IMPROVEMENT OF THE FIBROUS SORBENTS PROPERTIES FOR WASTE WATER TREATMENT FROM IRON IONS

Nataliia Tarasenko[1], Viktoriia Plavan[2], Maksym Koliada[2]

[1] Department of General and Inorganic Chemistry, National Technical University of Ukraine Igor Sikorsky Kyiv polytechnic institute, Ukraine
[2] Department of Applied Ecology, Technology of Polymers and Chemical Fibers, Kyiv National University of Technologies and Design, Ukraine
xtf.fdp@gmail.com

Pollution of waste water with heavy metal ions is an environmental problem and it takes place in many industries. Sorption sequestration of metals from waste water has become quite widespread due to the high efficiency and the absence of secondary pollution. Polymeric and textile waste can be a raw material for the production of fibrous sorption-active materials [1,2].

The aim of the study is the determination of the sorption properties improvement of the fibrous sorbents in relation to the iron compounds by the solutions of different nature plant polyphenols.

Fibrous textile wastes containing 70% polyurethane fibers 162C (linear density 4.4 tex) and 30% polyamide fibers 6.6 f20/1 (linear density 3.3 tex) were used to obtain a polymeric composite material with sorption properties. The efficiency of the sorbent depends on the presence of active functional groups capable of binding ions of heavy metals irreversibly. Polyurethane fibers are similar to polyamides due to their chemical properties, as they also contain amide groups -NH-CO-. However, the additional oxygen atom included in the polyurethane chain -NH-CO-O- gives it more flexibility. It is of a very high interest to determine the effective method of modifying chemical fibers to increase the activity of their functional groups**,** in particular by the method of controlled chemical destruction with breakdown of C-N bonds [3].

For chemical fibers modification the processing of the fibrous sorbent was carried out with a solution of plant poly phenols (PP) for 24 hours at a temperature of 20 and 40°C. The degree of absorption of PP by fibrous sorbent was controlled by changing the optical density of the solution. During this time, the optical density decreased by more than 30%, which indicates the absorption of PP sorbent, and at a treatment temperature of 40ºC, the absorption rate is higher than at 20ºC.

The saturated PP sorbent was subsequently used to study its effectiveness in relation to iron salts. Treatment with iron salts was carried out at a temperature of 20 and 40ºC for 24 hours. The content of iron compounds after applying of fibrous sorbent into solutions decreases mainly during the first 2 hours, and at 40ºC the process of sorption is more intense, although the degree of absorption of iron compounds from solutions is generally not high and is about 30%.

To clarify the experimental data on Fe^{3+} content in solutions after processing by fiber-based sorbents, we introduced the X-ray fluorescence analysis.

The interaction features of iron compounds with fibrous sorbent were determined by the method of IR spectroscopy. In particular, was confirmed the involvement of carboxyl groups of modified polyamide and polyurethane fibers, which form the basis of the sorption material, in interaction with iron ions.

Thus, fibrous textile waste can be used to produce environmentally safe polymeric composite materials for wastewater treatment from heavy metal ions. The degree of absorption of iron compounds from solutions can be increased by optimizing the modification process of the chemical fibers that are part of the sorbent, using the pre-regulated destruction of chemical fibers in order to activate surface functional groups, etc.

[1] Hoang, A. T., Bui, X. L., & Pham, X. D. A novel investigation of oil and heavy metal adsorption capacity from as-fabricated adsorbent based on agricultural by-product and porous polymer. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, **40**(8), 929–939 (2018).

[2] Adam, M. R.; Hubadillah, S. K.; Esham, M. I. M.; Othman, M. H. D.; Rahman, M. A.; Ismail, A. F.; Jaafar, J. Adsorptive Membranes for Heavy Metals Removal From Water. Membrane Separation Principles and Applications. In *Membrane Separation Principles and Applications: From Material Selection to Mechanisms and Industrial Uses*; Ahmad, F. I.; Mukhlis, A. R.; Mohd Hafiz, D. O.; Takeshi M.; Elsevier: New York, 2019; pp 361-400.

[3] W.E. Nelson. *Nylon Plastics Technology*, London-Boston: Published for the Plastics and Rubber Institute [by] Newnes-Butterworths, 1976. 230 p.