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Performance evaluation and fouling characterisation of two commercial SWRO membranes

Ibrahim M. El-Azizi*, Robert G.J. Edyvean

Department of Chemical Process Engineering, The University of Sheffield, Mappin Street, Sheffield, S1 3JD, UK
Tel: +44 114 222 5776, +44 114 222 7506; Fax: +44 114 2225701; email: I.El-Azizi@sheffield.ac.uk; R.Edyvean@sheffield.ac.uk

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ABSTRACT

The objectives of this study are to evaluate the performance of two different commercial seawater reverse osmosis (SWRO) membranes and to identify the causes of membrane failures. Membrane performances were evaluated by analysing the actual operating data and normalisation of permeate flow and salt passage. American Standards for Testing Materials (ASTM) and Homogenous solution diffusion (HSDM) standardisation methods were used. Comprehensive operating data for a period of 360 days were used to compare the accuracy of both methods. It was observed that the normalised permeate flow slightly decreased while normalised salt passage significantly increased during the operation period. The values of normalised permeate flows were identical by both standardisation methods, while the values of normalised salt passage were different. The standardisation methods showed that the performance deterioration of both RO membrane units is due to fouling. In order to determine the true identity of fouling two SWRO membrane elements were collected from the plant and subjected to membrane autopsies. The visual observation of unrolled membranes showed that the membrane surfaces and feed spacers were covered by loosely attached amorphous fouling material. Investigation by AFM found different types of fouling including inorganic, colloidal, and biofouling. The top surfaces of clean and fouled membranes were investigated by FTIR and XRD. FTIR results indicate that the major components of fouling materials are polysaccharides, silicate and hematite. XRD results indicate that the crystalline phase on the surfaces of both membranes was $CaCO_3$ scale as a mixture of calcite and aragonite.

Keywords: Desalination; Reverse osmosis; Membranes; Fouling; Autopsy

* Corresponding author.

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