paper is intended to solve the problem of creating environmentally friendly technology for the nitric acid production. On the basis of existing production the analysis of produced waste and methods of disposal was carry out. The new technological solutions for the chemical industry that will achieve a low or non-waste technology is a cavitation of HOOH. Thus, due to the intensification of the absorption step, it is possible to increase the yield of the final product (HNO_3) by 20 % and reduce emissions of gaseous wastes to levels appropriate sanitary norm without further purification. In our opinion, this technological approach can be quite useful for the present chemical industry which completely rules out the catalytic-purification stage.

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Filling of polymer hydrogels by nanoparticles of the hydroxyapatite

Solomiya Borova, Maksym Chobit, Viktor Tokarev

Institute of Chemistry and Chemical Technologies, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: chobit@polynet.lviv.ua

***Abstract* – In this work was development of new methods of synthese the hydrogel composites with nanoparticles of hydroxyapatite using sol-gel synthesis. At first the nanoparticles were synthesized in the presence of the peroxide oligomers which at the next stage provided polyacrylamide grafting on to the surface nanoparticles; that resulted in formation of the powder-xerogels capable to turn in to hydrogels. In accordance with other approach, the hydrogels filled were formed via in situ synthesis of the hydroxyapatite nanoparticles directly inside of the crosslinked polyacrylamide gels. The shape, composition and structure of the hydroxyapatite nanoparticles as well as polymer composites were investigated applying gas-liquid chromatography, X-RD analysis, scanning electron microscopy.**

Key words – hydroxylapatite, hydrogel, nanopartikel, polymer composite.

I. Introduction

Hydroxyapatite (HA) is the main inorganic component of bone and tooth tissue of the humans and animals. Therefore materials based on hydroxyapatite lately attracted considerable attention due to their high biological compatibility and biological activity, particularly in rehabilitation surgery, dentistry and as components of toothpastes and gels, cosmetics and hygiene products, food additives. To solve the problem of fragility of these materials for biomedical applications using their compositions with polymers. The problem of the obtaining high full composites caused by the poor adhesion (compatibility) of the polymer matrix to the surface of the bioceramics, which can lead to premature separation at the interface and as the consequence to deterioration of the mechanical properties of the composite material. Therefore, the use as surface modifiers, heterofunctional oligo peroxides (HFO), which are composed of functional groups on the one hand, that are capable to chemical interaction with the surface of fillers, and on the other hand - with the polymer, including peroxide groups that are capable to free radical reactions, opens new prospects for creating polymer composites.

II. Page Setup

During the work were used the following materials: calcium chloride, calcium nitrate, three monofosfat and differently substituted sodium phosphates (clean for analize), polymers of acrylamide – kation and anion active polymer product, and acrylamide polymer A-1510. Heterofunctional peroxide containing copolymers on the basis of peroxidic monomer 5-tert-butyl peroxy-5-methyl-1-hexene-3-yne (PM) and maleic anhydride (MA) was synthesized and cleaned in accordance with the technique [1].

Hydroxyapatite nanoparticles were obtained using sol-gel method as described in accordance with the reaction:

$$10\ CaCl_2 + 6\ (NH_4)_3PO_4 + 2\ NH_4OH \rightarrow$$

$$Ca_{10}(PO_4)_6(OH)_2 + 20\ NH_4Cl$$

Method of the synthesis was the next: were prepared 5% water solutions of CaCl2 and $(NH_4)_3PO_4$ in the molar ratio of Ca/P = 1.67. The HFO in the amount of 5% by weight. (by weight CaCl2) was pre-dissolved in a solution of $(NH_4)_3PO_4$. Calcium chloride solution was thermostatic at 40 ˚C in the reactor, with vigorous stirring of the reaction mixture. Then slowly, drop by drop added the solution of $(NH_4)_3PO_4$ and HFO, with the following incubation of the reaction mixture for 7 hours. pH was 8.5. After the end reaction mixture was filtered and washed three times with distilled water. Obtained precipitate was dried at room temperature to a constant weight.

III. Page Setup

Getting polymer hydrogel. For obtain hydrogel used polymers based on acrylamide of different chemical composition. The synthesis was performed as follows: selected samples were dissolved in two separate containers with the concentration of polymer 3% by weight. After complete dissolution of the polymers, solutions were mixed with the addition of 1M NaOH for increased activity of the cation polymer, the pH value was adjusted to 8.5 under stirring to receive the homogeneous system.

After that obtained hydrogel dried at 90 ˚C during the 12 hours to remove excess moisture. After that the dry hydrogel was prepared for further research.

The formation of the hydrogels with particles of hydroxyapatite. The formation of calcium phosphate containing polymer composites performed by the following procedure.

In a glass tube hydrogel layer is placed (thickness ≈ 1 cm). from bouth sides of the tube are added solutions of the $CaCl_2$ and $(NH_4)_3PO_4$. This system was left for 15 hours for the diffusion of cations and anions in to the free space between the hydrogel macromolecules . This leads to the formation of hydroxyapatite structure.

The hydrogel is formed as follows. In reactions take the part anionic and cationic polymers containing acid and amino groupes, respectively. During the mixing of this two polymers salt connections begin to form in the system, making thus crosslinked, three-dimensional structure of macromolecules between the initial polymers.

After the filling tube and adding solutions carried out the second stage of the process. A layer of hydrogel creates the semipermeable barrier for salt solutions Ca^{2+} and PO_4^{3-} ions. Due to the effect of ion diffusion in free

space between macromolecules of the hydrogel they undergo chemical interaction and, as a result, the particles of hydroxyapatite is formed as the final product.

To select the optimal synthesis conditions, there were obtain different samples of the hydroxyapatite. The synthesis of the hydroxyapatite was done as in the presence of peroxide modifier, and without it. The best results are seeing, when as initial reagents are used $CaCl_2$ and $(NH_4)_3PO_4$ in the ratio 1: 2, at pH 8.5.

The structure of the HA samples, synthesized by the sol-gel method, using $CaCl_2$ and $(NH4)_3PO_4$ was confirmed by X-ray analysis. Radiographs HA samples is shown in Figure 1.

The results of X-ray analysis shows that some samples contain traces of unwanted impurities present in the reaction. These impurities often observed at higher pH. This should be taken into account when washing the reaction products.

The shape and size of the hydroxyapatite samples were investigated by the SEM microscope.

Results of the samples of HA are shown in micrographs (Figure 2).

In the above picture seeing a significant difference between the samples of modified and not modified HA.

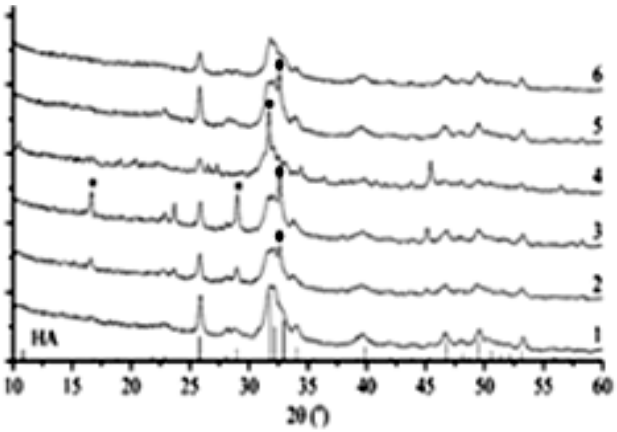
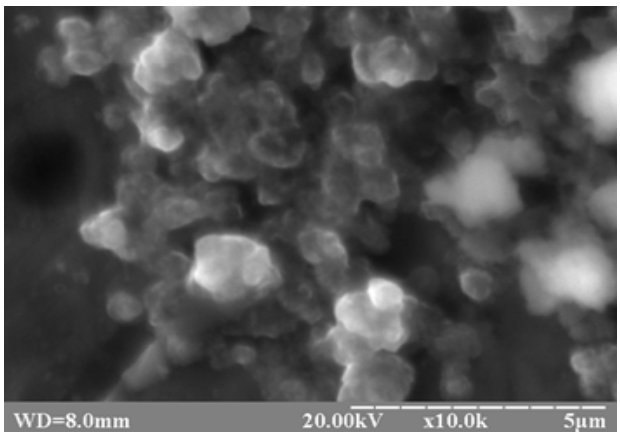
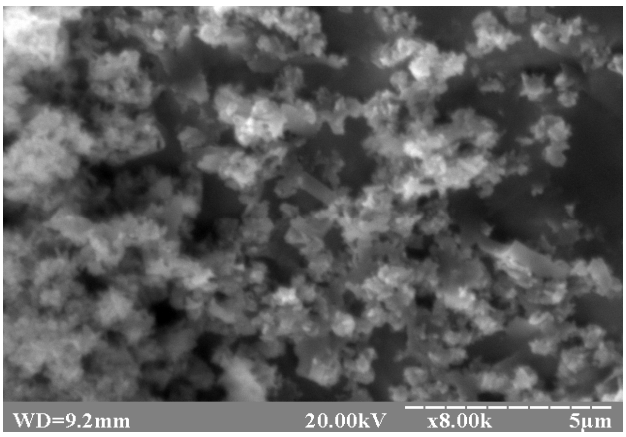


Fig. 1. XRD patterns of the HA samples: ♦ - ammonium chloride phase; ● - sodium chloride
* - ammonium phosphate

Figure 2 (a) no needle particles that correspond to form particles of the hydroxyapatite, which are clearly visible on the Figure 2 (b). There are also significant differences in the sizes of the samples.



a



b

Fig. 2. Microphotograph of the hydroxyapatite

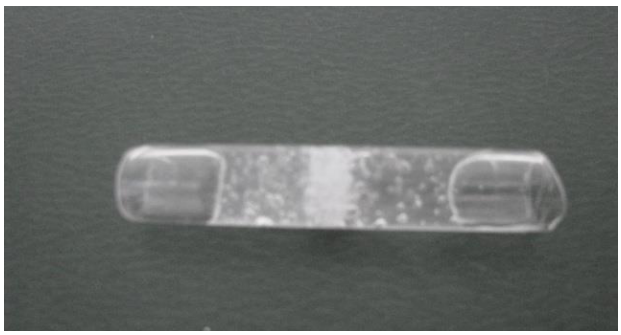


Fig. 3. Obtaining of the particles of hydroxyapatite in hydrogel

The studies were used to select the optimal conditions for the formation composites of the hydrogel. Figure 3 shows that composite hydrogel particles of the hydroxyapatite are formed in it by the method that is described above.

Conclusion

The results of the HA peroxidation indicate that the optimal conditions for the synthesis are pH = 8.5, as the using of these reagents gives the highest value of contents HFO. However, we can also state that the tri-substituted salts of phosphoric acid are characterized smallest content of the peroxide oligomer in HA. By increasing the pH decreases the amount of adsorbed modifier on the HA surface, probably, due to the better solubility of the last one. Managed to get a hydrogel with the HA crystals in the gel structure.

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Production of plasticizers from waste alcohol production

Taras Khomyn, Maksym Chobit, Yuri Panchenko

Institute of Chemistry and Chemical Technologies, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: chobit@polynet.lviv.ua

Abstract* – *The aim of this work was to study the possibility of recycling disposal alcohol production by its processing in order to obtain valuable products, namely plasticizers.

Key words – plasticizer, fusel, esterification reaction.

I. Introduction

Alcohol industry of Ukraine is one of the most developed sectors of the food industry. Raw alcohol, which, is obtained after the distillation fusel, contains a lot of impurities, different in chemical nature and composition. The total content of impurities typically doesn't exceed than 0.7% weight of ethanol. However, today, have not solved the problem of recycling such products as fusel oil production. Every year in Ukraine in the production of alcohol it is produced about 2 thousand tons.

II. Page Setup

The aim of this work was recycling the alcohol production to produce plasticizers.

To do this, received a mixture of esters based fusel oil adulterances methodby acid-catalytic esterification. As the catalyst used concentrated sulfuric and phosphate acid in amounts of 1.5% and 2.5% according to weight of phthalic anhydride. Because the reaction of the esterification is reversed, it should be performed with a small excess of one of the initial reagents (fusel oils) and selection of formed water. So, when in the literature review was found an optimal molar ratio of alcohols to phthalic anhydride, which is 2.2: 1. Proceeding from the fusel oil was found necessary amount of phthalic anhydride and catalyst. Also added 10 g of benzene as azeotropic supplement.

There has been constant heating of the reaction mass to support its boiling point of distillation azeotrope benzene -water. This vapor evaporated, appeared in the back of the fridge, where condensed and sent to the Dean-Stark attachment from which the organic fraction returned back to the reactor.

Stopping the allocation of water from the reaction mixture and its accumulation in the attachment Dean-Stark, indicating complete esterification reaction. The duration of the process depended on the nature and quantity of catalyst.

Purification of the reaction mixture is performed as follows. First, in a dividing funnel, the reaction mixture was washed with 10% sodium carbonate solution to bring the product to a neutral environment. This was happened bundles in organic and aqueous fractions. The aqueous fraction was poured and additional dried by organic extra burning $MgSO_4$, then spent filtering. The resulting product was subjected to vacuum distillation, during which distilled off remains unreacted alcohols. The temperature of the vapor varies in the range 56-59 ^oC when vacuum is 0.82 atm. Product analysis is carried out by means of chromatography and infrared spectroscopy. To determine the plasticizing properties of the product was conducted the determination of melt flow index (MFI) and study the thermo-mechanical properties of PVC with the addition of a plasticizer for the resulting product quality and without it. Thermomechanical studies were performed on the instrument FVD R7 / 90.

III. Page Setup

Esterification reaction is carried out in a reactor equipped with the attachment Dean-Stark reflux.

As the catalyst used concentrated H_2SO_4 and H_3PO_4 in amounts of 1.5% and 1.5%, respectively 2.5% according to the mass of phthalic anhydride.

Observated accumulation of water in the Dean-Stark attachment is shown in Figure 1. Thus, when used as a catalyst H_2SO_4 is observed more intense accumulation of water than using H_3PO_4, indicating greater speed of reaction. The main disadvantage of sulfuric acid was a significant burnt down of phthalic anhydride.

As a result of chromatographic analysis chromatogram obtained the product (Figure 2). It recorded four peaks which are probably correspond to the phthalic esters.

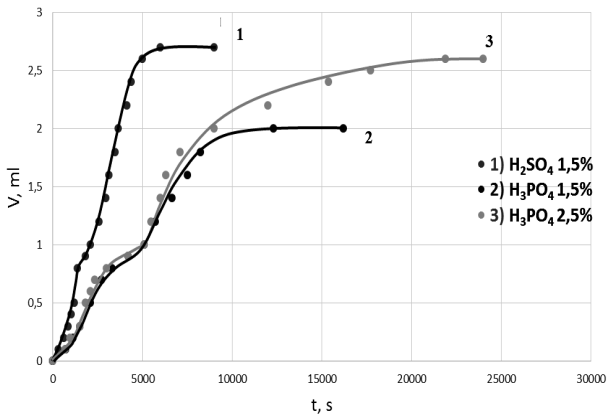


Fig. 1. Kinetics of accumulation of water fraction

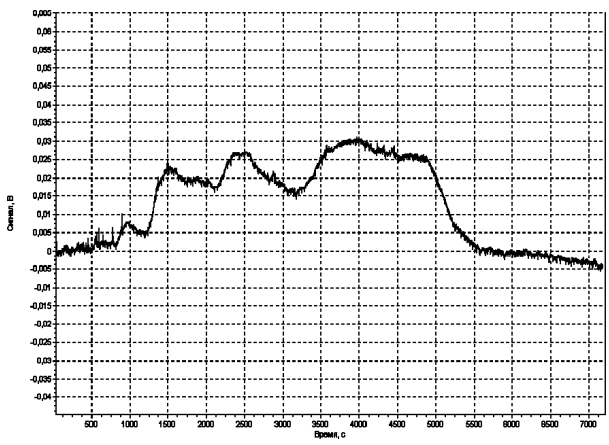


Fig. 2. chromatogram product

An infrared spectroscopy of the product, indicating the presence of ester groups (1740,1284,1124 sm^{-1}), that the presence of phthalic acid esters.

IR spectrogram is shown in Figure 3.

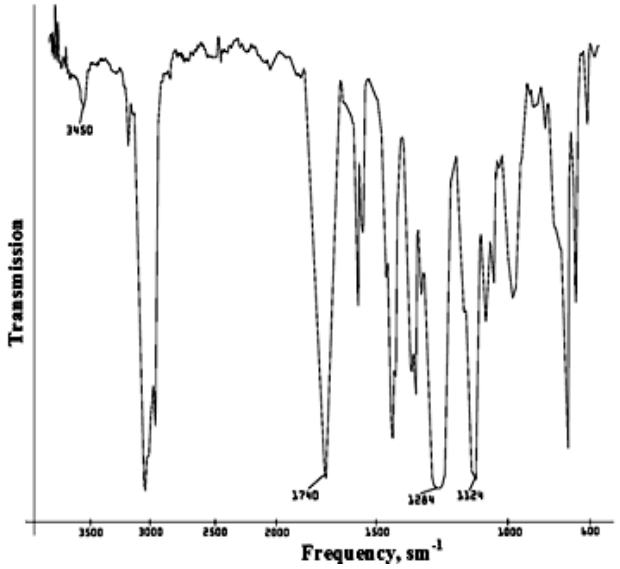


Fig. 3. IR spectrogram product

To identify plasticizing properties of the product is used plastomir extrusion type "YYRT." It has been experimentally determined the best conditions of the process: temperature 170 and 190°C and loads 14.95 kg and 11 kg. The results are shown in tabl.1

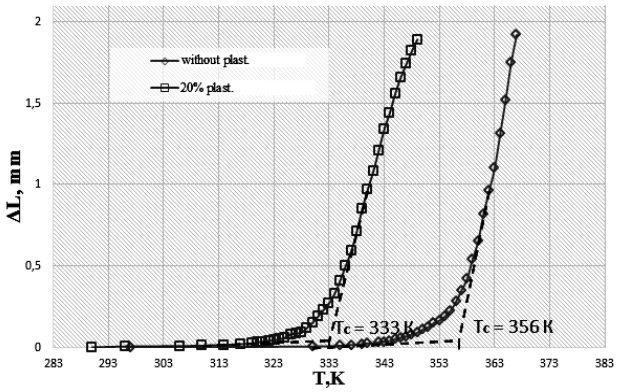
According to these results when adding the mixture of esters are observed an increase of 14 (at 20%) and 10.5 (at 10%) times the flow rate, which indicates a significant plasticizing properties of the product.

TABLE 1

RESULTS OF THE DETERMINATION OF THE MFI

Sample	Темр., °C	MFI, g/10m
PVC	170	0,22
PVC + plasticizer (20%)		3,078
PVC	190	0,123
PVC + plasticizer (10%)		1,3

Thermomechanical behavior of polymeric materials is an important characteristic that determines the conditions of their use. For comparison studies following samples were taken: 1) PVC plasticizer content of 20% (temperature plasticizing 170°C), 2) PVC plasticizer content of 10% (temperature plasticizing 190 °C); 3) PVC without plasticizer (temperature plasticizing and 190°C 170). The research results are presented in Fig. 4 and Fig.5.



Fi. 4. Thermomechanical curves PVC plasticizer content of 20% and without it, at received plasticizing 170°C

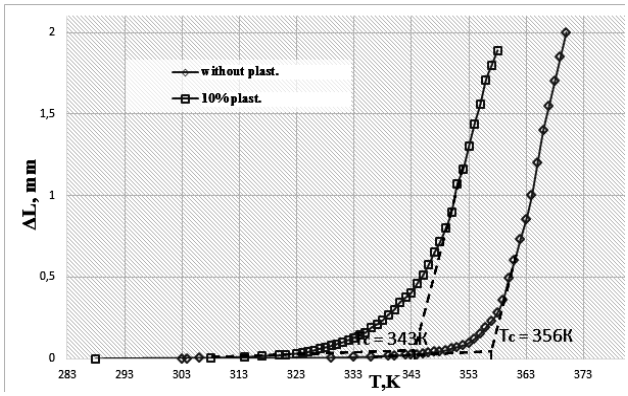


Fig. 5. Thermomechanical curves PVC plasticizer content of 10% and without it, at received plasticizing 190°C

As seen from thermomechanical curves obtained with increasing content of plasticizer in PVC increases its plasticity. So, determined glass transition temperature of PVC without plasticizer was 356K, using 10% plasticizer - 343K at 20% - 333K, indicating a distinct plasticizing properties of our product.

Conclusion

Thus, as a result of the research conducted the possibility of using fusel oil for the synthesis of plasticizers based on esters of phthalic acid. The features esterification process fusel oils and impact of the catalysts on its course. The method of gas-liquid chromatography and infrared spectroscopy determined presence in the obtained product containing phthalates alcohol fusel oil. The study of the glass transition temperature and melt flow index set plasticizing properties of the product. Thus, the use of the obtained plasticizer in an amount of 20% by weight. mixtures glass transition temperature decreased by 23°C and as an indicator of the melt flow rate increased by 13 times.

Modification of the chalk by plant oils

Wolodymyr Kot, Chobit Maksym, Victor Vasilyev

Institute of Chemistry and Chemical Technologies, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: chobit@polynet.lviv.ua

Abstract – *The processes of modification chalk by vegetable oils, to obtain polymeric composites were investigated. Hydrophobic process can be used in the construction industry too. Investigated the kinetics of filler modification in various natural environments. A physical-mechanical analysis of obtained polymer composites polyvinyl chloride and polystyrene was conducted. These studies have shown an increase in impact strength and good plasticizing properties, which leads to improved performance properties.*

Key words – chalk, plant oils, polymer composite.

I. Introduction

The development of the industry requires the creation of new polymeric materials with preassigned properties. The required properties are most easily achieved the creation of filled polymer (composite) materials. A significant advantage of polymer composite materials before the traditionally used materials are: use of cheap raw materials, which has a powerful base, saving the polymer binder, improving technological and consumer properties of the materials.

But the possibility of composite are limited to the contradictions between the mechanical properties and surface energies of filler and the polymer matrix. The first of them causes stresses in interphase layers, and the second is the aggregation of solid particles. Both of these phenomena lead to a significant reduction of the operational properties of materials. Therefore, at the present stage to produce composite materials using only modified fillers. That is the relevance of this problem lies in expanding the range of fillers by how new and modification of have already known.

At the same time, at the enterprises of food industry and catering after frying various products produced by a large number of overcooked vegetable oil that is not suitable for use in food. In this connection it is interesting to explore the possibility of using waste vegetable oil for the surface modification of dispersed mineral fillers (chalk) with the aim of further use for the filling of polymer composites. In addition, this chalk could be interesting to test as filler with low water absorption for use in building materials.

II. Page Setup

For research of process of modification of standards a build chalk of KMS-2 and vegetable oil was used. As a model of exhaust vegetable oil was used the sunflower-seed refined oil “Chumak”.

In sample dishes loaded chalk and distilled water, the volume of 25 cm^3. Then was added to vegetable oil. The resulting suspension was mixed using a magnetic stirrer. After completion of the modification reaction was filtered. The resulting precipitate was washed twice with hexane to remove oils that wasn’t adsorbability. Then the sample dried in air to constant weight.

Determination of modified filler gravimetric method performed by the content of organic component in the sample by calcination it in a muffle furnace for 5 hours at 500 ^oC. This method was used due to the difficulty of determining the amount of oil sorbed directly with the weight gain of the sample substrate. We know that chalk (calcium carbonate) may contain about 0.2-0.3% of bound and unbound water, with its content greatly depends on external conditions (humidity, temperature), in addition modification can also lead changes to this indicator. Consequently, it is difficult to change in mass of the sample controlled by adsorbed moisture can exceed the number of grafted modifier, ie gravimetric method has a very large error.

IR spectroscopic studies conducted on the instrument "SPECORD M-80" transmission spectrum in the range 3800-600 cm^{-1}. For the study sample was selected unmodified chalk, like chalk, modified in the aquatic environment and the environment of hexane, and the like sunflower oil.

Definition toughness polymer composites filled with chalk conducted in accordance with GOST 9454-78. For these studies used composites of polyvinyl chloride (PVC) and polystyrene filled with samples of chalk (filling ratio amounted to 40% wt.). Thermomechanical composites research conducted on the instrument FVW R7 / 90.

III. Page Setup

Were synthesized samples containing oil 3% and 5%, which was stirred for 30 minutes, in the aquatic environment and the environment of hexane.

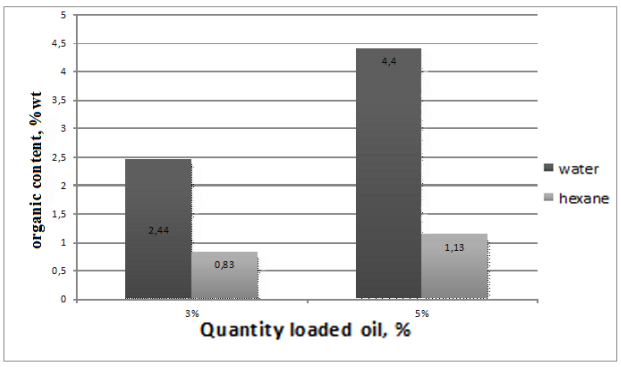


Fig. 1. Comparative characteristics of efficiency modifications depending on the reaction medium

Figure 1 shows the relative performance characteristics of modification depending on the reaction medium. As seen from the data surface modification in aqueous media is much faster and more efficiently than organic. Perhaps this is due to the insolubility of oil in an aqueous medium that is not affected diffusion of the reactants in solution and as a result a greater concentration of oil on the surface of the filler.

To confirm the modifications were prepared IR spectra of samples chalk. From the initial sample chalk spectrogram shows that the frequency shift is ion CO_3^{2-} in higher side (1436 cm^{-1}), which shows the difference from unmodified chalk calcite (CO_3^{2-} ion transmission frequency is 1430 cm^{-1}). In addition, the weak frequency band at 1080 cm^{-1} is in favour of aragonite and shoulder 850 cm^{-1} band at 880 cm^{-1}. Since the absorption band 720 cm^{-1} is not divided into 715 cm^{-1} and 730 cm^{-1}, it indicates the presence of calcite. In the modified sample chalk along with the presence of absorption bands of chalk - a mixture of calcite and aragonite - there is absorption of the carbonyl group with a frequency of 1744 cm^{-1} (νC=O) and 1190 cm^{-1} (νC-O). These frequency characteristic absorption due ester group of carboxylic acid residues that are part of triglycerides. Absorption band in 3010 cm^{-1}, 970 cm^{-1} indicate the presence of C=C fragments of molecules unsaturated carboxylic acid sunflower oil. These data clearly indicate $CaCO_3$ surface modification of vegetable oil.

Impact strength of the samples is: for the composite output of chalk - 7.5 kJ/m^2, for composite modified with chalk in the aquatic environment - 8.8 kJ/m^2, for composite modified with chalk among hexane - 10.5 kJ/m^2. Increase toughness composites modified relatively unmodified chalk is: for composite, which used chalk, modified in the aquatic environment - 17% for the composite, which used chalk in a modified environment hexane - 40%. Improving the physical and mechanical properties of composites filled with chalk, modified sunflower oil can be explained by a better compatibility with hydrophobic surface modified polymer matrix.

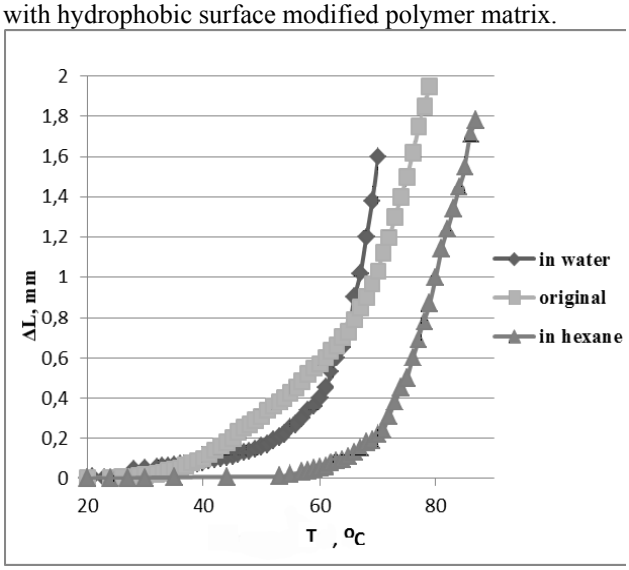


Fig. 2. Thermomechanical curves of polymer composites based on PVC, filled with water repelling agent and chalk no modificated

Figure 2 shows the thermomechanical curves obtained polymer composites. As seen in Fig. 2 thermo-form curve using unmodified chalk has a very fuzzy boundary transition polymer in viscous state. When using modified chalk this shift is more pronounced. In addition, he shifted toward higher temperatures, which is especially evident for chalk modified in hexane. This means that the product of such a composite can operate at higher temperatures, and thus it will keep its shape better than a similar, filled with unmodified chalk.

Composites were also prepared by polymerization filling. To this vial was loaded blend filler and styrene, and then closed ampoule and heated at 100 ° C for 15 hours for full curing. As fillers were used: 1) unmodified chalk; 2) chalk, a modified 5% oil in an aqueous medium; 3) chalk modified 7% oil in water. Fig. 3 shows the thermomechanical curves obtained samples.

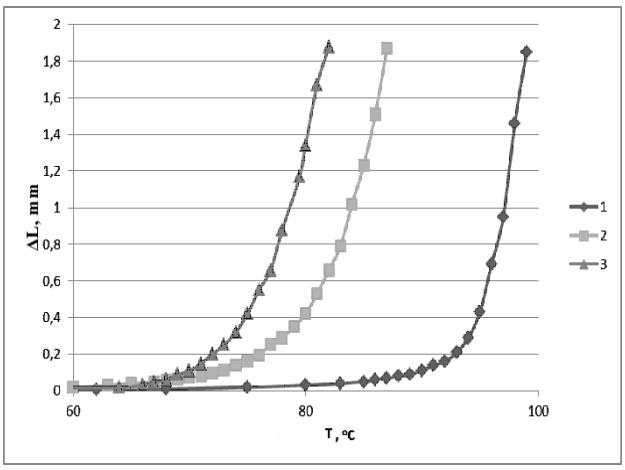


Fig. 3. Thermomechanical curves polystyrene polymer composites with fillers: 1 - unmodified; 2 - modified oil 5%; 3 - modified 7%

It is known that polystyrene which is an amorphous polymer has a big drawback - it is very fragile and has a low impact strength. From the curves shown in figure 3 shows that the surface of chalk with water repelling agent is a good plasticizing agent for polystyrene with plasticizing process can be controlled by changing the amount of oil taken for the modification of the original chalk. Plasticizing composite will increase its impact strength, reducing fragility. In addition, thermo-mechanical analysis curves shows that the composite filled with water repelling agent chalk, compared to the same with unmodified, can be processed at lower temperatures, which will reduce power inputs in the processing of composites.

Conclusion

Thus, the results of the research confirmed the possibility of using vegetable oils for surface modification of chalk and its subsequent application to obtain composites. In this research, the features of the kinetics of hydrophobic chalk sunflower oil. The presence on the surface of chalk sunflower oil confirmed by IR spectroscopy. Modified oil tested chalk as filler in polymer composites. In composite based on PVC modification chalk leads to a significant growth rate increases impact strength and heat resistance of the material. In composites based on polystyrene chalk water repelling agent shows good plasticizing properties.

Single Stage Acrylic Acid Obtaining based on Methanol and Acetic Acid

Roman Nebesnyi, Iryna Shpyrka, Anastasiia-Bohdana Shatan, Andriy Lukiyanchuk, Volodymyr Ivasiv, Yuliia Nebesna, Nazariy Lapychak

Technology of Organic Products Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: nebesnyi@lp.edu.ua

***Abstract* – The new complex oxide acid type catalysts were developed and their performance in the process of aldol condensation of acetic acid with formaldehyde to acrylic acid was studied. The optimum conditions of the process were determined. It was established that these catalysts are effective in the process of methanol to formaldehyde oxidation, and also in the process of single stage acrylic acid obtaining from acetic acid and methanol in the presence of air.**

Key words – aldol condensation, oxidation, catalysts, acrylic acid, acetic acid, methanol, formaldehyde.

I. Introduction

Acrylic acid (AA) is a valuable product of chemical industry with a world production over 4 million tons per year. AA and its derivatives are used for production of the wide variety of valuable polymeric materials, paints, superabsorbents. AA also is used as intermediate for different functional materials production (microgels, hydrogels, drugs delivery systems, e.g.) [1].

The main industrial method of AA production is two stage propylene oxidation via the intermediate stage of acrolein obtaining [2]. This method is characterized by good economic efficiency and simplicity of technological designing but as it based on the oil raw material it is suitable only for the regions with good petroleum products availability. So in recent years growing of interest for extending of raw material base of AA obtaining and developing new methods of AA synthesis was observed. The promising method is AA production from renewable raw material – biomass (by using biological catalysts – enzymes) [3, 4].

Another one method which is of great interest to scientists is AA production based on formaldehyde (FA) and acetic acid (AcA) [5]. Both AcA and FA in industry are obtained from methanol (via carbonylation and oxidation reactions respectively) [6 – 8], and the common raw material for methanol production is synthesis gas which is obtained from natural gas or coal. Considering the much larger global reserves of natural gas and coal compared to oil, the use of these raw materials for organic synthesis is more promising.

The key for successful implementation of AA production based on AcA and FA is effective catalyst for this process. It is known that the reactions of aldol condensation may proceed through both, base and acidic catalysis. We have developed the catalysts of both types, and it also was found that acid catalysts have higher activity and efficiency than the base one [5, 9]. Also the correlation between the strength of acid sites of the catalysts and their selectivity was found [10]. It is an interesting fact that in recent years a lot of publications have been appearing which declare high efficiency of acid catalysts, particularly the catalysts based on metal oxides (Fe_2O_3, MoO_3, V_2O_5 etc.) in the process of methanol oxidation [8]. So we decided to continue our developments of acid catalysts for aldol condensation reaction and to test the best of them in the process of single stage AA obtaining based on methanol and AcA, combining methanol oxidation and subsequent reaction of the formed FA with AcA in one reactor on the same catalyst.

II. Results and Discussion

The first stage of present work is developing the new efficient catalysts for AA obtaining by aldol condensation of AcA with FA. So the new B–P–W–V–O_x/SiO_2 catalyst was developed and its catalytic properties were investigated at temperature range from 563 to 683 K, residence time 2 – 16 sec at equimolar initial reagents ratio.

The results showed that increase of residence time results in considerable increase of AA yield (Fig. 1). The exception is in temperature range 653 – 683 K where the maximum of yield is observed.

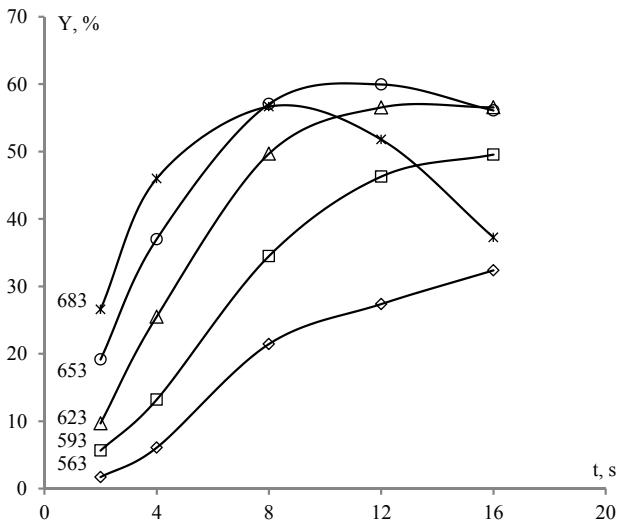


Fig. 1. Residence time effect on acrylic acid yield, temperature range 563 – 683 K

The maximum yield of AA obtaining within temperature range 653 – 683 K is caused by the specific dependence of selectivity of AA formation from residence time (Fig. 2). While the conversion of AcA is increasing within the whole residence time range (2 – 16 sec.) the selectivity of AA formation tends to decrease at longer residence time, especially at 653 – 683 K (Fig. 2). Within 563 – 623 K temperature range the selectivity of AA formation is high and almost is not influenced by residence time and temperature.

The investigated catalyst is developed for the industrial application, therefore the optimal conditions are chosen based on the maximum productivity of AA obtaining. The selectivity of AA formation is also an important factor. The desirable level of selectivity of AA formation (over 80 %) is achieved up to 653 K at contact time range 2-12 s. The maximum one pass yield of AA obtaining (60 %) was

obtained at 653 K at residence time 12 sec. But the optimum conditions of AA obtaining in terms of catalyst's productivity and selectivity is temperature 653 K and residence time 4 sec. At these conditions the one pass yield of AA obtaining is 37 % at selectivity of its formation 92 %.

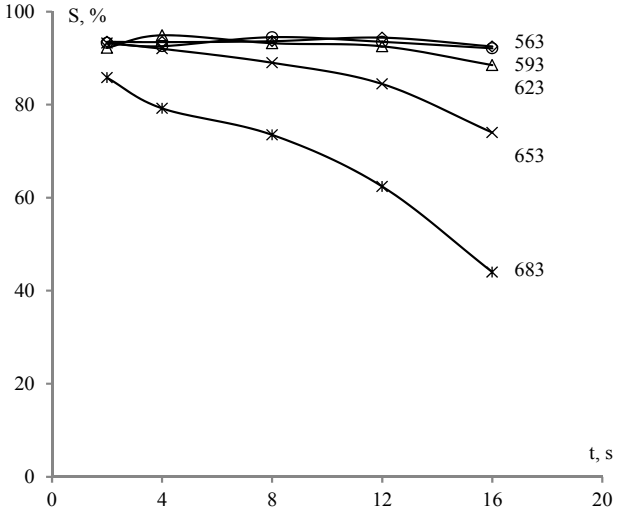


Fig. 2. Dependence of acrylic acid formation selectivity on residence time, temperature range 563 – 683 K

At these reaction conditions the developed catalyst was tested in the process of single stage AA obtaining based on methanol and AcA in the presence of air. The formation of AA has been detected. The reaction products were analyzed by chromatography. Under reaction conditions the one pass yield of AA obtaining is over 20 %.

Conclusion

Acrylic acid production by the aldol condensation of acetic acid with formaldehyde will provide diversifying the raw materials base of acrylate monomers production (makes it possible to use non-oil sources of the raw materials). Use of the developed B–P–W–V–O_x/SiO_2 catalyst allows for acrylic acid obtaining with one pass yield 37 % at selectivity of its formation 92 % and acetic acid conversion 40 % (residence time 4 sec., 653 K). In case of unreacted substances recycling, acrylic acid yield will be up to 92 %.

The very important fact is the same catalytic system shows efficiency in the process of single stage acrylic obtaining based on acetic acid and methanol in the presence of air. The one pass yield of AA obtaining is near 20 % at the same reaction conditions as in common aldol condensation method based on acetic acid and formaldehyde.

Acknowledgements

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Sorption Properties of Metal-containing Polymer-Silicate Fillers

Andrii Masyuk, Volodymyr Levytskyi

Department of Chemical Technology of Plastics,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: masyukas@gmail.com

***Abstract* – Sorption properties of metal-containing polymer-silicate fillers on regarding to different acid-base indicators have been investigated. The effect of the nature of metal and polymer modifier on the amount of active centers and specific active surface area of such material was determined. Moisture absorption of modified and not modified silicate materials has been found.**

Key words – metal-containing polymer-silicate fillers, modifier, sorption, indicators, moisture absorption.

I. Introduction

Becoming increasingly important polymer composite materials based on nanoscale fillers. In particular, it is expedient to use metal-containing polymer-silicate fillers, which received by compatible precipitation of sodium liquid glass (Na-LG) and water-soluble functional polymers under the influence of metal chlorides (Ba, Cu, Co, Ni, Zn, Fe) [1]. The functional active polymers acting as a modifier and that allows to regulatet the properties of fillers and increase their technological compatibility with polymer matrix of composites [2].

An important characteristic of these modified materials is their surface adsorption properties that are directly related to the process of their modifying and nature of modifier.

As a modifiers was used water soluble, surface-active polymers: polyvinylpyrrolidone (PVP) and polyvinyl alcohol (PVA). The macromolecule of modifier uniformly distributed in the silica framework due to a compatible precipitation of water-soluble silicates and polymers from an aqueous solution [3]. The use of number of precipitant with different nature of metal increases the range of possible use such materials.

Therefore, the establishment of nature of precipitant and modifier on sorption properties of metal-containing polymer-silicate fillers is an urgent task.

II. Experimental

For obtaining the polymer-silicate fillers previously prepared solution of PVP in Na-LG, for which were acted by solution of metal chloride and prepared metal chloride solutions with dissolved there PVA, which acted on the Na-LG [1]. The resulting precipitate was filtered, evacuated and thoroughly washed with distilled water, then dried in a vacuum dryer at 80-90 °C

To install the sorption characteristics of these materials, such as the amount of active centers of sorption and specific active surface area, was elected a number of indicators with functional groups of different nature and pKα value.

Sorption ability of studied materials determined by photocolorimetry on photocolorimeter KFK-2. Concentration of indicators in aqueous or aqueous-alcoholic solution was $(0,2\text{-}5)\cdot10^{-4}$ M, and the mass of samples 0,25 g. Material stirred in solution of indicator for 1h. after that the solution was centrifuged and absorbance measurements were carried out.

To determine water absorption using vapor saturated solution of sodium dihydrogen phosphate with constant value of relative humidity of 95%.

III. Results and Discussion

On the basis of the results of sorption of methylene blue in metal-containing silicate materials can be argued that the ability to sorption in the studied material has a specific and selective nature and likely determined by the nature of metal (Table 1).

TABLE 1

THE EFFECT OF METAL NATURE ON THE SPECIFIC ACTIVE SURFACE AREA S_a AND AMOUNT OF ACTIVE CENTRES q_a

№	Metal nature	$q_a\cdot10^6$ mol/g	S_a, m^2/g
1	Cu^{2+}	94,0	73,59
2	Ba^{2+}	77,8	60,94
3	Al^{3+}	94,6	74,06
4	Ni^{2+}	99,1	77,58
5	Zn^{2+}	96,4	75,46
6	Fe^{3+}	96,2	75,31
7	Co^{2+}	85,4	66,85

The lowest value of the specific active surface area and the number of active centers observed for systems where as precipitant were used barium and cobalt chlorides. This difference is related to structural features of the surface of such materials, and in the case of barium chloride with the possibility of the formation of soluble $Ba(OH)_2$ in the reaction medium and steric obstacles that are associated with large size of cation Ba^{2+}. At the same time, the influence of valence metal on sorption ability of metal-containing silicate materials are not observed, apparently confirms the homogeneity of the surface of studied materials.

It is established that the number of active centers of sorption studied of metal-containing polymer-silicate fillers depends essentially on the nature of the indicator (Table 2).

