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GRAFT COPOLYMERS AS BASIS FOR FABRICATION OF ENVIRONMENTALLY FRIENDLY FIBROUS CHEMOSORBENTS

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Creation of a new generation of technical textile materials, in particular, sorption-active materials, application of which allows to solve urgent environmental and social issues - based on implementation of high-end technologies - is one of important and promising directions for the development of textile industry. Utilization of such materials for monitoring and protection of the environment, when producing protective clothing for workers of different industry branches (chemical industry, health care facilities, construction industry, and service providers), creates conditions for human health protection, and for more efficient and safe work.

Technogenous environmental effects have resulted in deterioration of ecological situation. Development and application of sorption materials (among which chemo-sorption fibers hold a special place) plays important role in the integral solution of environmental protection and human health protection problems. Developed specific surface, which surpasses the surface of granulated sorbents up by an order of magnitude, significantly higher sorbtion speed, mechanical strength, a great variety of forms of fiber materials provide a basis for development of efficient sorption processes with utilization of different instrumentation.

One of the promising methods for obtaining new types of chemo-sorption fiber materials is graft polymerization of ionogen monomers and monomers which contain reactive nonionic groups, with their subsequent chemical transformations, for which chemical fibers of different types as polymer matrix are used [1], [2].

On the basis of the conducted studies of the behavior of graft polymerization of monomers, which incorporate functional-active groups, a number of extremely efficient reduction-oxidation initiating systems has been developed, containing fluctuating-valence metals, one component of which was fixed on the fiber [3], [4].

The established relationship of composition of fluctuating-valence metal complexes and their activity in initialization of graft polymerization made it possible to select as a component - which provides the highest efficiency of olefinic block copolymers (OBC) - copper complex compound. When employing OBC $Cu^{+1} – H_2O_2$, conversion of amino-alkyl esters of α, β- unsaturated acids, 2-methyl-5-vinypyridine and glycidyl methacrylate made up 70 and 98…100% accordingly with 90…100% degree of conversion into graft copolymer [2], [5], [6].

Graft polymerization, proceeding at the boundary of solid and liquid phases, is characterized by certain peculiarities, such as effect of crystallinity degree, degree of orientation and molecular dynamics of polymers on dynamics of the polymerization process and interaction of functional groups of graft polymers with low-molecular nucleophilic reagents [6], [7], [8].

On the basis of quantum-chemical calculations, records of infrared spectroscopy and electron microscopy, ideas have been developed regarding a place of bonding of graft chains of polymethyl aminoethyl methacrylate and polyglycidyl methacrylate to macromolecyles of polymer-matrix, regarding the mechanism of graft polymerization of appropriate monomers and dependency of the character of distribution of the graft components in the structure of the modified fibres from their chemical nature and structural peculiarities [9]. Data obtained by means of mathematical simulation of chemical reaction kinetics, which proceed during obtaining of chemosorbent fibers, have been used for determining the optimum characteristic of the process (durability, concentration of reagents, type of solvent) [10], [11], [12].

As modified reagents, which provide for incorporation of ionogen and complexing groupings into composition of graft copolymers, compounds of different structure have been used (Table 1) [13…18].

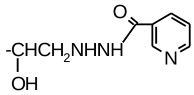
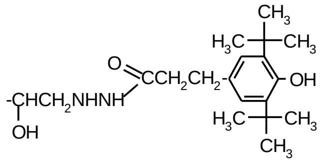
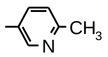
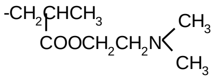
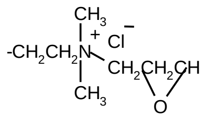
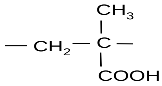
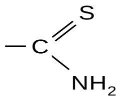
Change of the structure of functional groups makes it possible to produce fibrous chemosorbents, selective in relation to different cations; in return, it makes their employment a promising technique in technological processes of sorption and separation of platinum group metals, catchment of gold from exhausted citric gold-plating electrolytes, radionuclides from water solutions and emulsions, conducting monitoring of environment [19…21].

