

## Theoretical investigation of hybrid desalination system combining reverse osmosis and forward osmosis

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### ABSTRACT

Forward osmosis (FO) is a membrane-based desalination technique using an osmotic pressure gradient as a driving force. FO enables lower energy consumption to produce water than reverse osmosis (RO) because it does not require high transmembrane pressure. However, FO needs to be combined with other processes such as RO or evaporation because the draw salts in the FO products should be removed. This paper focused on theoretical investigation of combined systems with FO and RO for seawater desalination. A theoretical model to predict the performance of the combined systems was developed based on the solution–diffusion model and the modified film theory. The effect of internal concentration polarization on FO efficiency was also considered in the model. A pilot-scale system of FO and RO was assumed for model calculations. Results showed that the combinations of FO with seawater reverse osmosis (SWRO) have potential for desalination with high recovery (up to 80%). It was also found that FO may be incorporated with brackish reverse osmosis (BWRO) to produce high quality of water with higher flux and recovery than conventional RO-based desalination systems.

*Keywords:* Desalination; Water reuse; Reverse osmosis; Forward osmosis; Hybrid system

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