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Artificial neural network model for optimizing operation of a seawater reverse osmosis desalination plant

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Abstract

An artificial neural network (ANN) was developed to predict the performance of a seawater reverse osmosis (SWRO) desalination plant, and was then applied to the simulation of feed water temperature. The model consists of five input parameters (i.e., feed temperature, feed total dissolved solids (TDS), trans-membrane pressure (TMP), feed flow rate, and time) and two output parameters (i.e., permeate TDS and flow rate). Then, the one-year operation data (n = 200) from the Fujairah SWRO plant was divided into three data sets (i.e., training, validation, and test data set) to develop the ANN model. The trained ANN model was subsequently found to produce good agreement between the observed and simulated data (TDS: R^2 = 0.96; flow rate: R^2 = 0.75) in the test data set. The results of this study show that the variation of the feed water temperature and TMP was found to significantly affect both the permeate TDS and flow rate. From subsequent simulations with various temperature controls, it is further suggested that the permeate TDS can be reduced using a linear increase control (from 27.5 to 29.5°C) for the feed temperature in an SWRO hybrid system with multi-stage flash (MSF) distillation, such as the Fujairah plant.

Keywords: Seawater reverse osmosis membrane (SWRO); Artificial neural network (ANN); Temperature control; Multi-stage flash (MSF); Hybrid system

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