High degree of withdrawal of heavy metal ions from different solutions (including low concentration solutions) by means of fibrous chemosorbents makes their use advisable at the stage of final treatment of waste water and for development of closed-circuit water circulation systems. Employment of nonwoven fabrics made of polycaproamide fibers, modified by grafting with dimethylaminoethylmethacrylate, can be advisable as sorption-filtering media of individual protection equipment, such as respiratory protective devices, as well as filters for gas analyzers.

T a b l e 1. Characteristics of modifying compounds and properties of chemosorbent fibers

№	Modifying compound	Constitution of functional-active groups	COE, mmol/g	Sorbing compounds
1	Dimethylamine	$-\underset{OH}{CH}CH_2N(CH_3)_2$	3,0-3,5	HCl, SO_2
2	Hydroxy ethylamine	$-\underset{OH}{CH}CH_2NC_2H_4OH$	1,7-2,0	HCl, SO_2
3	Ethylendiamine	$-\underset{OH}{CH}CH_2NHC_2H_4NH_2$; $-\underset{OH}{CH}CH_2NHC_2H_4NHCH_2\underset{OH}{CH}-$	3,5-4,3	Zn, Cu, Ni, Cr ions
4	Triethylene tetramine	$H_2N-(CH_2CH_2NH)_2-CH_2CH_2NHCH_2\underset{OH}{CH}-$	2,5-3,5	Cu ions
5	Hydrazine hydrate	$-\underset{OH}{CH}CH_2NHNH_2$; $-\underset{OH}{CH}CH_2NHNHCH_2\underset{OH}{CH}-$	1,7-2,0	Zn, Cu, Ni, Cr ions
6	Polyethylenepolyamine	$-\underset{OH}{CH}CH_2NH-[(CH_2)_2-NH]_n-(CH_2)_2NH_2$ $-\underset{OH}{CH}CH_2NH-[(CH_2)_2-NH]_n-(CH_2)_2NHCH_2\underset{OH}{CH}-$	3,5-4,5	Chlorine complexes Pt, Pd, Ru, Rh, Os, Ir, and Cu, Cd, Pb ions
7	Guanidine	$-\underset{OH}{CH}CH_2NH\underset{NH}{\overset{\Vert}{C}}NH_2$; $-\underset{OH}{CH}CH_2NH\underset{NH}{\overset{\Vert}{C}}NHCH_2\underset{OH}{CH}-$	1,5	HCl
8	Potassium sulphocyanate Thiocarbamide	$-\underset{SH}{CH}CH_2R$	2-3*	Cu, Cr, Pb, V ions
9	Glycolic acid phenyl ether hydrazide	$-\underset{OH}{CH}CH_2NHNHC(=O)CH_2O-C_6H_5$	0,36	HCl, Cu ions

Table 1, continued

10	Nicotinic acid hydrazide		0,44	HCl, Cu ions
11	Propanoic acid hydrazide p-(4-hydroxy-3,5-ditert-bytyl phenyl)		0,36	HCl, Cu ions
12	2-methyl-5-vinyl pyridine		2,0-2,7	HCl, HF
13	Dimethylamino-ethyl methacrylate		1,5**	Pb, Cu ions
14	Epichlorohydrin		2,5-2,8	HCl, SO_3, $Au(CN)^-$
15	Methyl-acrylic acid		3,0-4,0	NH_3, Cu ions
16	$K_4[Fe(CN)_6]$	–	35 mg Fe/g	Radionuclides, ^{137}Cs
17	$(NH_4)_2S$		3,0-3,5***	Hg, Ag, Au, Pt, Pd, Rh ions, radionuclides

* OBE for Fe^{3+} ** COE for NaCl *** OBE for Ag^+

CONCLUSION

1. Possibility of employment of graft polymerization in relation to chemical fibers and chemical transformations of functional-active groups of graft chains as a method of incorporation of ionogen groups was examined.

2. Structural features and distinctive properties of fibrous sorbents, providing high efficiency of their use in the environmental monitoring and water purification systems, were demonstrated on the basis of experiments.

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