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Autopsy of NF membranes after 5 years of operation at the Ummlujj SWRO plant

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ABSTRACT

Application of nanofiltration (NF) membrane pretreatment to conventional seawater desalination processes at the Ummlujj SWRO plant generated much interest in the use of NF membranes in seawater desalination industries (thermal and SWRO). The present study was carried out to evaluate the condition of NF membrane elements after 5 years of continuous operation at the Ummlujj NF-SWRO plant. A total of 6 NF membranes removed from Ummlujj during annual replacements were subjected to performance evaluation. Out of the six elements, two NF elements from a single pressure vessel were subjected to autopsy and analyses based on their poor performance and also due to the fact both membranes (positioned 5th and 6th within the pressure vessel) were in continuous operation for 5 years. Autopsy included visual inspection, chemical and biological analyses of foulants as well as scanning electron microscopy and energy dispersive x-ray studies. The appearance and foulant contents on both membrane surfaces were the same and there was a remarkable reduction in their flux along with a significant increase in salt passage. Foulant deposits mainly consisted of organic matters that were easily scraped off from the membrane's surface but left stubborn stains difficult to clean, even with strong chemical cleaning agents. Thus, it was concluded that with long operation period, these foulants were strongly adsorbed onto the membrane surface and became irreversible in nature. The existence of organic foulants suggests the urgent need and application of a coagulation–filtration pretreatment process using a coagulant such as $FeCl_3$. This could be easily done by replacing the existing antiscalant SHMP, which is not necessary, as the current pH of the pretreated seawater feed of about 6.2 is sufficient to prevent scale formation on SWRO and NF membranes.

Keywords: Nanofiltration; Seawater; Fouling; Autopsy

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