

# Glycopolymers based on water soluble polysaccharide and blocked isocyanate

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**Abstract – Biodegradable adsorbents were synthesized via interaction of biopolysaccharide with blocked isocyanate. Glycopolymers based on cross-linked konjac glucomannan demonstrate good adsorption ability for phenol whereas xanthan based glycopolymers are promising for metal ion sorption from water solutions. The system adsorption capacity can be regulated by changing polysaccharide OH-group substitution degree, isocyanate or blocking agent.**

Keywords – polysaccharide, blocked isocyanate, adsorbent, biodegradable, water soluble.

## Biobased sorbents for water purification

A serious environmental problem is water pollution. Organic compounds, in particular phenol, even at low concentrations, are considered as priority pollutants since they are harmful to plants, animals and human. Due to the urgent need to overcome human environmental contamination, there is currently a demand for creation new low cost easy biodegradable adsorbents. Polysaccharides are interesting renewable, biocompatible and biodegradable raw reagents to synthesize advanced materials with versatile technical, chemical and physical properties. For environmental and purification purposes polysaccharide based sorbents can be used as alternative for expensive conventional adsorbents. Chemical modification of polysaccharide by blocked isocyanate (BIC), which is able to produce reactive isocyanate groups under elevated temperature, allows formation of cross-linked glycopolymer (GP).

## Glycopolymers based on water-soluble polysaccharide and blocked isocyanate

To obtain advanced polymers based on renewable reagents, eliminating any organic solvent the number of latent isocyanates blocked by  $\epsilon$ -caprolactam (CL) or aminocaproic acid sodium salt (ACA) were synthesized and used to cross-link the water-soluble polysaccharides xanthan (Xth) and konjac glucomannan (KGM).

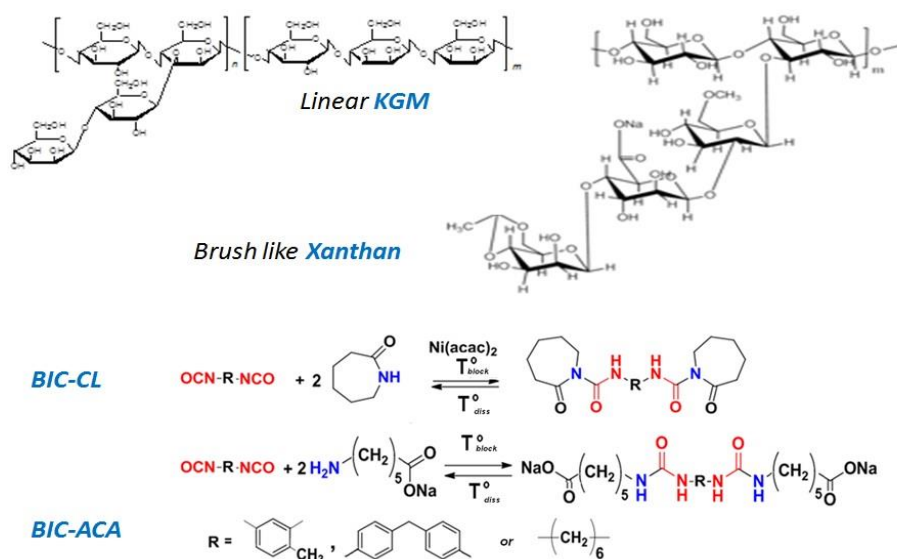


Fig.1. Polysaccharides structure and BIC blocking-deblocking reactions

The interaction of KGM and Xth with  $\epsilon$ -caprolactam blocked isocyanates occurs in heterogeneous conditions - in the melt of latent reagent on polysaccharide surface and powdered polymer systems were received. The interaction of KGM and Xanthan with water soluble ACA blocked isocyanates are conducted in homogeneous conditions due mixing in common solvent (water) to obtain the glycopolymers (GP) in the form of films.

Due to known adsorptive ability of initial polysaccharides the possibility was checked of GP to remove transition metal ions or phenol from their test water solutions prepared [1-2]. It was shown that GP-xanthan networks are prospective systems for extraction of heavy metal ions from their aqueous solutions whereas GP-KGM demonstrate good phenol adsorption ability.

According to Langmuir and Freundlich models GP have adsorption capacities ranging from 12, 8 to 32, 0 mg/g depending on isocyanate blocking agent structure and on polysaccharide group substitution degree. Variation of the balance of hydroxyl and urethane groups at the stage of cross-linking provides effective regulation of the complexation and capture of studied pollutions by glycopolymers.

Both GP-xanthan and GP-KGM synthesized materials are acid-, alkali- and thermo resistant. The obtained system is able to biodegrade in various microbial media. Influence of microbial media on the GP network were examined with the help of FTIR spectroscopy, thermogravimetry and micro image analysis of initial samples and after their exposure in aggressive microbial association (isolated from soils polluted by chlorine-organic pesticides) and natural microbial association (isolated from typical Ukrainian soil – chernozem) [3]. According to the data obtained the biodestruction in natural or aggressive medium leads to different results. Biodestruction in natural microbial medium occurs via degradation of saccharide units. Destruction of urethane component occurs under the influence of aggressive microbial medium.

### Conclusions

To satisfy the green chemical principles (usage of natural biodegradable and renewable polymer as reagents, synthesis of polymer systems passes without any solvents) glycopolymer sorbents based on water soluble polysaccharides xanthan or konjac glucomannan modified with blocked alkyl- or aryl-, di- or polyisocyanate were synthesized and used for phenol and heavy metal ion adsorption from water solutions.

### References

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