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# Development of a simulation program for the forward osmosis and reverse osmosis process

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**ABSTRACT**

Forward osmosis (FO) is an osmotic process that uses a semi-permeable membrane to effect separation of water from dissolved solutes by an osmotic pressure gradient. Unlike RO, FO does not require high pressure for separation, allowing low energy consumption to produce water. Therefore FO, a potential alternative to conventional membrane process, has been considered a novel technology for seawater desalination. There is no forward osmosis (FO) process simulation program yet, though. Therefore, the main objective of this paper is to develop such computer program based on the solution-diffusion model modified with the film theory for simulating and optimizing the FO, RO, and FO-RO hybrid process. The effect of concentration polarization on FO and RO process efficiency was also considered in the model. A MATLAB-based graphical user interface (GUI) program was used to develop the simulation program. Using the program, the effects of various factors, including the draw solution concentration, feed concentration, and feed pressure and temperature, on the FO and RO process performance were examined. The simulation results showed that the FO-RO hybrid process has higher recovery (66.8%) with reasonable flux (13.1 L/m$^2$-h) and permeate concentration (382 mg/L) than the FO and RO process. Thus, the advantages of the FO-RO hybrid process over the FO and RO process are its low permeate concentration and high recovery, which are difficult to attain in the FO and RO process, respectively.

*Keywords*: Forward osmosis; Program; Model; Hybrid process; Simulation

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