

Nanofiber based on polyacrylonitrile – as a sorbent for lead and copper ions

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Keywords: sorbents, electrospun nanofibers, polyacrylonitrile, sorption, copper and lead ions.

Abstract

Nonwoven materials (NM) based on polyacrylonitrile (PAN) obtained by the electrospinning method. Conditions of the electrospinning: voltage – 70 kV, the distance between the electrodes – 180 cm. Temperature and humidity were 31 °C and 11%, respectively. The concentration of PAN was varied between 6–18 wt. %. The optimal concentration of PAN for obtaining of elastic nonwoven film was 13 wt. %. Dimethylformamide (DMF) was used as a solvent. The nitrile group of PAN nanofiber was chemically modified in amidoxime group (PAN-oxime) by reaction with hydroxylamine hydrochloride. This was proved by weight (calculation of conversion of nitrile group) and FT-IR spectroscopic methods. It is shown that the optimal ratio of reactants were 2 (NH₂OH·HCl) : 1 (Na₂CO₃) at a concentration 0.3 M : 0.15 M, respectively. The surface of the PAN-oxime nanofibers did not show any serious cracks or degradation and presented almost similar morphology to that of pure PAN nanofibers. The average diameter of the nanofibers was (140±30) nm. The sorption properties of PAN and PAN-oxime NM for lead and copper ions in static condition were studied. The concentration of lead ions was determined with pyridylazoresorcinol by spectrophotometry (dependency A-C (lead) is described by the equation $y = 0.190C$, $R^2 = 0.999$). The concentration of copper ions was determined with the reagent "Tetra" by differential spectroscopy. The quantitative sorption characteristics of metals (the recovery (R, %) and the sorption capacity (Q, mg/g) were calculated. It is established that PAN NM no exhibits sorption properties, whereas the sorption capacity of PAN-oxime NM for copper and lead ions was (120±3) and (2±115) mg/g respectively. Kinetic curves and sorption isotherms of the studied metals were obtained. This experiments indicate the potential use of the PAN-oxime NM for the extraction and purification of water from lead and copper ions.