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Separation of benzalkonium chloride using polymeric membranes

Aleksandra Klimonda*, Izabela Kowalska

Faculty of Environmental Engineering, Wroclaw University Science of Technology, Wybrzeze S. Wyspianskiego 27, 50-370 Wroclaw, Poland, Tel. +48 71 3203639; emails: aleksandra.klimonda@pwr.edu.pl (A. Klimonda), izabela.kowalska@pwr.edu.pl (I. Kowalska)

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ABSTRACT

The paper presents the findings of an experimental research employing tubular nanofiltration and ultrafiltration modules for cationic surfactant (benzalkonium chloride, BAC) removal from water solutions of initial concentration in the range from 50 to 1,000 mg/L. The study involved characteristics of the surfactant (critical micelle concentration CMC, micelle size distribution) and an assessment of the membrane filtration efficiency in terms of BAC separation and the volumetric flux. The effect of the modification of process parameters (transmembrane pressure and linear flow velocity) on surfactant retention and fouling intensity was evaluated. The experiments showed that the removal of benzalkonium chloride (CMC = 350 mg/L, micelle size 11.8 nm) with the use of nanofiltration module AFC40 exceeded 74% in all range of concentrations tested. The surfactant concentration was found as an important factor affecting the hydraulic performance of membrane filtration – increasing BAC concentration in the feed solutions resulted in permeability deterioration and the most significant drop in volumetric fluxes was noted for initial solutions of 1,000 mg/L. Moreover, the pore size, the hydrophilicity of the polymer and its net charge strongly affect the membrane fouling by the cationic surfactant particles. The most prone to pore blocking was the ultrafiltration membrane, while the nanofiltration membrane characterized by the lowest MWCO and pore sizes showed the least flux reduction.

Keywords: Pressure-driven membrane process; Cationic surfactant; Quaternary ammonium compound; Ultrafiltration; Nanofiltration

* Corresponding author.

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