



Will calcium carbonate really scale in seawater reverse osmosis?

Tarek Waly^{a,b}, Saleh Saleh^a, Maria D. Kennedy^{a*}, Geert Jan Witkamp^c, Gary Amy^{a,b},
Jan C. Schippers^a

^aUNESCO-IHE, Institute for Water Education, Department of Urban Water and Sanitation, Westvest 7,
2611 AX Delft, The Netherlands

Tel: +31 15 2151715; email: m.kennedy@unesco-ihe.org

^bFaculty of Civil Engineering and Geoscience, Delft University of Technology, Stevinweg 1, Delft, The Netherlands

^cProcess and Energy Laboratory, Delft University of Technology, Leeghwaterstraat 44, Delft, The Netherlands

Received 14 October 2008; Accepted 8 March 2009

ABSTRACTS

The elimination of antiscalant chemicals in SWRO plants will result in a more environmentally friendly, sustainable and cheaper process. Practically, this can be achieved by determining the real scaling limits of calcium carbonate in SWRO. In supersaturated solutions the period of metastability before the start of crystal growth is commonly indicated as induction time (t_{ind}). Induction time longer than the average retention time of concentrate in a single-stage SWRO suggests that scaling will probably not occur. This research project aims to determine the induction times as a function of the saturation index and ionic strength for synthetic seawater. The experimental procedure utilized in this research is a sensitive and stable pH meter with accuracy of 0.01 pH units. The pH meter used was able to detect precipitation as low as 0.3 mg/l of CaCO₃. Induction time experiments were performed with synthetic concentrates with low and high ionic strength. The synthetic high ionic strength solution had the same ionic strength, Ca²⁺ and HCO₃⁻ concentrations as the SWRO concentrate at a recovery of 30% and utilizing water from the Gulf of Oman. The lower ionic strength solution comprise the same Ca²⁺ and HCO₃⁻ concentrations as of the high ionic solution but with lower NaCl content. Results showed a good correlation between the logarithm of the induction time and saturation index. The pH of SWRO concentrate with (30% recovery) is expected to be in the range of 8.25–8.3. Experimental results showed an induction time of almost 30 min using synthetic concentrate which is ca. 10–15 times longer than the average retention time of concentrate in a single stage SWRO (2–3 min). These results need to be verified with real SWRO concentrate.

Keywords: Induction time; Membrane; Calcite; Scaling; Antiscalant; Acid

* Corresponding author.

Presented at EuroMed 2008, Desalination for Clean Water and Energy Cooperation among Mediterranean Countries of Europe and the MENA Region, 9–13 November 2008, King Hussein Bin Talal Convention Center, Dead Sea, Jordan.