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Treatment of saline aqueous solutions using direct contact membrane distillation

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ABSTRACT

The treatment of highly saline aqueous solutions using direct contact membrane distillation (DCMD) was evaluated in this study. Experiments were conducted using a flat sheet polytetrafluoroethylene membrane with nominal pore size of 0.22 μm. Seawater, reverse osmosis (RO) concentrate collected from a wastewater reclamation plant, and a synthetic solution containing 2,000 mg/L of $CaSO_4$ were selected as the representative saline solutions. A gradual decline in permeate flux was observed at the beginning of the experiments when the seawater and RO concentrate solutions were treated using the DCMD process, most likely due to initial organic fouling and scaling. In contrast, when the saturated $CaSO_4$ solution was used as the feed, the permeate flux was stable for approximately 300 min of operation. However, when these solutions were concentrated beyond their solubility limit, crystallization of the sparingly soluble salts occurred on the membrane surface, leading to a complete loss of permeate flux at the end of the experiment. Contact angle measurement of the fouled and scaled membranes revealed a significant reduction in hydrophobicity. Membrane fouling and scaling were also confirmed by scanning electron microscopy analysis. The results suggest that pretreatment to remove organic matter is essential to prevent organic fouling. In addition, a major limiting factor for the treatment of saline solutions using DCMD appears to be the solubility of sparingly soluble salts.

Keywords: Direct contact membrane distillation (DCMD); Organic fouling; RO concentrate; Scaling; Saline solution

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