Desalination for the Environment
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temperature, SDI, and HAB). Realizing the benefits and challenges of thermal desalination, the authors identified a room of improvement to reduce energy consumption. Qatar Environment and Energy Research Institute (QEERI) and Qatar Electricity and Water Corporation (QEWC) took initiative to improve the performance of thermal desalination plants in Qatar through building pilot plants for developing field demonstration of novel ideas.

This work presents a techno-economic analysis of an improved MED design based patented idea GCC2016-31325 patent [1]. The new design creates a vapor route to avoid shear losses, frictions, and breakdown of film liquid around the tubes (dry zones) which will reduce brine carry over. A prototype model of the novel design is based on both process and CFD simulation. A process Visual Simulation Program (VSP) is used to perform process design and comparison between commercial MED desalination plant (63 MIGD, Rass Laffan, Qatar) and proposed novel design. The capital cost of the desalination plant is calculated using recent bidding of commercial desalination projects and the updated market material price. 3D-CFD simulation is performed to visualize the vapor uniformity within the tube bundle and determine the thermal losses encountered in the vapor route.

Thermal losses analysis shows that the bundle losses present almost 90% of the total losses which totally excluded by the novel design. Process simulation shows that the calculated heat transfer area of the novel evaporator is 20% lower than of existing evaporator due to thermal losses reduction. Furthermore, removal of demister in novel MED evaporator decreases evaporator width by 65%. Therefore, the footprint of the novel evaporator is 70% lower than the conventional design. The novel evaporator capital cost is 30% less than that of the conventional evaporator due to a significant reduction of the evaporator width and vapor box.

The 3D-CFD simulation of the vapor route inside the evaporator at different process recovery ratio shows that the novel design is superior to the conventional design in creating a uniform vapor velocity at the entrance of the tube bundle. This uniform vapor approach assures a uniform heat flux over the whole tube bundle to avoid overheating or scale deposition grown up. Moreover, the novel design minimized the thermal losses encountered in the vapor route. The possibility of entrainment is also significantly would be reduced due to avoid intersection between the vapor route and the seawater falling film.

Keywords: Thermal desalination, MED, Simulation, Techno-economics

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Long-term operating data of a full-scale SWRO desalination plant. Performance analysis

A. Ruiz-García[a], F.A. León[b*], A. Ramos-Martín[c], C.A. Mendieta-Pino[c]

[a]*Department of Mechanical Engineering, University of Las Palmas de Gran Canaria. Campus Universitario de Tafira, 35017 Las Palmas de Gran Canaria, Spain*
[b]*Institute of Intelligent Systems and Numerical Applications in Engineering (SIANI), University of Las Palmas de Gran Canaria. Campus Universitario de Tafira, 35017 Las Palmas de Gran Canaria, Spain*
**Corresponding Author e-mail: federico.leon@ulpgc.es; Tel. +34 686169516*
[c]*Department of Process Engineering, University of Las Palmas de Gran Canaria. Campus Universitario de Tafira, 35017 Las Palmas de Gran Canaria, Spain*

The RO technology is the most extended for seawater desalination purposes. The operating data in long-term of full-scale plants is key to analyse its performance under real conditions. This seawater reverse osmosis (SWRO) desalination plant had a production capacity of 5,000 m^3/d for irrigation purposes. The operating data such as conductivities, flows and pressures were collected for around 27,000 h from 2001 to 2004. The plant had sand and cartridge filters without chemical dosing in the pre-treatment stage, a RO system with one stage, 56 pressure vessels, 7 RO membrane elements (Toray™ SU820) per pressure vessel and Pelton turbine as energy recovery device. The operating data allowed to calculate the average water and salt permeability coefficients (*A* and *B*) of the membrane as well as the specific energy consumption (*SEC*) along the operating period. The calculation of the average A in long-term operation allowed to fit the parameters of three different models used to predict the mentioned parameter. The results showed a 30% decrease of *A*, parameter *B* increase around 70%. The *SEC* was between 3.75 and 4.25 kWh/m^3. The three models fitted quite well to the experimental data with standard deviations between 0.0011 and 0.0015.

Keywords: Seawater; Reverse osmosis; Desalination; Operating data; Long-term

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Water production by RO for the manufacture of paint in the automotive industry

A. Ruiz-García[a], F.A. León[b*], A. Ramos-Martín[c]

[a]*Department of Mechanical Engineering, University of Las Palmas de Gran Canaria. Campus Universitario de Tafira, 35017 Las Palmas de Gran Canaria, Spain*
[b]*Institute of Intelligent Systems and Numerical Applications in Engineering (SIANI), University of Las Palmas de Gran Canaria. Campus Universitario de Tafira, 35017 Las Palmas de Gran Canaria, Spain*
**Corresponding Author e-mail: federico.leon@ulpgc.es; Tel. +34 686169516*
[c]*Department of Process Engineering, University of Las Palmas de Gran Canaria. Campus Universitario de Tafira, 35017 Las Palmas de Gran Canaria, Spain*

Reverse osmosis is the most extended technology in seawater and brackish water desalination. This technology is used in many applications, one of them the manufacture of automotive paints. In this work, two years of operation of a brackish water reverse osmosis (BWRO) desalination plant are analyzed. The raw water intake was a groundwater well. The desalination plant had a sand and cartridge filters with antiscalant dosing as pre-treatment. The RO system had two stages with 40 pressure vessels (PV) in the first stage and 20 in the second stage with 6 BWRO elements per PV. The feedwater conductivity was between 680 and 2,100 µS/cm, the pH in the feed between 6,05 and 7,55. The feed pressure increase from 11 to 28 bars due to membrane fouling along the operating period. The RO system had a recovery around 75% with a production of 7,200 m^3/d approximately. The performance of the plant along these years was evaluated through the calculation of the characteristic parameters of the membrane, such as the average ionic and water permeability coefficients.

Keywords: Brackish water; Reverse osmosis; Desalination plants; Long-term; Operating data