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Membrane Distillation of Carbonized Fiber Membrane for Seawater Desalination

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Summary

Membrane distillation (MD) is a membrane technology that uses a vapor pressure difference as a driving force based on the temperature difference across a hydrophobic porous membrane. When cloth fibers such as natural fiber silk and synthetic fiber Cupra are carbonized at a high temperature, a highly hydrophobic carbonized fiber material can be obtained while maintaining the high porosity inherent in the cloth fibers. In this study, MD was measured using carbonized fiber membranes with different fiber materials and fabric making processes. For comparison, a porous polyvinylidene fluoride (PVDF) membrane was also used. The effects of the carbonized fiber membrane materials and fabric making processes on the physical properties and MD performance of the membrane were investigated.

PVDF membrane was prepared by the non-solvent phase separation method. The water contact angle and the surface free energy were estimated. The surface porosity was also evaluated. In the MD measurement, a 3 wt% NaCl aqueous solution heated to about 60°C was used as a feed solution and circulated on the membrane using a pump.

The carbonized fiber membrane showed a higher contact angle and lower surface free energy than the porous PVDF membrane. In the porosity measurement, the carbonized fiber membrane showed extremely high surface porosity compared to the PVDF membrane. It was concluded that the carbonized fiber membrane is an excellent hydrophobic porous material. In MD measurement, a linear relationship was confirmed between the permeation and time. The permeation flux was calculated from the slope of the obtained linear relationship. The permeation flux of the carbonized fiber membrane using silk as the fiber material and knitting in the fabric making process was about 5 times higher than that of the porous PVDF membrane. This will be due to the high hydrophobicity and porosity of the carbonized fiber membrane. The salt rejection was 99.9% for all membranes.