TABLE 2

AMOUNT OF ACTIVE CENTERS OF CU-CONTAINING POLYMER-SILICATE FILLER

Indicator	pKα	Modifier	$q_a\cdot10^6$, mol/g
Brilliant green	1,3	–	8,64
		PVP	7,84
		PVA	5,00
Bromophenol blue	4,2	–	6,36
		PVP	6,63
		PVA	–
Bromocresol purple	6,4	–	1,71
		PVP	0,88
		PVA	1,17
Methylene blue	9,7	–	94,00
		PVP	80,75
		PVA	87,10
Indigo carmine	12,8	–	2,28
		PVP	0,55
		PVA	1,58

As in the case of modified materials and not modified the highest activity shows up on methylene blue and brilliant green, and the lowest - bromocresol purple. At the same time, the sorption of methyl orange is not happening at all.

Found that the use of polymeric modifiers leads to a reduction of the specific active surface area and the amount of active centers on it. This feature as a result of of blocking the active groups on silicate structures due to interaction with the functional groups of the polymer modifier. Should be noted that for most of indicators PVP impact is more significant than the PVA. This difference is related to greater conformational parameters of PVP macromolecules and presence of more sophisticated functional groups.

Established that the modifiers also affect the specific active surface area (Fig. 1).

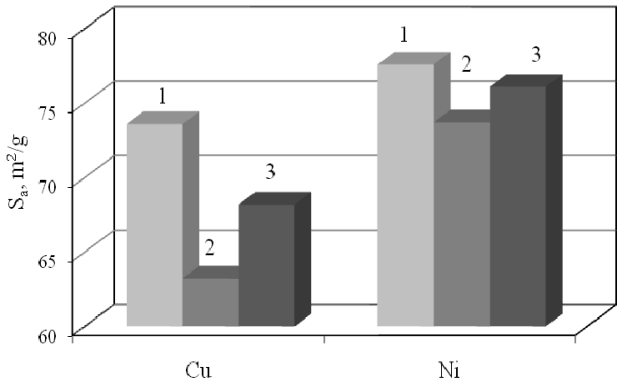

Fig. 1. The effect of modifier on the specific active surface area: 1 – without modifier; 2 – PVP modifier: 3 – PVA modifier

The established regularities of effect of the nature of polymer and metal on the surface characteristics to some extent confirmed by the results of the moisture adsorption studies which are shown in the Table. 4.

TABLE 4

MOISTURE ABSORPTION OF METAL-CONTAINING POLYMER-SILICATE FILLERS

Modifier	Precipitant			
	$CuCl_2$	$BaCl_2$	$ZnCl_2$	$CoCl_2$
	Moisture absorption, %			
Without modifier	52,4	20,2	37,5	39,5
PVP	25,5	12,6	17,3	16,2
PVA	28,9	7,2	32,7	32,3

Based on these data we can conclude that the obtained materials are characterized by a developed surface.

The modified silicate materials characterized by significantly lower values of moisture absorption than unmodified. This confirms the ability to block of silicate surface groups by macromolecules of polyvinylpyrrolidone and polyvinyl alcohol and reduced the porosity of fine particles.

The nature of metal differently affects on the absorption values of water, which is due to the peculiarities of interaction of metal with Na-LG during the reaction of obtained of metal-containing polymer-silicate materials.

Conclusion

In this paper established the effect of polymer modifier and the nature of metal on the sorption characteristics of metal-containing polymer-silicate fillers. Found that the specific active surface area and the amount of active centers in it depends on the nature of metal, for Ba^{2+} and Co^{2+} observed a significant reduction of these values.

At the same time, the use of polymeric modifiers, regardless of the nature of metal and indicator, reduces the amount of active centers and specific active surface area, which is associated with the blocking surface active groups of silicate structures due to interaction with the functional groups of the polymer modifier.

The modified silicates materials is observed a significantly lower moisture absorption values than unmodified, due to the blocking of silicate structures surface groups by macromolecules of polyvinylpyrrolidone and polyvinyl alcohol and reduced of the porosity of fine particles.

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Influence of poly(vinyl chloride) and polymer-silicate fillers on the properties of polyester resin

Diana Katruk, Volodymyr Levytskyi

Department of Chemical Technology of Plastics,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: SamoiliukD@gmail.com

Abstract – The influence of polymer modifier poly(vinyl chloride) (PVC) and polymer-silicate fillers on the physico-chemical regularities of structuring of unsaturated polyester resin have been investigated. It has been ascertained that addition of Zn-silicate fillers in polyester composition leads to slower curing speed, and the introduction of Ni-silicate fillers and PVC leads to accelerate the process of curing polyester oligomers. Physical-mechanical and corrosion properties of polyester materials modified by polyvinyl chloride and polymer-silicate fillers have been determined.

Key words: polyester, compositions, modification, polymer-silicate fillers, poly(vinyl chloride).

I. Introduction

The introduction of poly(vinyl chloride) (PVC) as a polymer modifier and polymer-silicate fillers into polyester composition will enable regulating the process of structuring connector through the formation of boundary layer with a lower degree of cross-linking [1]. Thus, the formation of coherent boundary layer, which is capable of deformation will reduce tensions on the border "polymer – filler" resulting from shrinkage and thermal deformation, as well as changes in the morphology and properties of polyester composites. These changes of the properties, especially rheological and physical-mechanical, are related to the influence of the filler on the structure and properties of a near-boundary layer of the polymer and the interaction between the filler particles themselves [2].

II. Experimental

For research was used unsaturated polyester resin brand Estromal 11.LM-02. As modifiers was used PVC brand Lacovyl PB 1156 and polymer-silicate materials, which were previously obtained by compatible precipitation of water-soluble silicates and polymers under the influence of metal chlorides of different nature [3,4].

The influence of PVC and polymer-silicate fillers (PSF) on physical-chemical properties of unsaturated polyester resins was performed by determining surface hardness and hardness by pendulum. The surface hardness of the samples was determined on Consistometers Hepplera at 293 K in pushing the polymer sample steel cone angle sharpening 58^0 08' under the weight of 5.0 kg for 60 seconds. Determination of hardness by pendulum was performed under ISO 1522-73.

Protective properties of coatings based on modified polyester composites in corrosion-active medium determined through research components of the system impedance metal – coating.

III. Results and Discussion

The introduction of nickel-silicate structures and PVC into the reaction medium leads to acceleration of the curing process of polyester compositions and the introduction of zinc-silicate structures has the opposite effect. This is likely due to a different effect of metals on all stages of the process of resins curing, especially at the stage of activation and the different nature of functional surface-active groups of fine polymer-silicate structures, including acid-base surface balance.

At the same time, in the case of forming the polyester composite including Zn-containing silicate filler that slows resin curing, the possibility of increasing the strength characteristics of the composite is created. However, in composites with a Ni-containing silicate filler that accelerates the process of connector structuring the conditions for the formation of structures with high internal stresses occur.

The introduction of poly(vinyl chloride) and polymer-silicate fillers also affects the performance criteria of polyester composites.

It should be noted that the polyester compositions show changes in physical-mechanical properties over time, as complete curing of polyester oligomers occurs within 10-30 days depending on the brand of polyester [5].

The values of surface hardness after aging for 28 days determined by two methods (using the Hepler consistometer (F) and by the pendulum (without heat treatment (H) та with heat treatment (H_{th})) are presented in Fig. 1.

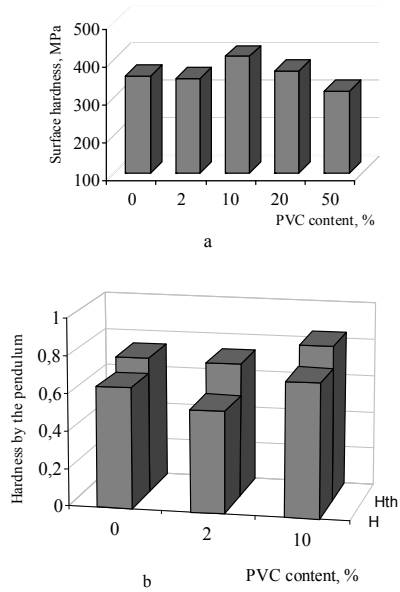

Fig. 1. Effect of PVC on surface hardness(a) and hardness by the pendulum (b) of polyester

As we can see, the hardness values defined by the two methods differing in the applied load vector are correlated with each other.

The introduction of PVC leads to the increase in surface hardness values by 10-50 MPa at its content in the composition about 10-20% by weight. Further increasing in the PVC content somewhat reduces the value of surface hardness, which is obviously due to a significant increase

in the heterogeneity of the system, the formation of interfacial areas where the density of a fluctuation mesh between structured polyester matrix and PVC macromolecules is reduced.

Heat treatment of polyester materials at 353-363 K leads to higher values for the pendulum hardness which is due to the additional structuring of polyester materials at the higher temperatures.

Composites containing some kind of metal-silicate formations have somewhat different patterns of changes in surface hardness compared to composites modified by PVC. The influence of the polymer-silicate filler and its composition on surface hardness of polyester resin is shown in Table. 1.

TABLE 1

EFFECT OF POLYMER-SILICATE FILLERS ON SURFACE HARDNESS OF POLYESTER COMPOSITES

№	Polymer-silicate filler*	F, MPa	Hardness by the pendulum	
			H	H_{th}
1	-	359,7	0,643	0,726
2	Ni	403,7	0,555	0,701
3	Zn	351,3	0,523	0,727
4	Co	375,2	0,656	0,767
5	Ba	436,4	-	-
6	Cu	446,1	-	-

* - a filler content of 2% by weight.

It is determined that the introduction of Ni-, Co-, Ba-, and Cu-containing silicate fillers leads to an increase of surface hardness values. However, in the case of the introduction of Zn-containing silicate filler the opposite effect is observed, that is surface hardness decreases slightly. These determined features are apparently caused by the varying impact depending on the nature of the cation of the polymer-silicate filler on the polymer matrix structuring processes, leading to the formation of polyester mesh with varying degrees of structuring and various interstitial molecular weight.

The influence of polymer-silicate fillers on the surface hardness of polyester composites modified by polyvinyl chloride is shown in Fig. 2.

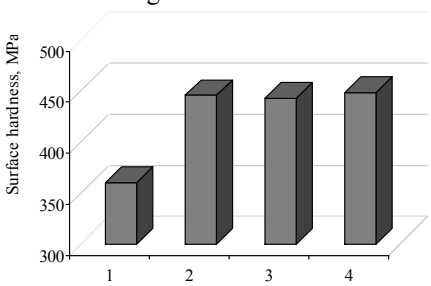

Fig. 2. Influence of PSF on surface hardness of the modified polyester resin (PVC content is 5% by weight; metal-containing silicate filler content is 2% by weight). Filler: 1- without filler; 2 – cobalt-silicate; 3 – cuprum-silicate; 4 – barium-silicate

Polyester composites modified by PVC which additionally contain metal-silicate fillers are characterized by high surface hardness values as opposed to a polyester resin modified by 5% PVC by weight. Thus, surface hardness values are almost identical.

To evaluate the protective properties of coatings based on modified polyester composites the impedance components of a system "metal – coating" were investigated in corrosion-active medium. This made it possible to estimate the changes of the dielectric properties of the polymer layer in the atmosphere and set the time when determining factor becomes the polarization resistance of electrode processes at the interface "steel – polymer coating" instead of the insulating properties of the coating itself.

It is revealed that the resistance of some modified polyester compositions, being high in the first days of research then dereased and approached the level of $1,5 \cdot 10^6$ Ohm·cm^2, indicating the penetration of aggressive environment to the steel substrate and loss of coating protective properties. After such a resistance reduction the appearance of the first points of corrosion can be observed on samples. The longest metal protection is provided by coverings on the basis of the modified polyester resin comprising poly(vinyl chloride) in an amount of 2% by weight and the nickel-silicate filler.

Conclusion

It is revealed that the process of resin curing and the properties of polyester composites modified by poly(vinyl chloride) is significantly impacted by the introduction both the polymer modifier and polymer-silicate fillers to the polyester composition. This allows adjusting the process of connector due to the structuring through the formation of coherent boundary layer with a lower degree of residual stresses.

It has been ascertained that modification of polyester composites by poly(vinyl chloride) allows adjusting the strength properties of the material. The introduction of PVC leads to the increase in surface hardness values by 10-50 MPa at its content in the composition of 10-20% by weight.

It was established that modified polyester materials containing PVC (in the amount of 2% wt.) and the nickel-silicate fillers have the highest corrosion resistance.

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Determination of the catalytic complexes structure in the cyclohexane oxidation

Oleksandr Ivashchuk[1], Oleksandr Suprun[2], Viktor Reutskyy[2]

[1]Department of Chemical Engineering,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: oleksandr.s.ivashchuk@lpnu.ua

[2]Department of Technology of Organic Products,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: reutskyy@polynet.lviv.ua

Abstract – A spectral analysis of catalytic solutions based on cobalt naphthenate in cyclohexanone with additives of ethanol and glycine for the cyclohexane oxidation process was conducted.

Key words – oxidation, catalyst, cyclohexane, complexes.

I. Introduction

Using different nature organic modifiers in the cyclohexane (CHX) oxidation in the presence of cobalt naphthenate (CoNph) significantly affects both the composition of the products and the oxidation rate [1]. This effect is associated with participation additives in creation of the intermediate complexes and associates with a catalyst and the oxidation products [2]. For testing these assumptions were made solutions spectral study of complex catalytic systems.

II. Resuts and discussion

After analyzing the results of studies of the cyclohexane oxidation effects of binary catalytic systems of different nature using, we see that in the presence of additives to CoNph of ethanol (ET) and glycine (GC) there are significant changes in the products composition and the speed of the process at different stages of oxidation (Table. 1).

The data obtained using two catalysts concludes that the nature of these additives (NC + NC + ET and GC) on the selectivity of the process is similar. The presence of additives leads to minor changes of amount of cyclohexyl hydroperoxide (CHP) in the oxidate; to a significant reduction of selectivity values of acids and esters; and to increasing of the aim products concentration – cyclohexanone (CON) and cyclohexanol (COL) – with shifting of the value [COL/CON] towards accumulation of the alcohol. The influence of the speed is multidirectional – ET speeds up and GC slows down the process, relative to CoNph.

The nature of the catalytic systems, which include different nature alcohols and amino acids is associated with the formation of complex compounds or ionic associates involving functional groups of additives with molecule of metal containing catalyst. To support this theory a spectral analysis the solutions of the catalytic systems was conducted.

IR-spectroscopy of the analyzed colloidal solutions catalytic systems was carried out using a spectrometer Specord M-80 in the cell thickness of 0,2 mm. Analysis of the spectra was based on the tables of characteristic absorption frequencies.

TABLE 1

OXIDATION INDICATORS OF CYCLOHEXANE WITH THE ORGANIC MODIFIERS USE (CONVERSION VALUE AT X ~ 4%)

T = 413 K, P = 1,0 MPA, C(CONPH)= 5,0×10^{-4} MOL/L

X, %	τ, min	S(CHP1), %	S(A2), %	S(ET3),%	S(COL4),	S(CON5), %	$W_{сер}\times10^3$, mol/l·sec	[COL/CON]	$S_{цп}$, %
CoNph									
4,00	50	10,40	19,62	5,94	37,92	26,11	0,12	1,45	76,42
CoNph – Ethanol									
4,03	40	11,78	4,30	0,00	56,52	27,40	0,16	2,06	95,69
CoNph + Glycine									
3,56	60	9,29	6,44	0,00	54,10	30,17	0,09	1,79	93,56

Note: [1] cyclohexyl hydroperoxide; [2] acids, [3] ethers, [4] cyclohexanol, cyclohexanone, [5]aim products

CON was used as a solvent, which in conditions of the oxidation process is presented in the reaction environment, as well as cobalt naphthenate, which under normal conditions is better soluble than CHX and COL. The concentration of variable valence metal salt (VVM) in the test solutions was 5,0•10-5 mol/l. The total concentration of the catalyst solution was 5% (mass.). The relationship between the components of the catalyst system was [CoNph : Additive] = (1: 1) (mass.).

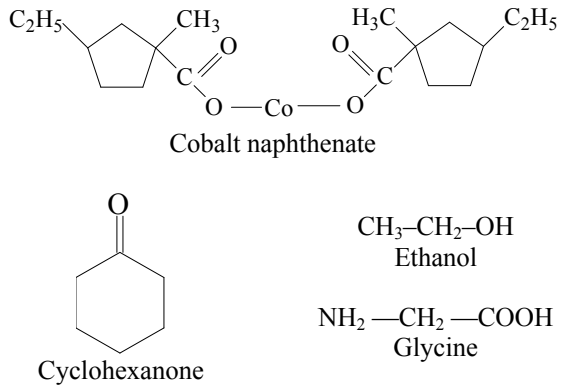

Fig. 1. The structure of the catalytic systems components

Comparing IR visible spectrum of prepared catalytic solutions with the spectrum of CoNph solution we are seeing some significant changes in the absorption bands at certain frequencies (Table 2).

There is no absorption at wavelengths 3300-2800 cm^{-1}, in the sample (CON + CoNph + ET) and there is a wide peak in the range 3700-3100 cm^{-1}; and there are two wide peaks within the 3700-3500 cm^{-1} and 3300-2800 cm^{-1} in the samples (CON + CoNph) and (CON + CoNph + GC) corresponding to the OH-groups in complexes with hydrogen bond.

In the sample (CON + CoNph + GC) there is a large peak at 1296 cm^{-1} and a small peak at 1260 cm^{-1}, when in the sample (CON + CoNph) at 1296 cm^{-1} it's small and 1260 cm^{-1} – large.

TABLE 2

THE INFRARED SPECTROGRAPHS RESULTS OF THE CATALYTIC SOLUTIONS

CoNph + CON		CoNph + CON + GC		CoNph + CON + GC *		CoNph + CON + ET	
ν, δ, sm^{-1}	group	ν, δ, sm^{-1}	group	ν, δ, sm^{-1}	group	ν, δ, sm^{-1}	group
–	–	992	-C-O-	992[5]	-C-O-	–	–
–	–	–	–	920[7]	C–O–C	–	–
		1040	C-OH	1040	-C-OH[3]		
1260[1]	$-CH_3$	1260[2]	$-CH_3$	1260	$-CH_3$	1260[3]	$-CH_3$
1296[2]	C–H	1296[1]	C–H	1296	C–H	1296[3]	C–H
–	–	1664	-C=C-	1664	-C=C-	–	–
1640	C=O	1640[3]	C=O	1640	C=O	1640[3]	C=O
3300-2800	OH...H	3300-2800	OH...H	3300-2800[4]	OH...H	–	–
3700-3500	–	3700-3500	-OH	3700-3500	-OH	–	–
–	–	–	–	–	–	3700-3100[6]	-OH, OH...H

Note: [1] big, [2] small, [3] increases, [4] decreases, [5] shifted, [6] appears (wide), [7] appeared, * (CoNph + CON + GC) solution after heating τ = 10 min. at T = 413 K.

The peak at 1296 cm^{-1} corresponding to absorption of C–H in alkanes and has increased by CH_2 presence in amino acid. Intensity of absorption in the sample (CON + CoNph + GC) have been increased at 1640 cm^{-1} compared to (CON + CoNph), which corresponds to the C=O in amino acids. The peak in 1664 cm^{-1}, which corresponds to -C=C- in (CON + CoNph + GC) increased as a result of possible interactions.

After additive of ethanol – sample (CON + CoNph + ET) – in the IR spectra peaks become sharpest and more expressed, which can be explained by the formation of more polar molecules – micelles.

After heating (sample (CON + CoNph + GC)) a peak appears at 920 cm^{-1}, corresponding to the C-O-C bonds – probably was held the interaction between the components of the catalytic solution. Maximum of the absorption (at 992 cm^{-1}) has been shifted toward longer wavelengths, which corresponds to C–O.

After heating most of the hydrogen bonds have been destroyed – there is less peaks at 3400-3000 cm^{-1} compared with samples (CON + CoNph) and (CON + CoNph + GC) without heating. After heating intensity of all the peaks have been increased, especially has been increased the absorption peak at 1040 cm^{-1}, corresponding to -C-OH group of atoms, that is the group which took place on this interaction.

Summarizing the research results of IR spectroscopy we can make the following conclusions:

- catalytic additive of ET and heating (CON + CoNph + GC) contributes to the destruction of hydrogen bonds presented in (CON + CoNph) and (CON + CoNph + GC);
- catalytic additive of ET promotes the formation of more polar molecules – micelles;
- interaction with complex formation occurred involving C-OH groups of the additives and reaction products.

The results of spectral studies of binary catalytic systems based on CoNph with the additives of different nature (alcohols and nitrogen-containing modifiers) can offer the following structural formula of the catalytic complexes (Fig. 2, 3):

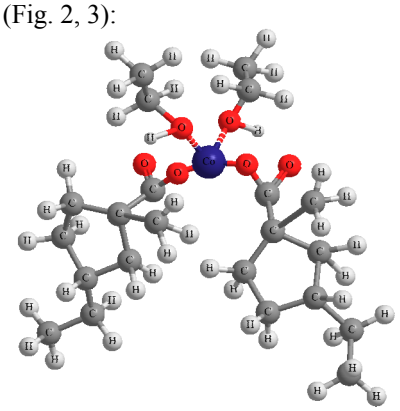

Fig. 2. Expected catalytic complex of cobalt naphthenate with ethanol

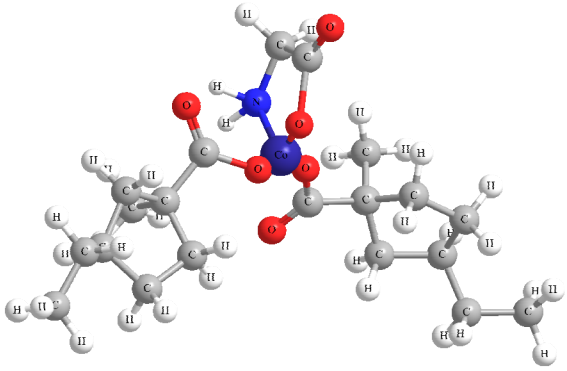

Fig. 3. Expected catalytic complex of cobalt naphthenate with glycine

Conclusion

The research of IR spektra indicates the creation and quantitative changes in the solutions that's confirms the assumption complexation involving all components of catalytic solutions.

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Molecular modeling of the isoquinoline and hinaldyne reaction of oxidation by peroxyacids

Ivanna Zvir,Volodymur Dutka, Natalia Matsyuk, Mariya Matsyuk, Galyna Zastavska, Yaroslav Kovalskyi

Ivan Franko National University of Lviv
Kyryla & Mefodia str., 6, 79005, Lviv, Ukraine,
E-mail: natalia.matsyuk@gmail.com

Abstract* – *Optimal-geometric structures of molecules was calculated with semi-empirical quantum-chemical methods. The heat of formation (ΔH_f), the heat of reaction (ΔH_{ex}) was found. Numerical values of ΔH_f was calculated theoretically is satisfactorily coincide with the data obtained experimentally.

Key words – heat of formation, oxidation, isoquinoline, hinaldyne, N-oxides, peroxydecanoid acid, structure of molecules.

I. Introduction

Modern computer technology empirical and semiempirical quantum chemistry allow predict geometric structure, energy and other properties of the molecules. Not spending experimental studies using methods of quantum chemistry we can predict the properties of materials, but between studies of the molecules in this way and experimentally there is a fundamental difference: the calculations can be conducted for nonexistent or unstable connections, and the existing components, with which conducting experimental studies in the laboratory [1].

Complexes of quantum chemistry program: empirical (GAUSSIAN and GAMESS) and semi-empirical (MORAS and Hyper Chem) are widely used in practice [2, 3]. All quantum-chemical calculations we carried out using MOPAC 2012 [4] with graphic interface Winmostar 3.75 [5].

Choose of the methods of quantum-chemical calculations it is important, as this can provide valuable information for the elucidation of the mechanism of reaction on which we can predict the reactivity of molecules.

II. Results and discussion

In our work, the results of quantum-chemical calculations of molecules isoquinoline, hinaldyne and their N-oxides are presented. In literature there are no data from studies of quantum-chemical oxidation of organic compounds, so we carried out molecular modeling these processes by peroxydecanoic acid oxidation.

Quantum chemical calculations give valuable information about the optimal geometric structure of molecules, heat of formation, potential of ionization, dipole moments, and other important characteristics. A special interest is the choice of method of calculation as packet of program MOPAC 2012 contains several semi-empirical methods of calculation. To calculate the heats of formation adopted the following methods: AM1, PM3, PM5, PM6, RM1.

An important characteristic of oxidative process is the heat of reaction ΔH_{ex}. To find ΔH_{ex} performed quantum-chemical calculations of optimum geometrical structure and the heats of formation ΔH_f starting materials and products of reaction and comparing the received results with thermochemical data. Optimal geometric structures of isoquinoline, hinaldyn and products of their oxidation are shown in Figure 1.

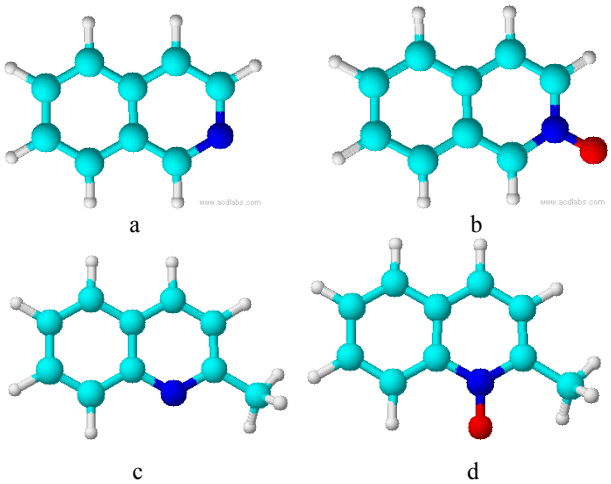

Fig. 1. Optimal geometric structures of isoquinoline (a), hinaldyne (c) and products of their oxidation (b, d)

Molecules of isoquinoline, hinaldyne and their –oxides – flat, and the data of quantum-chemical calculations show that the oxidation of organic compounds does not lead to deformation of the phenyl nucleus. Angles in atoms of the compounds are close to 120°.

Table 1 shows the results of quantum chemical calculations of isoquinoline molecules various semi-empirical methods.

We receiving heat of formation (ΔH_f), dipole moment (D), energy the highest occupied (HOMO) and lower vacant molecular orbitals (LUMO), the area (S) and volume (V), potential ionization of molecule (I_x). During the calculation ΔH^0_f For energy HOMO and LUMO we calculated electronic chemical potential (μ) and stiffness molecules (η).

It is noteworthy that, isoquinoline ΔH^0_f was calculated theoretically is in the range 188.05-209.33 kJ/mol and well coincides with the data obtained by thermochemical methods, numerical value which is $\Delta_f H°_{gas}$ = 204.61 kJ/mol. The dipole moment isoquinoline found experimentally equal 2,53 ± 2,73 Debye [6], while in the calculations numerical value D = 2.15 - 2.72, that is well-designed setting matches the experimentally found.

The calculation parameters using quantum chemical methods for isoquinoline-N-oxide molecules are shown in Table 2.

The heat of formation of isoquinoline-N-oxide was calculated theoretically is in the range 194.39 - 252.56 kJ/mol and well coincides with the data obtained by thermochemical methods, numerical value which is $\Delta_f H°_{gas}$ = 204.61 kJ/mol isoquinoline found.

TABLE 1

PHYSICO-CHEMICAL PARAMETERS OF ISOQUINOLINE CALCULATED BY SEMI-EMPIRICAL METHODS

Parameters	Method				
	AM1	PM3	PM6	PM7	RM1
Heat of formation, kJ/mol	204.1	194.3	209.3	203.3	188.1
Dipole moment, Debye	2.2	2.2	2.7	2.7	2.4
E_{HOMO},eV	-9.2	-9.3	-9.3	-9.3	-9.0
E_{LUMO},eV	-0.3	-0.5	-0.7	-0.8	-0.3
μ, eV	-4.7	-4.9	-5.0	-5.1	-4.6
η, eV	8.9	8.7	8.5	8.4	8.7
Area, $Å^2$	162.4	162.2	163.2	162.5	161.8
Volume, $Å^3$	160.5	160.3	161.8	160.9	159.9
Potential ionization, Ev	9.2	9.2	9.2	9.3	8.9

The dipole moment of of isoquinoline-N-oxide found experimentally equal 3.73 Debye [6], while in the calculations numerical value D = 3.73 - 4.26 Debye, that is well-designed setting matches the experimentally found.

TABLE 2

PHYSICO-CHEMICAL PARAMETERS OF ISOQUINOLINE-N-OXIDE CALCULATED BY SEMI-EMPIRICAL METHODS

Parameters	Method				
	AM1	PM3	PM6	PM7	RM1
Heat of formation, kJ/mol	252.5	211.2	194.9	204.5	194.3
Dipole moment, Debye	3.7	3.9	4.2	3.8	3.7
E_{HOMO},eV	-9.0	-9.0	-9.0	-8.8	-8.8
E_{LUMO},eV	-0.4	-0.7	-0.9	-1.1	-0.3
Area, $Å^2$	171.9	171.5	172.2	171.5	171.0
Volume, $Å^3$	171.3	170.7	171.7	170.9	170.2
Potential ionization, Ev	8.8	8.9	8.9	8.7	8.6

The heat of reaction of isoquinoline oxidation to isoquinoline-N-oxide by peroxydecanoic acid designed by law Hess shown in Table 3. The numeric value for this reaction ΔH_{ex} was calculated by thermochemical data in literature missing, because it has not given opportunities to compare it with data ΔH_{ex} obtained on the basis of quantum-chemical methods.

TABLE 3

THE HEAT OF REACTION OF ISOQUINOLINE OXIDATION BY PEROXYDECANOIC ACID CALCULATED BY VARIOUS SEMI-EMPIRICAL METHODS

Method of calculation	ΔH_{ex}, kJ	Method of calculation	ΔH_{ex}, kJ
AM1	-83.5	PM7	-138.9
PM3	-80.8	RM1	-96.8
PM6	-151.7	Thermochemical data	-

It should be noted that ΔH^0_f hinaldyne was calculated theoretically is in the range 151.41 - 187.13 kJ/mol and well coincides with the data obtained by thermochemical methods, numerical value which is $\Delta_f H°_{gas}$ = 159.1±3.1 kJ/mol. The dipole moment of hinaldyne experimentally found equal 1,86 ± 1,95 Debye [6], while in the calculations numerical value D = 1.67 - 1.98, is well calculated parameter found to match experimentally. Potential of ionization of the molecule hinaldyne-N-oxide was calculated theoretically is in the range 8.33-8.61 eV and well coincides with the literature, which constitute 8.00 ± 0.05 eV. The dipole moment is 4.0 Debye experimentally found [6], while in the calculations received during D = 2,94-3,43 Debye.

Conclusion

Thus quantum chemical calculations make it possible to obtain results and predict the reactivity of substances. Based on the results for the oxidizing isoquinoline and hinaldyne by peroxydecanoic acid we can conclude that the mechanisms of these substances are similar.

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Peculiarities of the oxidative polycondensation of aniline derivatives in solution of polyvinyl alcohol

Halyna Stasyshyn, Galyna Zastavska, Mariia Koval, Volodymyr Dutka

Ivan Franko National University of L'viv, UKRAINE
Kyryla & Mefodiya Str. 6, L'viv 79005,
natalia.matsyuk@gmail.com

Abstract – Studied oxidative polycondensation of aniline peroksydysulfatom ammonia in solution of polyvinyl alcohol. It is shown that water-soluble polymer can interact with aniline. Kinetic curves are characterized by oxidative polycondensation of two plots that indicate the nature of the avtokatolitychnyy. During the process available polymer-polymer materials that have film-forming and conductive properties.

Key words – aniline, polyaniline, polyvinyl alcohol, viscosity, electrically conducting

I. Introduction

Electrically conducting polymer-polymer materials possess unique properties because the study of conditions of their receipt and of investigation of physical and chemical parameters received considerable attention. [1, 2].

II. Objects of research

In our work studied specific oxidative polycondensation of aniline derivatives peroksodysulfat amaniyu the presence of polyvinyl alcohol (PVA). Under these conditions can be formed of polymer-polymer composites (PPK) who have film-forming properties, and the presence of a PPK polyaniline (PAN) will predetermine the electrical conductivity of the polymer material.

The resulting composites can be used to produce conductive coatings. On the formation mechanism of the composite method of preparation will affect the reaction mixture. The first stage of the process of obtaining PPK is to obtain aqueous solutions of PVA. In contact with water PVA polymer swelling is observed, the degree of swelling depends on the pH.

In the table 1 shows the extent of swelling water-soluble polymers of methacrylic acid (PMAK), poly acrylic acid (PAK) and polyvinyl alcohol (PVA).

The kinetics of of swelling has a classic look dependencies with the release of the plateau area, with water molecules capture polymeric matrix lasts 30-50 minutes.

TABLE 1.
THE DEGREE SWELLING OF INVESTIGATED POLYMERS (D) AT DIFFERENT VALUES OF PH SOLUTION

pH	The degree of swelling (H) ml / g		
	PVA	PMAK	PAK
6,86	10,5	3,99	4,62
1,68	4,25	3,64	4,45

The degree of swelling of H found by the ratio of the volume of water absorbed to the mass of the polymer. As you would expect numerical values of H depend on the pH. At pH = 6.86 degree of swelling of and PAC for PMAK up 3.93 and 4.62 ml / g, while PVA value H proved to be more a factor of 2 than for other polymers. When reducing the pH to 1.68 numerical value N for PVS decreases more than in 2 times, while PMAK PAC and the degree swelling of varies slightly. The intensive mixing and heating the of samples PVS that are absorbed the water leads to the formation of viscous polymer solutions. Increasing the number of PVA in aqueous solution spends significant growth of the relative to the viscosity of the derived gel (Fig. 1).

Introduction to the aqueous solution of 0.002 mol of aniline leads to an increase in viscosity compared to the original of PVA solution. This fact indicates the interaction of the polymer matrix - aniline, that results in conformational changes of macromolecules state and growth the viscosity of the polymer.

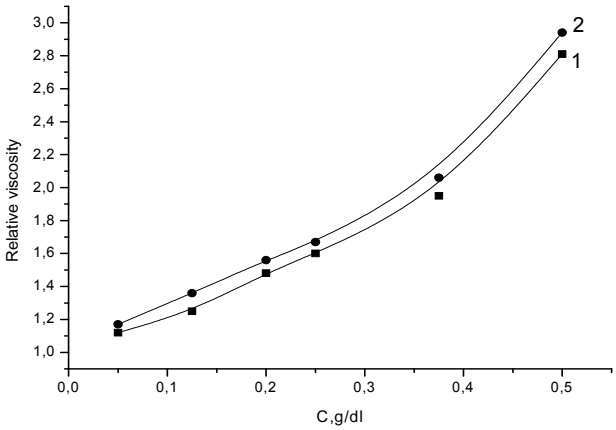


Fig. 1. Relative viscosity the contents of PVA 1, and with the addition of 0.002 mol of aniline 2.

Investigation of conductivity solutions with of PVA and of PVA plugins 0.002 mol aniline confirms the conclusion of the interaction with aniline polymer matrix (Fig. 2)

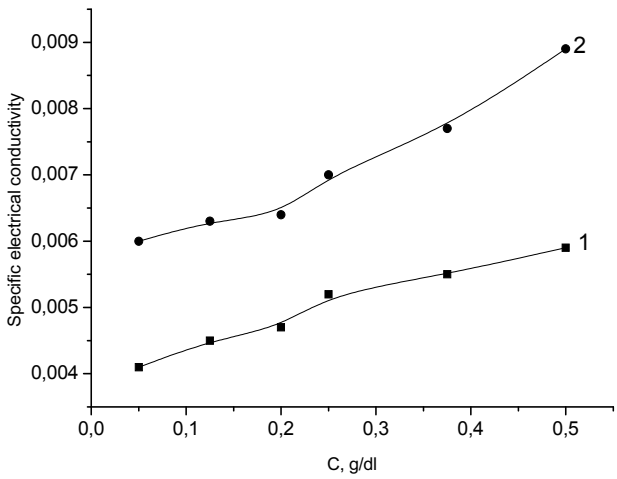
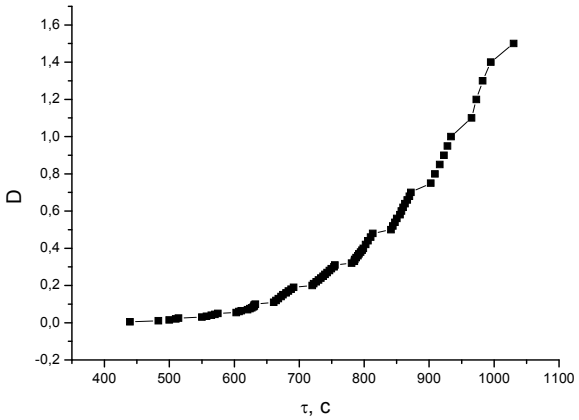
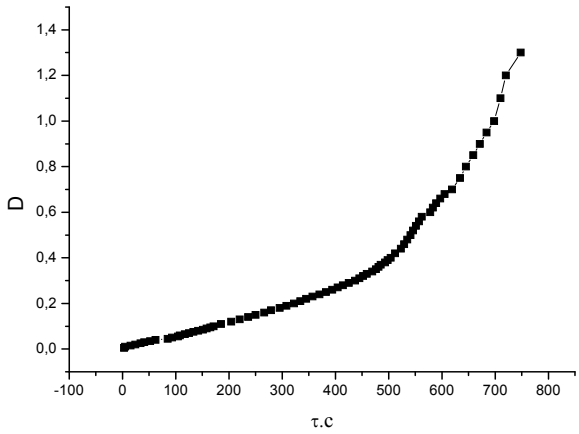


Fig. 2. The dependence specific conductivity the contents of PVA 1, and with the addition of 0.002 mol of aniline 2

Adding to the aqueous solutions of of PVA and aniline-oxidant ammonium peroksodysulfat will lead to the formation of polyaniline. As known in the oxidation of aniline in solution peroksodysulfatamy formed PAN, with the optical density of the reaction mixture increases. As known in the oxidation of aniline peroksodysulfatamy PAN formed by in solution and the optical density of the reaction mixture increases. By measuring change in optical density (D) from the time the polycondensation can be obtained kinetic curves oxidative polycondensation. Obviously aniline interaction with polymer matrix will affect the kinetics of oxidative polymerization. The kinetic curves oxidative polycondensation of aniline are shown in (Fig. 3)



a



b

Fig. 3. Change in optical density (D) the reaction mixture with time in the presence of 2% of PVA. Peroksydysulfatu ammonium concentration of 0.1 M, C_{AH} = 0.01 (a), C_{AH} = 0.05 (b)

The kinetic curves are characterized by two stages (Figure 3) At the initial process stage the optical density varies slightly, but after a defined period reaction rate increases sharply, indicating the character avtocatalitical oxidation of aniline peroksidisulfat ammonium. Construction of kinetic curves in logarithmic coordinates has allowed determine the total rate constants of the first and second □2 □1 process, numerical values are given in Table 2.

TABLE 2.

THE TOTAL RATE CONSTANTS OXIDATIVE POLYCONDENSATIONS OF ANILINE MONOMER WITH DIFFERENT CONTENT OF 2% OF PVA SOLUTION (peroksydysulfatu ammonium concentration of 0.1 mol / l.)

The concentration of aniline	$k_1 \times 10^3$, c^{-1}	$k_2 \times 10^3$, c^{-1}
0,01	4.23	11.87
0,025	4.35	11.95
0,05	6.65	13.87

Conclusions:

The obtained data indicate that changing the concentration of aniline in the reaction mixture can change the speed of the first and second process stage. The rate of oxidative polymerization will affect the nature of the polymer, which is used to produce the PPK. The resulting polymer-polymer composites have electrically conductive and film-forming properties.

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Medical waste management in the pandemic disease conditions

Anna Rolewicz-Kalińska

Faculty of Environmental Engineering,
Warsaw University of Technology, POLAND, Warsaw,
E-mail: anna_rolewicz-kalinska@is.pw.edu.pl

Abstract – ***This paper focuses on the risk for medical waste management system in terms an outbreak of pandemic disease.It analyzes the most important properties of infectious medical waste and recognizes the main risks. In addition, an attempt was made to identify the key linkages between the increasing the number of cases and risks associated with infectious medical waste stream.***

Key words – healthcare waste, medical waste, infectious waste, pandemics, waste management.

I. Introduction

For few years it has been observed an increasing interest in security issues. This is mainly a result of increasingly emerging threats of various type and intensity ¬ natural disasters, pandemic diseases and terrorist attacks. It is implicated to different systems and environments. Healthcare activities can lead to the generation of waste that might be infectious (or hazardous in other way) and cause effects on human health and on the environment. Medical waste, due to the where they arise and potential infectious properties, are among the most troublesome and dangerous waste groups. According to the World Health Organization (WHO), more than 23 million infections, hepatitis B and C and HIV in hospitals is caused by a worn needle-stick injuries [1]. This is just one of many risks associated with hospital waste management, however, it shows how serious the risk might entail improper handling of this specific group of waste.

II. Infectious medical waste

Infectious medical waste were considered particularly dangerous and require very careful handling [2][3]. They are also the biggest source of risk in the system of medical waste management. What is the definition of infectious waste? To define infectious waste, it is necessary first to define medical waste. Medical waste is all waste resulting from medical procedures (performed by doctors and nurses) and from research in the field of medicine [4]. In practice, it is assumed that potentially infectious are all waste that have been in contact with the tissues and body fluids of people (including tissues and fluids themselves) [1], [3]. At the legal level, the definition of medical waste, including infectious waste, is usually contained in legislation or in internal policy documents/guidelines applicable in each country.

Based on the guidelines of the WHO [1], among infectious medical waste can be divided into the following groups: anatomical waste (parts of the body), infected needles and sharps, materials from laboratory work, waste from surgery and autopsies of patients with infectious diseases (eg. Textiles, equipment that came into contact with blood or body fluids); residues from infectious patients and waste from dialysis.

Infectious waste cause risks associated with expousure for all kinds of pathogenic microorganisms. Some pathogens have the ability to live on inanimate surfaces for weeks or even months (table 1).

TABLE 1

THE ABILITY OF SURVIVAL OF SELECTED PATHOGENS [5]

Infectious agent	Observed survival time
HBV	– few weeks on the surface with dry air – one week on the surface at 25°C – several weeks in dried blood – 10 h at 60°C – experiencing a 70% ethanol
Infectious dose of HBV or HCV	one week in dried blood in the needle for injection
HCV	seven days in blood at 4°C
HIV	– deactivation in 56°C – survive 15 minutes in 70% ethanol – survive 21 days in 2 ml of blood in ambient temperature – drying reduces virus concentration of 90-99% for the next few hours

This threat applies in particular to people who have direct contact with the waste – patients, medical staff, technical staff in yhospoital and staff from companies engaged in waste disposal.

Infections associated with medical waste management come mainly as a result of uncontrolled cuts, stings or abrasions, that as a result cause contact of human blood with disease pathogen [6]. Particularly dangerous are waste contaminated with blood and body fluids, *eg.* used needles and surgical tools. Infection rates depends largely on the type of pathogen, the depth of puncture, the blood volume, the stage of infection to the patient, and the effectiveness of post-exposure procedures [3]. The probability of infection after a needle stick injury infected estimated as follows [7]:

- hepatitis B – risk level 6-30%;
- hepatitis C ¬ risk level 2-7%;
- human immunodeficiency virus HIV – risk level 0.3 –0.5%.

