A conceptual NF/RO arrangement design in the pressure vessel for seawater desalination

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\textbf{ABSTRACT}

The main objective of this study is to understand the operation mechanisms of reverse osmosis (RO) membrane and optimization of the operating mechanisms of the RO system in order to reduce the membrane fouling and/or energy requirements. Typically, the high-pressure RO membrane vessel is loaded with membrane elements having the same flux and salt rejection rate. It has been conceived that when different types of RO elements are loaded into the pressure vessel in a special arrangement according to their permeability and salt rejection rate, this arrangement has the potential for reducing the energy consumption of the RO plant. Here, a conceptual design is introduced to describe this new idea. The effects of feed salinity and temperature were investigated in this paper using the reverse osmosis system analysis filmtec membrane design software. A two pass membrane treatment process was designed for desalting seawater at different salinities varied from 35,000 ppm to 43,000 ppm. The results showed a net energy saving from 2.5 to 3% (depends on the feed salinity) could be achieved. The effect of the feed temperature was also investigated, and the new design was found to be more energy efficient. Membrane scaling was also investigated in this study, and it was found that the new membrane arrangement design was less efficient than old design at feed salinity 35,000 ppm and vice versa at feed salinity 45,000 ppm. This was attributed to the use of high membranes permeabilities in the new design.

\textbf{Keywords:} Water and salt permeability; Reverse Osmosis; Pressure vessel design; Energy consumption

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