

# Potentiometric Determination of Hydroquinone in Natural Waters

Halyna Petrushyna<sup>1</sup>, Olha Stepanova<sup>2</sup>, Anzhelika Shevchenko<sup>2</sup>, Viktoriia Zhukovska<sup>2</sup>,  
Valeriia Karpenko<sup>2</sup>, Inna Morenko<sup>2</sup>

1. Department of chemistry, Dnipro State Agrarian and Economic University, UKRAINE, Dnipro, 25, Voroshylova str., E-mail: petrushyna.h.o@dsau.dp.ua

2. Faculty of Water Engineering and Ecology, Dnipro State Agrarian and Economic University, UKRAINE, Dnipro, 25, Voroshylova str.

**Abstract** – *A new graphite modified electrode was created. In graphite cylinder electrode was fixed polymer composite material consisting of polyurethane, 18-molybdophosphate and graphite powder. The electrode was used for potentiometric determination of hydroquinone in natural waters.*

**Keywords** – potentiometry, hydroquinone, Wels-Dawson type heteropoly complex, 18-molybdodiphosphate, natural waters.

## Introduction

Phenols are one of the most common pollutants entering the surface waters of the enterprises of the oil refining, shale processing, wood-chemical, coke-chemical, anilin-dye industry, as a result of forest alloys, as well as with drains of the hydrolysis industry. In sewage from industrial enterprises, the content of phenols can exceed 5-10 g/L. Especially large concentrations of phenol in the runoff of coke plants are up to 20 g/L. The removal of phenolic waters in reservoirs and streams worsens their overall sanitary state, affecting living organisms not only by their toxicity, but also by a significant change in the regime of nutrients and dissolved gases (oxygen, carbon dioxide). At concentrations of 75 mg/L phenol inhibits the processes of biological purification, at a concentration of 0.01-0.1 mg/L there is an unpleasant smack in fish meat. Phenols in water can enter into the reaction of condensation and polymerization, forming humus-like complex and other fairly stable compounds. Stable compounds of chlorophenols are formed in the population as a result of phenol-containing water chlorination. The smallest traces of these compounds (0.1 µg/L) give the water a characteristic smack and smell. The process of self-purification of reservoirs from phenols proceeds relatively slowly and its traces can be transferred by the flow of the river over long distances.

Therefore, the search of simple and express methods for phenols determination in natural and sewage waters is an actual task. Potentiometry is a simple and reliable method of analysis. In addition, portable devices that are used in this method allows allow to rapid analyze at the sampling site without preserving a water sample. Potentiometric determination of hydroquinone using an electrode based on 18-molybdophosphate is presented in this paper.

## Experimental

A polymer composite material (CM) consisting of polyurethane (polymer matrix), 18-molybdophosphate (reagent) and graphite powder (to increase electrical conductivity) was developed. The composite material was fixed over graphite electrode (Fig. 1). The molybdenum Dawson structure heteropoly complex 18-molybdophosphate  $P_2Mo_{18}O_{62}^{6-}$  (18-MPC) is an oxidizing agent. The reaction between it and some reducing agents occurs almost immediately, the recovery proceeds without destruction of 18-MPC, which makes it possible to use it repeatedly [1]. Interaction between 18-MPC and various reducing agents occurs at different acidity of solutions. Thus, the variation of the pH of the solution allows the determination of several substances in a joint presence [2]. The IR spectroscopy method established that in the composition material there is no chemical interaction between the polymer and 18-MPC.

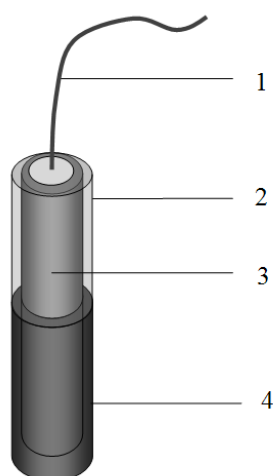


Fig.1. Electrode for potentiometric determination of hydroquinone: 1 – copper wire, 2 – polyurethane protective layer, 3 – graphite electrode, 4 – polymer composite material

The influence of pH on the characteristics of the calibration curve for the potentiometric determination of hydroquinone was investigated. The most optimal for potentiometric determination of hydroquinone is pH 4. The electrode shows response for the hydroquinone over the concentration range of  $2 \cdot 10^{-5}$ - $10^{-2}$  mol/L with the slope of  $69 \pm 1$  mV per concentration decade, and the response time is 6 min. The electrode exhibits good selectivity for the hydroquinone with respect to a large number of inorganic ions (Table 1).

Table 1

Selectivity coefficient values for the electrode calculated by the fixed interference method

Interferents	$K_{A,B}^{pot}$	$-\lg K_{A,B}^{pot}$	Interferents	$K_{A,B}^{pot}$	$-\lg K_{A,B}^{pot}$
$Na^+$ , $Ca^{2+}$	$5.0 \cdot 10^{-5}$	4.3	$Al^{3+}$	$2.9 \cdot 10^{-4}$	3.5
$Zn^{2+}$ , $CH_3COO^-$	$6.0 \cdot 10^{-5}$	4.2	$SO_4^{2-}$ , $PO_4^{3-}$	$5.0 \cdot 10^{-4}$	3.3
$Cl^-$	$7.2 \cdot 10^{-5}$	4.1	$Cu^{2+}$	$2.3 \cdot 10^{-3}$	2.9
$CO_3^{2-}$	$1.1 \cdot 10^{-4}$	4.0	$Fe^{3+}$	$1.7 \cdot 10^{-3}$	2.8
$NH_4^+$ , $Mg^{2+}$	$1.6 \cdot 10^{-4}$	3.8	$Br^-$	$2.0 \cdot 10^{-3}$	2.7
$S_2O_3^{2-}$ , $NO_2^-$	$1.8 \cdot 10^{-4}$	3.7	$K^+$ , $Fe^{2+}$	$2.5 \cdot 10^{-3}$	2.6
$NO_3^-$ , $SO_3^{2-}$	$2.7 \cdot 10^{-4}$	3.6	$F^-$ , $I^-$	$8.6 \cdot 10^{-3}$	2.1

### Conclusions

The electrode was successfully used for the determination of hydroquinone in natural water samples. The results are in good agreement with those obtained by spectrophotometry method.

### References

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