Potentially infectious waste are produced in all surgeries, treatment rooms, hospital wards and all kinds of institutions related to health care (hospices, blood bonation centers, dialysis centers etc.) [8].

III. Risk of a pandemics

Over the past 20 years in the world there were diagnosed cases of more than 30 new diseases (including eg. SARS and new types of avian and swine flu) [9]. Analyzing the possibility of epidemics and pandemics, due to the high risk for human health and life, there are taken into account very dangerous infectious diseases (bacterial and viral) [10][11], such as:

- bacterial: anthrax bacillus, Mycobacterium tuberculosis, Corynebacterium diphtheriae, Bordetella pertussis, Legionella bacillus, cholera, spirochete Borrelia, Yersinia pestis;

- viral: virus smallpox virus, hepatitis C virus, HIV, rabies virus, influenza virus, hemorrhagic fevers: yellow fever, Hantaan, Q, Ebola, Marburg and Lassa.

Due to globalization of life on our planet, health problems upward in one country can become problems around the globe and lead to epidemic and pandemic attacks, and thus to the rapid increase in the number of cases and hospitalizations[12]. One can distinguish the following factors facilitating outbreaks of pandemics[13]:

- global nature of transport and food trade;
- common traveling (for tourist, business);
- migration of population;
- natural disasters;
- new pathogens and diseases (including zoonotic);
- sexually transmitted diseases;
- the risk of a terrorist attack using biological agent.

Most of the dangerous infectious diseases requires treatment in hospital, some in intensive care units. Regarding the fact that the amount of medical waste generated is closely related to the number of medical services, rapid increase in of cases can lead to overload the medical waste management system. An additional problem is the way the classification of medical waste in terms of epidemic and pandemic diseases; in this case, normal procedures for classification may be insufficient to ensure the sanitary and epidemiological safety. In case of a pandemic diseases it can be expected threats to the functioning of the medical waste management system, due to:

- overload of healthcare system due to increased number of: cases, deaths and patients in intensive care units,
- lack of medical staff;
- not infectious waste may become infectious;
- availability of capacity for disposal of medical waste may not be sufficient;
- increase of costs of health care units.

Conclusion

The outbreak of infectious disease on the scale of the pandemics represents a real risk in these days of intensive migration of the population. Such situation, especially particularly if applicable to certain dangerous illnesses, can cause sudden overload of health care facilities and rapid increase in provided medical services. For this reason medical waste management system, which is directly affected by the amount of provided health services, should include procedures related to the occurrence of an pandemic infectious disease. It is one of the challenges in the medical waste management, because now spreads of a pandemics are not analyzed in the context of infectious waste. Developing plans and procedures for dealing with infectious waste in cases of extreme conditions, is necessary to ensure the sanitary safety and the stability of both, health and waste management systems.

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Peculiarities of hydrogel – polyamide composition membranes formation

GalynaYatsulchak[1], Mariia Komyshna[2], Yuriy Melnyk[3]

[1]Department of Chemical Technology of Plastics Processing, Post Graduate, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: galya.yatsulchak@gmail.com

[2]Department of Chemical Technology of Plastics Processing, Student, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: komishnamariam@mail.ru

[3]Department of Chemical Technology of Plastics Processing, Senior Scientific Worker, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: jjmelnyk@ukr.net

Absract – Quality composition of the subphase for modification of hydrogel membranes by ultra thin polyamide layer is selected. It was designed the laboratory appliance which allows applying the surface layer of polyamide by direct contact of the hydrogel film with a thin layer of modifying solution. The compositional film membranes based on hydroxyethyl methacrylate cross-linking copolymers with polyvinylpyrrolidone and aliphatic polyamide are obtained.

Key words – hydrogels, polyvinylpyrrolidone, polyamide-6, modification solution, subphase, compositional film membranes.

I. Introduction

Modern development of membrane technologies requires the creation of new polymer membranes, which in turn stimulates the development of technological methods for various membrane materials combining their component layers to improve functional properties.. Composite membranes preferably consist of several successive layers, each of which provides certain options filtration process or as a composite whole [1]. Hydrogel membranes are characterized by good permeability, but the lack of strength, which narrows the scope of their use. It is therefore gaining increasing importance to solve the problem of strengthening hydrogel tapes by modifying the surface layers of reinforcing material, the ability to maintain separation of hydrogel membranes and improve their physical and chemical properties. The preparation of such membranes will use them under increased pressure, particularly in the process of ultrafiltration or hemodialysis. Polymer hydrogels are macromolecular hydrophilic stitched systems that are capable of absorbing large quantities of water, while maintaining the properties of solids. Hydrogel materials along with hydrophobic properties and high compatibility with biological tissues must own and other target properties such as permeability, mechanical strength of the material in the hydrated state, etc. [2]. Combining in one material these properties can create unique polymer products, including new membrane materials of medical and biological purposes. These objectives can be achieved through the creation of composite materials. The method of modifying the application of solutions from the surface of the liquid phase allows obtaining composite membranes with ultrathin coatings on porous matrix.

II. Result and Discussion

As a basis for forming composite membranes used hydrogel membrane film obtained by polymerization using compositions based on aqueous solutions of HEMA with PVP [2]. Previous studies by solution composition for forming permeable polyamide ultrathin tapes [3]. These solutions consist of mixtures of polyamide-6 and PVP solvent system based on aqueous solutions of formic acid (HCOOH). Inert liquid phase (phase sub) prepared from a mixture of cyclohexane (C_6H_{12}) and carbon tetrachloride (CCl_4).

Physical and mechanical properties of synthesized tapes composite membranes in hydrated state determined by breakthrough film attached to the annular clamps, under the pin indenter the developed methodology [2]. Pellicle membrane permeability measured in dynamic mode using laboratory dialyzer during dialysis aqueous solutions of model substances (sodium chloride) for developed methodology [4]. To obtain composite membranes were chosen method of deposition of ultrathin polyamide tapes on the surface of the water-containing hydrogel. This polyamide layer firmly kept on the surface of the hydrogel due to physical interaction related polymer substrate and the surface modifying layer. Cut the selected method is applied in thin films on a solid substrate surface with a liquid phase. Liquid phase allows modifying solution spread about on the surface, forming a uniform layer of a thin tapes. To ensure the spreading of such a modified solution should have a lower density than subphase not dissolve and do not interact with it.

Having regard to modifying the composition of solutions based on formic acid solutions and mixtures PA–PVP as inert liquid phase was chosen mixture of cyclohexane and carbon tetrachloride, which are infinitely mixed together. Cyclohexane does not react with any component modifying solution, but has a low density and CCl_4, in turn, the high density insoluble and does not react with water [5,6] and polyamide-6 (PA-6) [7] but it is partially soluble PVP in an amount of less than 1% [8] and formic acid is less than 3% [5].

Neat quantitative composition of the liquid phase consisting of a mixture of cyclohexane and carbon tetrachloride containing the last above 60% vol., Allowing it to spread surface modifying solutions based on mixtures of PA-6–PVP in the solvent system: HCOOH–H_2O. Titration studies found that a composition subphase provides its minimal physical interaction with components modifying solution. Research the liquid organic phase of formic acid was carried out at the maximum of their contact, which reached intense stirring in contact and at the phase boundary - when carefully poured acid on the surface of the liquid subphase without additional mixing. Established that the solubility of formic acid significantly depends on the contact interface. Intensive phase dispersion leads to the formation of emulsions formic acid in the organic phase, which

eventually splits and content of formic acid in subphase eventually decreases. For contact at the phase boundary HCOOH – subphase, the amount of acid increases due not significant acid solubility in solvents but not exceeding 0,5%.

To form the composite hydrogel membrane we developed a laboratory setting (Fig. 1), in which the location of the drive drum in the bath liquid (subphase) equipped with barrier allows the hydrogel coating on the surface of the film subphase, and the presence of the drying chamber allows control mode drying and forming a composite film.

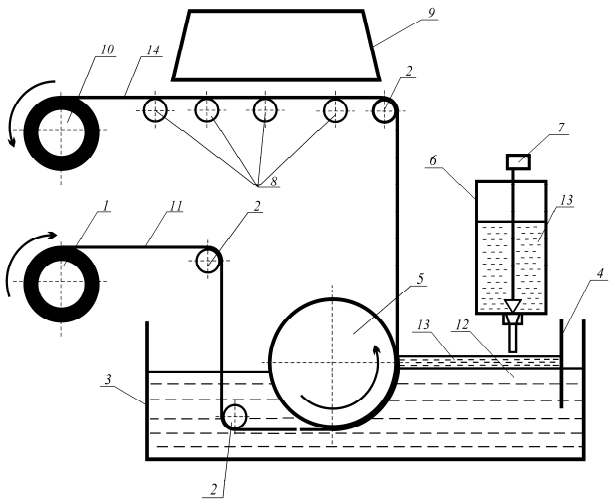

Fig. 1. Scheme of laboratory setup for forming composite hydrogel membranes

To form the composite films spool with hydrogel film set in a knot unwinding *1*, and the free end of the film rounding all components of the installation, including a guide roller *2*, drive drum *5*, which is located across the width tub *3*, guide roller *2* and backing roller *8* and fixed winding *10* in the node. Bath *3* filled with liquid (subphase) *12*. On the surface subphase *12* located between the driven drum *5* and four barrier with reservoirs feed *6* to measured out polymer solution *13* and *4* moving barrier set its thickness. Turned on hydrogel patei unwinding unit *1*, the drive drum *5*, the composite film winding unit *10*, the drying chamber *9*. Hydrogel pates *11* via guide rollers *2* moved through the liquid subfazu *12* rounding drive drum 5 and the output of subphase contact with the modifying solution *13* is deposited on its surface, rounds guide roller *2* and moved on supporting rollers *8* through the drying chamber *9*, where the solvent evaporates at a temperature of 75-80 ^{o}C and composite films formed in a hydrated state at *14* winded bobbin winder in the node *10*.

With this method of deposition of ultra-thin film held firmly on the surface of the hydrogel due to physical interaction related polymer substrate and the surface modifying layer.

Research has established that strength at break of the obtained composite membrane in the hydrated state can be forwarded to regulate within 0,2-1,1 MPa, thus changing their relative elongation at break in the range of 90...300%. Determined that according to the composition and technological parameters of forming synthesized composite membranes characterized permeability coefficient for sodium chloride $(0,3\text{-}2,3)\cdot 10^{4}$ $mol\cdot m^{-2}\cdot hr^{-1}$.

Conclusion

So we worked out the technology, design and installation subphase composition chosen for forming composite polymer membrane lining in the form of hydrogel layer coated on one side reinforced polyamide ultra-permeable layer. Research has established that obtained using the proposed method hydrogel-polyamide composite membrane characterized by increased strength compared to the hydrogel matrix and adjustable selective permeability, which are determined by the composition of the mixture PA−PVP, its concentration in the solution and modifying the temperature and time parameters forming.

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Effect of heat treatment on brewer's yeast fermentation activity

Tetiana Kharandiuk, Ruslana Kosiv, Liubov Palianytsia, Natalia Berezovska

Technology of Organic Products Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, Email: tetyanakharandyuk@gmail.com

Absract – The influence of temperature treatment of brewer's yeast strain Saflager W-34/70 at temperatures of -17, 20, 25, 30, 35, 40 °C on their fermentative activity was studied. It was established that the freezing of yeast leads to a decrease of fermentation activity in directly proportional to the duration way. Fermentative activity of yeast samples can be increased by 20-24% by heat treatment at 35 °C during 15-30 minutes.

Key words – high gravity brewing; brewing yeast; heat treatment.

I. Introduction

Development of new and improvement of existing technologies aimed at intensification of alcoholic fermentation, reducing losses of raw material, reduction of cost and thermal power resources are important tasks of the brewing industry.

New and promising technology is high gravity brewing which is fermentation of highly concentrated wort with it's subsequent conditioning. However, a high solids content in the wort leads to a decrease in the rate of alcohol fermentation.

To implement the above benefits, number of conditions of the production must be followed, particularly during the fermentation process. Fermentation and maturation of beer wort should not last longer than in traditional technology, because otherwise there will not be obtained the desired economic effect. And this can be achieved only if there is an optimal composition of the wort, optimal conditions of aeration and the availability of highly active viable yeasts [1].

In high gravity brewing fermentation of wort is usually occurs in cylinder-conical fermentation apparatuses. This process is accompanied by a hydrostatic pressure on cells and a high concentration of carbon dioxide, ethanol and other metabolites which are accumulated at the end of the main fermentation, that can reduce the final rate of wort fermentation.

Task of technologist - reverse the negative impact of the aforementioned factors [2]. One way of solving the problems of high gravity brewing technology is activation of yeasts. For this purpose, various factors influence may be used, in particular physical methods of influence on the metabolism of yeast cells, including pressure, temperature, treatment in a magnetic field UHF waves, laser, ultraviolet rays and ultrasound [3-5].

Temperature has a significant impact on the energy and constructive exchange of cells, specific growth rate of the yeast and generation length. The shock of heat occurs in yeast for short-term rise in temperature to 37 ... 40 ° C. Thus, there is active synthesis of certain proteins, but in a few hours metabolism returns to normal [3].

It was established that the cells undergoing the effect of high temperatures, becoming not only heat resistance, but also alcohol and osmostolerant, which is especially important in high gravity brewing.

Previously, researchers reported on the stimulating effect of cooling the yeast to temperatures -17 ° C on their maltase activity [6]. The purpose of the work was to study the influence of temperature treatment and its duration on the fermentation activity of brewer's yeast.

II. Methods and research objects

The object of research was lager yeast strain Saflager W-34/70, which are used in European and national breweries. Yeasts were cultured in unhopped wort of 10% solids concentration at 25 °C in three stages. Yeast biomass was separated by centrifugation at 4000 rpm for 10 min.

Yeast fermentation activity was determined by Express method (modified Warburg method) [4]. Yeast samples were placed in Dry-air thermostat with a temperature of 20, 25, 30, 35 and 40 °C and a refrigerator with a temperature of -17 ° C for 5, 15, 30, 45 and 60 minutes. The future impact of temperature treatment on fermentation activity of yeast was studied in wort wih 16% solids content at 15 °C. Wort was concentrated by evaporation.

III. Research results

Fermentative activity of yeast is an important technological feature that determines the length of the main fermentation, physical and chemical properties of beer, its biological stability. In terms of the brewing industry as the seeding yeasts sedimented yeast are used up to 10-12 generations, which, after removal of the apparatus and washing them with cold water are stored for two days under water with a temperature of 1-2 °C. Longer storage leads to a decrease in fermentation activity.

Brewers experience shows that yeast seeding without preparation into cold wort are accompanied by a releasing of amino acids and nucleotides into the culture medium. As a result, their reproduction slows down or even stops, indicating a yeast sensitivity to temperature hopping.

The results showed that treatment of yeast at temperatures of 20, 25, 30 and 35 °C for 15 min. leading to increasing their fermentation activity (Fig. 1). The temperature of 40 °C is unfavorable because there is a significant loss of enzyme activity of yeast. The highest activity of yeast was achieved after treatment at 35 °C, which can be considered as optimal.

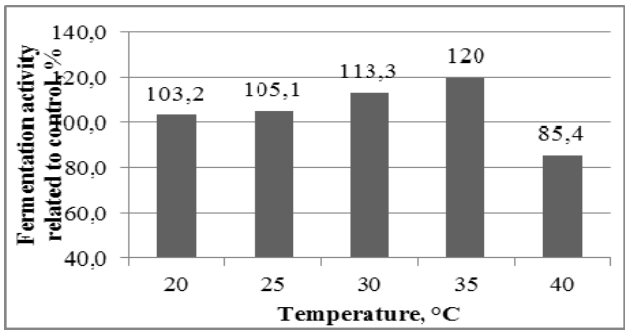

Fig. 1. Effect of treatment temperature on the fermentation activity of brewing yeast strain Saflager W-34/70

The effectiveness of heat treating of yeast depends not only on temperature but also on the duration of exposure. As a result, short-term increase in temperature of the yeast slurry to 35 °C caused the reduction of fermentation activity of the samples to 11% compared to control (Fig. 2), which correlated with previous studies. Instead, as a result of yeast holdig at this temperature for 15 and 30 minutes fermentation activity of samples increased relative to control in 19.6 and 24% respectively. With further increase in the duration of heat treatment of yeast activity decreases, which can be explained by cells autolysis (Fig. 2).

However, cooling the yeast slurry at -17 °C temperature adversely influences on this yeast strain. Fermentative activity decreases in proportion to the duration of the heat treatment (Fig. 2). This negative effect can be explained by the formation of frozen water crystals inside the cells, and consequently, their destruction.

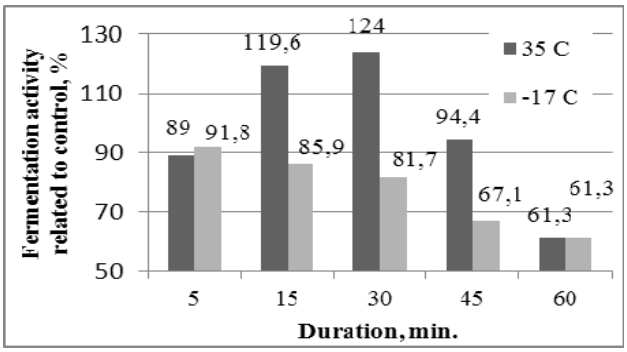

Fig. 2. Effect of heat treatment at 35 and -17 °C on the fermentation activity of brewing yeast strain Saflager W-34/70

Conclusion

Therefore, on the basis of the results it was found that treatment of yeast before fermentation at the optimum temperature of 35 °C for 15-30 minutes allows to achieve increase of fermentation activity at 20-24% relative to control. Freezing yeast at -17 °C adversely affects their fermentative activity directly proportional to the duration of the temperature treatment.

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The legal status of malleable- and functional signatures in light of Regulation (EU) No 910/2014

F. W. J. van Geelkerken,[1,3] H. C. Pöhls,[2] S. Fischer-Hübner[3]

[1]Swedish Institute for legal informatics, Stockholm University, Sweden, Stockholm, Universitetsvägen 10, SE-106 91, E-mail: franciskus.vangeelkerken@juridicum.su.se

[2]Institute for IT-Security and Security Law, Chair of IT-Security, University of Passau, Germany, Innstrasse 43, 94032 Passau, E-mail: hp@sec.uni-passau.de

[3]HumanIT, Karlstad University, Sweden, Karlstad, Universitetsgatan 2, SE-651 88, E-mail: simone.fischer-huebner@kau.se

Abstract – In this article, we analyse the legal status of malleable- and functional signatures in light of 910/2014/EU. Both these forms of signatures possess beneficial properties which already legally acknowledged signatures do not. Namely, they allow subsequent changes by authorised parties to for instance anonymise or remove personal data from signed documents. We conclude that the legal status of both these forms of electronic signatures is – depending on cryptographic properties of the malleable- or functional signature as well as the chosen signature-scheme – similar to that of a qualified electronic signature.

Key words – electronic signatures, digital signatures, verification, identification, malleable signature, functional signature, electronic identification, regulation no. 910/2014.

I. Introduction

In this article, we provide an overview of two 'classes' of cryptographic signature schemes, and determine their legal position in light of Regulation EU 910/2014 [1] (hereafter eIDAS). In general, the legal status for three different categories of electronic signatures was, from 19 January 2000 until 16 September 2014, regulated through Directive 1999/93/EC [2] (hereafter ESD). As of 1 July 2016 the ESD will become fully repealed by eIDAS.

To determine the legal status – at a European Union level – of more recently emerged cryptographic signatures such as malleable- and functional signatures, we first elaborate in section II on the legal definition and status of different categories of electronic signatures.

Thereafter, in sections III, we go over the technical details of respectively malleable- and functional signatures schemes,[2] to conclude with an overview of the key-differences between the different categories of electronic signatures already (explicitly) regulated and malleable- and functional signatures. Based on these key-differences, in section IV, the legal status of malleable- and functional signatures in light of effectual regulation at a European Union level will be determined.

II. The legal status of electronic signatures

It is possible to distinguish between three different categories of electronic signature (***ES***):

(1) Basic signatures (***BS***);
(2) Advanced signatures (***AS***); and
(3) Qualified signatures (***QS***).

Before expounding on these three categories, though, it is necessary to elaborate on three related terms of high importance. Based on respectively article 3 section 9, section 13, and section 22 eIDAS;

(1) Signatory means a natural person who creates an electronic signature;
(2) Electronic signature-creation data means unique data which is used by the signatory to create an electronic signature; and
(3) Electronic signature-creation device means configured software or hardware used to create an electronic signature.

As said, it is possible to distinguish between the following three different categories of **ES**s. The first, basic signatures (***BS****s*), are defined in Article 3 section 10 eIDAS as data that has to fulfil three requirements;

(1) The data needs to be in electronic form;
(2) The data needs to be attached to, or logically associated with, other electronic data; and
(3) That other electronic data needs to be used by the signatory to sign.

The second category, advanced electronic signatures (***AS****s*), are defined in article 3 section 11 j°. 26 eIDAS. The most notable difference to ***BS****s* is that additional requirements are put on the linking and the data used to create the signature. When combining the different requirements of these articles and the aforementioned definitions, an ***AS*** (in its barest essence) is a ***BS*** which additionally fulfils the following requirements:

(1) The ***BS*** is uniquely linked to signatory;
(2) The ***BS*** is capable of identifying the signatory;
(3) The ***BS*** is created using unique data that the signatory can, use under his sole control; and
(4) The ***BS*** is linked to the data to which it relates in such a manner that any subsequent change of the data is detectable.

The third category, Qualified electronic signatures (***QS****s*), are defined in article 3 section 12 eIDAS. Based on this article in conjunction with article 3 sections 10 and 11 eIDAS and article 26 eIDAS, a ***QS*** has to comply with six requirements. The first four are similar to that of an ***AS***, with the addition of the requirements that a ***QS*** is an ***AS*** which is;

(1) created by a qualified electronic signature creation device (***QD***); and

[2]his article will not go into too many of the cryptographic details; for more technical details and an overview of signatures see [3]; for an in-depth analysis of the legal evidentiary value of malleable signatures see [4].

(2) created using electronic signature-creation data based on a qualified certificate for electronic signatures (***QC***).

The requirements for a ***QC*** and ***QD*** are defined in Annex I and Annex II of the eIDAS. Seeing as these requirements are less relevant to the underlying research question, they will be not be elaborated on at this point. It is important to note though that based on article 25 section 1 eIDAS, *all* electronics signatures à priori have legal effect, are admissible in legal proceedings, and that a ***QS*** has the same legal effect as a handwritten signature.

To determine the legal status of two not yet specifically regulated forms of electronic signatures respectively malleable- and functional signatures schemes will be elaborated on hereafter.

III. Malleable electronic signature scheme

A malleable signature-scheme can be defined as;

> *A digital signature scheme with an additional function whereby, on input of message (**m**) and signature (σ), it is possible to efficiently compute derived signature (**σ'**) on an altered message (**m'**) for transformation (**T**) that has been allowed with respect to the message (**m**) and the signature (σ), i.e.* **(m' = T(m))**.[3]

As such, when an ***MS*** is used by the Signer[4] to sign a message, this message can subsequently be altered by the Sanitizer[5] within the scope predefined by the Signer's provided transformation without invalidating the original electronic signature. ***MS****s* are of great use, because cryptographic schemes make it possible to prove that if the transform ***T*** removes or changes information, such that the information – previously contained in ***m*** – is no longer contained in ***m'***, then the information originally in ***m*** cannot be reconstructed from ***m'*** and ***σ'***. For ***MS****s* this property is cryptographically well-known as privacy.[6]

As an ***MS*** is in electronic form, is attached to, or logically associated with, other electronic data (the document to sign), and electronic data (the Signer's key) is used by the signatory to sign, no elaboration is necessary to conclude that a malleable signature is a ***BS*** ex article 3 section 10 eIDAS. Hereafter, ***MS****s* and their characteristics will be analysed to assess whether they (can) fulfil the requirements of – and can be qualified as – an ***AS*** or ***QS***. The reason for this interest is that only the ***QS*** awards some additional legal value following from the statement that a ***QS*** is equivalent to a handwritten signature. Note, that neither eIDAS nor EDS endorse any further legal value of a ***QS***, it is left to member states' individual legal texts to assign these in each specific legal circumstance.

Can an *MS* be qualified as an *AS*?

To be able to conclude that an ***MS*** can be qualified as an ***AS***, an ***MS*** has to fulfil all the requirements the eIDAS prescribes for an ***AS***. As stated, a ***BS*** has to fulfil four requirements to be qualified an ***AS***. The first three requirements can be fulfilled with the aid of asymmetric cryptography, whereby the signature generation key (***sk***) can be kept secret and under sole control and the verification key (***pk***) can be made public. To achieve the linkage and the identification function public key infrastructures (PKI) – that are currently already in place – can be facilitated. This means that whenever an ***MS*** can be instantiated with a signature algorithm for the Signer's signature that is legally established and for which the keys are hence compatible with the already deployed public key certificates,[7] the existing trust infrastructure can be facilitated.[8]

An ***MS*** based on a cryptographic signature algorithm which is legally accepted naturally fulfils the requirement of the Signer's initial signature being created using unique signature creation data.

Next to that, the signatory can keep these unique signature creation data under his sole control, and thus the signature created by the ***MS*** is both uniquely linked to- and capable of identifying the signatory.

It can therefore be concluded that an ***MS*** complies with the first three of the four requirements laid down in article 3 section 11 j°. 26 eIDAS. Compliance with the fourth and last requirement (the ***ES*** is linked to the data to which it relates in such a manner that any subsequent change of the data is detectable) might, however, appear to pose a problem seeing as an ***MS***-scheme is specifically used to make it possible for a Sanitizer to alter the message <u>after</u> it has been signed. In general, this does, however, not mean that such a change would not be detectable. In general verification yields:

Sign $(m,scope,sk) = \sigma$	**Sign** $(m,sk) = \sigma$
	Sanit $(m,\sigma,change) = (m'_{[scope]},\sigma')$
Verify (m,σ,pk) **= True**	**Verify** $(m'_{[scope]},\sigma',pk)$ **= True**
Situation 1: Unchanged.	Situation 2: Changed within scope.

The verification of a signature created by an ***MS*** scheme only yields true if the public key ***pk*** corresponds to the secret signature generation key (***sk***) and only in the following two situations; (1) the message ***m*** and its signature ***σ*** remain unaltered; or (2) the message has been altered within the predefined scope into $m'_{[scope]}$, and a derived signature ***σ'*** has been computed[9]. If the original message is transformed by any third party beyond the

[3] Derived from [5]

[4] Hereafter the term Signer is used to refer to the initial signatory mandating a Sanitizer to sign on its behalf.

[5] We use the original work's American spelling to stay close to the existing body of technical work, in 2003 the term Sanitizer first occurred [6].

[6] Not to be confused with the legal term privacy.

[7] Technically the format is also known as X.509

[8] For examples of ***MS*** schemes which were designed with this in mind, see [7].

[9] The calculation of that derived signature is done by an algorithm denoted usually as ***Sanitize*** or ***Sanit***, whereby it should be noted that the ***Sanitize*** algorithm does not require the Signer's secret signature generation key as input.

scope (altered into $m'_{[non\text{-}scope]}$) no valid signature can be derived and the verification will yield:

$$\textbf{Verify } (m'_{[non\text{-}scope]}, \sigma, pk) = \textbf{False}^{10}.$$

In general, an ***MS*** does not differentiate between situation 1 and 2 and returns valid. For legal compliance, however, the detectability of a modification must hold true regardless of the change being authorised or unauthorised, as the eIDAS clearly states "*any subsequent change*".[11] Hence, we need to be able to verify an ***MS*** and get the following three results:

(1) Valid and unmodified (***MS*** created by the Signer),
(2) Valid and modified in authorised way (derived signature correctly computed by Sanitizer), or
(3) Invalid (***MS*** does not verify, indicating malicious or erroneous corruption).

Hence, if there are authorised changes[12] the signature verification must flag the document as containing changes subsequent to signing.[13] This form of triple detectability can be achieved if the ***MS*** offers a cryptographic property called non-interactive public accountability.[14] Moreover, it is important to note that in an ***MS***-scheme the derived signature (***σ'***) still verifies under the Signer's public key. As long as the changes after signing (and any subsequent changes) were within the authorised scope the Signer is still identifiable by the Verifier as the signatory for any validly derived message. If the scheme is public non-interactive accountable this can be done in the same manner as a regular ***AS*** signature verification, requiring only the Signer's public key (***pk***).

In summary, a non-interactive public accountable malleable signature that builds on a signature-scheme allowing the linking of public signature verification keys to the signatory fulfils all four criteria of article 3 section 11 j°. article 26 eIDAS. This means in light of the eIDAS an ***MS*** is an ***AS***, and the legal position of an ***MS*** is the same as that of an ***AS***.

[10] The same applies for the situation where the signature is altered, but the same (unaltered) message is signed, or for the situation where both the signature and the message are altered, i.e.**Verify (*m, σ'[non-scope], pk*)= False** and **Verify (*m'[non-scope], σ'[non-scope], pk*)= False**

[11] There are differences in the level of detectability in technical algorithms, as well as in technical definitions of the protection goal of Integrity, for more see [4] and also [8].

[12] Or technically only if the signature was derived by ***Sanit***, to keep the cryptographic property of privacy as argued for in [4], [7], and [8].

[13] This is one of the central results obtained by Henrich C. Pöhls in his PhD. thesis, see [4].

[14] An ***MS*** satisfies non-interactive public accountability, if and only if, given a valid message and a signature over the message, a third party can correctly decide whether the message-signature pair originates from the Signer or from the Sanitizer without interacting with the Signer or Sanitizer, i.e. just from using public knowledge of the message, the signature and the Signer's (or the Sanitizer's) public signature verification key.[4]

Can an *MS* be qualified as a *QS*?

To assess whether an ***MS*** can be qualified as a ***QS***, it is necessary to evaluate whether an ***MS*** complies with the aforementioned six requirements of a ***QS***.

Seeing as we concluded in the previous section that an ***MS*** can be qualified as an ***AS***, ***MS***s comply with the first four requirements of a ***QS***. It is therefore only necessary to assess whether it is possible to create an ***MS*** based on a qualified certificate for electronic signatures (***QC***) using a qualified electronic signature creation device (***QD***).

As follows from Annex I to the eIDAS a ***QC*** has to comply with ten requirements, and none of these requirements pose more of a problem in the case of ***MS***s when compared to other forms of ***ES***s. Especially not if the underlying signature scheme, and with it the keys, is equivalent to a legally accepted scheme. It can therefore be concluded it is just as possible to create an ***MS*** based on a ***QC*** as it is to create any other ***ES*** based on a ***QC***.

Annex II to the eIDAS consists of four articles in relation to ***QD***. Article 1 contains technical requirements a ***QD*** has to comply with, and these should, similar to the requirements a ***QC*** has to comply with, not pose more of a problem in the case of ***MS***s when compared to other forms of ***ES***s; as such this requirement will not be elaborated on. Article 3 states that only a qualified trust service provider may generate or manage electronic signature creation data. Because this provision is irrelevant to the question whether an ***MS*** can be qualified as a ***QS*** this provision will not be elaborated on. Article 4 states that qualified trust service providers may only duplicate the electronic signature creation data for back-up purposes under specific conditions. Because this provision, like article 3, is irrelevant for answering whether an ***MS*** can be qualified as a ***QS*** this provision will not be elaborated on either.

The second article of Annex II eIDAS is highly relevant for the question whether an ***MS*** can be qualified as a ***QS***, and thus what the legal position is of an **MS**, as it reads;

> *[**QD**s] shall not alter the data to be signed or prevent such data from being presented to the signatory prior to signing.*

As such, in essence, a ***QD*** has to fulfil two requirements;

(1) A ***QD*** should not alter the contents of the data to be signed prior to signing;[15] and
(2) A ***QD*** should not make it impossible to show the data to the signatory prior to signing.[16]

In [9] it is stated that the problem of not knowing / showing all possible derivations of a document signed by an ***MS*** would prevent an ***MS*** from being qualified as a ***QS***. After consulting these authors it became clear though

[15] A qualified electronic signature creation device can in that sense be likened to an automated postage meter or franking machine, the application of postage or franking to an envelope does not alter the contents of the envelope.

[16] As such, based on the previously used analogy, the signatory can verify that the contents of the envelope were not altered by the application of postage or franking.

that their conclusion is based on a very limited and strict interpretation of German legislative texts that requires electronic signatures to be functionally equivalent to handwritten ones and lists those functions.[17] Under a strict grammatical interpretation the ***MS*** could therefore neither fulfil the *Abschlussfunktion* (conclusory function) nor the *Perpetuierungs- oder Integritäts-funktion* (archiving or integrity function). The argument for their conclusion was that the ***MS*** during signature generation will not be able to present to the signatory all the different versions it might have after subsequent authorised changes.

In forthcoming follow up work of one of the authors the reasoning is, however, less strict by arguing that an ***MS*** can be treated as a blanket statement.[18] It is thus, not a problem that the ***MS*** by its design leaves room for many versions – potentially too many to display – of the signed document. While the technical details may matter for legal questions regarding e.g. liability, technically the ***QD*** does not prohibit the showing of the various iterations.

The last requirement which needs to be fulfilled is that an ***MS*** can be created by a ***QD***. In fact in [10] it was shown that certain ***MS*** (including [7]) can be executed in such a way that the secret signature generation data never leaves a smartcard, which is technically recognised as a ***QD***. Hence it is possible to generate ***MS***s using ***QD***s. As long as the modifications by the third party take place within the predefined authorised scope, verification will yield valid:

$$\textbf{Verify } (m'_{[scope]}, \sigma'_{[scope]}, \text{pk}) = \textbf{True}$$

Once the Signer has created a valid signature using an ***MS***, any authorised alteration or modification of the contents does not need the Signer's secret signature-creation data to generate the σ', which means the (altered) data does not need to be shown to the signatory again nor does it involve the use of the signatories ***QD***. But, if the modification of the contents exceeds the predefined authorised scope, verification will logically yield invalid:

$$\textbf{Verify } (m'_{[scope]}, \sigma'_{[scope]}, \text{pk}) = \textbf{False}$$

In case of an invalid signature, i.e. verification yields False, the invalid signature does not increase the legal value of the document.

Seeing as neither the requirements for a ***QC*** nor the requirements for a ***QD*** pose a problem in light of an ***MS***-scheme, it is possible to conclude that the legal position of an ***MS*** is the same as that of a ***QS***[19] if the following conditions are met:

(1) The ***MS*** offers non-interactive public accountability,
(2) A legally accepted cryptographic asymmetric digital signature scheme for the Signer's signature is used,
(3) A qualified certificate for the Signer's public key exists, and
(4) The execution of all algorithms involving the Signer's secret signature creation data is computed inside a ***QD.***

IV. Functional electronic signature scheme

Unsurprisingly, a functional electronic signature-scheme relies on the use of a functional signature (***FS***). In short an ***FS***-scheme works based on a key pair consisting of a secret master key (***sk***) to sign messages with and a public key (***pk***) to verify these signed messages. The ***sk*** can be used to sign any message with, and the signatory can derive a separate signing key for a specific task or function (sk_f). This separate signing key (sk_f) the Signer can hand over to any third party so that this party can perform a specific task or function (***f***) on the message (***m***) on behalf of the signatory. With the sk_f the third party can generate a valid signature after transforming the original message. The following overly simplified equation captures that functionality;

$$\textbf{Sign } (f(m), sk_f) \rightarrow \sigma.$$

A valid signature is only created when $\mathbf{sk}_f$ is used to sign a message within the predefined function's image, i.e. the output of ***f***. For a cryptographic overview on ***FS*** see [3]. Therefore, when either ***f(m)*** or ***m*** is verified it yields;

$$\textbf{Verify } (m,\sigma,pk) = \textbf{True} \text{ and } \textbf{Verify } (f(m),\sigma,pk) = \textbf{True}.$$

Whereby it is important to note that the latter equation holds true if, and only if, the third party did not exceed the scope, defined by the function ***f*** and the input ***m*** to that function, it was authorised to sign by the signatory. The use of an ***FS***-scheme does not pose too many problems in light of the eIDAS as the term signatory is, as stated before, defined in article 3 section 9 eIDAS as;

A natural person who creates an electronic signature.

In essence this definition states that a signatory is a person who can create <u>any</u> form of electronic signature, i.e. a ***BS***,

[17] See for example *Deutscher Bundestag*. Drucksache 14/4987, Dec. 2000 (German only).

[18] Blanket statements are underspecified statements, similar to blank cheques. Legally, you are allowed to leave certain fields underspecified or empty, allowing them to be filled with information later. From [4]: In German law it is found that if a blanket statement is done in a consented way, any specific information filled in later is attributed to the original signatory of the blanket statement, see BGH 11 July 1963 – VII ZR 120/62, 1963 (German only).

[19] This conclusion – an ***MS*** can be qualified as a ***QS*** – is not affected if one can identify the Sanitizer and hold the Sanitizer accountable as an individual party. See [3] and [4] for different classes of malleable signature schemes: redactable signature schemes (RSS) allowing for public subsequent erasure of signed data, and sanitizable signature schemes (SSS) allowing for subsequent changes but only by specified Sanitizers. See also very recent work on accountable RSS [11].

AS, ***QS***, ***MS***, or ***FS***, either on his own behalf or on behalf of a person or entity he represents.[20] And as an ***FS*** is in electronic form, is attached to, or logically associated with, other electronic data, and is used by the signatory to sign, it can be concluded that a ***FS*** is an ***ES***.

Can an *FS* be qualified as either an *AS* or *QS*?

To determine whether an ***FS*** can be qualified as either an ***AS*** or a ***QS***, it is important to point out that an ***FS*** is, in principle, the same as any other electronic signature, except for the fact that;

(1) instead of using a ***sk*** the signatory (i.e. the third party) uses $\boldsymbol{sk_f}$ to create $\boldsymbol{\sigma}$; and

(2) instead of being able to sign any ***m*** the third party is only authorised to sign a predefined function of ***m*** on behalf of the principal.

Because the four requirements an ***ES*** has to comply with to be qualified as an ***AS*** neither contain requirements regarding the signature key, nor contains requirements regarding the scope of the authorisation the signatory has to sign, it can be concluded that an ***FS*** can be qualified as an ***AS***. Regarding the need to know all derivations c.q. iterations of the message at the time of signature creation, the same arguments as for ***MS***s**,** and the same arguments for blanket statements, apply.

Similarly, because the additional two requirements an ***ES*** has to comply with to be qualified as a ***QS*** (next to the first four which make it possible to qualify ***FS*** as an ***AS***) do not contain a requirement regarding either the signature key or the scope of the authorisation the signatory has to sign, it can be concluded that an ***FS*** can be qualified as a ***QS*** if it can be shown to be able to have the signature creation data inside a smartcard or other suitable ***QD***.

Because the third party is always identifiable,[21] if the legal status of the $\boldsymbol{sk_f}$ in relation to the third party is similar to, or the same as, the legal status of a "normal" signature in an ***FS***-scheme with respect to the Signer, it can fulfil the requirements of both an ***AS*** and a ***QS***.

In sum, an ***FS***-scheme complies with all of the six aforementioned requirements for a ***QS*** because the third party to whom the principal provides the $\boldsymbol{sk_f}$ is always identifiable which means the third party is the (mandated) signatory representing the principal.

[20] Despite the rephrasing of the definition in the eIDAS, similar to the (old) article 2 section 3 ESD, under the eIDAS a signatory can act either on his own behalf or on behalf of a person he represents.

[21] Seeing as the principal derives **sk*f*** from **sk** for a specific task or function and for a specific party, this party is always identifiable. If the third party hands over the **sk*f*** to another party who signs any message with it, the third party is considered the signatory and the third party will be liable for any damages which might arise from an alteration of the message beyond the predefined scope.

Conclusion

The legal standing of malleable signatures (***MS***s) has been analysed in light of Regulation EU 910/2014 (eIDAS), the latest signature legislation at an EU level. We assessed whether they can be qualified as qualified electronic signatures (***QS***). Qualification as a ***QS*** is the highest level of assurance awarded by the eIDAS after meeting six requirements. It gives the document with the ***QS*** the same legal standing as a document signed with a handwritten signature and it cannot be denied legal effect in legal proceedings.

An ***MS*** – in form of the signatory's original signature or in the form of derived signature generated by the authorised third party – can be qualified as a ***QS***, as codified in article 3 section 12 j^{o}. 3 section 11 j^{o}. 26 eIDAS, if the ***MS*** has certain cryptographic properties.

Apart from standard cryptographic security properties, like unforgeability, in particular the cryptographic property of public non-interactive accountability allows the cryptographic verification of an ***MS*** to technically function like existing legally well recognised digital signature algorithms, such as RSA with SHA2, and be based on existing public key certification infrastructures.

The factual value of this malleably signed document is determined by the specific circumstances of the case and the applicable legislation, as well as the evidentiary value attributed to signed documents based on this legislation, of an individual EU Member State.

It should be pointed out that allowing any party to subsequently modify certain well-definable parts of the signed document might aid usability, this does, however, complicate assigning liability to the Sanitizer. Therefore, we advise using ***MS***s which allow identifying the Sanitizer by its derived signature and are designed to comply with the requirements for a ***QS***, as this makes it possible to hold the Sanitizer technically accountable and legally liable for any modifications which might occur subsequent to the signing by the Signer.

The same line of argument is applicable with regard to the legal status of functional signatures (***FS***s). As such, ***FS***s can – if they contain specific cryptographic properties like public non-interactive accountability – be qualified as ***QS***s in the sense of article 3 section 12 j^{o}. 3 section 11 j^{o}. 26 eIDAS.

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The problem of training school psychologists at the University

Oksana Binas

Department of Theoretical and Practical Psychology ,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: binas.oksana@ukr.net

Abstract – our research is devoted to the professional competences of psychologists in Ukraine. As it turned out, there is no official standarts for this qualification. Therefore, analyzing the international experience, we disscuss the possibility of professional competences as to school psychologists.

Key words – school psychologist, competence, skills, American students, personality traits .

I. Introduction

For about two decades our universities have been preparing and producing psychologists, most of them employed in the education system. Since the early 90s of the last century the departments of psychology have been opened in many high schools and faculties because of the sharp increase in demand for practical psychologists. According to V. Bochelyuk and V. Zarytska [6], today the 36 traditional universities, 20 pedagogical universities, 30 non-governmental institutions and 15 technical universities are preparing psychologists. But can we say that this training is effective? What competences can the universities give and cannot? To make this question clear we decided to analyze and compare the requirements for the competencies that are expected from psychologists at the Western universities, including the universities of the USA, and Ukrainian.

