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Vacuum enhanced direct contact membrane distillation for oil field produced water desalination: specific energy consumption and energy efficiency

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ABSTRACT

This paper presents a study for energy requirements of lab-scale membrane distillation (MD) unit. This lab unit consists of flat-sheet membrane module with two circulation pumps, heater, and cooler to study the effect of different operating conditions on both specific energy consumption (SEC) and energy efficiency (η_E) via vacuum enhanced direct contact MD method. The flux and the two parameters of energy (SEC, η_E) were measured using different temperatures, different feed flow rates, and different feed salt concentrations. The two membranes used were neat polypropylene (PP) membrane and PP/multi-walled carbon nanotubes (MWCNTs) composite membrane. The membranes were synthesized via phase inversion process, using xylene as a solvent, methyl iso-butyl ketone as a coagulant and dispersion medium for MWCNTs. The results showed that the highest η_E was 39.5 with SEC 1,649.2 kW h/m^3 at flux 52.5 kg/m^2 h using 15 L/min feed flow rate of synthetic feed water with salt concentration 10,000 ppm at 55°C feed temperature. On the other hand, using our prepared membrane for the desalination of oil field water, the values of η_E and SEC were 12.1 and 4,189.5 kW h/m^3, respectively.

Keywords: Direct contact membrane distillation; Oil field produced water; Specific energy consumption; Energy efficiency

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