Study of Scale Removal with Charged Reverse Osmosis Membranes

(Development of Bipolar Reverse Osmosis Membranes for the Separation of Mono- and Divalent Ions)

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Summary

In order to obtain monovalent ion-permselectivity in reverse osmosis, we developed double layer membranes which consist of positively and negatively charged layers (bipolar membranes). In this study, theoretical and experimental investigation have been carried out.

We have theoretically investigated the ion-selectivity of mono- and bipolar reverse osmosis membranes on the basis of the extended Nernst-Planck equation. Monopolar reverse osmosis membranes have high selectivity for coions according to ion valence, but not for counterions. On the other hand, bipolar membranes have high rejection for divalent cations and anions, and low rejection for monovalent cations and anions. Further more, it is suggested that bipolar membranes are effectively applied to ion separation of seawater.

Bipolar reverse osmosis membranes were made by the adsorption of positive polyelectrolytes on the surface of the negatively charged membranes (NTR-7410, 7450, Nitto Electric Industrial Co.).

Increasing the amount of adsorbed PEI on negatively charged membranes made rejection for magnesium chloride higher and that of sodium sulfate lower, but that of sodium chloride was almost constant. Bipolar membranes formed in PEI solution of 50 and 100 ppm showed good mono- and divalent ion-selectivity for both anions and cations.

The bipolar membranes formed at 100 ppm PEI solution were found to be effective for the separation of artificial seawater.