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A control methodology for the feed water temperature to optimize SWRO desalination process using genetic programming

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Abstract

This paper presents a novel methodology to determine an optimized control method for feed water temperature in a seawater reverse osmosis (SWRO) desalination process using genetic programming (GP) which is an evolutionary algorithm used to find functional forms through training data. Two functional models were determined by GP with operation data collected over four years from Fujairah SWRO plant. The models showed high accuracy (>99.0%) in terms of the average error rate between the observed and the predicted values. The first model involved the permeate water flow rate with a functional temperature correction factor (TCF), water transfer coefficient, and net driving pressure (NDP) and the second is the salt passage ratio with a functional TCF, salt transfer coefficient, and total dissolved solids (TDS) in the feed. To determine the optimized control of the feed water temperature, a new control methodology with the two functional models was proposed and applied to a simulation of the feed water temperature, which showed better performance in terms of the permeate flow rate. Applying the optimized control of feed water temperatures to a plant under identical operational conditions, it was found that the permeate flow rate could be increased by approximately 900 m^3/day under a steady condition of 600 ppm in permeate TDS.

Keywords: Seawater reverse osmosis (SWRO); Desalination; Temperature correction factor (TCF); Temperature control; Genetic programming (GP); Hybrid system; Multi stage flash (MSF)

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