

SWRO system performance optimization: part I – energy recovery devices

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ABSTRACT

Specific energy consumption (SEC) of seawater reverse osmosis (SWRO) is explored in relation to classes of energy recovery devices (ERDs), under different operating conditions. A test system of one array, 100 pressure vessels containing 7 SW30HR–380 elements is used via retrofitting the results of ROSA9.1 design software for calculations of SEC for different ERD categories of pressure exchanger (PX), hydraulic turbocharger (HTC) and Pelton turbine (PT), and their relevant equations. Parameters ranged as: feed temperature 15°C–45°C, feed flow rate 30–60 gpm (6.8–13.63 m³/h), and feed salt concentration 32–52 g/L. SEC increases with increasing feed salinity and/or feed flow rate, and SEC decreases with increasing feedwater temperature. ERD saves SEC by 38%–63%. In terms of SEC, for a system withdrawing water with a salinity of 42 g/L, using ERD saves from 48% to 54%, 37% to 42%, and 36% to 41%, for PX, HTC, and PT, respectively. At different operating conditions, PX has the lowest SEC, followed by HTC and PT. Moreover, a new approach leads to determine the curves of SEC as a function of the system recovery, with and without using ERDs, has been carried out.

Keywords: SWRO optimization; Energy recovery device; Pelton turbine; Hydraulic turbocharger; Pressure exchanger; Specific energy consumption; SW30HR–380

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