II. Theoretical analysis of problem

First of all, it should be noted, what the concept of "competence"includes. So competence - is: 1) a set of knowledge, skills and attitudes that allow the individual to act effectively or perform certain functions to achieve certain standards in a particular industry or professional activity; 2) the ability to mobilize a particular situation knowledge and experience with regard to external circumstances; 3) the ability to apply knowledge and skills effectively and creatively to solve problems in their professional activities; 4) ability to operate efficiently, perform a task or work [4].

Competencies include everything that a person is able to learn, observe, measure, receive and practically applied, be flexible and be retrained as necessary.

According to the American Association of psychologists in an effort to move forward psychology in connection with the assessment of competence, provides the principles under which it is important that competence is positioned as a total, holistic development abilities [5].

In the 1920s the term "competence" was based on evaluation of features and approaches for prediction of human behavior. Also nowadays is made description of educational and training requirements is based on competencies for students, graduates, trainees, interns and doctors [5].

School psychologists are partner families, teachers, the responsibilities of which include creating a safe, healthy environment and a favorable learning environment[1].

School psychological services are available in a wide range. School psychologists recognize the school context as an important development. Namely:

- Possess effective approaches in teaching students;
- Have an understanding of the principles of life and organization of the school system;
- Apply psychological principles of learning and development competencies of students within and outside the school;
- Advising teachers, other school professionals and parents on the cognitive, emotional, social and behavioral performance of students;
- Diagnose and assess the need for development and develop educational programs that meet the diverse needs of the school,
- Contribute to improving relations between parents and teachers [2].

If you take into consideration the American Association of Psychologists (APA), the school psychologists receive specialized training in colleges where acquiring a bachelor's degree, and can only work assistant to psychologist.Only masters and specialists with the degree of Doctor of Philosophy have a right to work in school psychology. While studying developing these skills, which are requirements for professional competence of school psychologists:

- Active listening;
- Social sensitivity;
- Understanding the content of reading;
- Effective communication skills;
- The ability to communicate effectively in writing;
- Assessment of their work and the work of others;
- Critical thinking;
- Decision-making;
- Complex problem solving;
- Time management;
- Negotiation skills;
- The ability to instruct;
- Human resources management;
- Systems analysis skills;
- Using mathematical methods to solve related professional issues [2].

Speaking about the knowledge the American school psychologists are expected to have first of all it should be a comprehensive knowledge of psychology, therapy and counseling, excellent knowledge of English, education and training systems in the country, sociology and anthropology, mathematics, computer cybernetic technology, management, public relations and knowledge of the documents and the right to education.

What personality traits should be cultivated in the school psychologists? According to NASP (National Association of School Psychologists) first of all, this care for others, cooperation, reliability, self-control, attention to detail, independence, leadership, analytical thinking, initiative, flexibility, social orientation, resistance to stress and propensity for innovation. Relevance, its own

independence in decision making, value recognition and achievement should also have great value for school psychologists[3].

In contrast to the above, Ukrainian education system today hasn`t clearly outlined the state standard of professional competencies of school psychologists. Therefore, each university independently describes the list of desired features for the psychologist that it plans to develop in the process of bachelor's or master's degree psychology. Typically these university standards are quite general, described a general list of competencies, not isolating separately competences of human resources manager, clinical or school psychologist, etc.

The general set of skills which are expected from psychologist are following [7]:

- Research skills;
- Communication skills;
- Teaching skills;
- Diagnostic skills;
- Designing skills.

G./ Panok thinks that we have a three-tier system receiving professional psychological knowledge. The first level is general theoretical preparation, study the history of psychology, general psychology, psychophysiology, personality psychology, experimental psychology, and certain branches of psychology (social psychology, engineering psychology, developmental psychology, etc.).On the second level there is special psychological preparation and expected to master the general information on methods of work in a certain direction practical psychology.The third level - a knowledge of the specialty. This level includes the skills, techniques and experience in a particular psychological techniques, such as family counseling at school, correction of deviant behavior among adolescents [6].

There are also developments of Donbass Psychologists Association, which tried to formulate the requirements for professionally important qualities psychologist and identified four blocks:

- the first unit professionally important qualities include orientation and motivation of professional activity;
- the second unit - it demands that relate to social and perceptual qualities of the perso, the ability to display true social objects, including the psychological observation;
- the third unit - the requirements for personality traits that are connected with the processing and understanding of social media.
- the fourth unit - quality requirements related to the transfer of information to the impact on other people, communication [8].

And still we cannot find any special competencies which are expected from school psychologist.

Conclusions

As we see, the Ukrainian psychology in comparison with Western, particularly American, in a way of incipience, and the issue of requirements for specialist competences in particular. Today most demands sound quite general and do not disclose the content of the competencies that are needed during the acquiring specialization including specializations psychologist in education. This issue remains open and requires detailed both theoretical and empirical study, particularly through research requirements and expectations of school staff and parents, professional skills and competencies of successful school psychologists.

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The problems of gender inequality in the printed media of Ukraine, Poland and Hungary

Victoria Demnyk

Lviv Polytechnic National University, Institute of Law and Psychology, UKRAINE, Lviv, 1/3 Knyaz Roman St., E-mail: victoria-demnuk12345@ukr.net

Abstract – The problem of gender inequality have been existed during centuries and nowadays it is not less important. It becomes one of the values that are of top priority for many developed countries. The main role in decreasing the level of gender inequality plays awareness of society, that can not be achieved without the help of mass media. The paper describes the situation concerning the gender inequality problem in the printed media of Ukraine and its neighborhoods – Poland and Hungary.

Key words – gender inequality, media, men, woman, problems.

Gender equality means an equal visibility, empowerment, responsibility and participation of both sexes in all spheres of public and private life. Achieving gender equality is central to the protection of human rights, the functioning of democracy, respect for the rule of law and economic growth and competitiveness. Gender stereotypes are generalised views or preconceived ideas, according to which individuals are categorised into particular gender groups, typically defined as "women" and "men", and are arbitrarily assigned characteristics and roles determined and limited by their sex. Stereotyping becomes problematic when it is used as a vehicle to degrade and discriminate women[1].

It is not a secret that achieving gender equality is a long process. One month is not enough for changing the thoughts of the millions people. Mass media plays a key role in both preserving and transforming behavioural models and social stereotypes in Ukraine. According to the sociological survey, that was organized by the research institutes The Ilko Kucheriv Democratic Initiatives Foundation (DIF) and Razumkov Centre in July 2015 the media is among those social institutes which have the greatest trust of Ukrainians. Despite the fact that the last three years were characterised by decline of the thrust to mass media the balance of trust-distrust is still positive.

Ukraine ranks 59th (out of 140 countries) on GDI, compared to its neighbours Hungary (31), Poland (33)[2].

The media plays a key role in maintaining the societal attitudes that keep women out of public life and public management in Ukraine. Nearly 70% of all print and TV news are dedicated to men and executed by men. About 85% of the names mentioned in the print media overall are male. That figure increases to 96% in articles about politics or economics. Men predominate in media coverage of politics and culture, as well as in traditionally feminine areas of public life such as health and education. Even in seemingly "gender neutral" areas such as sports where men and women are both professionally present, men get three times as much publicity as women. Almost half of the scant references to women are related to family life, which only accounts for 6% of total media coverage.

Although readers are both women and men, print media focus on areas of interest to men. According to surveys, 52% of men consider politics the most important issue to cover, compared to 5% of women, so it comprises 46% of total print media coverage.

Few journalists are aware of, or interested in, gender topics, while editors often oppose the publication of reports on "women's" issues. Even though about 40% of journalists are female, they do not necessarily work from a gender perspective. For example, women editors dedicated less space for women and gender issues in their newspapers/magazines than their male counterparts. Men and women are portrayed differently in Ukrainian media. In over 80% of cases, men appear as experts and interview subjects. Female specialists or professionals are rarely interviewed. This is particularly notable in political stories quoting legislators and parliamentarians. While the majority of decision-makers in Ukraine are men, the number of media references to women in politics is much lower than their actual representation. Most media references to women are stories about actresses or singers, not decision-makers. While men are presented with their full name, position and professional background, women are often introduced as the "wife" or "mother" of prominent men[3].

Many people do not think that there are any "gender equality" problems to address in Ukraine, or they consider "women's issues" related to family welfare, as predicated during the Soviet period. They think that after the government solves other priority social and economic issues, it can deal with "women's problems". Most media do not report on gender equality issues or women's organizations, so many Ukrainians are not even aware that they exist. The public needs more information and a better understanding of gender equality issues and activities[4].

The problems related to gender inequality are conveyed in polish media. 50% of the population of Poland and 41% of Hungarians trust journalists and so results of their work. Though indications are similar to ukrainian the situation in aforecited countries is not the same. People are more aware about their rights and there is a tendency in covering some aspects of the problem[5][6].

The claims that depict inequal position of female in printed media of Hungary and Poland covered the three topics:

1. Roles at home: claims that state that different household chores (such as repairing things, do-it-yourself activities, daily cooking, cleaning, looking after children etc.) are mainly done by one of the sexes, or these duties are shared in marriages or relationships.
2. Roles at work: claims that state that certain professions or positions are more suitable for one of the sexes, or the opposite of it (women and men are equally skilled). Claims about gender discrimination (or lack thereof) at the workplace, e.g. in salaries or during promotion, also belong here.
3. Conflict of work/household roles: claims that state that there is a trade-off between career/financial well-being and being a 'good' parent, from the employers',

employees' or the state's point of view, or statements mentioning parental leave from work.

There are existing differences between the perception of attitudes in the countries in both the topics and the occurrence of traditional views. In Poland, the most frequently made claims concerned gender discrimination at work and skills differences between men and women, i.e. the discourse was dominated by work related issues. In Hungary, the single most frequent claim was also discrimination at work, but claims around the family, and especially the conflict between having a career and having children also got considerable attention.

In general household-related topics arise more frequently in the media than work-related topics. While the Hungarian discourse tends to be relatively conservative in all related subtopics, the Polish discourse is more ambivalent: having children and a career are rarely portrayed as incompatible, while the early return of mothers to work is most often depicted in negative (conservative) terms.

In Hungary media coverage reflect a dominance of conservative gender roles attitudes and a preference for public services as opposed to market-based childcare. Yet, there are a few signs suggesting a slow move towards less conservative views: the incompatibility of child-raring and having a career appears relatively frequently and is portrayed as a controversial issue in the media.

In Poland the media suggest a move towards less conservative gender roles, especially regarding the involvement of fathers in childcare. Though the division of care in the household is not often discussed in the media, when it is, men are often portrayed in non-traditional roles (such as looking after a child or taking parental leave) and statements about future trends are also significantly less traditional than the descriptions of the past or present.

According to international comparisons Poles are not significantly more conservative with regard to gender roles than other nations in Eastern Europe. Though in comparison to other EU countries, gender stereotypes and a conservative view of the family seem to prevail, attitudes of younger age groups tend to reflect more gender balanced relations at home and in the workplace[7].

The prevalence of traditional attitudes towards gender roles points to the need for more action on the part of agencies promoting equal opportunities, in monitoring the media and other channels that may reinforce gender stereotypes, raise awareness about them among journalists and experts who may, often unwittingly, contribute to the process[8].

It will take a long-term approach to changing gender relations, stereotypes and attitudes. People must remember about this target because the situation could be only changed due to understanding and participation of wide range of the public in the process. As Tarja Halonen, Former President of the Republic of Finland, said: "All nations have their own traditions, and gender stereotypes are part of it. But it is good to remember that they are made by people and can be reformed by people".

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Role of the parents in shaping readiness to school education among special needs children

Iryna Dorosh[1], Larysa Malynovych[2]

[1]Department of Applied Linguistics,
Institute of Distance Education, Lviv Polytechnic National University, UKRAINE, Lviv, 2/4 Karpinskyi St.
E-mail: Ira.Stepanivna@gmail.com

[2]Department of Theoretical and Applied Psychology,
Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, 1/3 Knyaz Roman St.
E-mail: malynovychlarysa@ukr.net

Abstract* — *The article describes the socio-psychological problems that ensue in families raising children with disorders in development to address issues of preparation for school. Modern national and foreign concepts are represented including theories about the role of parents in shaping the future of the pupil. We have outlined the main reasons preventing the effective socialisation of preschool child with disorders. Emphasise is put on types of work with parents and approaches to organise work to solve this issue. The role of new educational institutions in the organising of correctional and rehabilitation process is highlighted in the article, indicated the necessity of establishing integrated family support when preparing child for a school.

Key words – children with disorders, PPS – psychological preparedness for school, CER (Centre for Educational Rehabilitation).

I. Introduction

The resolution of the issue of social, psychological and pedagogic aid during preparation to school is one of the common issues occurring in the families raising children with developmental disorders. The issue of parents in shaping the personality of high school age children is studied by many national scholars, among them L. Borshchevska, V. Zolotoverkh, I. Kobel, V. Kobylchneko, S. Kulbida, E. Lieonhard, K. Lutsko, T. Sak, Y, Syniova, V. Tarasun, V. Tyshchenko, V. Turchynska, L. Fomichova, O. Khokhlina, A. Shevtsov, R. Yurova [4]. Modern methodology theory of psychological, pedagogic and social researches have accumulated experience of many foreign scholars: I. Guba, Y. Lincoln, M. Miles, Q. Patton, J. Creswell, E. Babbie, M. Gall, W. Borg, K. S.Gorard & C. Taylor; the conception of ecological approach to the study of the family in the works by U. Bronfenbrenner, B. Bodner-Johnson, V. Selingman, R. Darling, N. Demydiuk and family-oriented approach in the researches related to child's development by C. Jackson, M. Marschark, K. Meadow-Orlans, M. Sass-Lehrer, A. Turnbull has been studied; the conception of positive psychology by M. Seligman and M. Czikszentmihalyi has been elaborated; the theory of loss and grief by P. Rich & K. Kubbler-Ross and theory of bilingualism for the education and upbringing of deaf children, developed by L. Vyhotskyi, M. Marschark, K. Meadow-Orlans, C. Mayer & C. Akamatsu, has been reviewed [3].

II. State of the problem

Simultaneously, a number of reasons leading to low efficiency of the child social integration factor is outlined: low economic status of the parents, lack of effective education and support from the state, as well as passive social attitude towards the phenomenon of child disability. Family estrangement from the educational process is considered to occur due to child's isolation at specialized boarding schools, which still remain to be the most common type of compensatory education establishments in Ukraine. Major types of psychologist work with the family have been determined: diagnostics and consultation [1]. Psychological and diagnostic work is oriented at the methodology of a special needs preschooler developmental potential, consultation is related to the choice of educational establishment for the child considering the type, location and degree of the damage. The scientists have outlined two trends in working with parents: meeting general requirements that are similar to those set to the upbringing of all children, resolution of special tasks that would compensate for developmental delay [6].

III. The results of study

Obviously, lack of continuity in the operation of the kindergarten and school impact the quality of school education. The delay in shaping cognitive activity, emotional and volitional sphere, immaturity of mental and speech activity will result in disadaptational processes that reduce the possibility of effective curriculum mastering and formation of motivation to school education [2, 5]. A number of scientific researches demonstrated that positive influence of the integrated environment providing possibilities for personal self-improvement to healthy school kids, also shapes empathy, compassion and ensures that things are evaluated from the perspective of humanity.

Recent scientific researches register changes observed during the process of selection of educational establishment by the parents. They fight for the right to study at the educational establishment located nearby their place of residence with the possibility of individual form of studies, integrated or inclusive tendencies. It is confirmed that parents mostly possess information about the complexity and structure of child disorder, contents and results of his/her education, his/her abilities to learn, behavior during classes or at home, favorite activities and toys, individual activities, daily routine, duties around the house [1]. Because there is no common vision for optimal development of children with psychomotor development disorders and support of qualitative education for them, it is proved that the society has outdated stereotypes regarding life opportunities of such kids. The absence of thoroughly structured curriculum for preschoolers with developmental disorders, specially trained staff and methodological basis for its creation help perpetuate outdated stereotypes regarding the personality development of the child with developmental disorders.

Limited number of financial and methodological support with the usage of computer technologies in preschool age are partially compensated for by computer software, though only 10 - work with PCs, which impacts the efficiency of correctional and rehabilitation process and interaction with families. Simultaneously, lack of information on recent achievements in early diagnostics and organization of correctional and rehabilitation process is observed [6].

Conclusion

Educational establishments of the new type – Educational and Rehabilitation centers – being either newly founded institutions or reformed outdated Soviet facilities (boarding schools) now look for the solution to this issue . The creation of initiative groups, civil parents' organizations, diagnostics and consultation centers, private educational establishments also positively change the situation. Additionally, unclear understanding of the problem spectrum, difficulties and tasks that arise on the way to preparation of the special needs child to school education offset the results of psychological diagnostics, consultation, developmental disorders prevention and may lead to further academic failure determined by the low level of PRSE.

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An inclusive preschool education as the basis of inclusion in the system of education

Yaroslav Fedan

Department of Pedagogy and Social Management, Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: fedanjaroslav@gmail.com

***Abstract* – Presented inclusive education in public administration education as a necessary element for the development of inclusive education. The importance of multilevel support and assistance during educational process in the redevelopment of the school, classes, programs and activities in order to all students without exception trained and spent time together is discussed.**

Key words – Inclusive education, inclusive education, public administration.

I. Introduction

In the development of the government education system for persons with special needs, clearly stands out in Western countries inclusive form of education, which is the origin and formation stage in Ukraine.

Since the 90's. 20. top model of governance in respect of persons with special needs, inclusion determined, based on recognition and respect for individual human differences and provides for the continuation of the relative autonomy of every social and social group.

II. Te problem of inclusion in Ukrainian schools

The essence of inclusion revealed in its conception. The basic concept of inclusive education through research analysis of foreign and domestic scientific works were selected:

- recognition of equivalence of all students and teaching staff for society;
- increase the degree of participation of pupils in education and extracurricular activities and the simultaneous reduction of commuting students;
- changes in the policies of the institution, practice and school culture in order to bring them into line with the various needs of students who are studying in this school;
- overcome barriers to quality education and socialization of all students, not just students with disabilities;
- Analysis and study attempts to overcome barriers to acquire knowledge in secondary schools for certain categories of students;
- the reforms and changes to improve the situation of social protection for all students;
- belief that the differences between pupils - a resource that promotes pedagogical process, not obstacles to be overcome;
- recognition of the rights of children to education in school, located in a residence;
- improve the situation in schools in general for students and for teachers;
- recognition of the role of schools not only in improving the academic performance of students, but also in community development;
- partnerships between schools and local communities;
- recognition that inclusion in education - is one aspect of inclusion in society. [3]

The composition of inclusive education include inclusive education and inclusive education in schools. Explore inclusive education in isolation, without taking into account the process of inclusive education is impractical because inclusive education is the first step in the process of state administration inclusion and allows early child with special needs to be included in the learning environment, and will enable the early stages of a child with special needs be included in the learning environment, given the fact that 24% of children with disabilities from 3 to 6 years are educated and trained in preschool institutions [1] in the "Concept of inclusive education" emphasizes that inclusive education in Ukraine has introduced since from pre-schools where the educational activities especially the younger generation [3]. Therefore, we should pay attention to the concept of inclusive education, which V. Boyko treats as "purposeful development of each individual growing, regardless of psychophysical development as a unique human individuality in terms of inclusive society" [1]. However, this definition is incomplete because it is too generic and does not include or includes indirectly pedagogical component of interaction between teacher and participant inclusive process. Therefore, under the inclusive education we understand the activity that occurs in different situations, interaction between teacher and students in the psychological-pedagogical and social support of their educational, gaming, labor, permits and other types of activity and communication, to develop the individual or separate individual qualities of each member of the group or class, which included children with special needs.In Ukraine, the practice of inclusive education came earlier than inclusive education. Thus, a child who has limitations in health, by attending regular kindergarten, the end does not always find a place with favorable conditions to continue schooling. Therefore, training, education, acquisition of social experience, solve social and educational problems of young pupils in inclusive educational environment ensures their successful socialization [2]. However, for the successful education of preschoolers and primary school children are necessary conditions for their involvement in the school, where he has created inclusive educational environment.

The process of inclusive education of preschoolers and primary school children in inclusive educational environment covers all areas of a child in school, that is socially determined. However, experience shows that to date in the public consciousness prevailing misconceptions about inclusive education. Hence, the implementation conditions of inclusion needs to break stereotypes and mastering new forms of work by all parties to the educational process. In this direction works the Ministry of Education, which offers to spend in schools "Lessons of kindness" on "Look at us as equals",

aimed at drawing public attention to the problems of the disabled and forming positive public opinion tolerant attitude to children with special needs, the destruction of psychological, physical and social barriers that exclude or limit their participation in complete life-giving activity. Such measures are important in human centric state educational policy and should not be a one-time action, but a lengthy process that involves overcoming stereotypes and sometimes incorrect perceptions of students with disabilities, creating a positive, caring attitude which is oriented to mutual assistance.

Using social triggers that are trigger community response to the problem, will focus on the educational environment to overcome the problem of inequality between "normal" students and students with disabilities. Obvious examples of social Trigger is a subject "Ethics" and elective courses "Basics of Christian Ethics" curriculum which recommended the Ministry of Education and Science of Ukraine, which focuses on basic Christian values as love of God and neighbor, compassion, gentleness, patience, meekness etc. Using these "triggers" conditioned by the need to ensure not only quality conditions in the environment, but also to overcome the psychological barrier between the students. In this context, the issue of humanization, including humanization of education flow out of the formation of social trigger "individual responsibility before God for their own behavior," which can enable to minimize the psychological barriers in communication and improve the relationship between students. This trigger, according to Emile Durkheim, establish and maintain a "social community", forms the ideals that promote social development and integrates state in a moral community - church anyone who follows them. And interaction with civil society organizations, a common class work, flexible schedule - to help teachers better understand the interests and needs of children, and help ensure that children with disabilities receive needed services and support.

Working with these children shows that each of them can adapt to society, enjoy a full life in the circle of family, peers, friends, that successfully socialize. Thus, the public administration inclusive education of persons with disabilities provides for the creation of appropriate conditions for their full development and personal development.

If forced implementation of inclusive education "from above" there is a danger of imitation "inclusion", it risks becoming a popular trend without a deep qualitative changes in educational process, that is, for reasons of unavailability fiction educational institutions obviously. This will discredit itself certainly noble, the idea of inclusion.

Considering the aspects of inclusive education should focus on its main principles: architectural accessibility of educational environment; introduction of special technologies, adaptive technical training, availability of learning and educational services, combining traditional and innovative approaches to learning; individualization and adaptation of curricula, teaching materials, textbooks incl nosology people with disabilities; creating an enabling environment for adaptation, self-determination and self-realization; socio-psychological and medical and physical rehabilitation, and more.

Foreign economists, educators and sociologists have shown a higher economic efficiency and social inclusion: budget special educational institution is several times the cost of training a child with special needs in preschool education.

Given the defined mechanisms for implementing inclusive education in the education system of Ukraine, which in its essence and activity characteristics should provide inclusive education process in all educational levels. Among them we have identified the following: legal, organizational, managerial, economic, educational, informational, psychological, social, medical rehabilitation, technical, architectural.

Conclusion

The main idea of public education management is to consolidate the efforts of educational and scientific community and the public administration system to ensure the competitiveness of the system of science and education, through the creation of a system of inclusive education and training to improve the mobility of human capital of people with disabilities in the European labor market.

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Unquality advertising in Ukrainian printed media

Mariana Kitsa

Law and Psychology Department, Lviv Polytechnic National University, UKRAINE, Lviv, Kn.Romana street 12,
E-mail: imkitsa@gmail.com

Abstract – In the article there are analised different kinds of advertising in regional Ukrainian press. It is investigated the quality of the publicity texts after the criteria of legality, literacy, originality and journalistic ethics. Advertising of poor quality is found out and it is grounded negative influence such kinds of ad on the readers audience and on the society on the whole.

Key words – advertising, influence, quality, press.

I. Introduction

With the technology we have in our world, we are persuaded to believe what is right and what is wrong. Magazines, television programs, movies and advertising are very well known forms of media and are used constantly in our society to influence on our lives. Nowadays modern society can't live without advertising. In actual fact advertising surrounds us everywhere we are. It is a rare moment when we are not in the audience of some ad or commercial. We confront so many ads every day that we overlook them and they become invisible. From the researches, the typical U.S. citizen will spend more than one year of his or her life just watching television commercials. In any daily routine life, people do tend to keep themselves busy all the time by reading newspaper, watching television, listening to the radio and reading other print media production. That's why the most amount of advertising is placed in mass-media.

II. Advertising in Ukraine

The most amount of advertising is placed on television (23,9%) and in newspapers (22,1%) [1]. That's why in our article we examine advertising in newspapers. Its pity, but Ukrainian ad market is not high-developed, that's why the advertising in printed mass-media is not of high quality. So we studied the phenomenon of poor quality advertising in Ukrainian press. Advertising can be defined as paid communication that is intended or designed to alter the perception and behavior of people and to cite H. G. Wells [2], advertising is 'legalized lying'. Advertising in printed mass-media can influence on the reader by its original text or by illustration. In our country there is also such kind of ad like hidden advertising, which influences on subconsciousness of the people and which is unrealized. As far as we know, the analysis of the problem of quality or unquality advertising is nowhere to be found in the literature. So we tried to define these terms and for better understanding the phenomenon of unquality advertising we proposed to divide it into two groups:

1. unquality advertising by form and method of presentation (dull uncreative ad messages, advertising texts, which are wrote with mistakes etc.)
2. unquality advertising by purpose of presentation (unconscientious and hidden advertising).

To analyze the advertising of the first group we learned the rules of foreign specialists on advertising such as David Ogilvy [3], Leo Burnett [4], Dominic Hettings [5] and others. They recommend to write creative, original and laconic advertising, using common words and phrases. They also advise to pay attention to the headlines of the advertising. It should consist of no more than 5 words and should be informative, ironical or witty.

When we analyzed the typical advertising in Ukrainian press(we chosed regional newspapers "Vysokyj zamok", "Express" and "Lvivska gazeta" and allukrainian "24", "Gazeta po-ukrainsky" and "Ukraina moloda"), we saw that our ad messages are usually very long and dull, so that it's hard to read the whole text to the end. In fact the ad is made without creativeness or original thoughts; there is no pointing about the advantages of the product, so that the reader is not interested in buying this commodity. The texts of advertising are written with the language mistakes, and this is the proof of the low professionalism of the journalist which wrote this ad. The most popular advertisers in Ukrainian press are the banks, operators of the mobile connection and the car traders. Their advertisings are alike among each other, so it is difficult for the reader to make a choice. Mostly ads consist of the long text without any illustration or with illustration which is not informative for the reader. We should say that the advertising in Ukrainian press is usually written by a journalist, not by copywriter, that's why the texts of the ad are long, dull, without interesting headline and slogan. The reason of this phenomenon is that Ukrainian people trust more to journalists, than to the advertisers. I can also say that in the regional newspapers there are more advertising than in the Ukrainian, but in such allukrainian newspapers as "24" and "Gazeta po-ukrainsky" sometimes are printed really quality ad messages with short text and vivid illustration.

The next group of ad which we analyzed was unconscientious and hidden advertising. These kinds of advertising are forbidden by Law "About advertising" but unfortunately such ad messages are popular in Ukrainian newspapers. Among unconscientious advertising the most often is printed ad of alcohol and tobacco. This ad messages are written without the warning about the damage to the health however such notice is compulsory. Another kind of unconscientious ad is advertising of medical preparations, which is printed without direction about the number and date of the special license. In Ukrainian newspapers are also popular ad texts about the services of different sorcerers and witch-doctors, though such advertising is forbidden by law. Unconscientious advertising can bring readers into the trickery and as a result it can be harmful for their health.

Hidden advertising is also printed in our newspapers. Hidden advertising is the text which has hidden purpose – to advertise a product, service or a politician and which is not printed under the headline "Advertising". So hidden advertising we should divide into the commercial and political hidden advertising.

Among hidden commercial advertising the most popular are ad texts about banks and about the services of mobile operators. And this is not strange because as we have already said these companies are the most widen advertisers in Ukrainian press. Hidden advertising is usually written by a journalist like a simple informative text, but when you read this publication, you will understand the hidden purpose of this text – to advertise some product or service. Hidden advertising in Ukrainian press is written in different journalistic genres – short story, analytic article or even essay. And no matter where is printed hidden advertising – in regional or in alukrainian newspapers – it always effects on the readers, and what is the worse – that this influence is unrealized. But when we get caught into the hidden commercial advertising – we may buy unquality product and what is the result of being caught into the hidden political advertising? Then the result is worse.

III. The problem of hidden advertising

Hidden political advertising is usually widened during the elections, but in fact it is printed in our press more often. Last summer, during the pre-election campaign hidden advertising was printed almost in each number of regional newspapers such as "Vysokyj zamok", "Express" and "Lvivska gazeta". Each of this newspapers supported different politicians.

Texts with hidden advertising were written like informative stories about the one of the members of political parties, and in general this advertising created a positive image to the political subject. Such texts should be printed under the notice "Political advertising", but they were situated under the heading "News" or "Official" so these messages are in fact a hidden advertising. It's good that the political hidden advertising is widening only in regional newspapers. In general Ukrainian press there is no such phenomenon. In such newspapers as "Ukraina moloda", "Gazeta po-ukrainsky" and "24" during the pre-election campaign there were articles about each political party, so we can't say that any of these newspapers supported some politicians.

It is interesting the phenomenon of printing hidden advertising in the newspaper "Ukraina moloda". Near the advertisng there is no mark as "Advertising" or "On the rules of the advertising". Insteas, there is a small letter R in the circle, printed in the corner of the publication. Such kind of printing of the advertising is not provided by the Ukrainian laws and in fact is illegal. Besides it is unhonesty for the older readers, which just can`t notice such symbol.

Sreaking about the unquality political advertisig, we should remember that mass media forms the political consciouness and political culture of the residents, and when people make the wrong choice – it is often the fault of the media. So the journalists should comply with law, with the journalistic ethics and with the own conscious.

Conclusion

So, in the conclusion we can say that in the Ukrainian newspapers there are a lot of unquality advertising. The quality of the advertising we can determine by the originality and the method of its presentation and by the legality of the ad. From my researching follows that the ad texts can be unquality as from the one of this positions, thus in both. Its pity that the texts of forbidden advertising are usually written in very original and creative form, and vice versa. And the presence of quality advertising from both this positions is a rare occurrence.

From the territorial position we can say that in the allukrainian newspapers there is less advertising, than in regional. We should also point out that from the one hand the advertising in regional newspapers such as "Vysokyj zamok", "Express" and "Lvivska gazeta" is more interesting and vivid, than in allukrainian press. But from the other hand, in the Ukrainian newspapers such as "Ukraina moloda", "Gazeta po-ukrainsky" and "24" there are less forbidden unquality advertising, than in the regional. So as we see there are more unquality, than quality advertising in Ukrainian press. And there are few reasons of this phenomenon. Unquality advertising touches to advertisers, advertise-makers, copywriters and journalists. The existing of unquality ad texts in Ukrainian press evidences about unprofessionality of the journalists or copywriters, which wrote the ad message, and the existing of forbidden kinds of advertising in our printed mass-media means about the deficiency of quality newspapers in Ukraine.

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Effects of abuse and neglect on children intelligence

A. Shyroka[1], I. Kuzo[2], I. Kubay[3], A. Franchuk[4]

[1]Theoretical and Applied Psychology Department, Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, 1/3 Knyaz Roman St., E-mail: sudylovska@ukr.net

[2]Theoretical and Applied Psychology Department, Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, 1/3 Knyaz Roman St., E-mail: IruskoOo@mail.ru

[3]Theoretical and Applied Psychology Department, Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, 1/3 Knyaz Roman St., E-mail: irina_sibelius@ukr.net

[4]Theoretical and Applied Psychology Department, Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, 1/3 Knyaz Roman St., E-mail: franchuk_nastya@mail.ru

Abstract – The results of empirical research of intellectual characteristics of children from Shelter at the age between 10-16 years have been processed. According to results, two distinct groups of children due to their intellectual abilities were distinguished. The first group consisted of 34% of children who does not have significant intellectual difficulties, the second group – 76% of children have considerable inelectual delays. Also the results of comparison of the children's from Shelter and Secondary School intellectual abilities are presented. The opportunities of further studies and the ways of promoting Shelter children's intelectual development are discussed.

Key words: intelligence, Street children, psychological assessment, mental retardation.

I. Introduction

The research was conducted in Lviv Shelter for children. There is temporary placement for children who for various reasons are systematically deprived by parental care. In some cases parents feel inability to cope with their children behaviour. In others children are forced to stay on the street because of the parent's alcoholism or antisocial behaviour. All of these children once went to school and it is expected that they will return there again. But mainly adults responsible for those teenagers don't ask such questions as: What are the mental abilities of the child? Or what kind of educational program does he need? One possibility to answer these questions is to measure of these children intellectual abilities in comparison with peers from Secondary Schools.

II. Problem of Street Children in Ukraine

Child needs to be cared for. And if the family pays no attention or severely abused the child, he becomes neglected and very often occasionally or completely lives the family and become a Street Child. There are four main reasons in Ukraine why children live their homes. Those are parents neglect, alcoholism, asocial parents' behavior and poverty [3].

How many homeless and neglected children are in Ukraine? According to the official statistics there were nearly 21 thousand in 2006, 20,6 – in 2007 and 17,8 – in 2008 year. In 2011 official statistics reported about 12 thousand of Street Children in Ukraine, while the UNICEF called a number of 120 thousands [5]. The majority of such children, which is 76%, are at age between 6 to 16 years old. There were 163 children got to Lviv Shelter during 2014 year, 147 of whom (90%) were from 6 to 18 years old. Most of them systematically avoided schooling.

III. Methods

This study was conducted during 2015 among children from Shelter and pupils of two ordinary secondary schools. Study involved 122 children in general: 52 students of 8th form, aged 13-14, 42 students of 5th form, aged 10-11, and 28 Shelter children between 10-16 years old.

Based on DSM-V criteria it was supposed that child meets the diagnosis of mild intellectual retardation if his scores for the Intelligence Scales are of approximately two standard deviations or more below the population mean, including a margin for measurement error (generally +5 points).

The IQ test administered during 45 minutes. Children were asked to solve different intellectual tasks from Wechsler intelligence test. Also, children were asked to memorize and reproduce 10 words and solve in mind brief logical problems (reasoning test). Pupils performed tasks in the group, while children from Shelter completed tests individually.

To get the final results we use Statistics 6.0. Software.

IV. Key Research Findings

Cluster analysis by K-means clustering results that there are two types of children in the Shelter as to the intelligence: with higher and lower scores, 36% and 64% respectively (Fig.1).

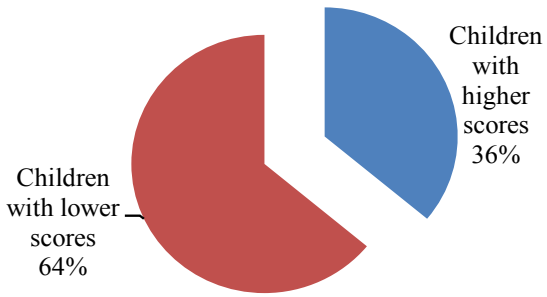

Fig. 1 Distribution of intelligence scores among Shelter Children

Results of K-means clustering shows existence of two statistically different groups of children (aged 10-16) with higher and lower intelligence scores

These groups differ statistically on the following scales: attention, reasoning, arithmetic skills, vocabulary and general knowledge.

What percentage of children from Shelter does enter the diagnosis of mild mental retardation? Scores of Shelter children aged 10-11 were compared with those of the pupils from 5th form, and Shelter children aged 13-16 with 8th form pupils.

The result shows, that all children from the group of lower intelligence (64%) have more than two standard deviations below the same age pupils mean for 2 and more scales (Fig. 2).

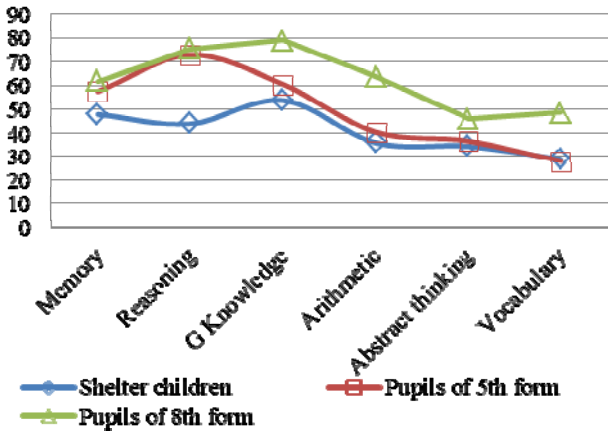

Fig. 2. Comparison of intelligence scores among Shelter children (aged 10-16) and pupils of 5th and 8th forms

Statistically they have poorer results on reasoning, general knowledge and arithmetic scales. Typically they had problem with understanding the meaning of such words as diagonal, right/left, horizontal/vertical , square shapes, the vowels/consonants letters, even/odd numbers etc. In the general knowledge test they did not know the answers for such questions as: what is the color of ruby, when is it a leap year, or what does it mean SOS letters. In arithmetic problems Shelter children normally were good at adding, dividing and multiply primes. But when the problem needed schematic entry terms, had two or more solving steps, fractions, proportions or percents children feel confused.

Conclusion

In the study we supposed that one of the possible reasons why Shelter children did not retain in the school environment is not only lacking of the social support but their intellectual capacities. This reason affects the child desire to learn, peers and teachers attitudes which resulting in the child's abandoning school.

The results suggest the existence of two intellectually different groups of children who come to the Shelter. Approximately 36% of them does not have significant problems with intelligence and cognitively are ready to study at school. But most part of the children and it is 76% experiencing significant intellectual difficulties: the average development of children aged 10-16 is on the level of 5-th graders or even lower. Especially they have problems with reasoning, general knowledge and arithmetic.

On the one hand, such findings are very important for future academic planning for those children. The one should take into account that without ongoing support such children are not ready to return to secondary school and study with peers.

On the other hand, the children's misbehaviour might partly be explained by their cognitive abilities. Mainly they are not good at problem solving, social reasoning or judgment in novel situations or school task organization among others.

However, these children require particularly intensive care on the development of intelligence competences. Our results show that much professional attention need the areas of reasoning, general knowledge and arithmetic. Children should be provided with individual guidance, shorter lessons and simpler tasks.

Also we believe that people around need to see and develop not only deficits but valuable and strong sides of these children.

Of course, cognitive development of the Shelter children is not the only one problem needed to fix. Children need to be taught pro-social skills, not violent communication, self-control and better self-management skills as well.

And we think that it is the only way to create better future for those 120 thousands children all over Ukraine.

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The importance of applicants' personal qualities in selection and training psychologists

Zoriana Lipiets

General and Applied Psychology Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: zoriana.lipiets@mail.ru

Abstract – The article contains some requirements for the psychologist as an individual and characteristics of the selection process for students to study psychology. There are many requirements for a person to become a psychologist, which include physical condition, mental health, intelligence, etc., but there is no a University that makes any researches to ensure those criteria in students that is educating. Obviously, nothing can be investigated or evaluated completely, but it would be more responsible and ecological to select applicants carefully for specialties that are socially significant. Ukraine does not have any systems of evaluating the candidates for education that take into consideration their individual features; this topic requires deep analysis and further study.

Key words – applicant, psychologist, personality, empathy, competence, counselors, characteristics.

I. Introduction

Nowadays, the profession of a psychologist becomes more popular in Ukraine. Since the image of a psychologist is not clearly formed, the youth chooses this profession not for the criteria of eligibility, but mostly are guided by myths. That is why the question of how effective the system of selection of applicants for specialty psychology arises. It is obviously, that the future expert needs to follow a number of requirements, and these requirements are related not only to knowledge that is given by a University, but also to the personal qualities and traits. Unfortunately, the process of academic education ignores them. It turns out, that after 4 or 5 years of University education, a specialist who will continue to work with people gets a great responsibility for the work done. One of the main rules of a psychologist - "Do not make any harm!". The young specialist often may not notice the influence on his client. The question arrises- who is responsible for his incompetent behavior? Perhaps, it would be logical if universities are. Again the question arises- in which experts universities would be responsible if they select students on the criterion of knowledge, without considering personal characteristics.

II. Theoretical analysis of a task

The number of requirements is given to a psychologist in Ukraine include two components: professional competence and requirements to an individual. The requirements to the professional competence are very often made by the employer or the skills and competencies that graduate should have are prescribed by the University. According to law, there are no special criteria to the qualification of a psychologist, except university diploma.

Currently, the requirements for individual psychologist are found in various textbooks, but none of them are declared at conventional requirements. Actually, the selection of students for education in Ukraine are made only considering the results of External Independent Tests. There are countries instead, that came to the selection process more carefully. For example, Mid-Atlantic state university in America traditionally included five elements for consideration: undergraduate academic record, standardized test performance (GRE), professional references, personal interview, and structured essay. Such method of selecting is used in some Universities of England and Germany [5].

Also, there is a National Councils in America that gives accreditation to psychologists in the sphere of education, which helps to make the selection of candidates for the occupation of psychologist.

The occupation of psychologist is completely different from other professions because the personality of a psychologist is the main tool of his or her work. Thus, any tool must meet some specific requirements.

In particular, D.B.Bohoyavlenska believes that a psychologist should be highly adaptable [1].

The most complete system of requirements to a personality of psychologist in Ukraine nowadays are created by N.Chepelyeva and V.Panok. According to their opinion, the determination of personal proficiency of a psychologist, are made by following criteria:

1. Physical condition.

The psychologist should develop his or her own strategy of recovery, needs to know his or her own resources, either way he or she might have a harmful effect on his health condition. Secondly, there are a number of physical defects that are incompatible with the occupation of a practicing psychologist. These defects include strong disability, big cosmetical defects or defects of speech, etc;

2. Mental health is also a critical requirement, because the psychological professions often are occupied by people with different types of personal disorders, who might carry out their own problems onto their work. Their activities will be ineffective, or, very likely, harmful and dangerous;

3. Intelligence.

The results of numerous studies show that psychologists with the level of IQ below average have many difficulties in their work. Particularly intelligence provides an effective analysis of features and personal traits and allows to overcome stereotypes (both personal and professional), is the central mechanism of understanding the behavior of another person. It is especially important for the psychologist to have a verbal component of intelligence together with a social one.

4. The system of self-regulation mechanisms and emotional endurance;

5. Sphere of motivation.

According to the authors, the occupation of psychologist is motivated by the interest to other people and by the desire to assist them in resolving their problems. The psychological mechanism of such interest, according V.H.Panok and

L.Umanets, is understanding and overcoming their own problems with similar nature [1].

Generally, the basis of the motivational sphere should consist of humanistic orientation. This is primarily altruistic positions, roles, attitudes in interpersonal communication, a high level of motivation to the profession, the prevalence of cognitive, altruistic, empathic motivation while working with clients, readiness to work with customers and focus on the positive results.

As for the vision of Western psychology on personal qualities that are necessary for the successful psychologist, the first one to define them was psychologist Carl Rogers, who identified features such as empathy, congruence and lack of estimation (1975).

