Analysis of the effect of advanced FO spacer on the specific energy consumption of hybrid RO desalination system

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ABSTRACT

Research involving hybrid forward osmosis-reverse osmosis (FO-RO) desalination has gained attention recently due to its potential to reduce energy consumption compared to traditional RO. This paper aims to understand the degree of the impact of advanced spacers in the FO process on the overall specific energy consumption (SEC) of FO-RO systems. The SEC for a representative advanced spacer is simulated and analysed under standard recovery and operating conditions. The results show that advanced spacers can significantly reduce SEC by up to 9.27% under the operating conditions considered. The results also show that placing an advanced spacer on the FO membrane draw side has a greater effect in reducing SEC compared to placing it on the feed side, due to the larger extent of ECP. It was found that FO channel pressure drop has insignificant impact on the SEC. The performance of advanced spacers in SEC reduction is most effective if the contribution of external concentration polarisation (ECP) to transmembrane osmotic pressure is high, if the contribution of internal concentration polarisation (ICP) is low, and if the effective transmembrane osmotic pressure is low. Optimal mixing in FO systems is therefore crucial to reduce SEC, especially for systems with severe ECP.

KEYWORDS

Advanced spacer; Forward osmosis (FO); Hybrid FO-RO system; Concentration polarization; Specific energy consumption (SEC)

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