

# Membrane distillation process with laminating membranes of positive and negative charges for evaporation of concentrated salt solutions

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## Summary

The permeation flux of water vapor in membrane distillation is affected by membrane properties, vapor pressure of the membrane and also operational conditions. Since the vapor pressure is related with the concentration of aqueous salt solution, the vapor flux through the pervaporation membrane is decreased with increasing concentration of the salt solution. The permeation characteristics using charged membrane having a hydrophilic Nafion film and a hydrophobic PTFE film was experimentally compared with those using a PTFE film, and was analysed by a composite-membrane model.

The transport properties of water vapor through a Nafion film was analysed by a solution-diffusion model, and those of vapor through a Nafion-PTFE membrane was analysed by a composite model consisted of a solution-diffusion model in Nafion film and a vapor-diffusion model in PTFE film. When a Nafion layer of the Nafion-PTFE membrane was  $10\mu\text{m}$  thickness, the permeation flux of water vapor in the Nafion-PTFE membrane was higher than that by a PTFE film at a high LiBr concentration. Since fixed charges of a thin Nafion layer laminated on PTFE film resulted in Donnan exclusion effect, the vapor permeation flux of a composite-membrane was increased rather than that of non-charged membrane.