Performance analysis of Thermal Vapour Compression integrated with Reverse Osmosis desalination system

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Abstract

Based on the thermal and membrane desalination technology, this study presents an analysis of an integrated single stage TVC-RO system. The hybrid system produces fresh water with an adjustable salinity in parallel operation. A steam ejector and a pressure exchanger are applied as the energy recovery devices. For comparison, a coupling system without energy recovery process is also modeled in the steady-state condition. System performance is evaluated by specific energy consumption and production ratio. The effects of several design parameters on system performance are investigated including boiling temperature, compression ratio, motive steam pressure, and target recovery rate. Results of the analysis indicate that the product salinity is adjustable in the TVC-RO system, and the system performance is largely dominated by system configurations and design parameters. To improve the system performance, the use of energy recovery device is necessary, and the membrane operation is recommended if the process is less demanding on product purity. A better performance can be obtained by increasing the target recovery rate of the RO membrane and decreasing compression ratio and motive steam pressure of the ejector. As the boiling temperature increases, one can expect that the production rate increases at a cost of a higher specific energy consumption.