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Characterization of biofilm bacteria isolated from two distinct seawater reverse osmosis systems in Saudi Arabia

Mohamed O. Saeed[a,*], W.L. Teng[b], Ibrahim A. Al-Tisan[a], Mohammed A. Namazi[a]

[a]*Saline Water Desalination Research Institute (SWDRI), Saline Water Conversion Corporation (SWCC), P.O. Box 8328, Al-Jubail 31951, Kingdom of Saudi Arabia*
Email: rdc@swcc.gov.sa
[b]*Technolgy and Water Quality Office, PUB, 82 Toh Guan Road East, WaterHub 608576 Singapore, Singapore*

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ABSTRACT

A study on type and tolerance of biofilm bacteria from two seawater reverse osmosis (SWRO) plants sourced from same lagoon but with different types of membrane and pretreatment regimens was carried out. One system uses hollow fine fiber seawater RO membranes of cellulose triacetate with membranes arranged in one element per vessel and the other system uses spiral wound seawater RO membranes of polyamide (PA/thin film composite) with membranes arranged in two elements per vessel. The first system (system-1) uses chlorine with acidification, coagulation, and media filtration followed by micron cartridge filtration. The second system (system-2) uses only acidification and micron cartridge filtration without chlorination. Three different bacterial isolates were found predominantly in membranes belonging to system-1 while nine bacteria species were isolated from membranes in system-2, two species from the feed side and seven species from the brine side elements, respectively. All bacterial isolates were identified by sequencing the 16S rRNA genes. The matrix-assisted laser desorption/ionization-time of flight mass spectrometry, despite good spectra, could not provide any reliable identification, indicating the limitation of the existing database for the identification of environmental isolates. The identified species were distinct to each SWRO plant; Alphaproteobacteria was the only common class in both systems, while Bacteroidetes seemed unique to the brine side element of system-2. To devise practical control measures for biofouling, tolerance tests were carried out on the biofilm isolates. All of the isolates were sensitive to a solution of 2% citric acid at pH 4.0 and a few isolates were also susceptible to osmotic shock in distilled water for varying time ranging from 3 to $\leqslant$ 24 h. On the contrary, exposure to chlorine and high salt concentration did not seem to have adverse impact on most of the isolates, making osmotic shock in hypotonic medium, a plausible alternative to control biofilm bacteria growth on SWRO membranes.

Keywords: SWRO membranes; Pretreatment; Biofilm Bacteria; Control Measures

*Corresponding author.

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