

Preparation and application of polyethersulfone ultrafiltration membrane incorporating NaX zeolite for lead ions removal from aqueous solutions

Haider N. Alfalahy, Sama M. Al-Jubouri*

Department of Chemical Engineering, College of Engineering, University of Baghdad, Aljadria, Baghdad, Postcode: 10071, Iraq, emails: sama.al-jubouri@coeng.uobaghdad.edu.iq (S.M. Al-Jubouri), ORCID (0000-0001-5080-411X), h.abdul-ameer1207@coeng.uobaghdad.edu.iq (H.N. Alfalahy)

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ABSTRACT

Polyethersulfone (PES) ultrafiltration membrane incorporating NaX zeolite crystals as an ion exchange material was prepared and examined for lead ions (Pb(II)) removal from aqueous solutions. A powder NaX zeolite was synthesized by a hydrothermal technique and characterized using X-ray diffraction (XRD), scanning electron microscope (SEM), energy-dispersive analysis by X-ray (EDAX), and Fourier transforms infrared spectroscopy (FTIR). Then, it was ground and added to a casting solution of 20%wt. PES in dimethylformamide (DMF). Mixed matrix membranes (MMM's) of NaX zeolite/PES were fabricated using the phase inversion method. The prepared membranes were characterized in terms of permeability, contact angle, porosity, thickness, and surface morphology using SEM, Atomic force microscopy (AFM), EDAX, and FTIR. The effect of initial metal solution pH (2–7), initial metal ion concentration (50–200 ppm), and initial feed temperature (25°C, 36°C, and 46°C) on the treatment efficiency and permeate flux was investigated at trans-membrane pressure (TMP) of 1.6 bar. The results showed that the permeation flux of the prepared membranes was higher than the base membrane due to enhancing the membrane's properties such as hydrophilicity by adding NaX zeolite. The highest removal percentage of Pb(II) ions (97%) was obtained at pH solution of 6, temperature solution of 25°C, TMP of 1.6 bar, and initial Pb(II) ions concentration of 50 ppm using M3. It was found that M3 has a much higher adsorption capacity than the other prepared membranes.

Keywords: Mixed matrix membranes; NaX zeolite; Lead ions; Ultrafiltration; Ion exchange; Adsorption capacity

* Corresponding author.