Nanofiltration of oily wastewater containing salt; experimental studies and optimization using response surface methodology

Hamidreza Abadikhah, Farzin Zokaee Ashtiani*, Amir Fouladitajar

Department of Chemical Engineering, Amirkabir University of Technology, No. 424, Hafez Ave., Tehran, Iran, Tel. +989356568774; email: abadikhah@aut.ac.ir (H. Abadikhah), Tel. +98216454 3124; Fax: +982166405847; email: zokaee@aut.ac.ir (F. Zokaee Ashtiani), Tel. +989124990549; email: fouladi@aut.ac.ir (A. Fouladitajar)

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ABSTRACT

Two separate predictive models were developed for optimization and modeling of the relative permeate flux decline ($J/J_0$) and Mg ion rejection (%) in nanofiltration (NF) of oily wastewater. Response surface methodology based on central composite design was employed to experimental design and a cumulative study of the effects of various operating parameters such as trans-membrane pressure (TMP), feed flow rate ($Q_f$), oil concentration ($C_{oil}$), ion concentration ($C_{Mg}$), and pH on the NF separation process. Analysis of variance for developed quadratic models exhibited high significance and applicability. The oil and ion concentrations were the most significant factors and their interaction had a prominent effect on both permeate flux and Mg ion rejection. The effect of feed flow rate on the performance was also found to be negligible. The maximum relative permeate flux of 0.86 representing minimum membrane fouling phenomenon was obtained at low levels of input parameters at TMP = 3.4 bar, $C_{oil} = 200$ mg/L, $C_{Mg} = 40$ mg/L, and pH 4. Whereas, high rejections were found at high levels of input factors.

Keywords: Membrane; Nanofiltration; Oily wastewater treatment; Rejection; RSM