

Experimental analysis and techno-economic study of once through long tube MSF desalination plants

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ABSTRACT

Recently, a high temperature (HT) once through long tube (OT-LT) MSF has been considered for a large scale thermal desalination plant with high energy efficiency (i.e., high performance ratio (PR)). This study has been conducted as a 4-year collaboration project between Saline Water Conversion Corporation (SWCC) and Doosan Heavy Industries & Construction which was started in June 2012 and scheduled to be finished by June 2016. In this study, a HT OT-LT MSF pilot plant was designed with 20 stages and built in SWCC-Desalination Technology Research Institute (DTRI), Jubail, KSA. The OT-LT MSF pilot plant was operated to optimize dosing rate of newly developed antiscalant at the top brine temperature (TBT) of 130°C and to evaluate the viability of HT OT-LT MSF technology from scale and corrosion issue. As a result of the first optimization experiments, the dosing rate of new antiscalant was optimized based on visual inspection, chemical analysis, and heat transfer measurement. Also, one month operation has been carried out to validate the stable operation of HT OT-LT MSF without scale formation, which shows a stable and successful operation with the optimized dosing rate. Also, a techno-economic analysis was conducted to evaluate levelized cost of water (LCOW) of high capacity HT OT-LT MSF using a detailed thermal and economic model. It reveals that the HT OT-LT MSF has significant improvement in HTC and reduction in CAPEX, and OPEX, leading to LCOW saving of 16% compared with Brine Recycle Cross Tube (BR-CT) MSF. Furthermore, a long term corrosion test for five months has been carried out in the absence of a deaerator as an on-going research, which is expected that corrosion risk can be verified at high temperature operation (130°C) and adequate selection of corrosion resistive materials can be available. Accordingly, HT OT-LT MSF can be considered as a competitive future large capacity and high energy efficiency desalination plant.

Keywords: Desalination; Once through long tube (OT-LT) MSF; High TBT; Scaling; Corrosion; Techno-economic analysis; Levelized cost of water (LCOW)

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