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Oxidation-reduction potential in saline water reverse osmosis membrane desalination and its potential use for system control

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ABSTRACT

Chlorination and dechlorination are required in most saline water (brackish and seawater) reverse osmosis membrane desalination processes, regardless of whether a membrane or conventional chemical conditioning is employed as a pre-treatment. Wastage of chemicals occurs when the dosing process is not automated. Titrations of chlorinated water (using sodium hypochlorite) with sodium meta-bisulfite were undertaken using water of different salinities, which were obtained by varying volume ratios of seawater to deionized water (4:0, 3:1, 2:2, 1:3 and 0:4). Changes in reduction and oxidation potential (ORP) were studied with variations in chlorine doses (0–5 mg L^{-1} NaOCl) and salinities. As expected, the ORP values were greater at higher than at lower chlorine doses for any given water. The greater the ratio of seawater to deionized water, the lower was the ORP value, with a difference of greater than 100 mV between the deionised water and the seawater at a high chlorine dosage. The results suggest that the ORP level would be lower for seawater than for brackish water in control of chlorine dose. The ORP decreased with sodium meta-bisulfite addition at high chlorine dosages $2 mg l^{-1}) while the opposite was observed at low chlorine dosages (≤1 mg L^{-1}). Free chlorine disappeared instantly following sodium meta-bisulfite addition. As more than 80% of the added chlorine was diminished in the seawater, 2 mg L^{-1} sodium meta-biosulfite was sufficient to reduce free residual chlorine to less than 0.1 mg L^{-1} as required for most of the cellulose acetate RO membrane in seawater desalination. To be safe and cost-efficient, a chemical dose controller can be developed using the ORP titration information.

Keywords: Chlorination; Dechlorination; Free residual chlorine; Ionic strength; Activity coefficient; Seawater; RO membrane

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