Pope and Kline (1999) during the reaserches of qualities of a psychologist, that influence on the successful work, have identified 22 characteristics. They are acceptance, emotional stability, open-mindedness, empathy, genuineness, flexibility, interest in people, confidence, sensitivity, fairness, warmth, friendliness, resourcefulness, sympathy, nonthreatening, tolerance for ambiguity, awareness of limitations, capability, patience, sincerity, cooperative, and sociability [2].

Ackerman and Hilsenroth's (2003) came up with 11 characteristics of psychologist —flexible, experienced, honest, respectful, trustworthy, confident, interested, alert, friendly, warm, and open [2].

Together with the characteristics that need to be present, during the researches there were discovered those that are undesirable for a psychologist. They include exhibiting irritability, defensiveness, lack of empathy, being judgmental, poor interpersonal skills, pervasive interpersonal and intrapersonal problems, and mental health diagnoses such as depressive symptoms and personality disorders [6].

Unfortunately, regarding to this issue in Ukraine, there is not enough researches published, especially about personal readiness of students to study psychology and subsequent professional realization. So our future empirical research will concern precisely this aspect of the problem. Examining students of first and fourth years, we will try to determine their personal level of preparedness required for the profession of psychologist. Also, it will be offered one of the mechanisms of enrolling students to study Psychology.

Conclusion

It is clear, that the profession of psychologist requires not only the existence of specialized knowledge and skills, but also the development of certain personal qualities of a person. The abovementioned researches generally agree that these qualities should be: respect of interpersonal relations, motivation to help others, developed emotional intelligence and reflexivity. Nowadays, National Universities have a tradition to select students for this specialty only by criteria of their school success and the results of External Independent Testing. On the contrary, our future empirical study will show that the proportion of students who are willing to study Psychology by such selection do not meet the necessary personal requirements, moreover have certain features that are contradicted the specialist of that sphere. Therefore, we aim to inquire about the necessity of implementation additional criteria of the selection process, particularly by motivation and personal qualities.

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Editorial column as self-promotion for publishers

Iryna Mudra

Journalism and social communication Department,
Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, 1/3 Knyaz Roman St.,
E-mail: ariane@ukr.net

Abstract – Freedom of thought and style, which came to replace the prescriptive monoideological press, predominant communicative function of journalism, market conditions, freedom of thoughts expression, appearance of authorial journalism – these new tendencies of modern Ukrainian journalism cause the interest to the author of the Media whose point of view has the authority and interest on its own, and it resulted in appearance of new genre form – editorial column.

Key words – Editorial column, marketing, promotion, journalism.

I. Introduction

Demand for the authorial journalism led to the emergence of such type of column, where the author is significant and authoritative for the audience. Editorial column is a separate genre of authorial journalism, in which editor says that he is concerned about as the head of the publication. With the help of this genre director of the newspaper enters into a communicative dialogue with the supporters.

The purpose of editorial column is not only to establish a dialogue with readers and making them interested in giving answers on topical questions but also to promote newspaper advertising and its marketing. Editorial column as a genre has its own subject, objectives, and research methods. Subject of the research of editorial column is the author's attitude to the facts, events, and things related to Publishing Director, his thoughts and feelings.

In a competitive environment effective dissemination of the newspaper publication as well as getting the most revenues and profits is possible only with direct participation of Editor in creating textual content not only as a head manager, but also as the author of the newspaper. Chief Editor has authority among readers; his name as well as his words attracts attention. Hence, the Media has a possibility to advertise itself without wasting money on advertising and to attract the reader's attention in order to promote the publication on the market of periodicals. However, in modern socio-political newspaper the editor column is not used very often, although it is applied to promote advertising of publication and is one of the tools of the Media marketing.

As a special genre editorial column has following tasks: it is not merely an expression of the newspaper director opinion but it also promotes the publication through authoritative name of the editor for marketing purpose - to promote the publication on the market of periodicals. Editorial column has its own method of cognition and reproduction, which has such characteristics as combination of analysis, facts, events and things related to the media, their assessment to clarify the reasons, consequences and publicistic factual imagery argumentation (with the help of publicistic images, paintings, portraits) – it is writing by author-editor his own original attitude.

In some current social and political publications of Ukraine on the first, sometimes on the second page there is a permanent heading "Editorial column", in which editor highlights the position of the head of the newspaper edition, talks about the problems of the edition, consults with readers, asks support or analyzes pressing problems of society, promotes the publication and urges to recommend it to friends ("Rural News", "New Time", "Ukraine is the Center"). Under the heading "Editorial column" in modern Ukrainian media not only editorial column is published, but also editorial articles, editorials, commentaries, essays, advertising and political articles etc.

Under the marketing conditions editorial column is a genre that has to meet the interests of readers, promote and modify the model of publication, strengthen its position on the Media market.

II. Background studies

There are small amount of works devoted to the study of editorial column. Researcher V.M. Galych in the article "Column as a genre," writes: "Journalists are using increasingly such varieties of editorial article as column of an editor or editorial column". V.O.Karpenko in his article ""Editorial genre" writes that editor uses genre of editorial column when it is necessary to convey editorial position to the readers. Y.A. Gordeev identifying genre characteristics of columns of printed media has shown that column as a genre as well as a column as heading may exist in parallel. However, no-one mention the editorial column as a way of self-promotion and marketing of publication.

III. Research question

In modern Ukrainian political newspapers text of editorial column is often a monologue or an appeal to readers with a specific problem or an explanation of the publisher position. Recognition of editorial column on the newspaper pages as a rule promotes its permanent location and a content (the newspaper "New Era" in the first place has a heading "editorial column" and in the edition "Ukraine-Center" on the fourth place of the editor appears under the heading "Explorer's Diary"). Editors of modern Ukrainian newspapers appear as the authors of editorial column with different purposes. Editorial columns contribute most effectively to the spread of publication, if it serves as communicative function of the press; establish a dialogue with readers, draw attention to the issues of the newspaper, thus causing a necessity to read the newspaper, encourage their audience to think, make a dialogue etc.

The primary task of the editorial column is to attract and hold the reader's attention and for that you need to know your audience. Editorial column also may help to study the newspaper audience. Newspaper editor may ask readers to help him to the study audiences in order to meet the readers' interests better. For example, conduct a

survey of readers “Who are you, our readers ". And on the same page publish a small questionnaire to form an idea of the real newspaper audience. One of the following columns could be written on the base of readers' responses to the questionnaire.

Especially valuable is a questionnaire for psychographic audience analysis. According to researcher S.M. Gurevych: "Lifestyle of people, especially their psychology, customs and traditions have a very strong influence on the formation of their information needs. Information about family traditions, relationships between generations, men and women, confessions to which the residents of the region belong to, etc. used to determine the type and the character of the publication, themes and publication style, peculiarities of the organization work of the newspaper» [1]. Using the hint of S.M.Gurevych questionnaires titled “Family customs”, " Family Traditions ", " The relationship between parents, children and grandchildren "," The relationship between men and women "," Religion that I profess " can be published. In the column editor can offer his readers a correspondence to these topics and prepare new speeches in the editorial column based on readers’ answers.

In some Ukrainian press, this rubric may appear when the newspaper is published at the first or last time, the structure of the newspaper changes, the anniversary number of the newspaper, financial problems appeared, the editor or the owner of the publication changes.

Editions of most famous socio-political newspapers don’t have the editorial column. Presumably, this is due to the fact that the leaders of popular publications are busy by organizing activities and don’t have the opportunity to write up to the publication. Some are unable to write up to the publication, while others believe they do not need to keep the editorial column, not realizing that the performance of editor has a special meaning for the audience because he seemed to represent the edition, which he is head of. Editorial speech in the newspaper is not considered by audience as a personal opinion of the author, but as a position of the whole edition. In the conditions of communication editorial column must perform communicative function, conduct a dialogue with the reader, to be written in a colloquial style.

Editorial column in the newspapers “New Era” and “Sivershchyna” is considered as a rubric for different genres, such as comment, open letter, review, article, essay, notes, correspondence and announcement.

Analyzing the editorial column in social and political press of Ukraine it was founded that editors use it with a dual purpose: to highlight editorial positions to social events, problems and as a means to promote the publication.

Themes of editorial column in social and political press can be selected that should be used for self-promotion and marketing of publications: greetings readers with happy holidays and different events, expressing gratitude for the support, describing topical events or phenomena; the desire to attract and encourage readers to communication; political advertising; answers to questions of readers; appeals to subscribe or buy publication, etc.

Having systematized omissions

IV. Recommendations

Having systematized omissions of publications in editorial columns, we can summarize:

- Variability of editorial column in time and locations, as well as it is used only once or for a short time in socio-political newspapers.
- The author of the editorial column should be only a newspaper editor, and not the other journalist, even more respected. Newspaper editor has to find time to talk with the readers of his newspaper.
- Editorial column should always have one location and one streak - the first one, in order to attract attention.
- Editors can use the editorial column to inform readers about editorial position on urgent social problems and events that relate to the editor and the publisher. In the column of the editor other interesting and skillfully written materials of journalists should be promoted.
- Editorial column contributes to marketing when contains analysis of questionnaires on topics that are interesting to readers.

Conclusions

Editorial column performs many functions:

- it is a means to self-promotion – it advertises publications and encourages its readers to buy and pay for the newspaper constantly;
- contributes to communication of dialogue editor with the readers;
- editorial column is not a navigation aid, but the preview that directs readers to the certain material of the publication;
- it is a means to advertise and preview the newspaper. The editor has to take care of advertising farsightedly as well as about marketing of publication.
- Editorial column should regularly appear in the press, that creates a sense of psychological contact, indifference and usefulness among the newspaper supporters. Also the authority of the editor is a means of promoting the publication. Editorial column enables to contact with readers asking them to subscribe and support the edition in difficult times. Speeches of the editor on the newspaper pages provide uniqueness of the newspaper.

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Consideration of the Management Styles for Successful Management of Educational Establishment

Maria Myshchyshyn[1], Alina Izotova[2]

[1]Pedagogics and Social Management Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: myshchyshynm@mail.ru

[2]Pedagogics and Social Management Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: izotova0911@gmail.com

Abstract* – *The work deals with the problem of using the efficient management style for successful management of educational institution. Autocratic, democratic, and liberal styles of educational managing are described. Main advantages and disadvantages of each management style are observed. The importance and impact of using effective management style in educational institution are underlined.

Key words – management style, successful management, educational establishment, autocratic style, democratic style, liberal style.

I. Introduction

You may become a specialist;
learn it; but you have to be born a manager.
Being a manager is what God and mother give you.
H. M. Zabolotnyi

The modern problems related to the issues of efficient state management and rational implementation of power require the examination of phenomena of leadership, management and management styles. The efficient state management is known to facilitate the stability and order, solution of various problems, favourable psychological climate in the collective, readiness of every employee to contribute to the implementation of hard tasks. When the manager sets proper tasks, determines the means for achieving goals and methods of control, drives the collective's opinion, motivates the employees to full-time work and high results, then the collective starts working as a smooth-running mechanism.

People have their own motives and able to set their own goals. They may be eager or not to do something, and depending on that they choose their behaviour. The management is a complex of actions taken by the manager to ensure the required behaviour of his/her colleagues.

Different management styles may be more or less efficient depending on the degree the executed work (settled task) structuring.

The management lies in the right of a person to charge with tasks, instruct, and demand their implementation, i.e. this is a process of managing the joint activity of group members. Whereas the genuine role of a manager, according to Ch. James, consists in managing the value system of organization.

II. Management Styles

The term of management style is widely used from 30-th year of last century and is closely connected in management and social psychology with such personalities as R. Blake and D. Mouton, M. Vinogradsky, V. Hladunskyy, A. Goncharov, O. Donchenko, O. Kuzmin, K. Lewin, Mc. Gregor, V. Tereshchenko and others. The peculiarities of style formation, its correction, levels of development have been examined by E. Klimov, A. Markov, V. Merlin. Different types of styles and features are singled out by E. Golubev, E. Il'in, A. Rean, etc .

The manager is a core member of any collective. The efficiency of management is determined by *the customized approach*, i.e. by possibility of successful solution of basic problems in human relations.

Each manager adopts certain stereotypes of managerial activity, which are called management style.

Management style (from Latin *stylus* – a stake used for writing) is a complex of principles, norms, methods and practices of influencing the subordinates with the aim of efficient implementation of managerial activity and achievement of the set goals; this is a method of working, behaviour pattern. The style of work relates to the mangers, subordinates or executors. Everyone has his/her own style of work, natural perception of style.

The choice of management style in educational institution depends on several factors. In particular, the specificity of the institution and its activities, the circumstances of tasks accomplishment, level of organizational development, style and working methods of top management, compliance of management style to the hopes of subordinates, individual-psychological qualities of personality (character, temperament, ability, intelligence), authority of manager, his/her level of culture and education, and general management experience.

Correct management decisions and skills of their presentation to the faculty, the ability to staff organization, functional distribution of responsibilities, creations of a positive climate within the faculty and the ability to plan impact on the activity of educational institution integrally. The results of good management are: the prosperity of the educational institution, increasing of its image; coordinated work of faculty; growing authority of the head; material benefits for institution; work satisfaction and others. The most important role in the implementation of good administration of educational institution is underlined by using favorable management style.

According to conventional scientific approaches, the main management styles are the following: autocratic, democratic, and liberal ones; three types of managers are differentiated accordingly (autocrat, democrat, and liberal).

Autocratic style. This style stipulates that the manager takes all decisions; competences are strictly defined; i.e. a rigid certainty of ranks of managers who are authorized to take decisions on certain issues related to the organization activity. The structure of management is very strict. This means that decisions approved at the top management levels are transferred to lower levels as directives to be out of questions – they are to be implemented for sure.

Democratic style. It is based on collective decision-making by managers (under especially difficult circumstances other professionals may be involved in decision-making, but employees are not generally involved in this process); deep knowledge of the managerial staff in the problem being resolved, aims of organization; and on all employees being informed of implementation of the set tasks and goals.

Liberal style. It is characterized by modest activity, unwilling and inability of the manager to take any decisions, avoiding any innovations, transferring his/her job responsibilities and functions to other managers and divisions. Under such management, divisions and organization are constantly losing their mobility; employees lose their motivation, initiative and interest in the business of organization.

Modern science increasingly is talking about using a flexible approach to the management of any institution. In order to accurately assess the situation, the manager must clearly understand his/her own abilities and the abilities of faculty, the nature of the tasks and power of employees' needs. Also, the manager must be ready to change his management style. The head who chose a certain style of leadership and clearly it follows may not be able to exercise effective leadership in another situation and another post. The educational manager who wants to work as efficiently as possible, get the most returns from subordinates, can not afford to use one style throughout a career. The modern manager must adapt his/her management style to a particular situation. Effective head is those who know how to behave in different ways that depending on the requirements of reality.

Conclusion

Therefore, it should be noted that efficient impact of the manager (head) of educational institution on the faculty and separate employees does not allow reckless inheritance of any style; it requires the manager to develop his/her own unique style of activity and impact.

Efficient leaders assist their subordinates in gaining responsibility and competence. In such case it is important to know, at what stage of development the collective is at the moment, how the process of its development is going to proceed, and what may be his/her personal contribution to facilitating this process.

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The Image of Successful Specialist in Technician and Humanist Students

Maria Myshchyshyn

Pedagogics and Social Management Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: myshchyshynm@mail.ru

Abstract – The motivational role of image of successful specialist in the process of professionalization is presented. The peculiarities of successful specialist's image in the minds of humanitarian and technician students are described with particular attention. The results of conducted study according to the professional qualities of successful specialist are presented. In the base of this study the model of successful specialist is elaborated. Joint for both groups are association of the successful specialist's image with financial-software, high level of professional qualification and such components as professional conversation, competent, purposeful, forceful and honesty; difficult components are communication and empathy for humanitarian and responsibility with attentiveness for technician students.

Key words – image, successful specialist, humanist, technician, professional and personal qualities.

I. Introduction

The dynamic changes of socio-cultural and economic situation in society, the development of information technology, computerization and automation of production, determine the emergence of new extended research in the sphere of professionalization that concern to changing views on professional values, professionally important qualities of inquired professional. Exacerbated the study of factors that contribute to the process of professional development of modern students. One of the most important component of this process is constructing the image of a successful professional. That's why there is a question about the components of image, which has been arising with the association of successful specialist in the mind of modern students, particularly is there differences of image in the humanitarian and technician students.

II. The Main Part

The modern researchers unanimous emphasize on the changing of social values, priorities, motivational incentives, life prospects of young people that are observing as a result of social and cultural development of society. According to T.M. Titarenko modern society in contrast to previous centuries is not "leisurely and predictable" because in that time the social and cultural impact on young people was established, monotonous and repetitive, that's why youth in present-day, according to the author, "can not remain the passive executor of someone else's will or invisible observer "[2, c.37, 38].

Such authors as M. I. Dyachenko and L. A. Kandybovych describe the following characteristics of students' developing as future specialist: growing strong professional orientation, developing the necessary skills; improved mental processes, position, experience; increasing the sense of duty, responsibility, professional autonomy, life position, rapidly growing student demands in the sphere of future specialty, based on intensive transfer of social and professional experience and forming the necessary qualities, growing social, spiritual and moral maturity, increasing student self weight in the process of skills' formation and experience needed as a future specialist strengthens professional independence and commitment to future practical work [1, p. 47]. According to scientists the period of study in the universities is the most sensitive and there is the culmination of intelligence, sensory processes, speed memorization of information, the ability to switch attention flexibly and a period of mastering the amounts of social roles that define citizenship, professional way, marital status, formation "I-concept" of personality.

In the process of professional formation of the future specialist it is actualized students ideas about themselves and formed a professional self-concept, that provides: developing image of "I", the interaction of self-concept characteristics of the profession (vision of oneself as a professional). The image of specialist is characterized by social nature, because it is forming in the process of activities and communication on the base of social-production knowledge that are embodied in language, objects of culture, norms and standards of activities (S. Rubenstein, L. Vygotsky, H. Kostiuk, O. Leontev, S. Maksimenko, etc.).

One of the most important factor of motivation for professional development and professionalization is mechanism of comparison "real I" as a set of imagination about the development of oneself knowledge, abilities, skills and opportunities from the one site and " perfect I" which denotes the set of imagination about oneself in the future, desirable qualities, knowledge, abilities, lifestyle, etc. (I. Cohn, S. Maksimenko, S. Moscovici, V. Moskalenko, H. Kostiuk, T. Titarenko, G. Gumenyuk and others).

In the professionalization context image "perfect I" is an image of successful specialist which runs the authentication mechanism of professional role, motivates to the realization of this image, and thus contributes to the process of professional formation of future specialist.

III. Study of Successful Specialist's Image

Based on the above ideas, we asked the question about the structure of a successful professional image that arises in the minds of students. Also, we wanted to find out whether there is a fundamental distinction in the imagination of different specialties students particularly technician and humanities students. For such reason the study that involved 295 respondents - students of Lviv Polytechnic National University, among them were future psychologists (44 students), sociologists / social workers (47), lawyers (68) and electric power engineers (136) was conducted. With the help of free image description of successful specialist students wrote down their imagination about individual and personal, professional and other qualities that should have specialist, in order to become successful. Further, using the method of content analysis the most important and the

most repeatable qualities was allocated and on their base the generalized model of a successful specialist image was formed.

During the study was found out that for most students the concept of successful specialist is equivalent to the term of financial-software, high level of professional qualification. It was immanent for technician and humanities students but there is some differentiation in the description of professional qualities. Study results were:

1) according to students-psychologists the successful person should be professional knowledgeable, competent, responsible, purposeful, honest, sociable, empathic, emotionally stable, punctual and strive for self-development;

2) for future electric power engineers the important qualities in their carrier are responsibility, honesty, punctuality, professional knowledge, purposefulness, perseverance, courtesy, qualification, accuracy and confidence;

3) future sociology / social workers associated successful professional image with the following qualities as courtesy, communication, commitment, professional knowledge, charisma, self-restraint, honesty, perseverance, responsibility, empathy, tolerance;

4) students that are studying in law faculty associate successful professional with professional knowledge, honesty, confidence, justice, kindness, commitment, communication, purposefulness, punctuality, perseverance, competence, emotional stability.

Summed up the results of content analysis of successful professional qualities we have developed general model of successful specialist's image.

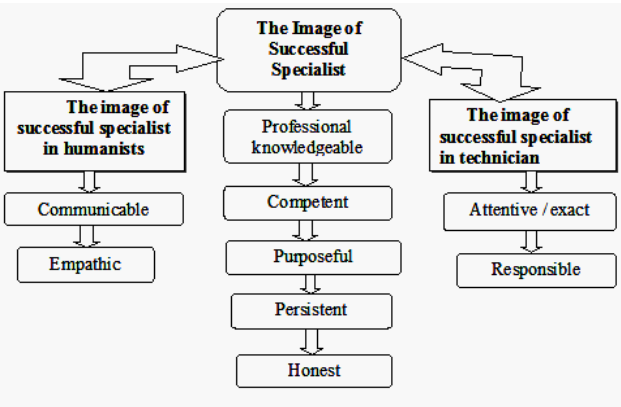

Fig. 1. Generalized image of successful specialist

Conclusion

Summarizing the results of study of successful specialist's qualities among the students of different specialties we have made the following conclusions:

1. There are some qualities of specialist personality that equal described by four specialties students: professional knowledge, purposeful, perseverance, competence, honesty. We presume that the combination of these qualities is the basis of generalized image of the modern successful professional (Figure 1).

2. The qualities can be divided into two groups: personal and professional. This qualities groups are closely intertwined in humanities. For example, for the psychologist and social worker such qualities as honesty, empathy, communication is not only personal but also professional important. The same we can talk about the lawyers - future judges, advocates, prosecutors which need extremely important qualities of character that are associated with honesty, fairness, emotional stability, self-confidence. According to the technician students the most important qualities are closely connected with attentiveness, exactness and responsibilities. As opposed to humanities communication and empathy are not important for them. They do not communicate with amount of people, solve their problems, conflicts or ascertain other to make some decision etc.

3. The image of the successful professional is the basic determinant of students' professionalization, since it starts the mechanism of authentication and allows students to supposedly try themselves on the role of subject of professional activity. Also, important is it motivational aspect that consist of prompting for professional realization and personal development through the mechanism of the comparison images "real I" and "ideal I" for the one side(in the context of professionalization " ideal I" is expressed through the image of "I am a successful specialist") and the desire to achieve this image for the other side. The image of "I am successful specialist" determines the development of professional identity and I – concept. Thus, the important aspect of motivation to the professionalization is the process of successful specialist image formation with taking into attention peculiarities of image in technician and humanities students.

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The impact of violence during childhood on personality development

Karina Bulachek[1], Anastasia Semenyuk[2]

[1]Theoretical and Applied Psychology Department, Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, 1/3 Knyaz Roman St.

[2]Theoretical and Applied Psychology Department, Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, 1/3 Knyaz Roman St., E-mail: nastya_semenyuk@ukr.net

Abstract – The impact of violence in different age catagory on the formation and development of personality. A brief study of the topic shows that any emotional, physical, mental or sexual abuse of children not only leads to the formation of various psychopathologies but also to the inevitable warping and inadequate rejection of both peace and people.

Key words – impact of violence, personality development, emotional, physical, mental and sexual abuse, childhood.

I. Introduction

The influence of childhood on personality formation plays a significant role in the life of every person as a child formed the character, behavior, the fundamental rules and regulations to further lifestyle. Therefore, if in childhood the manifestations of violence, it can lead to serious mental illness, from the formation of aggressive behavior to the split personality.

English Explorer of sexual violence Peter Dale [1] believes that any violence, including sexual, is emotional abuse, diversion, rejection, which the author calls "especially fall-back" and "something that causes significant harm to the personality development and the formation of coping mechanisms". The results of empirical research of many scientists who've developed a problem of formation of the personality when the child is being abused.

II. An overview of current research of child abuse

Some examples of research in which scientists interviewed different categories of people relative to the question of why they use violence against children. Among participants were both parents and children.

Special studies of the relations of adults to use various types of violence against children, conducted by domestic and foreign scholars, revealed that 60% of parents interviewed were convinced of the justification used measures of physical impact, and believe that physical punishment is necessary and effective means of controlling child behavior (1). A lot of parents resort to it at least once in my life in situations where, in their opinion, the child has violated the rules established by adults.

Among the main causes that provoke adults to apply measures of physical impact to the children, identified the following: bad behavior,school failure, not housework.

17% of respondents have used or approve of physical violence as a result of bad behavior of the child. Thus, characterizing this behavior indicated such characteristics as impulsivity, hyperactivity, excessive anxiety. Upon further analysis of the behavior of such children revealed that often the child with increased irritability and aggressiveness trying to attract the attention of adults, but faces aggression on their part.

13% of children suffer physical violence for poor training. It should be noted the fact that the use of physical impact for poor education often hides the failure of parents. But in any case the punishment will have extremely negative consequences. Some studies indicate that the normal population of children the prevalence of mental retardation is 2-3% and in the population of children who are abused, these figures reach 20-40% [2].

III. Psychological consequences of mistreatment

These studies led to such results as the formation, under the action of violence, "wounded child", a distorted self-image, aggressiveness, anxiety, inability to empathize, low self-esteem, suicidal behavior, addiction to alcohol, addiction.

These studies allow us to conclude that physical violence against children is quite common, as children are in a dependent position. And, as a rule, the more severely punished the children, the less they tend to talk about it. This forms a type of "scored."[3]

As a result of such actions children can feel quite contradictory feelings: fear, pain, shame, hurt, hatred, humiliation, sense. So the child that had suffered physical violence at the age of 3 to 6 years may experience the following symptoms: reconciliation with what had happened, the lack of resistance, passive response to pain, painful comments, criticism, please behavior, excessive compliance, pseudomoral behavior (apparently copies the behaviour of adults), negativism, aggression, lying, stealing, cruelty to animals, a tendency to arson. Elementary school age children there is a desire to hide the cause of damage and injury, the feeling of loneliness, lack of friends, fear of going home after school, strange food cravings (plaster, feces, leaves, snails, bugs, etc.). In adolescence a characteristic escape from home, suicide attempts, inappropriate behavior.

Psychological violence can be seen and the situation in which the child is in a family with adictive behavior (family of alcoholics, drug addicts). The child, trying to take over the family problems, denies their own needs and requirements. Such conditions do not allow the child to feel safe, to experience unconditional love, to behave spontaneously. The result of this form of parental relationship researchers call the fragility and permeability of borders I, the depreciation of the senses (and the loss of the ability to Express them) and the ability to establish emotional intimacy.

J. Bobl (1979), a well-known researcher of the phenomenon of maternal deprivation, introduces the term "inadequate parenting" and provides the following types of inadequate parental relationship: the absence of a

parent or separation of a child from the parent (when placed in the hospital, child care); lack of an adequate response to the search of care and affection rejection of child; threats to abandon a child, used as a disciplinary measure (parent/mother threatens to deprive the child of his love, to leave his family to commit suicide, etc.); provoking a father/mother, feelings of guilt or feelings of their own "bad" person in the child. (The child is exceptional criticism. The most extreme option is assigned to the child responsible for the illness or death of a parent); a disturbing attachment to the child relating to the provision of the pressure on him. The parent (usually the mother) seeks to become the only source of care in the child's environment. [4]

Describing the pernicious consequences of such a parental relationship, J. Bobl notes that "the formation of one or another of psychopathology in these cases is because the world for such children is always ambiguous, uncertain, and always dangerous."

Also, it was found that the effects of physical violence (beating, corporal punishment) is found in the anamnesis of patients with personality disorder significantly more often than patients with other pathologies.(1)

A. Rowen, D. Fo, J. Goodwin write that sexual violence experienced in childhood more frequently than other traumatic situations leads to the development of post-traumatic stress disorder (PTSD)

The consequences of PTSD have an impact on the overall psyche of the child, and these effects are evident in adulthood in the form of psychosomatic diseases, various forms of abuse (drugs, alcohol, drugs), various disorders associated with the rejection of my body (D. Mendell, Damone L., 1998). Observed violations in a sexual relationship with a partner. There are data showing that most men who perpetrate violence themselves in childhood were subjected to sexual violence. For many women, survivors, characterized by cases of violence, povtoryat them in adult life (1996).

Obsessive playing of traumatic event in children may be in the form of the game that is repeated, in which are traced the theme or aspects of the trauma.(1)

Conclusion

However, from the review of theoretical sources we see that the roots of many psychological ailments adult life lies in children's situations of hopelessness to the physical and psychological skrigende adult. We are convinced that the problem in Ukraine should not be condoned. But it requires a broader discussion in society on different levels to find more effective ways of helping children to have a secure childhood and future life.

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Ukrainian students' political decision making after the Revolution of Dignity

Anastasia Shyroka[1], Dzvenyslava Kobecka[2], Roksolana Danyliv

Theoretical and Applied Psychology Department, Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, 1/3 Knyaz Roman St.,
[1]E-mail: sudylovska@ukr.net,
[2]dzvenyslava.kobetska@gmail.com

Abstract – Article is presented the results of the study students' decision making on parliamentary elections 2014 in Ukraine. It is showed that revolution events on Maidan did not influence the process of decision making for whom to vote in more meaningful way. More active citizens made the same cognitive errors as less active. But they felt statistically more confident in their choice of parties and deputies, in the quality of back up information, and that in case of failure, they again ready to go to the barricades. The possibility to change the future by increasing the rationality of the citizens' choice is discussed.

Key words – political decision making, Revolution of Dignity, rationality, illusion of competence, cognitive errors.

I. Introduction

Democracy gives us the right to vote, which most people use. But whether we can well dispose of this right? Can we choose worthy people, which will have motivation to develop the welfare of the country? Different events happened in Ukraine since proclamation of the independence. But most of the time citizens expressed their disagreement by the actions of political leadership. Two times their dissatisfaction was so strong, which led to revolutions, first "Orange Revolution" in 2005 and then "Revolution of Dignity" in 2014. There is a paradox, because we choose the deputies with hopes for the better future, but the reality shows that we cannot choose the right people for reforms and economical growth. This article is an attempt to look at this phenomenon in terms of political choice, which makes an average student. Perhaps something wrong with this choice? And whether public events can elevate the quality of our political decision making: namely did events on Maydan influence the process of decision making for whom to vote on elections to Parliament among students?

II. Background studies

Shane Frederick (2005) offered to students of different universities three logical problems. These problems contain a hint of wrong answer. But if they were able to resist the temptation to give the first best answer, they solved the task correctly. It was found that students of the most prestigious universities, Harvard, Princeton and the Massachusetts Institute of Technology solved all three problems correctly only in half of cases. And only 20% of respondents from the universities with less strict selection coped with the problems [1]. We can assume that if those same students would have the task to make a political decision then in the best case only 50% of young people will make some effort to the process of decision making. And the rest pupils will be guided by the facts that are on the surface (advertising, news, other people opinions etc.). Note that these intuitive tips have very little in common with rational choice, quality facts and sources.

Group of researchers led by Alex Todorov (2005) [2] predicted the results of elections of senators, congressmen and governors in America by the way of students evaluation the photos of candidates. Rating students coincided with the victory of suitable candidates in 70% of cases. This result was confirmed during the election campaign in Finland, elections to the municipality in England, and various election campaigns Australia, Germany and Mexico [4, p.121-129]. The ability of such easy and fast decision making is appropriate in terms of human survival during evolution. But in the context of choosing political future of the country such strategy does not lead to the good consequences. There are no relevant scientific evidences that facial features linked to how well politician cope with his/her responsibilities.

We supposed that not only appearance, but much more types of irrelevant information can guide our political choice. And most people still do not realize that we often become victims of our own imperfect mental nature, even in very important decisions.

III. Research question

Mainly Ukrainian people believe that "Revolution of dignity" has changed our minds, made us wiser and more responsible for own future, aroused more interest to political life in the country and the desire to affect it. Have these events affected the ability of young people to invest more psychic energy in their own political decision making?

IV. Methods

The research was conducted 2 weeks before parliamentary elections 2014 in Ukraine. The study involved 105 students from Lviv Polytechnic National University. Students completed S. Federik three-item test, that measures people's ability to resist their first instinctive thoughts, answer questionnaire about their motivation to take part in the elections and their decision for whom to vote and why. So, the results of S. Federik test show us the personal ability to stop and think as opposed to giving first best intuitive answer. And as a result of filling the questionnaire we can count how many appropriate efforts the person make during process of political decision making (compare different candidates, canalize his/her previous professional experience, have read political program, use different sources of information etc.). Also the participants were asked to estimate their activity during events on Maidan on 5-point Likert Scale.

V. Results

The main results of the study are as follows: only 2% of participants coped with all three S. Frederick tasks correctly. But more than half of students put some efforts to resolve items and propose at least one not intuitive answer (though not always correct). However, correlation analysis showed that the ability to solve cognitively

complex tasks does not correlate with the amount of efforts students invests in political decision. Perhaps in this case context affects more than having specific cognitive skills. In other words the one can have the ability to "stop and think clearly", but, whether he use it depends on the situation.

Only 29% of students have tried to build on some rational arguments when they did their choice of political parties. For example, take into account the previous achievements of the candidates, educational level or proposed policy initiatives. But most of young people (it is 71%) thought like this: «Does this political party proclaim better future with Europe? Does it have strong leader? Was the candidate on Maidan? Does he help the army?» etc. All these options weakly predicted how the candidate will carry out the duties in parliament. But the vast majority of the students did not realize it and thought that their choice built on such evidences was good enough. 94% of them noted the medium and high level of confidence in their own choice. Also there was no correlation between the amount of rational arguments and personal evaluation of the quality of choice.

In order to assess the individual student efforts in the process of decision making we ask such questions:

Have you thought how your political decision for whom to vote affects the future? Half of the students take into account such possibility. However the rest (49 %) were astonished by the question. This might point at the tendency to live here and now in the euphoria of election promises and very poor prediction of the future.

Can you name any disadvantages of the party you are going to vote for? Only 43% of students can answer this question but more than half cannot. This statistic illustrates another cognitive weakness of our mind. As soon as we have found suitable solution, any contradicted information did not take into account anymore. So the decision looks almost perfect, what never happens in reality.

Can you name to sources of information you count on in making political decision and assess their quality? Students were equally confident that their sources were good enough regardless (an average of 3-4 out of 5) of real criteria of quality. So youth are extremely insensitive to the quality of information which backs up their final decision. As Daniel Kahneman writes: if the information is not discarded immediately as false, it enters the cognitive life and treats in the decision-making process, as evidence which backs up the final statement [5].

Student's gender, age and year of study did not affect their process of political decision making. The same cognitive errors made girls and boys, younger and older, freshmen and graduates.

Finally, whether the active citizenship during Revolution of Dignity influences the quality of the political decision? Can we say that people, who actively participated in the events, invested more mental energy in their voting decision? Not quite. More active students made the same cognitive errors. But they felt statistically more confident in their choice of parties and deputies, in the quality of back up information, and that in case of failure, they again ready to go to the barricades (57% vs 10%), whereas their peers are more likely will feel completely disappointed in case of failure (75% vs 11%). By the way, approximately 1/3 of the students described themselves as active participants of Maidan events, 1/3 – moderate and 1.3 - passive observers.

Conclusions

In this article we have tried to look at the political process in the country in terms of the rationality of voters. Students were a good example of how people tend to make mistakes and be guided by the illusion of competence. Even when they desperately want to change the system. We think that Ukrainians still need overcome a long way from emotional-spontaneous-revolutionary to careful-thoughtful-reflexive process of decision making in politics. And that might be the real chance to create a better future.

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Psychological aspects of money attitudes

Ilona Tymtsiv

Theoretical and Practical Psychology Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: ilona.tymtsiv@mail.ru

Abstract – In this article the theoretical analysis of the psychological characteristics of money attitudes is represented. The study of psychological aspects of attitude to money is necessary, as it will allow analyze and forecast macroeconomic phenomena more effectively and will provide deeper understanding reasons of different humans individual economic behavior as well as psychological effects staying in a specific economic area. According to of Golubeva`s A. research, there`s a difference in certain psychological features of peoples with different income level The development of psychology empirically has shown that the "man-finance" system is extremely synergetic. Thus, an interesting topic for future research is to explore what`s primary - is this personality determines a particular financial behavior, financial situation, or maybe there are some personality traits which are somehow modified and determine by the money attitudes.

Key words – money, attitude, financial behavior, money disorders.

I. Introduction

The psychology of money is not really explored area yet, but it is extremely relevant as well as socio-economic phenomena become more plastic, unstable, which certainly serves stress factor. Therefore, the study of psychological aspects of attitude to money is necessary, as it will allow analyze and forecast macroeconomic phenomena more effectively and will provide deeper understanding reasons of different humans individual economic behavior as well as psychological effects staying in a specific economic area.

Talking about the psychological aspects of money, it must be said that the socio-cultural approach considers them as: equivalent image of the things or services to which they are being spent; as a tool to achieve the goal; [1] as a means of achieving security, freedom, obtaining and keeping power or love (Kybyzova LY). [2]

II. Psychological specificity of attitudes to money

The attitudes toward money reflects the phenomena that arise on the human interaction with financial space. Attitudes includes an affective, cognitive and behavioral components. The study of Golubeva A. analyzes each of these components of the respondents with different income.

Interestingly, that in the cognitive plane people with income below average, money are not only perceived as a means of life and well-being, but they are also identified with a freedom, what`s less typical for people with higher incomes. In the affective sphere, the emotions manifested most clearly in the less-money situation model. It refers both to people with low and high-income. It`s specific, that in a lot-of-money model situations, the respondents with high income feel much more guilt than peoples, who have less income. Concerning economic behavior, the wealthy people manage their capital optimally and are able to make profitable investments, while poor people tend to build ambitious plans for future earnings but spend more than they can afford. At the same time, people with average incomes, tend to spend all earned money for stable life, but does not allow at least minimal financial growth. [3]

Psychometric Money Attitude Scale, developed by K. Yamauchi D. Templer (and popularized later by Ad. Furnhams researches) has opened new features in studying semantic characteristics of money attitudes. It highlighted the factors that determine the monetary guidelines and behavior, this are: gender, social environment, economic status, personal characteristics and others. For example, men tend to overcharge the value of money, and were found more competent at their disposal, able to take risks with a view to profit. Women, in turn, feel more frustration at the lack of money and more jealous of those who are not. In addition, women and young people tend to spend relatively more money as self- therapeutic factor. [4]

Psychologists also see in money an powerful cultural symbol that contains many contradictory and irrational collective perceptions, beliefs and attitudes. [5]

Western studies have shown how much there are myths on financial issues in a certain individual conscience. These irrational beliefs are formed in childhood and determine economic behavior through the emotions (Maggie Baker).

Margarita Tartakovsky, in her article “7 Mistaken Beliefs About Money” made a review of the current literature of the finance psychology and describes some misconceptions. For example, people tend to mix up net worth of things surround them, with self-worth. There`s also wrong people`s belief that someone is bound to take care about them, which leads to disorganization of their outlay. Also, people always want to have more money than they actually are able to make - this is the main cause of debts. The "pursuit of fashion" is another problematic point - people buy things which can`t afford.

Another problems which deform economic behavior is blind faith in the competence of financial advisors who rarely resorted to individual analysis of the client`s life situation and do not include influence of subjective psychological factors of money behavior. The financial culture of the Ukrainian society is extremely low, so the myth that efficiently money managing is just elementary, is very common for us. However, in practice, only certain ones analyzes or compares their costs with their income. [6]

When we talk about insurance, deposit savings or profitable investment, Ukrainian typically react with skepticism or even fear. Even if someone deliberately tries to improve their economic state, the behavior anyhow will leads by the imprints, even when it`s unrational. [7]

We see that complicated relationship with money are very common fact. Studies show that money is the first reason for divorce in the early years of marriage and a

common area of conflict for couples. Also, 3 out of 4 Americans identified money as the no. 1 source of stress in their lives. [8]

Obviously, people unconsciously seek to avoid frustration. Thus, within the gestalt therapeutic method originated thesis that most common protection mechanisms of a certain person, working in any other system of attitudes, equally triggered in relation to money. In particular, these are:

• merger (can be marked by using phrases such as "our money", "we earn," "we lack");

• retroflection (person didn`t endeavor to obtain the necessary income, not asking for money for the work);

• proflection (person hands out money and makes services that she would like to receive);

• deflection (escape from contact with money, people live as if they didn`t exist, are often dependent on others, even if it means minimal life level).

The contact cycle between people can also be applied when we consider exposure to the money. Such kind of analysis can show the way how to manage capital more consciously. There are three stages of the cycle:

1. prekontakt stage (it is important to analyze the emergence of money, their sources; strive to own money);

2. stage of contact (important to manage money according to the needs, enjoy the benefits obtained for them the prospect of saving accumulation);

3. postkontakt stage (important to learn the right way to "release" the money, not to spare them, and track the pleasure derived from the acquisition of important things or services; look for a new focus on earnings). [9]

III. Money disorders

However, experience shows that only certain ones resorts to such reflective analysis of their economic state, and therefore falls into self-destructive and self-limiting financial behavior that in common psychological science is classified like disorders.

There are three categories of money disorders:

1. Money Avoidance Disorders (also includes Underspending and Excessive Risk Aversion):

• financial denial: (person avoid to confront with the financial reality);

• financial rejection (any monetary income causes an acute feelings of guilt, what`s especially true for people with low self-esteem).

2. Money-Worshipping Disorders (also includes Pathological Gambling, Workaholism, and Overspending):

• hoarding (storage or capital gives a feeling of safety, security and ease anxiety);

• compulsive buying (purchases ritual provides a excretion of dopamine in the brain and, consequently, a temporary escape from worry and anxiety).

3. Relational Money Disorders (also includes Financial Dependence and Financial Incest):

• financial infidelity (concealment or misrepresentation concerning money deals);

• financial enabling (when people tend to give away money, even sacrificing their own financial well-being for others).

However, the foundation of the financial health isn`t that difficult, first step is a recognition of false financial guidelines, and their replacement with more productive once. Thus, working on the effective financial behavior will provide not only financial, but also emotional well-being. [8]

Conclusion

In conclusion it would be good to mention Simmel`s philosophical view on the phenomenon of money. He believed that money dehumanizes the person, negate its individuality. [1] However, the development of psychology empirically prove the falsity of this assertion because the "man-finance" system is extremely synergetic, where certain elements are closely interconnected and determine the characteristic qualities of each other.

Thus, an interesting topic for future research is to explore what`s primary - is this personality determines a particular financial behavior, financial situation, or maybe there are some personality traits which are somehow modified and determine by the money attitudes.

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Lonely life – a new way to happiness of modern human?!

Zoriana Vilchynska[1], Vira Vilchynska[2]

[1]Practical Psychology Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: zorina.v21@gmail.com

[2]Social Communication and Information Science Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: vira.vilchinska.dk@gmail.com

Abstract − The article discusses the choice of a lonely life. Therefore, the aim of this study was to show both advantages and disadvantages of living alone. The principal supporters of a strong, traditional marriage is becoming less and less. Despite a number of positive aspects a lonely life, it is proved that better in this life to have a couple, than do not go through life alone.

Key words – lonely life, happiness, a career, single people, married people.

