PROTECTION OF THE ENVIRONMENT

The scientific—practical conference "Application of new forms of fibre to solve ecological problems in various branches of the national economy" took place on April 14-15, 1993 in the Khimvolokno NPO (Mytishchi); it was organized by the Russian D. I. Mendeleev Chemical Society (a manmade-fibre section), the State Khimvolokno concern, the Khimvolokno Scientific Manufacturing Union, the Council of the primary organization of the Moscow D. I. Mendeleev Chemical Society, the Khimvolokno NPO, and the scientific—manufacturing ecological plant Ékopolis. More than 200 specialists from large industrial plants took part in the conference, scientific workers in institutes of the manmade fibre subbranch, and also specialists in other branches, who were interested in solving ecological problems by use of new types of fibre.

The conference was opened by G. D. Kovalev, Deputy General Director of the Khimvolokno NPO. He noted the preservation of the professional link between the manmade-fibre industry and the D. I. Mendeleev Russian chemical society and focused on discussion by the conference of the industrial activity of the Khimvolokno NPO associated with ecological safety in manufacturing. The work done by the present conference will help orient various branches of the national economy to the possibility of using new types of fibres in them to solve ecological problems.

I. G. Shimko, Deputy Director of the Scientific Industrial Ecological Enterprise Ekopolis came forward with a review article on the wide application of new types of fibres developed in the Khimvolokno NPO. In his report he mentioned such forms of fibre as ion-exchange fibre used to clean up acidic gaseous discharges and industrial waste water from salts of heavy metals, ammonium, etc.; carbon fibres, used to clean up gaseous discharges containing various organic solvents; hollow fibres used for thorough membrane cleanup of industrial and waste water from organic and inorganic contaminants, and also for separating gaseous media; carbon materials and thermally resistant polymers, which operate at high temperatures (400-550 and 200-350°C, respectively), for cleanup in filtration of gaseous discharges; biologically active fibres used in individual forms of technology; electrically conducting fibres, used as anastatic fillers and additives; and filter cloths, which operate in aggressive media. All of these fibres can be used in various branches of the national economy to develop ecologically clean technologies.

Below we give a number of reports which were read at the conference on the application of new types of fibres to solve ecological problems in various branches of the national economy.

PREPARATION OF SORPTIVELY ACTIVE FIBROUS MATERIALS TO MONITOR THE STATE OF THE ENVIRONMENT AND PROTECT IT, AND THEIR PROPERTIES

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Among the sorbents which are used to monitor the state of the environment and protect it and also to protect mankind from toxic substances, sorptively active fibres and textile materials based on them play a special role [1, 2]. This role is determined by the high sorptive power and rate of mass exchange processes, and by the low hydro- and aerodynamic resistance of these materials.

The most widespread method of preparing chemisorptive fibres are graft polymerization of biogenic polymers and chemical transformations of functional groups in the chain.

With the objective of preparing chemisorptive fibre materials of various types, methods have been developed for the method of graft polymerization to fibres of various chemical structure — hydrocellulose (C), polycaproamide (PCA) using redox systems (RS) and both ionogenic (dimethylaminoethyl methacrylate — DMAÉM, diethylaminoethyl methacrylate — DÉAÉM, methylvinlypyridine, and acrylic and methacrylic acids) [3-5] and nonionogenic monomers (acrylonitrile or glycidylmethacrylate — GMA) [6]. These methods make it possible to carry out graft polymerization essentially without formation of homopolymer at a rather high speed and with the possibility of devising ecologically clean processes.

On the basis of chemical transformations of functional groups (epoxy or nitrile groups) in graft copolymers (C-PGMA, PCA-PGMA, C-PAN, PCA-PAN) using reagents of compounds of various structure as reagents (aliphatic amine and polyamides, hydrazine hydrate, solutions of NaOH, etc.) chemisorptive fibre materials have been prepared which have ion exchange and complex forming properties [7-9]. Below we give a brief characterization of the results of using a number of chemisorptive fibres and materials based on them to solve ecological problems in various regions.

**Fibres Based on Graft Copolymers of C and PCA, Containing Hydrazidine Groups, in Processes of Sorption of Heavy Metal Ions**

On the basis of results from studies of the process of hydrazination of graft copolymers of cellulose and polyacrylonitrile and polycaproamide—polyacrylonitrile, conditions have been determined for carrying out the reactions which ensure a degree of nitrile group conversions into hydrazidine groups up to 30%. Thereupon the best result in the process is absorption of heavy metal ions from aqueous solutions were given by a fibre prepared by cyclization of a graft copolymer of cellulose and polyacrylonitrile (35% PAN) with a 6% solution of KOH (bath ratio M = 30, temperature t = 90°C, reaction time τ = 15 min) with subsequent hydrazidination with a 30% N₂H₄·H₂O solution (M = 10, t = 90°C, τ = 2 h). The static exchange capacity (SEC) of such a fibre in a 0.5 molar NaCl solution (mg/g) with respect to Cu²⁺ of 89, Co²⁺ of 57, Cd²⁺ of 45, Pb²⁺ of 43, Mn²⁺ of 48, Zn²⁺ of 48, Ni²⁺ of 89, and Cr³⁺ of 40. Thereupon the distribution coefficients, which determine the efficiency of extraction of metal ions from aqueous solutions, are from 0.6·10³ to 66·10³ mg/g, depending on the type of ion, the pH of the solution, and the character of the polymer—matrix.

For modified graft copolymers of PCA with PAN (PAN content 44% by weight), the SEC with respect to HCl was 4.6 mmoles/g; for modified C-PAN graft copolymers (PAN content 44%), 6 mmoles/g (hydrazidination in the presence of KOH for fibres which had been preliminarily cyclized under the action of NaOH). The change in SEC on repeated sorption—desorption cycles (consecutive treatment with 0.1 normal solutions of HCl and NaOH over a course of 2 h) did not exceed 10% after ten cycles.