

## Performance analysis of a trihybrid NF/RO/MSF desalination plant

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### ABSTRACT

The Saline Water Desalination Research Institute (SWDRI) of the Saline Water Conversion Corporation (SWCC), Saudi Arabia has been actively involved in developing the application of nanofiltration (NF) pretreatment to both seawater reverse osmosis (SWRO) and multistage flash (MSF) desalination processes. Full integration of NF, SWRO and MSF processes would result in enhancing the reliability, flexibility, plant productivity and ultimately reduce water production cost. Extensive experimental studies on a pilot-scale were conducted recently by SWDRI to establish the operational boundaries and constraints of the trihybrid NF/RO/MSF desalination system. The system was configured in such a way that the NF unit received seawater feed from the heat rejection of the MSF pilot plant and was able to operate at a fairly constant temperature of about 33°C which produced NF permeate (NFP) at a recovery ratio of about 64%. The SWRO unit which received the NFP as a feed yielded a permeate recovery of about 47%. Average chemical analysis of the RO reject (ROR) revealed that the sulphate and calcium concentrations were only 124 and 281 ppm, respectively, and was subsequently used as a make-up to the MSF pilot plant. The very low concentration of the sulphate and calcium ions in the brine recycle which were below the saturation limits enabled to operate the MSF unit safely up to a top brine temperature of 130°C (unit temperature design limit) and water recovery ratio of about 69%. In this paper, the operational performance of the trihybrid NF/RO/MSF desalination pilot plant will be presented. The established optimum operating conditions can be used as a guide to assess the techno-economic viability of the trihybrid desalination scheme.

*Keywords:* Trihybrid; NF; SWRO; MSF; High temperature

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