

No. 0903

## Development of Novel Reverse Osmosis Membrane with High Chlorine Resistance for Seawater Desalination

Hideto Matsuyama, Yoshikage Ohmukai, Tomohiro Sotani

*Department of Chemical Science and Engineering, Kobe University*

### Summary

Chlorine resistance is an important factor for desalination process using RO membrane. In this study, novel diamines with high chlorine resistance was investigated, and fundamental study for free volume in the membrane in terms of the resistance using molecular dynamic simulation and positron annihilation lifetime spectroscopy.

The retention ratio of molecular weight and the polymer weight loss after the immersion in chlorine solution were used as the evaluation for chlorine resistance of polyamide membrane. The influence of the diamine chemical structures on the chlorine resistance was discussed. Aromatic diamines with electrophilic groups had smaller electron density than aliphatic diamines with nucleophilic groups. This tendency resulted in the easier decomposition of polyamide from aromatic diamines during the immersion in chlorine solution. After screening 17 diamines, N,N'-dimethyl-m-phenylenediamine (N,N'-DMMPD) was selected in the preparation of the reverse osmosis polyamide membrane. The membrane prepared from N,N'-DMMPD and 1,3,5-benzenetricarbonyl trichloride (TMC) showed much higher chlorine resistance than commercial polyamide and cellulose acetate RO membranes. The heat treatment temperature and time remarkably influenced salt rejection and flux.

Among 17 diamines screened in the previous section, N-PED was adopted as a NF membrane resource with suitable rejection and high chlorine resistance. This membrane had rejections of more than 95% for NaCl and Na<sub>2</sub>SO<sub>4</sub> and low rejection for neutral molecule such as isopropanol. The prepared NF membrane showed high stability during chlorine treatment at 8°C. The rejection decreased during chlorine treatment at higher temperatures and longer immersion time. This is because the reactivity increased with an increase in the immersion temperature.

The free volumes in polyamide membranes were investigated using molecular dynamic simulation and positron annihilation lifetime spectroscopy. As a result, it was revealed that the size and fraction of free volume in the membrane increased with an increase in the amount of methyl group on diamines. By these fundamental structural analyses for polyamide layer, development of polyamide membrane with much higher chlorine resistance is expected.