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High-Efficiency Separation Process of Seawater by Osmotically Assisted Reverse Osmosis Using Novel Nanofiltration Membrane

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Summary

In this study, as a pretreatment of the seawater integrated utilization system centered on the desalination, salt production, and resource recovery processes that are the seawater utilization industry, the osmotically assisted reverse osmosis (OARO) using a novel NF membrane is used. A highly efficient separation process of seawater components was proposed. The OARO is a membrane separation method in which salt water having the same concentration is supplied to both sides of a semipermeable membrane and pressure is applied only to one side. Osmotic pressure does not act between the salt waters separated by the semipermeable membrane, and water permeation occurs even at a slight applied pressure. Therefore, the salt water can be highly concentrated or diluted by multistage. Furthermore, if a nanofiltration (NF) membrane with selective ion permeability is used as a semipermeable membrane, component separation into salt water enriched with divalent or higher ions and diluted salt water whose component ratio is biased toward monovalent ions can be achieved. However, when a conventional nanofiltration (NF) membrane is used, since the support layer has a dense structure, serious internal concentration polarization occurs, and an increase in effective osmotic pressure becomes a resistance to water permeation. Therefore, the advantages of the OARO cannot be utilized unless the support layer has a loose semipermeable membrane, such as a forward osmosis (FO) membrane, which has been actively researched and developed in recent years. In this study, a water/salt permeation model based on a nonequilibrium thermodynamic model was constructed. We have also developed a new NF membrane that combines an active layer with ion selective separation performance equivalent to that of an NF membrane and a loose support layer like an FO membrane.