I. Introduction

According to statistics, more than 300 million people around the world choose a lonely life, and a lot of them conscious and happy to go for it. Pollsters predict that in 2020 the number of bachelors in the world will reach 331 million. Today, in all developed countries, the families as well as a social institutions, are experiencing not the best of the times. Every year fewer and fewer couples design their marital relationship "as expected", and the number of registered divorces in families literally rolls over. Even today in the United States only 51% of the population are married instead in Ukraine of all marriges end in divorce 42%. Others live on their own. In EU countries, the loneliest are Germany, Denmark, Sweden and Norway. The principal supporters of a strong, traditional marriage is becoming less and less.

Obviously, there must be certain benefits in a lonely life. Is there something that inspires them to live such life? Is lonely life really a new way to be happy!?

II. The main results of researches

It is this idea that suggests a new study of British researchers, (Knowles, 2005) [4] which found that in reality the individual are aiming at a successful career, happy people, happy with their status. Today, the phrase «I'm alone» does not cause joyless thoughts of lonely cold nights. In today's hectic lifestyle lonely people are much more charmed and have great memories than their «engaged» friends. Perhaps modern single people no longer feel the unspoken discrimination because of their position and use their status to travel and experience new sensations in life.

A growing percentage of singles are due to later age of marriage and starting family after thirty years or closer to forty. «Social curse» loneliness behind. Single people use this time to make a career and explore the world before settling down. This is due to the gender revolution, because more and more women get engaged in profession and career, by it postponing marriage. There are a lot of selfconfident, strong women who live alone, and are independent of men. Of course this is not a permanent condition, but only a phase which people go through (Skices, 2005) [4].

A researcher, whose publication coincided with a national week of singles, showed that 82% of respondents say that their status gives them the opportunity to «experience something new in the life», 89% say that traveling alone increases their selfconfidence and allows them to be more spontaneous and easy going (Knowles, Skices, 2005) [4].

Describing their lifestyle, study participants said that employment at work creates the conditions for self esteem. 83% pointed out that a good career for single people is more important than for those who are married.

One of the modern demographers Jitya Rychtarikova, notes that in the modern Western world there is a trend : women tend to abandon the career of housewives to work alongside men (Rychtarikova, 2014) [5].

Single people can more clearly focus on the achievement of certain goals, not being distracted by family and interpersonal relationships. They quickly and effectively solve the problems of workers and reach career peaks rapidly. In contrast to the family of people whose career resembles a pyramid: increases gradually, based on kinship, acquaintances, a good relationship, and only then on the qualifications, education, ambition and career, singles can be faster. It resembles a candle: fast growing horizontally, is primarily based on self serving relationships, ambition, opportunity to get a better education and to get the best business experience, not bound by family obligations. They prefer to less depend on stable long term relationship, a more pragmatic and cynical (Whitehead, Poug, 2004) [5].

It is interesting to note that there are some religious and philosophical trends, who believe that to truly understand the divine is only capable of a lonely man, unfettered relationship with others. It is assumed that the state alone facilitates a focus on finding and reaching the other states of consciousness, finding themselves present, «the God within».

Despite all the positive aspects of a lonely life, there are less pleasant aspects in it too, that encourages people to it. One of the reasons why people choose a lonely life, is due to the fear of being abandoned, fear of the thought that a happy family that is united because of some circumstances, may end in divorce. Also due to previous unfortunate experiences, people are holding back in remarriage.

Today, in all developed countries, the families as well as a social institutions, are experiencing not the best of the times. Every year fewer and fewer couples design their marital relationship "as expected", and the number of registered divorces in families literally rolls over. This situation is not liked by many, but no matter how much government tries to influence it, the principal supporters of a strong, traditional marriage is becoming less and less (Lenders, 2012) [2].

The reasons for such situations are: economical, moral and religious. They all lead to the same result - the number of divorces is increasing simply at an alarming rate.

A very high a standards of life and a very powerful social protection, due to which people do not need each other. Hence, as soon as people get a slight feeling of discomfort or unatraction to the partner, it leads to immediat separation. Today, divorce is so common that it is accepted by public a very naturaly and do not dramaties about it in anyway.

However, the status of loneliness, there is an opposite point of view. In particular, (Hall, 2013) [1], the scientists conducted a study involving thousands of men and women of all ages for 10 years and have shown that people who feel loved and desired look an average of seven years younger than those who love life. In this study, the age of the volunteers was assessed each other by their appearance. It was assumed that the decisive factor in preserving youth was regularly having sex. During sex, the body's production of endorphin, hormones of pleasure and tranquility. They help sleep better, relax anxiety, improve the circulatory system, which of course affects the appearance of the person.

Interestingly, married people live longer (Ziegler, 2013) [3]. American researchers have found that men who were never married, have three times higher chance of premature death than those who tied the knot. This is especially important after the onset of 40 years.

In the study, the researchers took into account the way of life of volunteers and the presence of harmful habits. In spite of everything, married people are 2-3 times lower risk of premature death. This interesting fact, that scientists explain the fact that married couples regularly eat right and otherwise care for each other, which contributes to high quality care for the health and improve the emotional background.

Conclusion

According to the results of the theoretical analysis of the problem of loneliness of modern people can summarize that lonely lives can have both advantages and disadvantages. In particular, in single people it is aimed at a career and success, happy people, 82% say that their status gives them the opportunity to «experience something new in the life», 89% say that traveling alone increases their self confidence and enable them to be more spontaneous and easy going, busy at work creating conditions for self esteem. Describing their lifestyle, study participants said that employment at work creates the conditions for self esteem. 83% pointed out that a good career for single people is more important than for those who are married. However, on the other hand, single people with age are statistically more likely to have medical problems and generally shorter life expectancy.

The main factors that mediate a healthy married life scientists call: regular sex, mutual caring and emotionally warm relations. It can be assumed that the family life forms, despite some obstacles in career and personal development, continues to maintain its benefits for physical well being of the individual. But loneliness is not bad too, it is assumed that the state alone facilitates a focus on finding and reaching the other states of consciousness, finding themselves present quite often prevents a person to organize their lives around the above resources. Therefore, losing to regular sex, caring attitude of the partners and emotional warmth, lonely man loose their own health and longevity. Interesting, is a lot of lonely people of today are aware of this?

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Self-control as pre-condition of success

Nazar Yaroshchuk

Theoretical and Applied Psychology Department,
Institute of Law and Psychology, Lviv Polytechnic National University, UKRAINE, Lviv, 1/3 Knyaz Roman St.,
E-mail: big-nazar_3@bigmir.net

Abstract – Presented research project . The article offers a look at the phenomenon of self-control in the sport activity, especially Chinese martial arts, as kung fu fighting style. In pilot study plan, the fighting is used as a training of skills of self-regulation. It is assumed that such sport activity allows the young men to develop the skills of self-control and self-regulation in the battle that they can carry out for the other spheres of their lives. As an important additional variables study will examine the fighting experience and the frequency of trainings. As a result, we expect to describe the efficiency of such sport activity as kung fufighting. Research aim - to reveal the features of intercommunication of self-control development level with an emotional sphere, body motility, locus-control, volitional sphere and coping-strategies for people, which go in for sports.

Key words – self-control, volitional sphere, emotions, locus control, coping-strategies, consciousness, personality.

I. Introduction

Everyday life is filled with various stresses which are its inalienable part, which form stress reactions as a result of influence of non-standard terms on a human, which violate its homoeostasis. Every stress reaction of personality is accompanied by strong destroying emotions which create a disorientation effect in flowing of higher psychical functions and body motility, where ability effectively to control own activity in a stress situation by using of self-control will determine the personal success. Control of activity appears as a result of studies on the different stages of life, as is the factor of previous education and self-education of personality. And one of the most stress experiencing is saturate sporting activity.

Strong feelings saturation of sport activity, what personality can control in everyday life - it one of major terms of positive influence of sport on human personality.

Going in for sports assists the change of bodily and psychical condition of man.

The correctly organized employments strengthen a health, improve physical and psychical development, promote physical preparedness, capacity, perfect the functional systems of man organism. Body and psyche practice, working with loading, expanding the limits of their possibilities, growing competence and adaptability of personality.

Therefore research actuality consists in development of the practical methods of effective application of sportsmen self-control in sporting and everyday activity.

II. Description of the self-control phenomenon

People daily hear the most various interpretations of the self-control phenomenon in the different activity spheres. On the basis of scientific sources analysis of investigated issues such determinations of self-control were found in the different spheres of activity.

Self-control is the continuous comparing to the corresponding biological standard, where the signal of inconsistency, which appears a push to proceeding in the broken equilibrium, appears as a result of collation. Psychophysiology (I. Sechenov, A. Bernstein).

Self-control is a strength of human fortitude, which helps to reduce unnecessary emotions, take under control the different feelings, words and actions, correct internal defects, correlate the necessities and financial possibilities, in an order to operate most correctly in accordance with an actual situation. Entrepreneurial activity (V. Kolyvay, K. Solov'yenko, V. Zelenin).

Self-control is regular supervisions on the state of the health, by physical development and physical preparation and their changes under act of the regular engaging in exercises and sport. Sport (P. Hotovtsev, V. Ilinich).

Self-control is human ability to realize and control own essence on the basis of higher psychical functions (in future - HPF) personal development , what helps to regulate superfluous emotions, control motility in activity, form a willingness in every situation to operate most rationally and correctly.

The most rational description of the self-control phenomenon is based on its objective characteristics. Kirichenko T., Konopkina O., Zinchenko V. distinguish such physiological characteristics of self-control, as ability to control own emotions, functioning quality and control of HPF, control of shallow body motility, attracting attention, locus control, motivation in success achievement, adaptiveness, will to victory, behavior in coping-strategies [1,3,4.]. Thus, psychological mechanisms form the aggregate of psychical properties of individual, which in accordance with the own development level, determinate quality of self-control functioning in acts, behavior and form group on standards, values, as the personal so public character.

However, the question remains not fully studied, *on how many training experience is able to change the physiological indexes of personality*, which determine the base constituents of self-control development during going in for sports, such as development of volitional sphere, emotional control, locus control, choice of behavior strategies in stress situations, attracting attention, control of shallow motility, level of internal motivation.

Before sparring of sportsman there is the strange state, when shaking is felt whole-body, anxiety, state of obtrusive ideas, doubts insinuate oneself for the result of the performance. Quality and intensity of this state depend on the level of physiological preparation. This state influences on an organism in two ways - from one side, considerably excites the nervous system and under its action sportsman loses self-control, or, vice versa, there is strong dormancy of the nervous system what conduces to the constraint and interferes with freedom of actions[2].

Distinguish such prelaunch states of sportsman: 1) alertness - psychophysiological ability to enter into sparring and conduct it; 2) prelaunch fever - excessive agitation, alarm, increased irritability, instability of mood, causeless fussiness, carelessness, weakening of HPF;

3) starting apathy - a low level of emotional excitation, somnolence, absence of desire to compete, dismal, uncertainty in the own forces [2].

Basis of self-control forming is a volitional sphere of personality - special form of man activity, what consists in that a man carries out effort above itself for the sake of obstacles overcoming in realization of beforehand formed plan of actions.

Self-control is related to development of volitional sphere and planning of purposeful changes personality in itself, capabilities to control emotions and is based on the personal experience of capture the internal psychophysiological mechanisms and backlogs which are sent to the most complete realization itself, and also provides the submission of reasons during all life, construction of hierarchy of reasons and resolve of various conflicts.

Destroying influence of stress, which strongly grows in the period of prelaunch fever, conditioned by influence of strong-destroying emotions, and characterized by dispersal and confusing of HPF, coordinated and causal activity, form non-adaptive automatisms. Thus, a mental estimation is an interlink between perception of a stress event and its overcoming, controlling the emotional states and behavior.

An important role in the process of self-control of sportsman before sparring is played by own emotions control, that determines the measure of capacity for the recreation of technique, which provides a capacity for effective counteraction to the rival.

K. Izard marks, that the most effective method of adjusting of the emotional state is a method of the directed consciousness : 1) through other emotion; 2) through the cognitive adjusting; 3) through the agile adjusting.

At the same time one of features of man activity is characterized by that the result of activity display not always coincides with its aim. At that rate a man is inclined to explain and search consequences reasons of the actions in external or internal reasons, that in turn characterizes an orientation and force of locus-control.

A mental estimation which was formed on the basis of subjective situation perception influences on the subjective form of stress experiencing event, but also accordingly, where on the basis of opinions analysis, models and behavior in a stress situation, forms intensity and quality of further reaction activation and selection of coping-strategies. Coping-strategies are formed in the process of socialization of personality and focus personality depending on its level of development and situation on the problem estimation, emotions, and accordingly determine behavior in stress.[2].

Quality of coping-strategies functioning connected with the level of self-control development and is the system of actions which are used by a man in the situations of threat to personality and social prosperity, in the cognitive, emotional and behavioral spheres of personal activity and conduce to successful or less successful adaptation. Especially saturated by stress events is sporting activity in which it is necessary to form result achievement, to develop and use effective coping-strategies. Self-control is carried out as an only process which provides mobilization and integration of psychological features of man for aims achievement of activity and behavior. The process of self-control assists making of effective human behavior, that using it to manage on a way to realization according to the put aim.

III. Research results

According to the research results *in relation to the self-control indexes such, as ability to control own emotions, shallow motility of body and attracting attention,* it is possible to come to such conclusions:

1) sportsmen before sparring demonstrate 9-10 errors in a counterbalance to 3-5 errors in the quiet state (methodology is "Labyrinth");

2) 70% sportsmen are shown the most intensive height of emotional tension before the fight - 4,33 in a counterbalance 0,58 in the quiet state (modified test of Luscher);

3) the least effectively for sportsmen to concentrate own attention before the fight - the relation index of revised symbols amount to the amount of errors presents 2,05 in a counterbalance 2, 62 in the quiet state (methodology "Proof work" N. Bourdon) ;

4) during sparring sportsmen with a 5-7 annual experience of training-contention activity do 3 errors, beginners with 6-monthly experience of training do to 9 errors (video-analysis) ;

5) quantity of errors in sparring depends on :

- concentration level of sportsman attention before sparring;
- normal level of sportsman attention attracting, what is directly proportional to the general amount of years of going in for sports ($r=0,700$, $p\leq0,05$);
- control of shallow motility before and during sparring, depends on the normal level of shallow motility control, which strongly depends on the general amount of years of going in for sports ($r= - 0,767$;$p\leq0,01$) ;
- sport experience the key and prevailing element of which is fighter experience,

for a sportsman the amount of errors diminishes the height of self-control which a sportsman assumes in sparring ;

6) with the increase of self-control level, as in stress so in standard life situations grows:

- level of general self-government ($r=0,584$; $p\leq0,01$) ;
- general internality ($r=0,519$; $p\leq0,05$) ;
- internality in the sphere of attitude toward a health ($r=0, 561$, $p\leq0,01$) ;
- internal motivation ($r=0,337$, $p\leq0,05$) ;
- internality in the sphere of achievements ($r=0,383$; $p\leq0,05$) ;
- a capacity for creation of productive behavior model for achievement of the aims, which is formed on the basis of self-examination, realization of own possibilities and aims, where in future by using of developed HPF, forms and forecasts efficiency of plan component elements in case of personal realization of its success - realizes it on a way to gaining end.

Research results demonstrate direct connection between the level of self-control development and duration of training (See Table. 1).

TABLE 1

INTERCOMMUNICATION OF TRAINING YEARS AMOUNT AND LEVEL OF CHARACTEROLOGICAL FEATURES DEVELOPMENT RESULTS OF CORRELATION ANALYSIS

p≤0,01

Character traits	Term of training		
	10 > years	2-5 years	0,5-1 years
Motivation	0,805	0,535	0,243
Combination of activity spheres	0,732	0,458	0,236
Quality of realization in the contiguous activity spheres			
A general capacity for self-government	0,698	0,368	0,087
General internality	0,719	0,478	0,287
Internality in attitude toward a health	0,756	0,308	0,190
Internality in productive relations	0,733	0,372	0,205
Internality in the achievements field	0,861	0,446	0,235
Application of coping- strategies			
Confrontation	0,601	0,472	0,201
Ranging	-0,446	-0,224	0,465
Acceptance of responsibility	0,530	0,335	0,130
Escape-avoidance	0,473	-0,231	0,273
Planning of problems decision	0,623	0,299	0,223
Goal setting	0,730	0,306	0,125
Self-control	0,765	0,332	0,215

These cross-correlation copulas show that a level, quality and frequency with which a sportsman elects self-control strategy in a stress situation, grows with the increase of training years amount. In the process of life activity basic responsibility in obedience to the exhaust actions plan a man undertakes itself, for quality of implementation of which answers personally. Solving problem tries to control own emotional impulsive gusts, plans the method problem decision, and tries to adhere it, inclined to depend upon the help of surrounding in difficult life situations. A man lays responsibility for a 1) State of own health only on itself, and in case of diseases origin first of all searches its reason in itself, and then in external circumstances. 2) Qualities of norms setting of behavior, as in stress so in ordinary terms in accordance with own persuasions. In stress situations inclined: directly to participate in the problem decision or conflict situations, not avoiding and not escaping from them, inclined to depend upon the help of near surroundings. As a result of mans self-control level increase grows its capacity for creation of productive model of behavior for the aims achievement, which is formed on the basis of self-examination, realization of own possibilities and aims, on the basis of what a sportsman forms and forecasts efficiency of own activity plan and in case of the personal realization of its success realizes it on the way of gaining end.

It is necessary to develop internal motivation which determines integral development of personality, and especially development of self-control. It must be developed by self-examination of own essence, and by realization in those spheres of activity to which personality has senses and capabilities.

Going in for sports substantially promotes ability of sportsmen to self-control, as in quiet so in stress state, however not all sportsmen realize essence and application of psychophysiological skills domain, which them acquire during the systematic, exhausting and persistent training, that is why own more subzero capacity for combination of activity spheres. Hereupon is more successful in sporting activity and less successful in other spheres of activity. Intensive going in for sports and acquisition of practical experience straight related with ability to demonstrate the best skills of self-control, as in stress so in standard life situations, on condition of conscious internalization of the purchased skills.

At those respondents which combine the spheres of activity with the increase of years amount of going in for sports grows level, as general iternality so internality in different spheres, general capacity for self-government and self-government in the different types of human activity, grows using frequency in stress situations of such coping-strategies as: self-control, planning of decision of problems, goal setting, acceptance of responsibility, and goes down the frequency of using such coping-strategies as: ranging and escapes-avoidances. Those respondents which do not combine the sphere of realization characterized by lower level of these indexes.

Therefore a successful sportsman is that which:

- systematic working on itself, develops, as unique creative personality which in most cases operates according to own persuasions and not yielding under ruinous konformisty influence, however operates adhering to the norms acknowledged in general lines.
- tries on the basis of permanent prosecution of itself and self-examination as possible deeper and completer to realize its calling, capabilities and inclinations, clearly to define the realization spheres, which will strengthen the formed motivation which is motive force for understanding of new levels development in turn .
- developing in obedience to calling, spares to it most time and efforts, operating in obedience to own persuasions most self-weighted and correctly, however not forgets to develop integrally in obedience to secondary and tertiary capabilities, on the basis of self-development, purchased experience and capacity for combination of spheres of realization. Living by such lifestyle a man develops completer, promoting its adaptive, internality, capacity for self-government and also accordingly the personal success.

Conclusions

This research shows that a level and quality of self-control development straight depend on: traning duration ; level of internal motivation ; capacities for high-quality combination of activity spheres ; level of locus-control ; general capacity for self-government, forming and quality of coping-strategy realization.

Research results can be productively applied in psychology of sport for groups with training experience

from 2 to 5 years as training in which most efficiency in a state of stress bring such exercises, as tuning on the maximal use of technical and tactical descriptions in combination with the arbitrary adjusting of breathing frequency and conscious control after own thought.

With the aim of training self-control indexes improvement, for realization of which was worked out questionnaire, which included the synthesis of psychophysiological technician, for adjusting of psychophysiological eigenstate and was based on methodologies adaptation of S. Dmitrov, O.P. Bludov, B. Pervanov, P. Bogomolov. From 18 used technician the most effective results are got and described, namely:

- adjusting of breathing frequency during strong emotional tension grows on - 5% ;
- ideas concentration for achievement of victory, high result - 10% ;
- tuning on the maximal use of own technical, tactical and physical possibilities, through realization of own opinions, actions, psychophysiological state, and to their control, with forming of the further positive setting on decisive successful activity, by means of order method which forms self influence - 47% ;
- making for the sportsmen the conscious control of : thoughts, emotional state and external signs of it manifestation, and also with the help of the special physical exercises on weakening and tension of muscles in combination with respiratory exercises - 23%;
- self-suggestion - a sportsman convinces itself, that must win, applying : deep self-examination, high self-control, self-confidence, by activity - 5% ;

As a result of the training methods use by sportsmen, quantity of sparring errors during 3 - 4 months of training went down from 8 - 11 to 6 - 7 for 63% of sportsmen.

These research results can be effectively applied in : commercial, military, political, educational and teaching activity.

Quantity of sparring errors, which testify to the level and quality of self-control features and sportsman technical, can go down only from 10 to 3 errors for 5 years of the intensive training.

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New social media and intercultural understanding

Olena Astakhova

Abstract – New social media have become increasingly popular components of our everyday lives in today's globalizing society and cover almost the entire world today. They provide a context where people across the world can communicate, exchange messages, share knowledge, and interact with each other regardless of the distance that separates them. With its digital, convergent, interactive, hypertextual, and virtual nature, new media that nowadays transforming communication across cultures has brought human interaction and society to a highly interconnected and complex level.

Key words – new social media, intercultural, understanding, communication, globalization.

The rapid transformation of human society due to the impact of the convergence of new media and globalization directly influences the construction and development of cultural identity. Intercultural adaptation and understanding involves the process of promoting understanding through interaction to increase the level of fitness so that the demands of a new cultural environment can be met. Research shows that people tend to use new social media to become more integrated into the host culture during their adaptation and to maintain connections to their home countries [1], [2].

Intercultural communication has existed since the earliest times of history and civilization of mankind, and now the Internet has made it possible to access and create social networks and link between people from all over the world. In fact, we can access information, which is related to the culture of any person, the geographical location, climate and so on any continent.

Religion and culture can provide deep meaning and richness to our lives. Yet, throughout history, they have also been flashpoints for conflict and misunderstanding. In the wake of tragedies there is heightened interest in finding new ways to promote interreligious and intercultural dialogue. Unless ignorance and hatred can be overcome by tolerance and understanding, religious and cultural conflicts are likely to continue—and intensify. New technologies propel our interconnected world, with the Internet giving us powerful ways to connect to a diversity of people, places, and ideas. New social media has become a versatile and increasingly important part of our online lives. Websites such as Facebook, Twitter and YouTube allow users to communicate, engage, and create content and information at an unprecedented level of speed and accessibility [3].

New social media has an impact on us because it promotes the interconnectedness and interdependence of our culturally diverse world. Media for social interaction allows for people to communicate and engage with

Lviv Polytechnic National University, Institute of Jurisprudence and Psychology, Lviv, Ukraine, olena_astakhova@ukr.net

information that is quickly accessible on the Internet. In today's society, there is an increasing number of Internet users so new social media has become more popular in daily patterns and routines.

The communication that occurs in these online contexts promotes interactive dialogues that build understanding of different points of view. In social media, people have the opportunity to express their opinions to the public and participate in conversations and dialogue through a common virtual medium. While providing a common way of linking people together through knowledge, behaviors, and attitudes, a sense of belonging to a greater social network other than one's own local community is effectively created. The Internet exemplifies such a significant means in connecting to a diversity of people, places, ideas, and cultures [4].

"The multicultural world is enhanced by the experiences of sojourners, immigrants, and others who successfully make the transition from one culture to another", declares a professor in the Department of Communication at the University of Oklahoma Dr. Young Yun Kim. Intercultural studies focus on the interactions between people from different cultural backgrounds and adaptation is a dynamic process. A conversation between individuals from distinct traditions for the primary purpose of engaging religious difference in order to deepen one's own faith while expanding knowledge of the other.

The stages of intercultural adaptation are important to consider when drawing connections to social media use. The four stages are honeymoon, crisis, adjustment, and biculturalism (Lysgaard, 1955 in Chen & Starosta, 2005). During the honeymoon stage people experience initial euphoria with being abroad in a different country. The crisis stage consists of hostility and frustration with living in an unfamiliar culture. Then there is gradual adjustment and recovery, and biculturalism is the full adjustment and adaptation. In addition, communication is an important feature in this intercultural process. Having control over emotions affects the ability to engage in learning and understanding, while being more open and flexible in adjusting to living in another culture [5].

Another result of impact of social media is globalization that develops intercultural understanding. The advent of the new century, after years of immersion in the capitalism system, may mean a gradual transformation of the old society into a new one which demands a different way of thinking and lifestyle. The globalizing society represents a state of competition and co-existence among different cultures.

Although the history of contact between different societies or ethnic groups has been thousands of years, the impact of globalization on modern society is far beyond what people could imagine a few decades ago. In economy, for example, to succeed in global competition a modern company must possess the ability to seek for open markets around the world, to gain enough profits through effective management in global business transactions, and to meet the needs of global clients by acquiring the knowledge and understanding of local markets.

From social and cultural perspectives, globalization has a significant impact on sense of community,

establishment of civic society, and cultural diversity. Globalization has redefined the meaning of community with a new look at inclusiveness and collective sense of identity. The wall between traditional communities also collapsed due to the constant flush of globalization. This transformation, based on extension and expansion from the local to global level, provided citizens in the 21st century opportunities and challenges for learning how to harmoniously co-exist and develop an ideal future world.

Nevertheless, the coming of a global society won't necessarily guarantee that a new sense of human community will follow. A new sense of community requires members to fully involve in the construction of the global society through a learning process. It aims to tolerate the differences of races, classes, cultures, religions, and genders, and to cultivate the capacity of solving the problems or conflicts caused by stereotypes, discrimination, and prejudices. In other words, the ideal goal of the new global community is to develop a space in which members can co-exist peacefully through communication and dialogue. The change of the meaning of traditional community demands a redefinition of the concept of citizenship, which deals with the relationship between local community, national community, and global community [6].

Beyond the importance of establishing an initial "common ground" between individuals, there is little consensus on how to maintain and develop the conversation using new social media tools.

In recent years, interest in talking about religion, faith, tolerance, and dialogue on a variety of websites, pages, and social networking tools has increased rapidly. Popular fan pages and groups on Facebook, such as Faithbook, Beliefnet, and Peace.Facebook, demonstrate that people are interested in discussing their faith and culture on the same website they use to post their spring break pictures and connect with old friends. Additionally, many in the religious community see the utility in having a new social media presence, as evidenced by the increase in churches, synagogues, and mosques using sites like Facebook and Twitter to connect with their congregants and reach out to new members. Overall, respondents recognize that the opportunities—and challenges—represented by the use of new social media for dialogue are important, and many are working to carve out their most effective niche in this rapidly evolving field [7]

Each of us is the product of a society and culture, reflection on what we see by reference to our own experience and culture, are sometimes surprised in agreement of disagreement, admiring or criticizing the new, and event-social novelty. And new social media involves increasing contacts and more diverse between individuals coming from different cultures. If in the past concrete acts of communication between representatives of different cultures involved a relatively small part of the world's population, today, modern and contemporary realities, circumstances and consequences of these processes of communication have increased dramatically in frequency and complexity, which could be possible due to scientific and technological progress that led to a real explosion of social media. They have made it possible that planetary multicultural society now the classic history of theories of communication media.

The internet computer-mediated communication, social networks sites, mobile phones, Skype, text messaging, on-line games, virtual worlds, and blogs have dramatically increased contact between individuals and groups from different cultures. No longer restricted primarily to face-to-face encounters, people worldwide utilize new social media to communicate instantaneously with others regardless of geo-political boundaries, time, or space. Despite this revolution in cross cultural contact, communication researchers have largely ignored the impact of new media on intercultural communication and, instead, concentrated their limited scholarship on how new media is utilized in different cultures and how internet computer-mediated communication is influenced by culture [8].

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Towards the abyss: the influence of parents' alcoholism on the development in adolescence

Khrystyna Khomik[1], Yelyzaveta Honcharenko[2]

[1]Theoretical and Applied Psychology Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: kristina_94a@mail.ru

[2]Theoretical and Applied Psychology Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail:goncharenko.lisa@gmail.com

Abstract – The article presents a theoretical overview of the problem of deviations in adolescents who are determined by alcohol dependent parents. The behavior of alcohol dependent parents or one of them creates an atmosphere in the family, which inevitably creates resistant and mental sets in adolescents on the consumption of alcohol and updates the assimilation of norms and stereotypes of deviant behavior. The results of systematic use of alcohol that are manifested in the family, less visible to the public, but the nature and depth of its actions are the most dangerous and harmful. So, the most difficult consequences of alcohol dependence of parents for adolescents are the following: 1) the desire to consume alcohol; 2) increase in aggression and conflict, irresponsibility, which eventually can lead to antisocial behavior; 3) the emergence of vagrancy as a form of deviant behavior.

Key words: deviant behavior, norm, antisocial (delinquent) behavior, asocial (immoral) behavior, aggression, vagrancy, adolescence, family, alcoholism.

I. Introduction

In modern Ukraine consumption of alcohol by population has remained at a critical point for a long time. Production and consumption of alcohol in our country grows constantly. Thus, according to statistics, in 2012 Ukraine won 3rd place in the world for the consumption of vodka per one person and therefore still the words of Doctor V. Portuhalova, said in 1890, remain true, that the existing habit of consumption of alcohol is concerned and passed from generation to generation. However, parents who abuse alcohol may transfer to their child not only addiction, but also promote the development of other forms of deviant behavior.

Alcoholism is not the only sign of deviant behavior. It should be noted that deviant behavior - is generally a deviation from the established norm. In modern science typically three groups of deviant behavior are considered: 1) antisocial (delinquent), which contradicts the legal norms, threatening social order and people around them. This could be, for example, hooliganism, theft, robbery, physical violence, drug trafficking; 2) asocial (immoral), which is accompanied by breach of moral norms that threatens the welfare of interpersonal relationships. It can be manifested in aggression, sexual deviation, gambling for money, vagrancy, escapes from home, school absences, lie; 3) autodestruktyvna which deviates from medical or psychological norms and threatens the integrity and development of the individuality. In particular, self-destructive behavior can occur in such forms as suicide, chemical dependence, fanaticism, viktymnist - psychological tendency to become a victim [4].

II. Relevant researches

Scientists have long been interested in how children's alcoholism may be associated with parents' alcoholism. One of the earliest attempts to study the extent of alcohol abuse among children belongs to the editor of the first Russian anti-alcohol journal "Bulletin of sobriety" (1894-1898) N. I. Grigoriev. He sent to the heads of the rural colleges inquiry about the extent of alcohol consumption among rural children. Answers were received from different parts of Russia, which showed almost complete consumption of alcohol drinks among rural children who, in the majority, were joined, and sometimes were forced to use alcohol by parents. It should be noted that this study applies only to children in rural areas and therefore the results can not be transferred to the general population.

Besides, parents-alcoholics can pass the destructive addiction to their children by including them in the tradition of drinking, however, an adult himself, under the influence of alcohol, controls less his aggression.

Specifically, 1) alcohol removes inhibitory effect of the cortex on criminal and deviant behavior; 2) under the influence of alcohol occur changes in transmitter system that promote aggressive behavior; 3) chronic alcoholism leads to dysfunction of the cortex that contributes to the pathology of behavior; 4) also alcohol triggers sleep disorders [6, p. 91-92]. Thus, parents become to their children a model for imitation of aggressive behaviors. In particular, from the monograph of C. Starovycha it can be known that the aggressive and criminal behavior of parents-alcoholics in 50-80% of cases transfer to their children.

A.M Korovin, studying the nature of alcoholism of children: what they drink, the frequency of intoxication, the attitude of children to alcohol, showed that the first "alcoholic" teachers are parents. So, boys are taught by parents in 68.3% and girls in 72.2% of cases. A. I. Ishakova (1929), presents data about the frequency of consumption of alcohol drinks by parents and children in a variety of situations: daily consumption 4.5% of parents - 0.7% of children, on Sundays 7.3% - 2.0%, on holidays 54 2% - 25.0%, away 1.1% - 0.5%, often 7.5% - 4.8% [1]. This statistics clearly shows how growth of alcoholism of parents is accompanied by growth of alcoholism of children.

As for other forms of deviant behavior of children, the data of the survey of I.A. Horkova. [2] showed that 92 of the 100 examined adolescents with delinquent behavior (spec. Vocational school in Kolpino) grew in a very unhappy situation, while 88% of pupils' families mentioned alcohol abuse by at least one parent.

Besides alcoholism, 40% of children grew up in single-parent families, 11% of both parents deprived of parental rights, 19% of relatives, at the time of the survey, were in prison. The complete lack of control of behavior on the parents' part and indifference to the fate of teenager was noted in 76% of cases. So we can see that delikventna behavior in adolescence can often develop in dysfunctional families on a background of parents' abuse of alcohol.

The purpose of the study (N.A. Druzhynyn, A. G. Mutaliev, G. P. Kireev, S. V. Shaharova, A. I. Nazarov, I.V. Borowski, 2009) was to conduct integrated assessment of psychological status of adolescents, whose parents suffer from alcohol dependence. There were 222 adolescents aged 10 to 17 years under investigation. The experimental group consisted of 112 adolescents from socially disadvantaged.

In addition, in such families a father or both parents suffered from alcohol dependence and registered by the district psychiatrist. As a comparison group served a representative sample consisting of 110 adolescents whose parents raise their children in a relatively safe environment and do not abuse of alcohol. According to the received data, the researchers concluded that children whose parents suffered from alcohol dependence were different from the control group children in self-confidence, aggressiveness, conflicts and wayward character. They are characterized by rash boldness and propensity to adventures. These children are more often skeptical and cold for others. The relatively low value of factor G by a test of Cattell indicated that children whose parents suffer from alcohol dependence may be unscrupulous, irresponsible, with flexible attitudes to behavior, which can lead them to antisocial behavior. They also differed from the control group children in low self-control, indiscipline, which can also indicate about predisposition to antisocial behavior [3]. While this study is quite comprehensive, but it should be noted that alcoholism and socially disadvantaged families may make a powerful factor in the development of variations in the behavior of the child. Instead, it is still not fully known what impact these factors can have separately.

According to a survey conducted in late 2008 by the Moscow Humanitarian University, it was found that parents' alcoholism become the main cause of vagrancy in adolescence. The study was conducted with children in the streets and shelters in Moscow, with regard to document review. It turned out that 84% of surveyed children had single-parent families, parents of children suffering from alcoholism, drug addiction or involved in criminal activity.

Conclusion

It can be seen that the problem family together with parents' alcoholism create favourable ground for the development of severe forms of deviant behavior in children (alcoholism, vagrancy, predisposition to antisocial behavior). Especially alarming problems in the families of the former Soviet Union, according to P. V. Pinaev and D. Nekrasov [5], that cause manifestations of deviant behavior among adolescents are: 1) physical violence; 2) permissiveness; 3) excess of parental control; 4) sexual violence; 5) problems of intra-family relations; 6) personal properties of parents; 7) low financial status; 8) incomplete family; 9)big families; 10) adoption and guardianship and so on. Interestingly, in addition to parents' behavior, it is important to take into account the behavior of senior children, including sociologist Abby Fahan'ya who found that in families where the older children abused alcohol, 40% of teens started drinking. In families with older children, without alcohol consumption only 10% of teenagers have become addicted to alcohol.

According to the results of the theoretical review, we can conclude that parents' alcoholism together with social disorder affects the development of serious forms of deviant behavior of adolescents.

Specifically, we are talking about the development of such forms of deviant behavior as:

1) the desire to consume alcohol;

2) increase level of aggression and conflict, irresponsibility, which eventually can lead to antisocial behavior;

3) the emergence of vagrancy, as a form of deviant behavior.

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Attitude towards psychological knowledge in Ukrainian society

Oksana Kuta

Theoretical and Applied Psychology department,
Lviv Politechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: kuta.oksana.psycho@gmail.com

Abstract – There are a lot of problems in Ukrainian science. Old fashioned educational programs and students who are not interested in personal growth and professional development are some of them. We believe that all these results in misunderstanding and mistrust to the psychological science in Ukraine. People of different age might use psychological knowledge in everyday life more often – in case of solving personal difficulties problems or for improving quality of life. The results of empirical study of use of psychological knowledge among ordinary people are presented.

Key words – attitude, status of psychology in Ukraine, psychological knowledge, problem-solving, scientific knowledge.

I. Introduction

Psychological knowledge are centered around such interesting topics as reasons of human behavior, relations among people, ways of personal development, strategies of problem solving and conflict resolution, ways of improving quality of life in general. But our historical previous experience determines a lot the amount of value we pose on such knowledge. Many Ukrainians still think that the best way to cope with personal difficulties is to do it oneself or in close relations with friends/relatives, but not with a professional psychological help. Of course it might work in some cases but in others it can only worsen the situation.

Such striking examples the one can see at schools. Almost in every form there are some children who desperately need professional diagnostic and guidance. US statistics shows that in America only 20% of children with mental problems get appropriate help in time and it is 1 of every 5 children [1]. The same time we know that 50% of mental problems in adulthood begin before 18 years old [2]. We don't have such statistics in Ukraine, but our experience of studying and practicing at local schools shows that almost none of the children and his/her family get appropriate help in time. In some cases it results in bulling among classmates, low self-esteem or dropping out school.

Children, teachers and parents in general have not many opportunities to get psychological knowledge or to be introduced to best evidence-based practices, get advice about good professional literature and self-help books. Also there is no psychology subject in school program.

On the other side of the problem of insufficient knowledge is Psychological Department what is mainly lacking well-designed courses, evidence-based practices, modern scientific methodology and experience of spreading valuable knowledge around.

It is obvious that under such circumstances more people choose to solve their problems on their own.

But there are still people, mainly young generation, who doesn't agree the things go that way and are aiming to improve psychological science in Ukraine [1].

So, we decided to analyze and research information about this situation. We try to use scientific works, books and our own experience, because every day we can see, how people do mistakes in their life and jump to conclusion, because they want to solve the problems very quickly and do not want to listen to anybody, realize the main reason of situation or want to close eyes for problem. For example, very happy couple, which has not bad relationships, but has problems, does not go to psychologist, because they think, that there are no difficult situations, but they really need psychological help. In this way they have a lot of arguments and their relationships can be broken. Other situation is when boss does not want to give job to good psychologist, because he believes, that he can work with all staffs alone. In this way he cannot see all problems between workers and can lose good specialists. So, we see, that in two situations psychology can help people, but they have stereotype about psychology and they waste their time.

The other problem is based on incorrect psychological facts and information in the Internet. For example, student is looking for extra information about different types of personality and finds in Internet incorrect information. He uses this wrong information in routine life and makes wrong conclusions. We have always to check information and material from Internet resources. When we use some psychological information, we have to look for it on others resources or to ask the specialist.

Sometimes we can see in the Internet free or not lessons for society, for example, forums, lectures, which were organized by psychologists. These lectures are for everybody and do not depend on age. This problem is based on small numbers of lectures and sometimes speaker does not have a lot of experience.

II. Process of research

The main idea of our research was to show society how many people are interested in psychology like useful knowledge in routine life, how many people just know few psychological organizations and how many people are not interested in psychology and focused on solving the mental problems themselves. People had to choose one of these variants with no pressure. We gave people only three variants. First of them is 'I like psychology, I am interested in this, I know a lot of psychological organizations, always read psychological literature and use my experience or knowledge in routine life or different situations'. Second variant is 'Sometimes I use psychology in my life and know just few psychological organizations'. Third variant is 'I am not interested in psychology, I have never been using it in my routine life and I do not know any psychological organization in my city or in Ukraine'. People have to choose one of these variants, which is closer for their position for psychology science. We did not make others variant, because, first of all, they need to read questions and ask themselves, do they know something about psychology. Perhaps, people,

which were asked in our interview, will change their opinion about psychological position in their life. We asked people to answer question as honestly, as they can, because we want to show real information and situation in this article and discuss statistic, which we have.

III. The main results of research

We manage to explore attitude to psychology. We asked 50 people, what they think about psychology in their life. 40% answered that they read psychological literature and use psychological knowledge in different situations. It means that people are interested in psychology and think that this science takes important place in their activity. We may suggest that this category of people can solve their problems easily, because they use psychological knowledge. This type of people, perhaps, is thinking about their growth and wants to improve their social skills. 24% answered that they know few organizations, where they can get psychological help. It means that this category is not interested in psychology but they know some useful things about psychology and if they need, they can use it. This type of people think that psychology is useful science, but they are not excited about it and do not want to use it every day. They do not have a lot of experience, but they can look for new information and improve their knowledge. If they will improve their psychological skills, they will use it more and more, it will be easily for them. 36% answered that they do not read any psychological literature, do not look for interesting information and do not know any organizations. This category is not interested in psychology and is focused on solving their problems by themselves. They do not understand and realize which role and position psychological science has in other sciences and life. We can try to explain to this people, that psychology is useful and can help them. But how can we do that? Psychologists can write interesting and easy for understanding articles, so in this way we can take the spotlight on psychology for this category of people.

In these results we can see that attitude to psychology in Ukraine is not bad, because 40% answered that they are interested in psychology and use it. But 36% answered that they are not. So, we have ’50:50’ situation. It means that Ukrainian psychological science is developing every year, more and more people understand and use psychology in routine life, use it in different spheres, like studying, business etc. The best idea is to spread psychology in every social organization. For example, at school teachers can make new subject like ‘first steps in psychology’, in university lectors can make psychology one of the main subjects and make interesting psychological competition or conference of actual themes in psychology. Actually, we can construct student`s mind. By the way, a lot of people do not read psychological literature, because it is hard to understand all the scientific words. We can make people interested in psychology by writing books easier for understanding. Psychological society has to give more possibilities to study psychology for people, who are not specialists.

Conclusion

Psychological science was not popular in Ukrainian society. There are stereotypes, that people do not need psychology in routine situations or professional spheres. When people forget about psychology moments of their life, it may bring a lot of problems. But our research shows that situation is not bad and bigger part of people who answered the questions is interested in psychology, like it, use it or know psychological organization. 36% people, who answered that they do not use psychology just need time, and we believe that psychological science will be important part in Ukrainian society, and psychology will be studied at school, in every faculty at university and psychologist will be a good specialist in every organization.

One of the good ways to solve this problem is to make new researches and to present it on different conferences. For example, research ‘What I know about relationship’, ‘What I know about psychology’, ‘Can I analyze my personality’, ‘How I can solve the problem in my family’, ‘What I can do for society’, ‘Do we need psychology’ and others.

We have to show people, that psychology is not magic, and psychological organization is not Hogwarts. Psychology is real thing, which can help. We believe that the main word in this article is ‘HELP’. In our opinion, if we want to spread psychology in Ukrainian society, we need to show, that psychology is really helpful, and it doesn’t matter in what situations.

We believe that psychological society will be interested in this research and will decide to make a new one. Perhaps, the result of new research will be better and we will not worry about future of psychology in Ukraine.

