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Studies on the Recovery of Calcium and Magnesium from Red Seawater by Nanofiltration Membrane

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Abstract : This paper reports the results of nanofiltration (NF) polymeric membrane for the recovery of divalent ions (calcium and magnesium) from Red Seawater. Pilot plant experiments have been carried out using Alfa-Laval (NF 2517/48) membrane module. System was operated in both total recirculation mode (permeate and brine) and brine recirculation mode under hydraulic pressure of 15 bar. Impacts of some chelating agents on both flux and rejection have been also investigated. Results indicated that pure water permeability ranges from 17 to 85.5 L/m²h at 2-15 bar. Comparison with seawater permeability under the same operating pressure values reveals lower values of 8.9-31 L/m²h manifesting the effect of the osmotic pressure of seawater. Overall total dissolved solids (TDS) reduction was almost constant without incorporation of chelating agents. On the contrary of expectations, the use of chelating agents N-(2-hydroxyethyl) ethylene diamine-N,N´,N´-triacetic acid (HEDTA) and ethylene glycol bis (2-aminoethyl ether)-N,N,N´,N´-tetraacetic acid (EGTA) showed flux decline of about 3-15%. Analysis of rejection data of total recirculation mode showed reasonable rejection values of 35%, 59% and 90% for Ca, Mg and SO_4, respectively. Operating under brine recirculation mode only showed a decrease of rejection to 33%, 56% and 86% for Ca, Mg and SO_4, respectively. The use of chelating agents has no substantial effect on NF membrane performance except for increasing the total Ca rejection to 48 and 65% for EGTA and HEDTA, respectively. Results, in general, confirmed the powerful separation of NF technology for softening and recovery of divalent ions from seawater. It is anticipated that increasing operating pressure beyond the limits of our investigations would improve the rejection and flux values. A trade-off should be considered between operating cost (due to higher pressure and marginal benefits as manifested by expected improved performance). The experimental results fit well with the formulated rejection empirical correlations and the published ones.

Keywords : nanofiltration, seawater, recovery, calcium, magnesium
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