Ion-exchange polymer complexing materials based on polyacrylonitrile

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The level of usage of polymer ion-exchange fibrous materials has been increasing at an alarming rate in many developed countries around the globe. In contrast to granulated ion-exchangers, ion-exchange fibrous materials possess a larger specific surface area that promotes the high rate of sorption. In this work we intend to report the latest research results on obtaining anion-exchange materials by chemical modification of "Nitron", an industrial polyacrylonitrile fiber. The modification of the fiber was realized by interaction of the nitrile groups of the polymer with nitrogen-containing bases such as a hydroxylamine (HA), hydrazine (HD), N,N-dimethylhydrazine (DMH), hexamethylenediamine (HMD) and ethylenediamine (EDA).

Stable sorption fibers were obtained during the investigation of reaction of "Nitron" fiber with HA in presence of the cross-linking agent-HD. The chemical modification of polyacrylonitrile fibers with HD and particularly with N, N-dimethylhydrazine in water solution occurs difficultly. Therefore, “nitron” was activated by 1 % solution of NaOH at 90 ^{0}C during 1-3 minutes before the modification by these reagents. Acidic moieties formed in this process accelerated the reaction of -CN groups with HD and DMH. Under the same hydrazidation conditions, the SEC values of activated fibers are much higher than those of fibers obtained without activation.

Furthermore, the catalytic action of HA on hydrazidation reaction of nitron was identified. In the presence of HA in the substrate mixture, the reactions of polymer’s nitrile groups with HD and DMH occurred easier. Besides, a higher degree of conversion was achieved. By treating nitron with HMD and EDA, ion-exchange fibers containing both weakly basic and strongly basic functional groups were obtained. In these cases, the diamines execute the function of crosslinking agent and modifier of nitrile groups at the same time. The reaction of nitron fiber with HMD, without a solvent or in an organic solvent, was carried out at the temperature 130-160^{0}C. Sorption materials (SMA-1) obtained under these conditions mainly contain strong alkaline amidine groups.

Thus, the obtained ion-exchange fiber sorbents are perspective for using in hydrometallurgy, in the purification of industrial wastewater from toxic metals, disinfection of drinking water from natural resources, as well as for production of bactericidal materials for medicine.