Improving second-pass permeate quality using thin film nanocomposite (TFN) membranes

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ABSTRACT

Since the initial development of thin film nanocomposite (TFN) reverse osmosis membranes, a concerted effort has been made to optimize performance in first-pass seawater applications in order to lower energy usage. As the potential for greater energy savings can be harder to achieve in brackish water (BW) and second-pass seawater applications, increased membrane rejection is an attractive goal for many BW plants. A pilot plant was identified in Israel utilizing ground water with total dissolved solids of 2,900 ppm that suited an experiment to demonstrate the potential for TFN membranes to provide better salt rejection at the same projected feed pressures as standard Thin Film Composite (TFC) BW membranes. The pilot was undertaken using TFN membranes (400 square foot elements) in Stage 2 of the Lahat BW desalination facility. Eight (8) elements were loaded in a single pressure vessel. Feed water was taken from the concentrate of the plant’s Stage 1 train and had an average conductivity of 5,864 μS/cm. Average feed temperature was 26.8˚C, feed pH was 7.6, and feed pressure was 12.2 bar. The pilot’s recovery was 63%. After collecting two months of operating data on a daily basis, the operation of the pilot and, in particular, the permeate quality proved to be stable. Daily data was normalized to element test conditions: 2,000 ppm NaCl, 225 psi, 25˚C, 15% recovery, and pH 8. This normalization showed a stable element flux performance of 10,700 GPD (40.5 m3/d) and 99.75% rejection. The flux data obtained compares well with TFC membranes. However, the element rejection is up to 0.25% higher than average TFC elements, based on published specifications from membrane manufacturers. TFN technology is demonstrating the potential to enhance the performance of TFC elements which are applied to BW projects. This study found that TFN membranes deliver higher rejection than standard TFC elements in BW situations.

Keywords: Membrane desalination; Thin-film nanocomposite; Highest salt rejection; Brackish water desalination

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