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2nd INTERNATIONAL ACADEMIC CONFERENCE
"ENVIRONMENTAL PROTECTION, NATURAL RESOURCE MANAGEMENT AND TOURISM 2015"
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The Kinetics of Oxypropionic Acid on Natural Zeolite

Anna Gyvljud, Vira Sabadash, Jaroslav Gumnitskij

Department of Ecology and Sustainable Nature Management (ESNM), Lviv Polytechnic National University, UKRAINE, Lviv, S. St. George Square, 2,
E-mail: anna91businka@gmail.com
virasabadash@gmail.com
jgumnitsky@ukr.net

Abstract – This paper presents the results of experimental studies of the kinetics of ion exchange adsorption of lactic acid by zeolite in the periodic conditions. The results of experimental studies make it possible to determine the kinetic coefficients of the diffusion process.

Key words – kinetic, zeolite, hydroksypropionic, wastewater, internal diffusion.

I. Introduction

The need to find and develop new technologies for dairy plants wastewater treatment proved low efficiency of existing wastewater treatment facilities. The proposed adsorption technology of wastewater treatment of dairy plants allows to solve the problem of reducing the aggressiveness of the environment, has low power consumption, and can be implemented in a wide range of changes in the composition of wastewater [1,2].

The aim was to investigate the kinetics of internal diffusion of ion adsorption process of hydrohypropionic acid on natural zeolite and determine the effective rate of internal diffusion. Investigated the static and kinetic adsorption of lactic acid on klynoptylotite of Sokyrnytsa deposite [1]. Sorption properties of natural zeolite on hydrohypropionic acid were investigated. The use of natural zeolite of Sokyrnytsa deposits as high effective sorbent is appropriate in the treatment of industrial waste water from dairy processors from hydro-hypropionic acid it was established [1,2]. The adsorption properties of natural zeolite and activated carbon were compared. As a result of studies have found that activated carbon adsorbs better the lactic acid than the zeolite. Proved that molecules of lactic acid via carbon radical exhibit affinity to non-polar sorbents, i.e. the activated carbon. The dependence of the masstransfer coefficient to the intensity of mixing was established. The maximum degree of intensification of internal diffusion process was shown.

II. The results of investigations

Investigation of sorption of hydruxypropionic acid on natural zeolite in propeller type agitator was carried out. The experiment was carried out in the process of mixing a solution of lactic acid (concentration C = 0,002mh / dm 3) with 50 g of zeolite with different speed. The above graph shows the difference absorption process lactic acid adsorbent at different speeds. The concentration of lactic acid was determined by pH - using ionomer IM-160. The experimental setup is on the Fig.1.

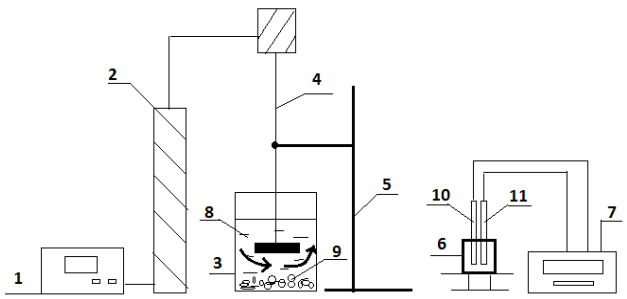

Fig. 1. Experimental setup
1 - digital mixer controller; 2 - motor of the mixer;
3 - vessel with a solution of lactic acid and zeolite;
4 - propeller type agitator; 5 - tripod; 6 - tube;
7 - ionomer IM-160; 8 - lactic acid solution; 9 - zeolite;
10 - ionoselective electrode; 11-electrode

Kinetic curves are shown in Fig. 2.

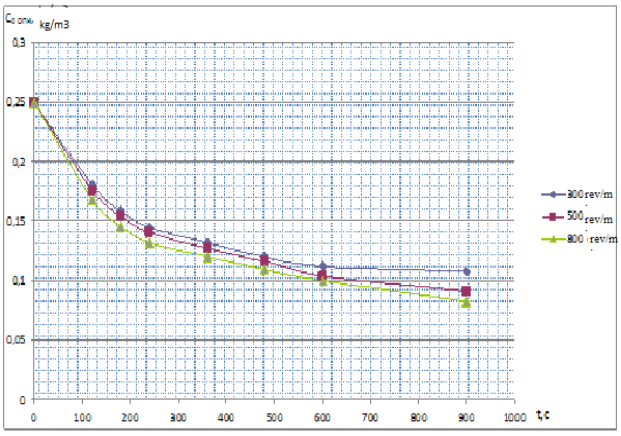

Fig. 2. Kinetic of adsorption of oxypropionic acid (DIC) by zeolite for different numbers of turns:
• - 300 rev / min .; ■ - 500 rev / min .; ▲ - 800 rev / min

This data shows that for the initial concentration of oxypropionic acid C_0 = 25 mg / dm^3 the kinetic curves of a different nature, and with increasing intensity mixing achieved a significant rate of absorption, especially in the initial time. This is evidence that in the initial moments kinetic is determine by the diffusion what makes them different, so it is the transport of acid molecules to the outer surface of the adsorbent. After filling the outer layer diffusion begins in the domestic law of the adsorbent. The dependence of absorption kinetics of the number of turns n shows that the number of turns n □400 kinetics is independent of the number of turns, that plays a major role inside the diffusion process in which the number of Bio wich tends to ∞. At its greatest intensity observed in the range of initial concentration. Assuming spherical particle shape for the mathematical description of the sorption component mixing conditions for internal diffusion process using equations obtained solution of differential equation of molecular diffusion in spherical particles with a mechanical stirring apparatus for Bi = ∞. The solution makes it possible to determine the change in the concentration of component C in the liquid phase over time in Eq. (3),(5).

$$\frac{C}{C_0} = 1 - \frac{1}{1+\alpha}\left[1 - \sum_{n=0}^{\infty} A_n \exp\left(-\mu^2 Fo\right)\right] \quad (1)$$

where:

$$A_n = \frac{6\alpha(\alpha+1)}{9+9\alpha+\alpha^2\mu_n^2} \quad (2)$$

where:

μ_n - positive roots of the characteristic equation are determined from dependence;

Fo - Fourier criterion $Fo = \frac{D_{e\phi} \cdot t}{R^2}$;

Def - effective internal diffusion coefficient, m / s;

τ - time, s;

R - radius of grain adsorbent, m;

$\alpha = \frac{VC_0}{m_{a\partial} \cdot a*}$ - system Settings; V - volume of fluid m^3;

m_{ad} - the mass of adsorbent, kg.

$$\frac{tg\mu_n}{\mu_n} = \frac{3}{3+\alpha\mu_n^2} \quad (3)$$

For large values of root μ_n and large value of time τ the exponent tends to zero, so the first one can restrict root characteristic equation μ_n egion regular mode) and Eq. (1) can be reduced to the form:

$$\left(\frac{C}{C_0} + \frac{\alpha}{\alpha+1}\right) / \left(\frac{1}{\alpha+1}\right) = A_1 e^{-\mu_1^2 Fo} \quad (4)$$

Logarithm (4) shows that in the semi logarithmic coordinates $\ln\left(\frac{C}{C_0} + \frac{\alpha}{\alpha+1}\right) / \left(\frac{1}{\alpha+1}\right) = f(\tau)$ gives a straight line.

After converting of the Eq. (4) put in value to the average concentration of oxy propionic acid $\overline{C} = C_0 - C_i$ and adsorbate concentration in the sorbent $C_a^* = C_0 - C_0^*$, where C_0^* corresponds to the equilibrium concentration of the starting solution at adsorption oxy propionic acid zeolite in static conditions in Eq. (5), we obtain:

$$tg\alpha = \mu_1^2 \frac{D_{e\phi}}{R^2} \quad (5)$$

The coefficient of internal diffusion hydruxypropionic acid zeolite $D_{ef} = 2{,}62 \cdot 10^{-12}$ m^2/s was set.

During the process of lactic acid adsorption on zeolite the release of sodium ions in the solution was indicated.

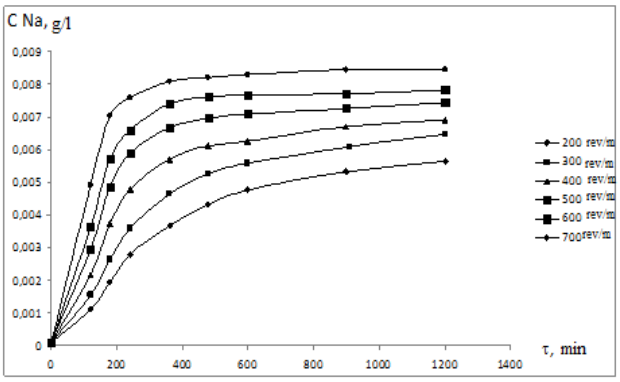

Fig. 3. Kinetic of the release of sodium zeolite adsorption oxypropionic acid agitators

During the experiment, calcium and magnesium cations weren't observed, indicating the formation of insoluble calcium lactate and magnesium on the surface and in the pores of the sorbent.

These compounds can increase the diffusion resistance of sorbent and reduce its sorption capacity.

As shown in Fig. 3 the number of turns enhanced ion exchange process that can be described by the following scheme of reactions:

$CH_3 - CH(OH) - COOH \leftrightarrow$
$H^+ + CH_3 - CH(OH) - COO^- K_1 = 1{,}4 \cdot 10^{-4}$

$CL(Na) + H^+ + CH_3 - CH(OH) - COO^- \rightarrow$
$CL(H) + CH_3 - CH(OH) - COONa$

Conclusion

Analyzing the experimental results we can conclude that the adsorption capacity of sorbents for lactic acid correlated with a decrease of acidity of model wastewater.

The results of experimental studies make it possible to determine the roots of the characteristic equation and effective coefficients of internal diffusion process of ion exchange sorption of hydruxypropionic acid by zeolite.

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The Influence of Agriculture on Water Quality

V. Pohrebennyk, R. Politylo, U. Klochko

Department of Environmental Protection and Audit,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery Street 12, E-mail: vpohreb@gmail.com,
polirom@gmail.com,
ulana21klochko@gmail.com

Abstract – the work is dedicated to the issues of analysis ofthe quality state of surface-water in the Lviv area, tocomparing of mean values of indexes of quality of 2014 tothe corresponding mean values of indexes of quality of waterlast year.

Key words – mean values of indexes, coefficient of muddiness, maximum permissible concentration (MPC), biological consumption of oxygen(BCO_5), chemical consumption of oxygen(CCO), mineralization, nitrates.

I. Introduction

Unrefined flows of agricultural production are one of so urcesof contamination of waters. Sewer water carry in itse lfdangerous compounds, morbific microorganisms, insecticides and herbicides, biogens that enter in thecompl ement of fertilizers.

In the riverheads of the rivers of the Lviv area look after contamination of the rivers, that creates inter-regional and international problems. On the general of superficial water resources in area of negatively such factors influence: upcast in the reservoirs of unrefined and cleared not enough flows of agriculture and industry, contamination of surface-water by mining - extracting enterprises, unsystematic and out-of-control chemicalization of agriculture, absence of bank-protection zones and off-shore stripes on water objects, large thrown open of soils, regulation of river-bed of the rivers, failure to observe of the sanitary-hygenic state of rural courts and unsettled state of dumps of domestic waste in settlement. Quality of surface-water of flat part of territory of Ukraine depends on the amount of effluents and degree of their cleaning, charges of water, atmospheric precipitations, superficial agricultural and to the flow from the urbanized territories. A superficial agricultural flow consists of superficial flow from the thrown open territories, drainage flow, superficial flow from territories of stock-raising complexes.

II. The quality state of surface-water of the Lviv area in 2014

In 2014 the laboratory of monitoring of waters and soils of Lviv was quarterly execute the analyses of quality of surface-water of the Lviv area in 17 створах, from what the Western Bug is in a pool, 8 - in a pool Dnister, 3 - in the pool of Syan. The estimation of quality of water was carried out in obedience to the coefficient of muddiness .

The mean values of indexes of quality of water in 2014 were compared to the corresponding mean values of indexes of quality of water last year, that it is resulted on image 1-4. The change of quality of water in the points of supervisions depends on amount and quality of effluents of enterprises, unorganized flows, meteorological factors, hydrological terms of the rivers during sampling of water and others like that.

On the figure1 exceeding over of level of MPC is brought for BCO_5 for pools year of Lviv Region, in particular maximal values are got for range in the p. of Kamjanopil (16,5 times), and minimum - for range the Western Bug- city Sokal - 1,0 times.

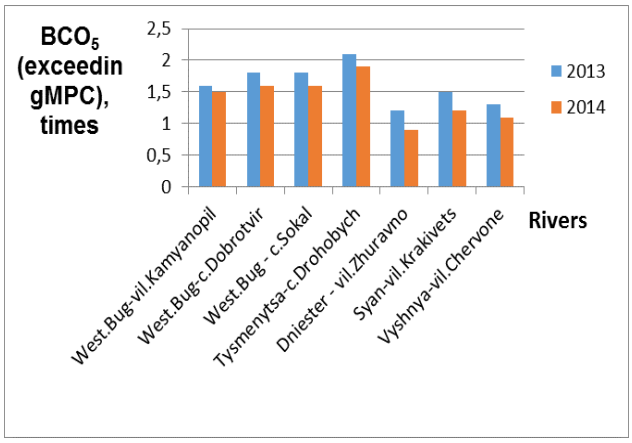

Fig. 1. The exceeding MPC of BCO_5 for river basins of Lviv region

On the figure 2 exceeding over of level of MPC is brought for CCO for pools year of Lviv Region, in particular maximal values are got for range in city Drohobych (2,1 times), and minimum - for range there is the Dniester – village Zhuravno - 1,3 times.

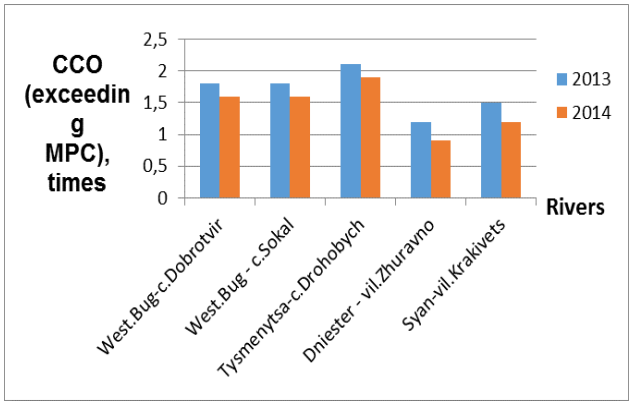

Fig. 2. The exceeding MPC of CCO for river basins of Lviv region

On the figure 3 exceeding over of level of nitrates is brought for pools year of Lviv Region, in particular maximal values are got for range in Sambir (15 times), and minimum – for range the Vyshnja is a village Chervone - 0,8 time

On the figure 4 exceeding over of level of mineralization is brought for pools year of Lviv Region, in particular maximal values are got for range to Drohobych (2 times), and minimum - for range the Dniester is a village Zhuravno 1,2 times.

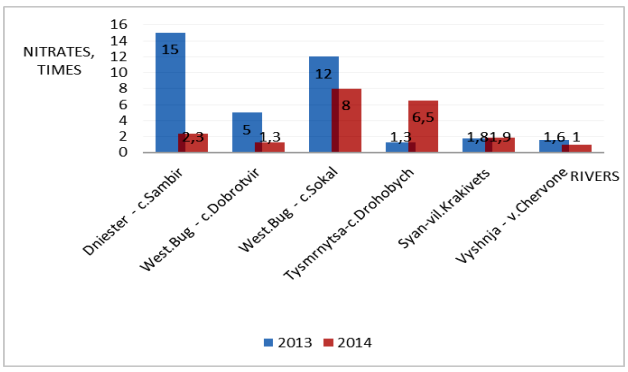

Fig. 3. Exceeding of content of nitrates for pools year of Lviv Region

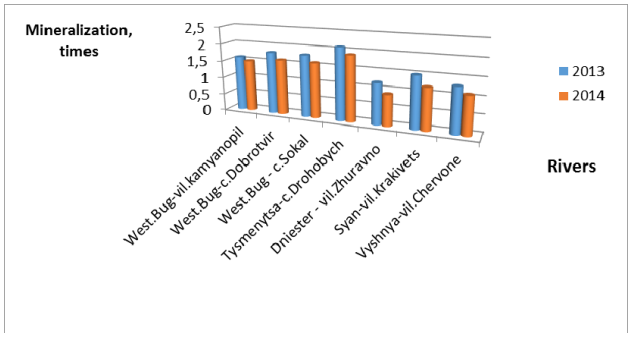

Fig. 4. Exceeding of level of mineralization for pools year of Lviv Region

TABLE 1

VALUATION OF THE QUALITY OF SURFACE WATERS LVIV REGION ACCORDING TO CONTAMINATION FACTORS

Name opening	coefficient pollution	verbal characteristic of the coefficient pollution	CDA
1	2	3	4
River Dniester-city Sambir	1,02	weakly polluted water	1,2
River Dniester-city Rozvadiv	1,54	weakly polluted water	1,2
River Dniester-village Zhuravno	1,39	weakly polluted water	1.2
River Tysmenytsa-city Drohobych	3,59	moderate polluted water	0,9
1	2	3	4
River Stryj- village Verhne Synyovydne	1,00	clean water	1,5
River West Bug- city Dobrotvier	2,41	weakly polluted water	1,2
River West Bug- city Sokal	2,26	weakly polluted water	1,2
River Sklo-village Krakivets	1,79	weakly polluted water	1,2
River Vyshnya-village Chervone	1,68	weakly polluted water	1,2

Conclusion

In 2014 water in most of the Western Bug basin alignment was characterized as "poorly muddy", in alignment - "The Western Bug - Kamyanka-Buzka" - as "mildly muddy", and in the Poltva - as "dirty". Downward on stream of the Western Bug tends to the improvement of quality of water.

Comparatively with the last year quality of water is in all rangs the Western Bug and in the Rati became worse, and in the Poltva - did not change substantially.

Comparatively with the last year quality of water became better in Strvyazh and on all alignments on the rivers the Dniester and the Stryi. Quality of water in the the Zubra River and of the Tysmenytsa River became worse.

Increase of mineralization of water in the rivers of the Tysmenytsa and the Stryi, in rangs "The Dniester – vil. Rozvadiv" and "The Dniester - it is predefined the of Zhuravno" by the different hydrological terms of the rivers during sampling.

Water in all alignments of pool of the Syan was "poorly muddy".

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Determination of Electrical Conductivity of Ion Exchange Resins

Myroslav Malovanyy, Kateryna Petrushka

Department of Ecology and Sustainable Nature Management, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: mmal@polynet.lviv.ua, petrushka-katja@rambler.ru

Abstract – The paper is devoted to the determination of electrical conductivity of the ion exchange resins. We described the basic conditions under which the research was conducted. The methods used and experimental results are presented too.

Key words – electrical conductivity, ion exchange resins, resistance, cell, "ion exchanger – solution" system.

I. Introduction

Electrodialysis with the resin membranes is one of the main methods in membrane technology. It is the combined method in which the processes of electrolysis and dialysis are combined. Application of the gaskets from insulating materials results in substantial increase of the voltage and reduce of the working surface of membranes during the electrodialysis.

Therefore, the use of ion exchange resins in the form of granules as the intermembrane filling is of great interest. But the necessary condition for successful application of the gaskets from insulating materials in electrodialysis is the preliminary research of conductivity of materials that will be used for the intermembrane backfilling.

Electrical conductivity depends on many factors, including the nature of the substance, the solvent and its concentration, and the temperature. By the value of the electrical conductivity we can determine the content of various substances and their compounds in the investigated solutions. It is determined by measuring the electrical resistance of the layer of fluid contained between two electrodes immersed in the investigated solution using different conductivity measuring instruments.

Requirements to the exact measurements of electrical conductivity, are the following:

- precise temperature control;
- the elimination of polarization of electrodes;
- very high precision of electrical measurements.

Electrometric method of determining the electrical conductivity allows to accelerate and to increase the accuracy of its determination in comparison to other methods [1]. Research of electrical conductivity was began in the late nineteenth century and now domestic and foreign researchers continue this work [2, 3].

Determination of electrical conductivity comes to measurement of resistance because it is inversely proportional to the resistance. The problems of periodicity and the frequency of the current control of the conductivity are relevant. The decision of these problems lays in the automation of measurement of the specified parameter and comparative analysis for determining the quality of the solution and the process of stabilization [4].

Electrical conductivity of fluids (liquid mineral and organic fertilizers, electrolyte solutions, etc.) is used as a measure of their concentrations, and therefore the theory of commutation modes of the measuring electrodes now gets wide practical application. On the border of phase separation electrode-liquid the polarization of contact voltage occurs, which is caused by a potential jump and has a polarity opposite to the polarity of the applied voltage. At the same time molecules seem to form a double layer, whose properties differ from the properties of molecules, polarized at a greater distance from the phase separation surface. Therefore the criterion of the possibility for application of such an approach in a particular experiment can be one that takes into account the impact of the potential jump on the measurement results [5].

In completely dry state ion exchange resins have a high electrical resistance. When the resin swells, there appears the ability to conduct electrical current. This property is used for electrochemical regeneration of ion exchangers.

The ion exchangers are divided into anion and cation exchangers that exchange respectively negatively or positively charged ions and amphoteric exchangers that are able to exchange the both types of ions. The most common organic synthetic ion exchangers are the ion exchange resins. The ion exchange resins are obtained by polymerization or by polycondensation of organic compounds and by chemical transformations of the polymers. Ion exchange resins based on styrene copolymers with divinylbenzene, phenol-formaldehyde resins, polyamines are widespread now.

In case of applying the weak acid cation exchanger in acidic form before the membrane water treatment the partial softening of the water will take place with its full decarbonation and if the pH will be lowered to 3÷4 it will not absolutely affect the work of membranes [3, 4].

II. Problem Statement and Approach to Solving

The known methods of measurement of specific electrical conductivity of granular resin make impossible to carry out the measurements in a wide range of concentrations of the equilibrium solution. That is why we proposed the approach to measure the resistance of the grains layer of granular resin after the removal of the equilibrium solution by centrifugation.

The ion exchange resin was placed in the electrodialysis cell and set in the balance with the investigated solution. We took the ion exchange column with porous bottom and two fixed in the wall electrodes as a measurement cell The equilibrium solution was removed by centrifugation, the cell was placed in a rubber case and kept in a thermostat at a constant temperature of 25 ^{0}C. With the help of the alternating current bridge (1000 Hz) we determined the electrodialysis cell resistance (R_x), on the base of which the value of specific electrical conductivity of the ion exchange resin ($k_{см}$) was calculated. It was defined from:

$$k_{см} = \frac{\Gamma}{R_x} \quad (1)$$

where: Γ – the measurement cell constant determined on the base of known electrical conductivity of the ion exchange resin in the isoelectric point, which has been found from the separate experiment:

$$\Gamma = k_{iso} R_{iso} \quad (2)$$

where: R_{iso} – the measurement cell resistance, measured after centrifugation, when the ion exchange resin was in the equilibrium with the isoelectric solution.

III. The Research Methodology and the Results

We have been studying the system of "the KU-2 ion exchange resin – NaCl solution". The research was carried out according to the following algorithm:

1. A series of NaCl solutions (0.1, 0.2 ... 0.5 M) was prepared.
2. We measured the resistance of each solution in the U-shaped tube which is not filled with a resin (in the cell) with the help of electrodes submerged at the same depth.
3. The dependence of 1/R on the NaCl concentration (where R – the electrical resistance of the U-shaped tube) was built for the sodium chloride solution.
4. The U-shaped tube was filled with ion exchange resin.
5. The ion exchange resin have been set in equilibrium with the 0.1 M solution of NaCl in the U-shaped tube. To do this on one knee of the U-shaped tube we placed the separating funnel at 0.5 liters and from it at a low speed the solution has been supplied. The resistance of the solution which flowed from the tube through the other knee has been recorded periodically. The solution supply from a separating funnel has been stopped when the resistance of input and output solution were the same.
6. Only after that the electrodes have been immersed into the U-shaped tube on the same level and the resistance of the resin-solution system has been measured.
7. Similarly, we have set the equilibrium and then measured the resistance of the resin-solution system for NaCl solutions of other concentrations.
8. The dependence of inverse resistance (1/R) of the resin-solution system on the concentration of the solution was calculated.
9. The point of intersection of the obtained dependencies for pure solution and for resin-solution system allowed to determine the concentration of the isoelectric solution (in this concentration the electric conductivity of the solution is the same as the conductivity of the resin).
10. We prepared 1 liter of solution with the concentration of the isoelectric solution.
11. According to the methodology described above (see 5) we have prepared the ion exchange resin in equilibrium to the concentration of the isoelectric solution.
12. One by one the previously prepared examples of ion exchange resin which were in equilibrium to a certain concentrations have been transferred to a centrifuge cell. This cell had the sizes that allowed her to enter the centrifuge (about 5 cm in height and with the required diameter). Electrodes were installed approximately 1 cm from the porous bottom of the cell. Ion exchange resin was placed into centrifuge cell above the electrodes.
13. The measurement cell has been located in the centrifuge and the excess of solution has been removed by centrifugation.
14. The resistance of the cell with ion exchange resin was measured.
15. According to the reference book we have found specific electrical conductivity of NaCl solution, built the concentration dependency and then determined the value of k_{iso} at C_{iso} value using this dependency.
16. The constant of the cell has been calculated by the formula (2).
17. Using the value of Γ constant, the value of the specific electrical conductivity has been calculated for each concentration of the solution.

Conclusion

The system of "the KU-2 ion exchange resin – NH_4Cl solution" is at the stage of experimental research. The results that will be received during the experiment will allow us to develop an algorithm for calculation of the physical – chemical parameters of ion-exchange purification of model solutions of waste water and industrial multi-component solutions.

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Monitoring of Performance of the Municipal Wastewater Treatment Facilities

Vira Shandrovych, Myroslav Malovanyy

Department of Ecology and Balanced Management
of Natural Resources, Lviv Polytechnic National University,
UKRAINE, Lviv, st. Stepan Bandera, 12,
E-mail: virashandrovych@ukr.net,
mmal@ polynet.lviv.ua.

Abstract* – *The paper has engaged monitoring of performance of the municipal wastewater treatment facilities of Lviv by analyzing the average monthly data of their operation, obtained in a chemico-bacteriological laboratory of the Lviv City Utility Enterprise "Lvivvodokanal". Also, performance of aerotanks of the same facilities has been studied by carrying out check measurements of the concentration of dissolved oxygen and ammonium in them.

Key words – monitoring, wastewater treatment facilities, dissolved oxygen, aerotanks, active sludge.

I. Introduction

According to specialists, today quarter of the wastewater treatment facilities and sewerage networks in Ukraine in monetary terms is out of their depreciation life [1].

Most of the operating treatment facilities have a range of deficiencies in common. In particular, majority of the plants is characterized by low energy efficiency, poor wastewater purification and unsolved sludge disposal issues [2].

II. Page Setup

Today, the determinant method is a method of biological wastewater treatment. The most popular objects, where this process is carried out, are aerotanks, which operation is based on the utilization of active sludge. Aerotanks have unquestionably positive features, which are especially useful in treatment of domestic wastewater. Among others, these are structural simplicity, operational reliability (i.e. treatment of stable, nontoxic and moderately concentrated in terms of contamination wastewater), relatively low cost of water processing and ability to treat wastewater of the different content [3].

Aerotanks are widely used in combination with secondary settling tanks for wastewater treatment. A role of the secondary settling tanks in a biological wastewater treatment complex is to retain sludge microorganisms coming to the sludge mix from the aerotanks.

Efficiency of the treatment process in aerotanks and a state and oxidizing capacity of the sludge are determined by a range of conditions, among which are: wastewater content and properties, hydrodynamic mixing conditions, the relation between the amount of delivered impurities and viable sludge, oxygen regimen in the facility, temperature and active reaction of the environment, availability of nutrients, presence of process activators or inhibitors [4]. We studied performance of the wastewater treatment facilities in Lviv.

III. Page Setup

The wastewater treatment facilities of Lviv consist of two parts (Facility 1 and Facility 2) (Tab. 1).

TABLE 1

LVIV TREATMENT FACILITIES

Lviv treatment facilities	Hydraulic capacity (ths.m^3/24 h)	Actual wastewater amount (ths.m^3/24 h)
Facility 1	140	100
Facility 2	350	300
Treatment facilities in total	490	Around 400

Domestic, industrial and runoff wastewater flows to the wastewater treatment facilities by a closed sewer (the Poltva River). The total design capacity of the Lviv wastewater treatment facilities, as shown in the Table 1, is 490 ths.m.^{3}/24 h. The average daily wastewater treatment rate is 440 ths.m^3/24 h)

By content, wastewater flowing to the Facility 1 is industrial and domestic, and to the Facility 2 is mostly domestic.

Performance of the aerotanks is assessed based on the average monthly data on operation of the Facility 2, provided by the chemico-bacteriological laboratory of the Lviv City Utility Enterprise "Lvivvodokanal". After comparing the received output concentrations of contaminants from the Facility 2 with the relative TLV values, we cannot state that the wastewater is entirely treated at the treatment facilities and that the treated water is suitable for domestic or fishery utilization, since the required level of purification by a range of indicators (ammonium nitrogen, nitrites and iron) is not reached, according to the TLV for fishery utilization of treated wastewater.

In the aerotanks at the Facility 2 we measured the concentrations of dissolved oxygen and ammonium nitrogen. The obtained results are provided in the Table 2, where, besides the readings of a sensor of the treatment facilities and potentiometeric measurements, measurement results received in the chemico-bacteriological laboratory of the Facility 2 are given.

The Table 2 shows that the readings of the dissolved-oxygen meter and the instrument of the treatment facilities are somewhat different, and in some cases vary greatly. However, there is a certain correlation in the relation between the dissolved oxygen measured by the sensor of the treatment facilities and by us under the laboratory conditions. Better conformity in the measurement results can be observed in the potentiometric measurements and the results of the chemico-bacteriological laboratory.

The results also show that the highest DO values are recorded in the 2nd aerotank. Therefore, we have decided to study the DO concentration profile more precisely within the 2nd aerotank. The measured values are shown on the diagrams below (fig. 1 and 2).

TABLE 2

CONCENTRATION OF DISSOLVED OXYGEN IN AEROTANKS OF THE FACILITY 2

AEROTANK / C(DO), MG/L		№1		№2		№3		№4		№5		№6	
		Corridor II	Output	Corridor II	Output	Corridor II	Output	Corridor II	Output	Corridor II	Output	Corridor II	Output
Jul. 17, 2013	1	0,18	0,25	9,9	6,04	5,69	0,24	8,55	4,01	6,3	0,29	0,32	0,19
	2	0,44	0,41	3,67	2,33	3,4	0,54	2,69	1,73	3,15	2,6	0,11	0,37
	3	-	0,96	-	3,12	-	2,24	-	1,68	-	2,56	-	0,37
Oct. 02, 2014	1	0,32	0,26	0,35	3,64	0,36	4,82	0,99	6,16	0,28	1,69	0,82	0,80
	2	0,46	0,35	0,89	2,16	3,64	2,12	0,61	2,21	0,12	1,23	0,42	0,39

1 – readings of the sensor of the treatment facilities, 2 – readings of the dissolved-oxygen meter **sens*ion 6***, 3 – data measured in the lab

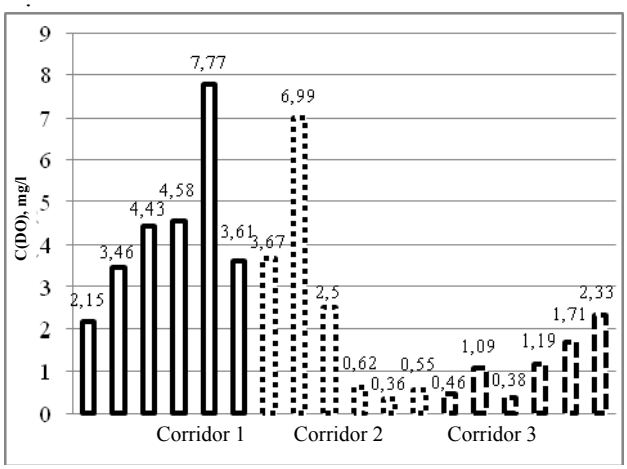

Fig. 1. DO concentration profile in aerotank No. 2 (July 17, 2013)

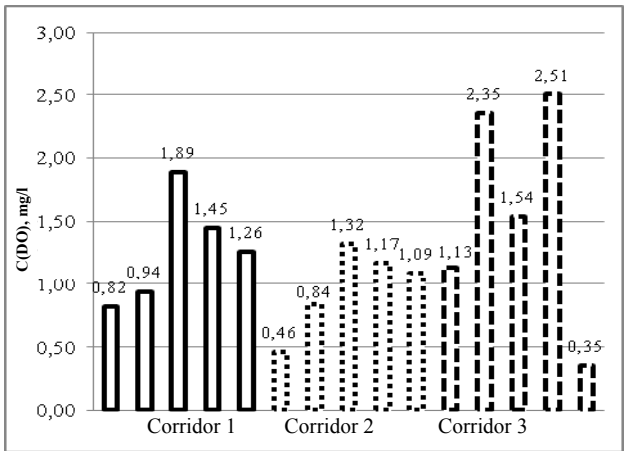

Fig. 2. DO concentration profile in aerotank No. 2 (October 02, 2014)

The obtained results allow us to make a conclusion that the DO concentration is not always within the values, which ensure the required purification level. At some points it is too high (9.9 mg/l), and at the others it is too low (0.18 mg/l), when normal aeration requires the DO concentration to be within 2.0 mg/l. The present aeration level does not provide necessary purification of wastewater and results in higher power consumption.

An analysis of the monitoring data shows that there is no consistency in the organization of the process of wastewater treatment from ammonium ions. First of all, the data shown in the Figures does not give a reason to say that automatic regulation of a constant dissolved-oxygen concentration value by the aerotank's profile is efficient. The data in the Fig. 1 and 2 demonstrates that the concentration of dissolved oxygen by the aerotank's profile is more of a random nature. This may be explained either by faulty operation of the sensors, imperfect automatic regulation or improper installation of the air supply system in the aerotank, and most probably – by all of these factors together.

Conclusion

Based on the conducted measurements and the obtained results, we can make a conclusion that after final outflow the treated wastewater is of a required quality level for its further domestic utilization, but not fully meet the norms for water to be used for fishery purposes.

Performance of the aerotanks at the Facility 2 is not efficient enough and requires improvement. This improvement should involve replacement of the system of oxygen supply to the aerotank on the basis of control signals of the sensors. The control signals should be generated based on the concentrations of ammonium ions, and not the DO concentrations.

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Environmental Control of Phosphogypsum and Tars of Rozdil State Mining and Chemical Company "Sirka"

Elvira Dzhumelia, Volodymyr Pohrebennyk

Department of Environmental Safety and Nature security activities, Lviv Polytechnic National University, UKRAINE, Lviv, G. Chuprynky street 130,
E-mail: elviradzhumelia@gmail.com

Abstract – The purpose of this work is the environmental control of phosphogypsum and tars of Rozdil State Mining and Chemical Company "Sirka", definition of soil pollution in the area.

I. Introduction

Utilization, waste recycling and disposal of large-tonnage manufactures are important problems the relevant industries. It become environmental content of state level when hundreds thousands tons of solid waste, contaminated by toxic substances formed in the dumps.

Production and using of phosphate fertilizers produce significant amounts of phosphogypsum dumps — solid wastes, which contain heavy metals such as Cadmium and Plumbum.

Rozdil State Mining and Chemical Company "Sirka"is included in the "List of 100 objects that are major polluters of the environment in Ukraine." Waste of sulfur production, which emerged as a result of open pit mining of sulfur, were drawn up in tailings located in different parts of the territory and waste production of mineral fertilizers composed of phosphogypsum dumps. Also on industrial ground enterprise is kept modifier such as "MG", which is made of tar residues.

II. Materials and methods of research

On Rozdil State Mining and Chemical Company "Sirka" is:

- about 60 million t of sulfur ore tailings;
- 3,045,400 t of phosphogypsum;
- 1.5 million m^3 of acidic water;
- 17195 t modifier such as "MG", made from neutralized tar residues and boiler residual of maleic acid anhydrite;
- thousands t of substandard sulfur residues and other chemicals;
- thousands of hectares of land disturbed by mining works which are not used;
- ruins of buildings that will never be used for new production, etc.

Today on the territory of tailings and adjacent areas is not carried out any production activity. According to data of Rozdil State Mining and Chemical Company "Sirka" on the balance sheet are 3,045.418 t of phosphogypsum. Enterprise made waterproof dump phosphogypsum arranging the contour of neutralizing limestone layer. As a result, it isg eliminated acidic water from phosphogypsum dump into the river Dniester.

Despite the waterproof of bottoms dumps, long term storage of solid wastes, including phosphogypsum, leads to the penetration of toxic substances in soil and filtering, eventually forming areas of contamination.

Rains dissolved gypsum and wash out toxic compounds (fig. 1).

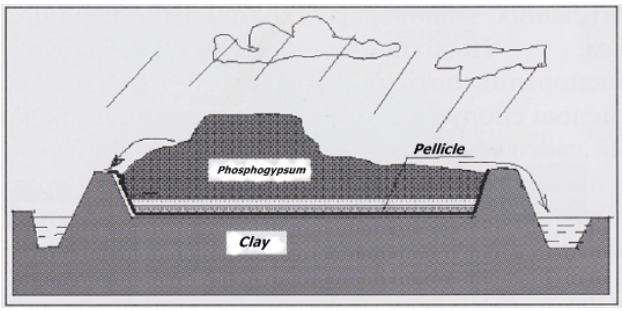

Fig. 1. Scheme structure of phosphogypsum dump

Pollutants after falling into soil do not remain inactive, they cause changes or positive or negative effects, change the the natural chemical balance of the ecosystem. Polluted soil is lost clear structure and characterized by a decrease of the overall density. All of this reduces the water permeability of the soil, a sharp deterioration in water-air regime.

Now, there aren't practically methods of forecasting the possible pollution of the environment and modeling of migration of heavy metals in soils.

According to this actual branch of research for Ukraine is developing measures to protect soils against the negative influence of toxic compounds contained in dumps.

The modifier "MG" is dangerous for the environment and is made of tar residues in 2001-2002, which it is imported from Hungary by state enterprise "Spetsservis". Since oil refining industry waste were stored on the territory of Rozdil State Mining and Chemical Company "Sirka". They were used as evidence in a criminal case. Currently, the criminal case is closed.

Up to this day, in spite of repeated appeals leadership of Rozdil State Mining and Chemical Company "Sirka" and the executive committee and city council members of Novorozdil various issue about export of tar residues haven't solved.

It is defined qualitative and quantitative composition of metals in soil samples near the landfill of phosphogypsum and near the area of the modifier by X-ray fluorescence (using analyzer EXPERT 3L (fig. 2)) method. EXPERT 3L analyzer is measured the mass fraction (%) of major chemical elements by X-ray fluorescence analysis. Range of measuring chemical elements (range control) is from Natrium (^{11}Na) to Uranium (^{92}U).

Fig. 2. analyzer EXPERT 3L

III. Research results

The soil, which is located near the dump of phosphogypsum contain the following metals (data for 2015.):

- Zinc (Zn) (0.014%), Arsen (As) (0.003%) — are Class I of danger of heavy metals (very dangerous);
- Nickel (Ni) (0.008%), Copper (Cu) (0.005%) — are Class II of danger of heavy metals (moderately dangerous);
- Iron (Fe) (2.009%), Mangan (Mn) (0.076%), Strontium (Sr) (1.845%) — are Class III of danger of heavy metals (low-dangerous);
- Silicon (Si) (4.171%), Sulfur (S) (34.629%), Calcium (Ca) (56.504%), Titanium (Ti) (0.414%), Yttrium (Y) (0.011%), Cerium (Ce) (0.298%), Rubidium (Rb) (0.004%), Niobium (Nb) (0.002%), Rhodium (Rh) (0.005%).

In the data in 2013 it is exceeding the Phosphorus (P) in 8.25 times (table 1).

TABLE 1

SOIL SAMPLES NEAR HEAP OF PHOSPHOGYPSUM, 2013

Element	Units of measu-rement	MPC or back-ground value	Result of measu-rement	Excess
Cadmium	mg/kg	0.68	0.51	
Cobalt	mg/kg	5	3.44	
Copper	mg/kg	3	2.01	
Nickel	mg/kg	4	0.97	
Plumbum	mg/kg	6	5.16	
Phospho-rus in terms of P_2O_5	mg/kg	31.08	256.44	8.25
Chrome	mg/kg	6	1.35	
Zinc	mg/kg	23	16.78	

In soil, which is located at the area of the modifier of the "MG" is contained the following metals (data for 2015):

- Zinc (Zn) (0.006%), Plumbum (Pb) (0.009%) - are Class I of danger of heavy metals (very dangerous);
- Mangan (Mn) (0.142%), Iron (Fe) (0.563%), Strontium (Sr) (2.521%) - are Class III of danger of heavy metals (low-dangerous);
- Silicon (Si) (1.570%), Sulfur (S) (17.897%), Calcium (Ca) (77.176%), Titanium (Ti) (0.101%), Argentum (Ag) (0.014%).

In the data for 2013 it is exceeding the Cadmium (Cd) (in 1.65 times), Plumbum (Pb) (in 1.42 times), nonpolar hydrocarbons (in 3.83 times) (table 2).

The spreading one of the most dangerous heavy metal which is depended on the distance from the industrial ground of the modifier is shown in fig. 3:

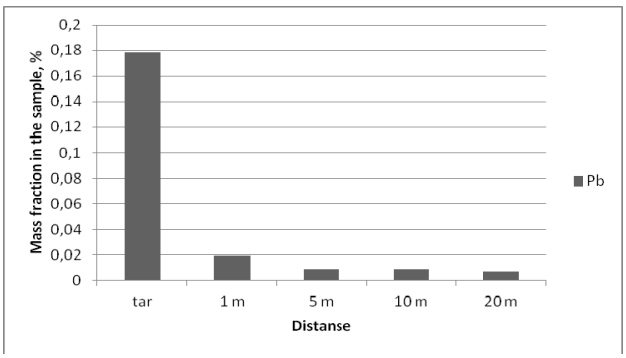

Fig. 3. The spread of Plumbum.

TABLE 2

SOIL SAMPLES NEAR AREA WITH MODIFIERS, 2013

Element	Units of measu-rement	MPC or back-ground value	Result of mea-sure-ment	Excess
Cadmium	mg/kg	0.68	1.12	1.65
Cobalt	mg/kg	5	4.45	
Copper	mg/kg	3	2.13	
Nickel	mg/kg	4	2.76	
Plumbum	mg/kg	6	8.49	1.42
nonpolar hydro-carbons (oil products)	mg/kg	245	938	3.83
Chrome	mg/kg	6	1.26	
Zinc	mg/kg	23	15.67	

Conclusion

Consequently, on the territory of Rozdil State Mining and Chemical Company "Sirka" are tailings, smelting sulfur, which is extracted from the quarry, dumps of phosphogypsum, tar modifiers, Strontium, Arsen, Zinc and other dangerous items. This causes to disruption of the ecological balance.

