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Development of Organosilica Reverse Osmosis Membrane for Long-Term Use by Washing

Kazuki Yamamoto

Department of Pure and Applied Chemistry, Faculty of Science and Technology,
Tokyo University of Science

Summary

Desalination using reverse osmosis membranes is attracting attention as a possible solution to the water shortage problem. Aromatic polyamide membranes are currently used. However, long-term use of the membranes is led to fouling problems, where contaminants adhere to the membrane surface. Since polyamide membranes are weak against sodium hypochlorite and cannot be directly cleaned, alternative materials have been developed. Our group has focused on organosilica membranes, which are organosilicon-based polymers and have confirmed high chlorine resistance. However, their water permeability and salt rejection are lower than those of polyamide membranes. In this study, to improve the water permeability, we prepared composite membranes with polyacrylic acid and attempted to improve the water permeance of the composite membranes. Fouling and cleaning recovery tests were also conducted to verify the potential for long-term use of this material. Polyacrylic acid (weight average molecular weights of 5000 and 25000) was added to the amino group-containig organosilica (BTESPA) membranes, and the membranes were prepared by interfacial polymerization. The membranes were subjected to water permeation tests using 2000 ppm NaCl solution at a pressure of 1.5 MPa. The results showed that the water permeance of the membrane prepared with polyacrylic acid with a weight average molecular weight of 5,000 and amino group: carboxyl group ratio of 4:1 was about three times higher than that of BTESPA membrane. This is because polymerization progressed sufficiently under basic conditions due to the small amount of carboxyl groups. In the fouling test, clogging of the membrane was confirmed by a water permeation test with DTAB as a surfactant, and the subsequent washing with pure water eliminated the clogging to some extent. In the cleaning recovery test, in which the membrane was immersed in a 500-ppm sodium hypochlorite solution for 1 hour, a change in the water permeance was observed, indicating that a change in the surface condition had occurred. Significant performance degradation was not observed, indicating that the product can be used for a long period of time with cleaning.