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Improving the reverse osmosis desalination system with tilted oval spacers in a zigzag configuration

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ABSTRACT

Seawater reverse osmosis desalination is an efficient way to produce pure water from seawater, however, its cost remains high, which motivates us to make some improvements in the process, such as the design for more efficient membrane modules. Given this, a two-dimensional CFD model is used to carry out a comparative study between commercial feed spacers arranged in a zigzag configuration and novel designs of feed spacers, that is, oval tilted spacers. In comparison to the models most reported in the literature, the unit cell approach used in this modeling appears to be more representative of the complete membrane module and needs less computational resources. The numerical simulations performed for inlet mass fractions ranging from 0.0002 to 0.002 kg/kg and transmembrane pressures ranging from 81 to 1,247 kPa show that cells equipped with 20° tilted ovals generate ~ 2% less salt deposition on the membranes and produce ~ 1% more permeate flux than the commercial design. These encouraging results quantified for a single cell are expected to increase for a complete membrane module composed of thousands of cells.

Keywords: Concentration polarization; CFD; Desalination; New spacer designs

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