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Research on Seawater Desalination, Concentration and Membrane Modularization by Membrane Distillation using Carbonized Fiber Membranes.

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Summary

Membrane distillation (MD) is a membrane technology that uses a vapor pressure difference as a driving force caused by the temperature difference between the feed and permeate solutions across a hydrophobic porous membrane. Fluorine-based membranes such as polyvinylidene fluoride (PVDF) membranes are generally used in MD, but there are concerns about the toxicity of fluorine, and the development of alternative membranes is desired. Carbonization of bamboo rayon cloth at high temperature produces a highly hydrophobic carbonized fiber material that retains the high porosity of the original cloth fiber. In this study, MD measurements were performed on porous PVDF and carbonized fiber membranes, and the effects of the morphology and the hydrophobicity of the membrane surface on MD performance were discussed. In addition, the anti-fouling properties to proteins were also evaluated.

The carbonized fiber membranes were obtained by carbonizing bamboo rayon cloth at 300°C. The porous PVDF membranes were prepared by a non-solvent induced phase separation method. The degree of hydrophobicity of the membrane surface was evaluated from the water contact angle. In the MD measurements, 3 - 26wt% NaCl aqueous solutions were used as the feed solution. A mixture of 3 wt% NaCl solution and bovine serum albumin (BSA) was used to evaluate the anti-fouling properties of membranes. The feed solution was circulated at 60°C on the membrane.

Water contact angle of the carbonized fiber membrane was much higher than that of the PVDF membrane. The MD flux across the carbonized fiber membrane was 12% higher than that across the PVDF membrane. The salt rejection was consistently higher than 99.8%. The permeate flux in 26wt% NaCl aqueous solution as feed was 80% of that in 3wt% solution, confirming that MD produces not only water, but also concentrated seawater with a much higher NaCl concentration from seawater. The anti-fouling property to BSA of the carbonized fiber membranes was higher than that of the PVDF membranes.