One solution of the problem of waste accumulation is developing technology of using recycled materials. For example, phosphogypsum can be used in the manufacture of building materials.

The main ways of using phosphogypsum in order to recycling are:

- manufacturing of building materials;
- agriculture;
- road construction;
- processing of phosphogypsum in sulfuric acid;
- extraction of various substances of phosphogypsum, including rare earth elements.

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Radioecological monitoring of water resources in the Chernobyl exclusion zone

R. Politylo, O. Borovyk, V. Yakovleva

Department of Environmental Protection and Audit,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery Street 12, E-mail: polirom@gmail.com

Abstract – The general characteristic of water resources of the Chernobyl exclusion zone is presented. Methods of radiological monitoring of groundwater in Chernobyl exclusion zone is given. Monitoring results can be used for prediction the state of pollution and they are the basis for calculations of radionuclide migration in the Dnipro cascade. In closed ponds of exclusion zone for many years will be kept high levels of water pollution. The main factor in the self-cleaning of none closed water objects from pollution are internal processes and sedimentation in the soil. Water objects to compared with closed ponds relatively quickly cleared from radionuclides by constant washout.

Key words – environmental radiation monitoring, exclusion zone, radioactive pollution, radioactive elements, water resources, radioactive waste.

I. Introduction

The Chernobyl disaster is one of the largest and the most complex disasters in the history of nuclear energy, which made impact on the environment as Ukraine, Belarus, Russia and many European countries. But the most significant consequences were the ecological consequences of the disaster in areas directly near to the Chernobyl nuclear power station.

The Chornobyl exclusion zone is an open source of radioactivity, in which there are various types and forms of radionuclides, and it is the real potential danger for the population living in the surrounding area for the whole population in general. Therefore, a radiation monitoring is one of the main necessary measures.

The system of environmental radiation monitoring in the exclusion zone exist more than 25 years of formation and development in difficult conditions, which identifies high levels of radioactive contamination dynamics in time, anthropogenic activities. Conduction radiation monitoring made it possible to constantly monitor the radiation situation in the area of environmental objects exclusion. Monitoring results can be used for prediction the state of pollution and they are the basis for calculations of radionuclide migration in the Dnipro cascade. Also using these results we can determine the suitability of water for drinking water supply, for irrigation, definite priorities in water protection activities to reduce the negative impact of radioactive pollution on staff and the public.

II. Results and discussion

The aim of this work is evaluating the state of underground water resources in the Chernobyl exclusion zone on the results of radiation monitoring.

To achieve this goal we must define the dynamic distribution of 90Sr and 137Cs in water in the exclusion zone and conduct radiological assessment of water facilities in Chernobyl exclusion zone.

On figure 1 is shown placement of water resources and sampling points in the Chernobyl exclusion zone.

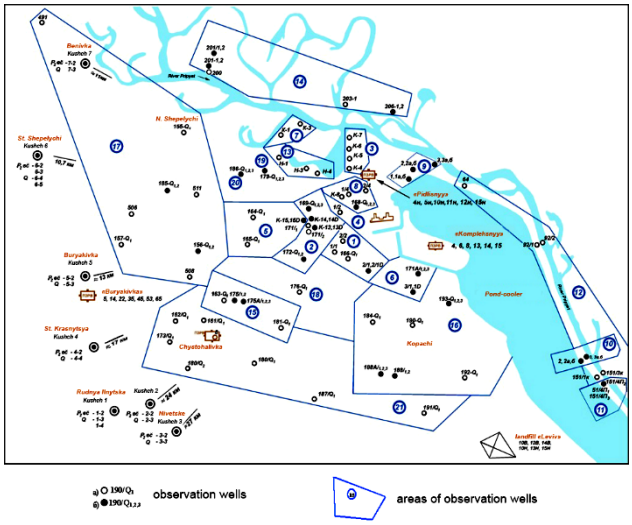

Fig. 1. Layout of network of observation wells in 2014

Monitoring of exclusion zone is a system of supervision component of State environmental monitoring system aimed at collecting, processing, transmission, storage and analysis of information about radiological stage of environment; forecasting its changes and development of scientifically-based recommendations for management decisions in accordance with the department program of emergency.

In the exclusion zone and mandatory evacuation zone, radiation monitoring of groundwater was carried in 138 wells, 21 of these is located in the network of operational radioactive waste. Temporary point of radioactive waste "Red Forest" in *districts of Budbasa and Yanivsky backwater* is controlled by 21 wells. In the district cooling pond involves 32 wells. Other wells located in places of temporary points of radioactive waste and characterizing groundwater in the regional plan.

All water samples were analyzed for contents of ^{90}Sr and ^{137}Cs. The value of the errors in the determination of volume activity of ^{90}Sr in water less than 2% when the content of a ^{90}Sr 1000-10000 Bq / m3, increasing to 2-3% at values not exceeding 1000 Bq / m3. Errors definitions of ^{137}Cs in the water in most cases do not exceed 3-4% in volume activity of ^{137}Cs within 100-200 Bq / m3, increasing to 5-9% at smaller values of ^{137}Cs in the water.

In monitoring wells located in certain areas with significant levels of pollution of groundwater and water supply networks in the city of Chernobyl, frequency control is 1 time per month on other places - 1 time per quarter, 2 times a year.

As a result of radiation monitoring of groundwater in water supply networks of the city. Chernobyl concentration of ^{90}Sr in water is within 1.5 Bq / m3, 137Cs within 1-10 Bq / m3.

During 2014, using the existing network of observation wells of significant changes in trends in migration of radionuclides and radiation state of formation of groundwater is not fixed. This is due to instability of decrease migration or state of the network of wells and its practical impossibility to provide additional work.

In general, the process of migration of radionuclides from the temporary location of radioactive waste in 2014 was characterized by a certain stability in the annual intensity cut (with strong amplitude fluctuations content 90Sr).

As in previous years, the maximum radionuclide migration at observation wells is detected on such objects as districts of Budbasa, Yanivsky and Semyhodskyy backwaters and lake Azbuchyn, where volume activity of ^{90}Sr reaches respectively 140, 51, 70 and 47 kBq / m^3, the content of ^{137}Cs - 0,53, 0,26, 0,21 and 0.42 kBq / m^3.

According to the physical state of the objects such as points of radioactive waste and temporary points of radioactive waste in exclusion zone, and the total activity of groundwater pollution, the greatest danger in the near future will be on such objects as "Red Forest" - (districts of Budbasa and Yanivsky backwater), district cooling pond PC-14, district "Pidlisny" and Lake Azbuchyn. The smallest danger of groundwater pollution will be on objects in district "Buryakivka" and the solid waste landfill near village Leliv. Other objects are medium dangerous.

Lower rates of content of ^{90}Sr characterized the radiation state of groundwater within the "Red Forest" near the village Lisovyy. The maximum volume activity of ^{90}Sr is 8 kBq / m^3 which fixed in water wells K-13.

The maximum content of ^{90}Sr is fixed in the water well number 2A near the lake Azbuchyn - 47 kBq / m^3. The maximum volume activity of ^{90}Sr in district of the cooling pond is fixed in the well 3b (PC-14) - 9.3 kBq / m^3.

In general, the nature of the dynamics of volume activity of ^{90}Sr in water wells in different areas near plants and the first flood terraces with large amplitude oscillations (depending on the conditions of formation) does not give grounds to assert neither depletion of sources of radionuclides nor their building.

The problem of ^{137}Cs, in general, in the water drinking supplies and in the groundwater currently is not relevant. Only water wells in some areas in districts of Budbasa with high levels of surface pollution and Yanivsky backwater, volume activity of ^{137}Cs is 0.2-0.5 kBq / m^3. Background volume activity of ^{137}Cs in the water wells is about 0.06 kBq / m^3.

The content of ^{90}Sr in water wells near Lake Azbuchyn in September 2014. (right bank of the River Pripyat) reaches a value of 20-47 kBq / m^3. The persistent concentration of ^{90}Sr, with some tendency to increase, there are in water wells that characterize radiation state of the flow of the River Pripyat. In water wells number 1 in district of the lake Azbuchyn (which is located about 150 meters upstream from the railway bridge and 15-20 m from the water district of the River Pripyat) concentration reaches to 18 kBq / m3.

Conclusion

We can make decision about the main sources of radioactive pollution of groundwater and formation water resources of radionuclides are stocks of radionuclides, which are concentrated in temporary points of radioactive waste and distributed in natural landscapes. The volume activity of ^{90}Sr, as the main pollutant in the water of certain areas of the wells in districts of Budbasa, Yanivsky and Semyhodskyy backwaters reaches respectively 140, 51 and 70 kBq / m^3. Outside the area of temporary points of radioactive waste majority of content of ^{90}Sr is within 0.1-0.4 kBq / m^3, ^{137}Cs - 0,01-0,04 kBq / m^3. Results definitions of radionuclides mainly are formed by the specific conditions and geological structures of wells.

Today there is a problem of informative of network's supervisory wells and control of migration of radionuclides in the zone of aeration, which is aggravated. Therefore, the problem of assessing the impact of items radioactive waste and temporary points of radioactive waste in radiological groundwater is more urgent now.

Further development of radiation monitoring of groundwater is associated with the urgent need to improve the state of knowledge of problems of redistribution and migration of radionuclides in water resources. For this purpose it is necessary to perform additional drilling observation wells, determination of macro and micro components of groundwater geochemical environment indicators migration, hydrogeology parameters and zone aeration and periodic technical inspection of existing observation wells using geophysical methods for wells.

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The characteristic's impact on environment of laminated product's plants

O. Nahurskyy [1], S. Tsyhaniuk[2]

[1]Department of Environmental Protection and Audit, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery Street 12, E-mail: o_nagurskyy@ukr.net

[2]Department of Environmental Protection and Audit, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery Street 12, E-mail: extrimal093@gmail.com

Abstract – We developed an ecological estimation of the influence of production on the environment. The methods of cleaning of the polluted gaseous environment were analyzed as well as the technological 4-stage plan of cleaning the flue gas from the coal ashes and SO_2 was proposed.

Key words – ecology, lamination, gas environment, environment, flue gases, coal ash, SO_2.

I. Introduction

Healthy environment – a necessary condition for human existence. Excessive concentration of agriculture and industry has caused catastrophic pollution of air, water and soil. Modern scale environmental changes created a real threat to life and health of citizens of Ukraine. The rate of environmental degradation Ukraine has become such a scale that went beyond the speed of biological adaptation of living organisms to habitat. Objective medical evidence suggests growing impact of environmental factors on physical potential of our society.

Human security and state of the surrounding environment – one of the most important characteristics of quality of life, scientific, technological and economic development. The development of science and technology, due to the needs of the economy, increasing social and economic security of society, at the same time leads to safety to human health and the environment.

Exceeding the permissible anthropogenic load on the environment, maximum permissible concentration of harmful chemicals reduces the level of environmental safety. Dust worsen the ecological environment, causing premature wear industrial equipment and housing and communal services, harmful to health. In this regard lately all over the world are increasingly focused on the fight against dust release in various industrial processes. The problems of human impact on the natural environment Ukraine objectively required to develop new and more effective instruments to ensure the environmental safety of Ukraine.

II. Measures to reduce emissions of pollutants

The biggest impact in the production activity for the production of laminated products undergo atmosphere. Air pollution causes poisoning forests are particularly harmful sulfur and nitrogen oxides, which are emitted by boiler houses and traffic. For they alone cause a weakening of life trees and forming sulfuric and nitric acid they cause maximum damage, dropping to the ground acid rain. Seeping into the ground, they erode the root system and eventually leached nutrients such as calcium and potassium.

Wood - material that people in ancient times processes and uses for different purposes: production tools, housing, furniture, interior elements, etc. Etc. Wood is relevant, always fashionable, environmentally friendly, economical. In the wood industry employed a significant number of people, some of them – directly in the process of cutting and processing wood.

Often workers are systematically treated wood, especially in small private woodworking enterprises underestimate the degree of risk exposures. Research [1-5] show that a significant risk factor for employees woodworking companies are dust timber. Dust can cause a range of diseases depending on several factors.

To clean the flue gases from sulfur oxides used absorption and adsorption.

Absorption – a selective absorption of certain components of the liquid vapor gas mixture sinks. The chemical interaction component absorbed with absorbent absorption process called chemisorption.

Adsorption – the absorption component gas, steam or porous absorbent solid solution, i.e. separation process, characterized by the transition of a substance from a gas (vapor) or a liquid to a solid. Reversible process – desorption.

Spent combustion gases, after the step of removing impurities, adsorption to come clean installation of SO_2, flow chart of which is shown in fig. 2.1.

Before adsorption is necessary to cool the combustion gases to improve the process of absorption. The flue gases are fed into the space horizontal pipe and tube heat exchanger. Cooling by using recycled water.

Technology continuous purification of exhaust gases from sulfur dioxide involves the work of two absorber.

In the first adsorber serves flue gases, after cooling to a temperature <30°C. Before absorber in a line of exhaust flue gases injected ammonia, the interaction which is formed on the surface of the adsorbent ammonium sulfate. When saturated adsorbent sulfur oxides gas supply for the first unit stops and switches to another.

For the first adsorbent regeneration absorber is fed water that washes ammonium sulfate. After the final wash through the absorber layer blown air, heated in an electric air heater. A solution of ammonium sulfate is collected in containers and can be used as liquid fertilizer.

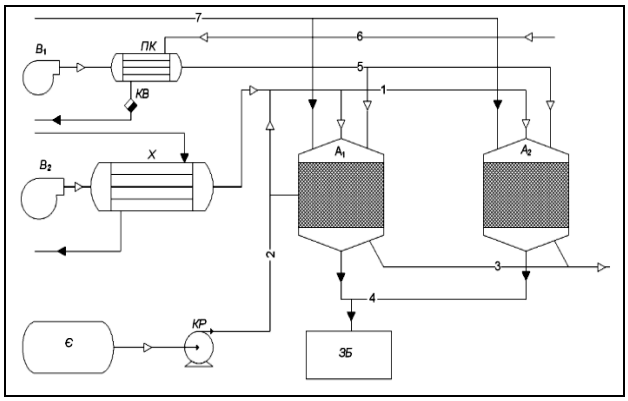

Fig. 2.1. Technological scheme of flue gas cleaning SO_2: В1,2 – ventilator; А1,2 – adsorber; Х – refrigerator; ПК – steam heater; КВ – kondensatovidvidnyk; Є – container with ammonia; КР – compressor; ЗБ – collection

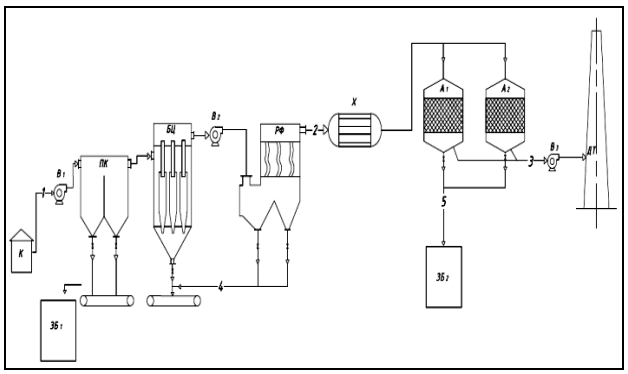

Fig. 2.2. Flowsheet cleaning of flue gases from coal ash and SO_2: К – boiler house, В1-3 – ventilator, ПК – pyloosadzhuvalna camera, БЦ – battery cyclone, РФ – bag filter, Х – refrigerator, А1-2 – adsorber, ДТ – stack, ЗБ1-2 – collection.

The flue gases of coal ash particles out of the boiler room for further purification. Then fan fed into the pyloosadzhuvalnu camera, where the rough cleaning. The effectiveness of such cameras capture at coal ash does not exceed 70%. Further gas cleaning (particles up to 10 microns) is in the battery cyclone. Then served in the air bag filter for complete purification of coal ash size of 0.01 microns.

After solids removal stage flue gases are cooled in a heat exchanger and fed to the adsorption purification of SO_2. To ensure the continuity of the technological scheme provides two adsorbers.

Flue gases are emitted after the adsorber through the chimney into the atmosphere.

Conclusion

For decades, the impact of environmental pollution on the health of the population studied as an example of large industrial centers. However Lviv region is quite industrialized and urbanized, with numerous sources of pollution harmful to human health factors.

Enterprise producing laminated products of their stationary sources of air emissions are pollutants, styrene, dioxins oxide, soot, sulfur dioxide (SO_2), coal ash, carbon monoxide, dust timber.

Since most company emits SO_2 and coal ash, it was suggested technological schemes purification of flue gas from these pollutants.

The introduction of such treatment facilities will reduce the negative impact on the atmosphere.

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Space-functional role of consortiums of ecotones of protective type to ensure the environmental safety on railway lines

Maria Ruda[1], Volodymyr Pohrebennyk[2]

[1]Institute of Environmental Economics and Management, Ukrainian National Forestry University, Lviv, UKRAINE, Lviv, 103 Gen. Chuprynky street, E-mail: marichkarmv@gmail.com

[2]Vyacheslav Chornovil Institute of Ecology, Nature Protection and Tourism, Lviv Polytechnic National University, UKRAINE, Lviv, 130 Gen. Chuprunky, E-mail: vpohreb@gmail.

Abstract – A multi-factor analysis of the impact of the Lviv Railway transport on the environment takes into account the properties of natural systems: multiple connections, stability, commutability, additivity, invariability as well as multivariable correlation of nature components. One of the important steps towards ensuring environmental safety in the railway transport is the formation of ecologically balanced system of nature management on the basis of environmentally clean technologies. A fundamentally new model of environmental safety in railway transport is of great polyfunctional importance as this enables, on the basis of the landscape-ecological methods, to form consortiums of protective ecotones that will provide the maximum spatial-temporal efficacy.

Key words – ecotone, geoekotone, railway, protective forest plantations.

I. Introduction

The railway transport of Ukraine is part of the integrated transport system, it is an industrial technological complex of organizations, enterprises of public transport designed for the needs of public production and the country's population in domestic and international transportation as well as provision of other transport services.

However, along with the benefits offered by the railway transport, there arise accute issues of environmental safety during its use, which is caused by its negative and even destructive impacts on the environment. That is why ensuring a high level of safety on railway transport in Ukraine is one of the main objectives of transition to a harmonious development, while the development and implementation of innovative methods to provide environmental safety, based on cumulative function of established floro-coenotic systems along railway lines, is relative and timely.

II. Results and discussion

One of the most important steps toward minimization and elimination of environmental impact, in accordance with the National Environmental Strategy of Ukraine and the pan-European strategy of conservation of biological and landscape diversity, is the formation of an ecologically balanced system of nature management on the basis of environmentally clean technologies in transport sector. That is why an important role in the mechanism for reduction and neutralization of such impacts in future should belong to the formation of highly productive phytocomplexes with powerful potential for phytostabilization and phytoextraction of contaminated soils. Forest plantations are designed, first and foremost, to protect railway lines against adverse aerodynamic effects and ensure regular and uninterrupted rail traffic at any time of the year. Today, the protection from snow and sand drifts, mudrock flows, snow avalanches, landslides and rockslides, soil erosion, acoustic and radioactive contamination is fulfilled by protection forest plantations along the railway lines.

Since ecotones, as distinct from ordinary protection plantations, have specific autotrophic and heterotrophic blocks, edatope and climatope, we can propose a hypothesis that ecotones should be viewed as border ecosystems with inherent biotic cycles and flow of energy, and which are able to perform more efficiently than usual railway protective forest plantations a variety of functions to ensure environmental safety.

The spatial-functional role of protective ecotones on railway lines is dominant in the optimization of their components because the arrangement and size of the plantation should be governed by the windbreak effect as well as direction of turbulent air flows that are harmful to railway lines and adjacent agrocoenoses. From the aerodynamic standpoint, the windbreak effect of forest shelterbelts as spatial grids consists in the speeding down and transformation of latency of wind flows at a distance of 5 H (H – protective height of the plantation) on the windward side and 25 H – from leeward side. However, such design of protective plantations leads to deterioration of other functions performance.

On erosion-prone lands (steepness of more that 200), the arrangement of protective plantations must be performed according to the principles of contouring-reclamation organization of the territory with application of relevant soil-conservation agricultural techniques and waterworks which reduce the risk of soil erosion to a minimum.

That is why, at present time, railway protective forest plantations should be considered not only from the point of view of their utilitarian value as a means of railway lines protection against adverse natural and anthropogenic factors but primarily as a system of forestry measures to optimize the spatial infrastructure of railway landscapes, i.e. as a system of protective ecotones which have a strong potential to ensure environmental safety on the lines of railway transport.

Years of research on the spatial functional characteristics of the protective forest plantations on the Lviv Railway lines have shown that these plantations have acquired traits of ecotone because they have seen a dramatic increase in the number of coenopopulations, which confirms the general ecological principle of life diversity at the phase boundary or environment interface according to V.Vernadsky.

As a result, a kind of parademe system is formed along the Lviv Railway lines,consortium, that significantly differs from natural one due to overlapping ecological niches. This consortium has much in common with conserved

(ecological) corridors because the integrated assessement shows increasing species diversity of agrosystem flora by 7 – 73 %, entomofauna – by 27 – 62.5 %, zoofauna – by a factor of 2.7 times.

In the consortiums of protective ecotones along the Lviv Railway lines, one can observe the effect on trophotopes and geochemical processes along the railway lines and adjacent agrocoenoses. Thus, along the railway lines Lviv – Sambir, Lviv – Stryi, and Stryi – Mukachevo, there is evidence of the reduction in run-off of up to 1.3 %, annual average temperature by 3-80, dissipation of acoustic flux – by 15.2 dB, also a high cumulative ability of plantations is observed.

According to the field studies, we have classified the protective ecotones of the Lviv Railway by characteristics of profile, i.e. the structure and composition of plantations by their origin. Full-profile protective ecotones are plantations where the structure of shelterbelts (ecotones) can be clearly seen, they can be found in all sections of the Lviv Railway where the protective forest plantations were artificially created (Fig. 1). Predominantly, they consist of one or, less common, three strips. Ecotone is formed at the boundary of two different anthropogenic tracts in a railway precinct. Across the study sections of the railway lines, only mixed stands were observed, no pure stands were found.

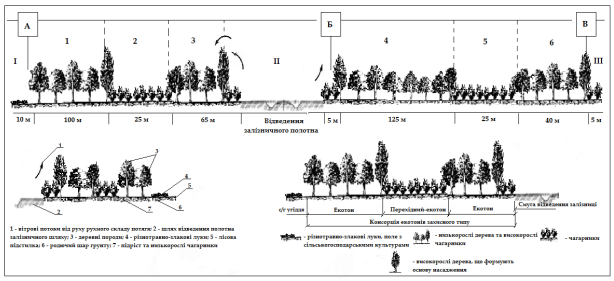

Fig. 1. Diagram of the vertical structure of the full-profile consortiums of protective ecotones at the Lviv Railway: A – herb-grass strip, field of crop plants; B – railway precinct; C – consortium of protective ecotones; 1, 3, 4, 6 – ecotones; 2, 6 – transition ecotones; I – agrocoenosis; II – anthropoenosis; III – primary stands.

Partial-profile protective ecotones are predominantly the remains of natural forests where it is impossible to distinguish well-defined strips – actually ecotones (Fig. 2).

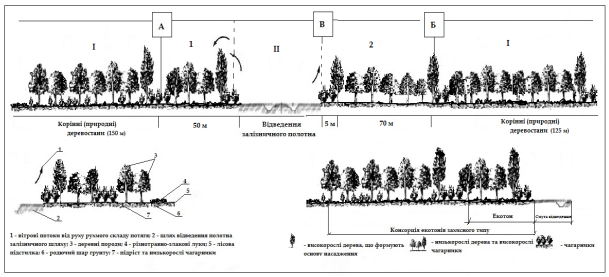

Fig. 2. Diagram of the vertical structure of partial-profile consortium of protective ecotones at the Lviv Railway: A – primary (natural) stands; B – consortium of protective ecotones; C – railway precinct; 1, 2 – ecotones; I – agrocoenosis; II – anthropocoenosis; III – primary stands

The complex and differentiation characteristics of cumulative function of protective ecotones depends on the morphology and composition of forest communities – edificator. The water regime of the soil under the forest shelterbelts is characterized by greater amplitude because of the accumulated snow and increased consumption during the growing season. The trophotopes in the forest shelterbelts tend to change toward intensive accumulation of humus and nutrients in the soil profile. In the affected area, they are characterized by increased moisture in the first meter depth of the soil on average by 30-55 mm and a higher content of humus and nutrients as a result of increased input of organic substances and intensification of humification processes.

In the structure of vegetation in the consortium of protective ecotones, there is a significant amount of synanthropic and acclimatized species. Active processes are currently observed of human-induced changes in primary stands to form natural-anthropogenic stands in a wider array.

The aggregate of protective ecotones at the Lviv Railway is functioning as a single system or forest reclamation complex that serves as the ecological framework where elements and subsystems interact providing a synergistic effect. Proceeding from the necessity of shifting to landscape-ecological principles of management and ensuring the maximum possible protective effect, the creation of a system of protective ecotones is one of the most innovative ways of ensuring ecosystem sustainability, in particular, enhancing their buffering capacity due to partial renewal of forest ecosystems as an integral component of natural landscape, which will provide for environmental safety on railway lines using only natural mechanisms of environmental protection.

Conclusion

Successful operation and development of rail transport is dependent on the condition of natural systems and availability of natural recourses, infrastructure development of the built environment, socio-economic environment of society. In this case, between each of the rail transport system there is a direct and backward linkage, as well as certain limitations in the use of natural systems, labor and financial resources.

The difference between the parameters of ecological factors of ecotones and those of related protective forests is a prerequisite for formation of specific coenoses and changes in theit population structure. Particularly, ecotones can see the formation of their unique specific populations of plants and animals or there may arise a situation where part of a population is in the same community, the other part – in another community, while the third is found in the ecotone.

The cumulative capacity of consortiums of protective ecotones is determined by comprehensive impact on the environment and has environment-forming and environment-stabilizing functions. A systemic and balanced spatial arrangement makes it possible to achieve significantly positive impacts on the adjacent areas.

That is why, it is of importance to form consortiums of ecotones on the basis on landscape-ecological methods, which will provide for the maximum spatial and temporal efficacy and will have a significant synergistic effect in ensuring environmental safety on railway transport lines.

Formation of Agrophysical Properties in the Affected Soils of Recultivated Areas

Oksana Iziumova

Zhytomyr State Technological University, UKRAINE,
Zhytomyr, Cherniakhovsky street 103,
E-mail: oksanaas1@rambler.ru

Abstract* – *The work studied the process of forming agrophysical properties of sod-podzolic soil on reclaimed territories after opencast mines. It is established that in case of withdrawal, reclaimed land from agricultural use, the 30-year period after the remediation is insufficient to restore agrophysical parameters and condition of disturbed soil due to natural factors of soil formation. The residual effects of its physical degradation manifested in changing the parameters of structural state, density, porosity, and as a result, the quantitative characteristics of water-physical constants and forms of moisture content of the ground.

Key words – recultivated soils, soil structure, soil porosity, soil density, soil moisture, soil moisture content.

I. Problem

Mining adversely affects the efficiency and environmental condition of land, involved in mining developments. Holding open cast mining withdraws from agricultural use large areas of productive land, destroying the earth relief, producing large overburden dumps. Therefore, one of the most effective measures to renovate the natural state of the soil cover is reclamation of lands and bringing them to a state most suitable for agricultural production. However, carrying out reclamation associated primarily with fundamental violation of evolutionary indicators of balanced physical structure of the soil, of which the dominant place tales structure of the soil. This index serves as the main criterion for the physical structure of the soil and determine the full range of natural, water-physical and agrochemical soil characteristics and modes.

Despite the scientific and practical relevance of the subject, the accumulation of experimental data on the formation of agrophysical soil characteristics under conditions of techno genesis is insufficient. In particular, for reclaimed areas there are not explored recovery time characteristics of the physical structure parameters and physical constants of water and soil disturbed by natural soil conditions. Therefore, the purpose is to establish laws in the process of restoration of natural and water-physical properties of sod-podzolic soil on reclaimed areas after mining development.

II. Materials and research methods

The results of study of soil agrophysical properties were conducted on sod-podzolic sandy soils of Zhytomyr region, located in the territorial limits of Irshansk mining plant for extraction and processing of ilmenite ore. Reclaimed in the mid 80-ies industrial plot of over 80 ha has not been in agricultural use, which created the preconditions for the study of recovery of agrophysical characteristics of soil reclaimed areas by natural factors.

Research of consequences of the change of agrophysical remediation of soil parameters were based on a comparative analogy and carried out by comparing the changes of physical indicators of disturbed ground with specified control.

The reliability of the results was provided by selection of the required number of individual soil samples, making it possible to reliably estimate the measurement parameters. To this end, on not reclaimed area in three places we laid heel-in of soil with disclosure of humus and eluvial horizons. A similar heel-in, as a control, was laid at a distance of 50 meters from the boundary of the study area. For laboratory determination of parameters of agrophysical properties of the soil, in these heel-ins in 8-time repetition using cylinder capacity of 109 cm^3 and height of 5 cm we selected undisturbed samples (monoliths) of soil horizons of 0-5; 5-10; 10-15 and 15-20 cm.

To determine the structural state of the soil, we selected additional soil samples from identified horizons, which defined macroagregate state using dry and wet sieving according to Savinov, water strength structure in stagnant water determined by the method of Andrianova.

For laboratory determination of parameters of water and physical constants in selected undisturbed samples (monolith), we determined: the total moisture (TM) by fill of monolith with capillary water after its saturation; the smallest (field) moisture (SM) according to the modified method of S. I. Dolgov; Humidity of capillary connection gap (HCCG) according to accelerated method of V. B. Mackiewicz; sustainable wilting humidity indicator (SWH) – by the method of S.I. Dolgov according to soil moisture on border0 of wetting. Soil moisture was determined by gravimetrically thermostat method with thermal regime of drying 105 ° C.

III. Results and discussion

The results of our research found that injuries of the soil at remediation works had significant impact on the index of macrostructure in 0-20 cm soil layer (Fig. 1).

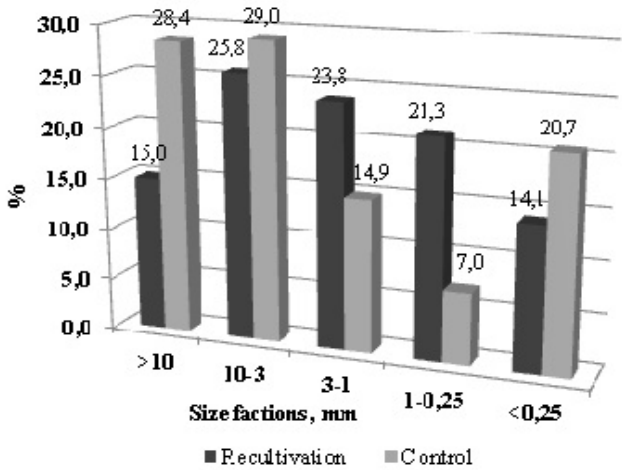

Fig. 1. Macroagregate composition of 0-20 cm soil layer (for dry sieving)

Most vulnerable to mechanical soil abuse proved to be structural units larger than 10 mm, the contents of which decreased from 28.4% (control) to 15.0%. This trend can be traced for structural units ranging in size from 3 to 10-mm.

Due to the relative decline of participation in a ground of largest components of macrostructure, the relative percentage of small factions rose from 14.9 to 23.8% (1.3 mm) and from 7.1 to 21.3% (size fractions 1-0,25 mm). Structural units smaller than 0.25 mm, forming the microstructure decreased from 20.7% (in control) to 14.1%.

According to the established in agronomic literature conclusion, the optimum size of the structural units included macrostructure size from 0.25 to 10 mm and coarse microstructure with the size of the structural units of 0.25 to 0.01 mm. The most valuable are recognized structural components ranging in size from 3.0 to 0.25 mm.

Considering it, the evaluation was conducted on the existing soil structure, the results of which are shown in Fig. 2. In the analysis we highlighted the optimal size of macro aggregates from 0.25 to 10 mm and the sum of fractions <0.25 and> 10 mm.

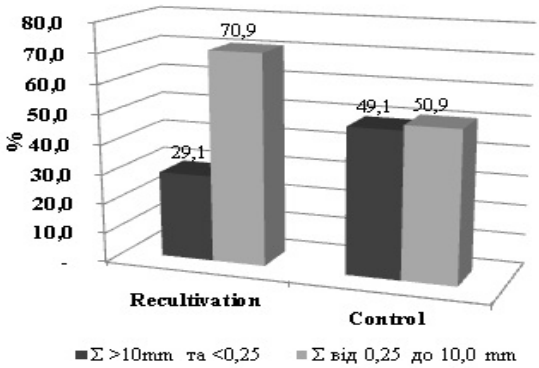

Fig. 2. Distribution of ground macrostructure according to its agronomic value

As we can see from the above histograms, reclamation significantly damaged the natural relationship between these structural elements. These changes were accompanied by the general increase in the proportion of structural units ranging in size from 0.25 to 10.0 mm in the background of percentage fractions smaller than 0.25 and more than 10 mm.

Quite important is the question of ascertaining the nature of the formation water resistance patterns on disturbed soils. To this end, we conducted wet sieving soil samples, the results of which are shown in Fig. 3.

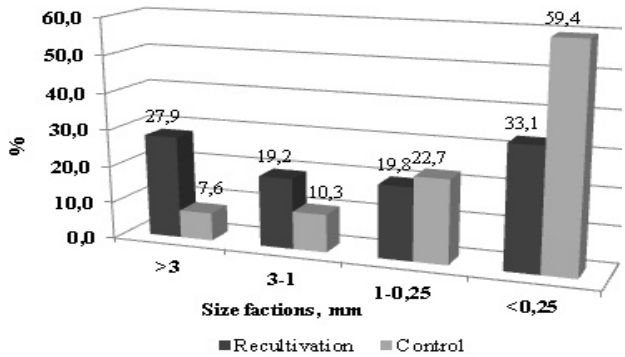

Fig. 3. Macroagregate composition of 0-20 cm soil layer on the results of wet sieving (%)

The presented data shows that after a long stay of structural units with size> 3 and 3-1 mm in water, from 19.2 to 27.9% of their amount retained its structure and suffered no destruction, meanwhile in the control sample this figure was less than 7, 6-10,3%. In analyzing the structural units of smaller size (1-0, 25 mm and <0.25 mm) we established the opposite trend.

Studies have shown that 30-year period of reclaimed land stay in undisturbed condition is insufficient for a full recovery performance of its physical structure: the density of content and total porosity specified in the Table 1. As seen from the above data, density of content for arable (0-20 cm) soil stabilized during the period at 1.14 g / cm^3 and remained significantly lower than the rate in the control region (1.24 g / cm^3). The largest average value are in the control - 1.27 g / cm^3 and the reclaimed area - 1.16 g / cm^3 at a depth of 10-20 cm layer of soil.

TABLE 1

SOIL DENSITY OF CONTENT (G/CM^3) AND TOTAL POROSITY (%) OF SOIL

Soil layer, cm	Control		Recultivation	
	g / cm^3	%	g / cm^3	%
Values for each layer				
0-5	1.21	54.1	1.2	60.4
5-10	1.21	53.9	1.14	58.1
10-15	1.26	50.9	1.16	57.4
15-20	1.28	51.2	1.16	56.2
Average values				
0-10	1.21	54.0	1.12	59.2
10-20	1.27	51.6	1.16	56.8
0-20	1.24	52.8	1.14	58.0

Total porosity consists of pores, which are very different in shapes and sizes. Obviously, the size of the pores in the first place will depend on water, air, thermal and biological properties of soil. The results of our research found that performance capillary porosity, unlike non-capillary is more stable and slightly changed in the depth of arable soil for both areas (Fig. 4).

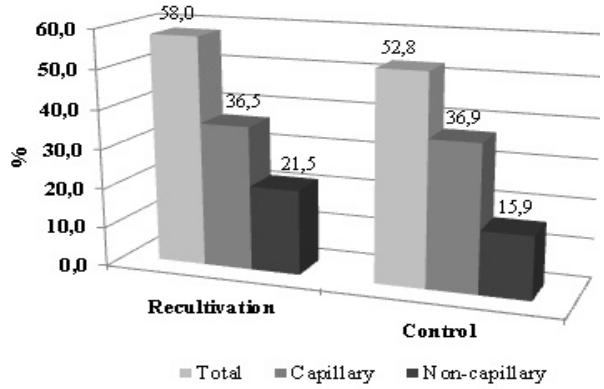

Fig. 4. Values of porosity of 0-20 cm soil layer

Index of capillary porosity on the reclaimed area was 36.5% and in fact did not differ from control values (36.9%). Non-capillary porosity varied significantly with depth. Its higher performance characteristic were found in the upper layers of soil, and noticeably reduced with the depth. Indicators of non-capillary arable soil porosity unlike capillary, as shown in Fig. 4, exceeded control values in 1.4 times and made 21.5%.

Changes in the physical structure of the soil under the influence of remediation affected the nature of the fluid formation and physical constants (Table 2). Soil moisture, which corresponds to TM for topsoil increased by 5.3% to 45.6%. Decisive role in shaping productive moisture content play SM and HCCG, characterizing respectively upper and lower limit of optimal moistening the soil for plants. As seen from the above data, soil moisture, which corresponds to SM and HCCG, on the reclamation area was significantly lower and amounted to 29.3 and 18.2%, while in the control area it was at level 32 and 23%. However, sustainable wilting humidity on impaired territory was less dynamic and actually meet the benchmarks.

TABLE 2

SOIL MOISTURE FOR WATER-RELAVANT PHYSICAL CONSTANTS, % IN THE DRY SOIL

Depth, cm	Reclaimed area				Control			
	TM	SM	HCCG	SWH	TM	SM	HCCG	SWH
0-10	46.5	29.5	18.4	11.4	42.9	31.8	22.6	11.7
10-20	44.6	29.1	17.9	10.8	37.6	32.1	23.3	11.1
0-20	45.6	29.3	18.2	11.1	40.3	32.0	23.0	11.4

The full moisture capacity is determined by the total porosity of soil. It describes the state of wetting of the soil, when all the pores filled with water, and thus serves as a criterion of its water accumulation capacity. Studies have shown that because of the remediation, ability of the water accumulation of soil increased and total potential moisture content for 0-20 cm layer increased from 99.9 mm (control) to 104 mm (Table 3). However, the main role in the moisture of plants play the moisture content, which is within the least moisture capacity and capillary moisture communication gap because it is most readily available and held in the ground for a long time. It is formed after free outflow of gravitational moisture and soil for a long time held exclusively by capillary forces. As seen from the results of research, the volume of moisture content as a result of remediation decreased from 79.4 mm to 66.8 mm (TM) and from 57.0 mm to 41.5 mm (HCCG). A similar trend is observed in regard of change in moisture content that meets its borders of availability for plants (SWH).

TABLE 3

POTENTIAL MOISTURE CONTENT FOR APPROPRIATE WATER AND SOIL PHYSICAL CONSTANTS, MM

Depth, cm	TM	SM	HCCG	SWH
Reclaimed area				
0-10	52.1	33.0	20.6	12.8
10-20	51.7	33.8	20.8	12.5
0-20	104.0	66.8	41.5	25.3
Control area				
0-10	51.9	38.5	27.3	14.2
10-20	47.8	40.8	29.6	14.1
0-20	99.9	79.4	57.0	28.3

The practical interest has the question of the formation of soil moisture reserves, taking into account the extent of its availability for use by plants. Accordingly, we identified the following categories of soil moisture, the humidity in the range from TM to SM - the most available to plants, but does not play a decisive role in their moisture due to it short stay in the root layer of soil; from SM to HCCG - accessible (optimal) for plants moist; from HCCG to SWH - difficult to accept for plants, but plays a role in their moisture; lower SWH is practically unavailable to plants. [3] The results of our researches have established that the transformation of the physical structure of the soil, its porosity influenced by long period ongoing remediation the mobility of soil moisture and its availability for plants (Table 4).

As seen from the above data, the reclaimed area has a small (7.1 mm) increase in potential reserves of available moisture due, in our view, to increase of the volume of non-capillary pore space in the soil. This assumption is confirmed by the significant growth of excess moisture in the soil, which is formed in the range of TM-SM. The volume growth of such moisture content was the highest and amounted to 0-20 cm soil layer 16.7 mm. At the same time due to destruction of soil pore size of capillary volumes of moisture forms decreased from 28.7 mm (control) to 16.2 mm.

TABLE 4

THE DISTRIBUTION OF POTENTIAL MOISTURE CONTENT OF 0–20 CM SOIL LAYER BY CATEGORIES OF THEIR AVAILABILITY FOR PLANTS

Category of availability	Reclamation		Control		"+", "-" To the control. mm
	mm	%	mm	%	
Total reserves	104.0	100	99.9	100	4.1
Unavailable	25.3	24.4	28.3	27.7	-3.0
Available, total	78.7	75.6	71.6	72.3	7.1
including: inaccessible	16.2	20.6	28.7	40.1	-12.5
excess	37.2	47.3	20.5	28.6	16.7
and optimal	25.3	32.1	22.4	31.3	2.9

Among the categories of soil moisture in relation to its availability, the greatest practical interest represents moisture content category, limited to the upper (TM) and lower (HCCG) ranges outside the optimal wetting of the soil. By this measure reclaimed area proved to be close to the control. As seen from the above data, the volume of moisture content were at 22,4-25,3 mm respectively and made 31.3 and 32.1% of the total available water in the soil.

Conclusions

Reclamation of mining areas involved for a long period of development significantly alters evolutionary equilibrium of agrophysical properties of sod-podzolic soil. 30-year period is not sufficient to restore the physical structure of the soil. The consequences are manifested in ongoing remediation decrease of soil density content, which during the period stabilized at 1.14 g / cm^3, which is substantially lower than the rate in the control region of 1.24 g / cm^3.

There were changes of the total porosity of soil on reclaimed areas. The porosity of the soil throughout the depth of arable soils significantly exceeds the reference values for arable soil, which totaled 58.0%, which is 5.2% above the reference level. It was established that the performance of capillary porosity, unlike non-capillary is more stable and slightly changed in the depth of arable soil for both areas.

Reclaimed area preserves quantitative soil properties regarding moisture content to the extent of their availability to plants. Against the general trend to the growth of total available potential moisture content and their forms (7.1 mm) in the arable soil layer increases the volume of unproductive (excess) water (up to 16.7 mm) and decreases the number of severely accessed (12.5 mm) forms. Volumes of most productive ground moisture content that are classified as "optimal" stabilized at 25 mm, which practically corresponds to parameters obtained in the control region.

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4 F. Kolessa, street, 79013 Lviv, Ukraine
tel. +380 32 2582146, fax +380 32 2582136
vlp.com.ua, e-mail vmr@vlp.com.ua