Improving Seawater Membrane Distillation: The Development of Carbon Nanotube-coated Nickel Hollow Fiber Membranes

Almulla, Farah

Water use has been growing more than twice the population rate in the last century. Considering the sources of seawater account for as high as 97% of all water on the Earth, seawater desalination can address substantial water scarcity problems. Membrane distillation is a thermally driven separation process that can be used in the process of seawater desalination. The aim of this novel project is to determine the efficiency of hydrophobic Carbon Nanotube/Nickel hollow fiber membranes in the distillation of seawater by measuring their water flux rates and salt rejection percentages in comparison to state-of-art polymeric membranes. Commercial nickel powder was used to make nickel (Ni) hollow fiber membranes. Composites with CNTs enwrapping whole Ni hollow fiber tubes using the chemical vapor deposition (CVD) process were prepared. Vacuum membrane distillation was used to study the desalination performance of CNT/Ni hollow fiber tubes fabricated at different CVD growth times at a 60°C temperature of the seawater solution. A 5-minute growth time of CNTs gave a water flux rate of 78.5 kg m-2 h-1 and more than 99% salt rejection. The distillation fluxes of CNT/Ni-hollow fiber (5 min growth) membranes were then studied at different temperatures of the seawater solution. CNT/Ni-hollow fibers have displayed more than three times as much higher permeate flux, with a salt rejection of more than 99%, in membrane distillation than the reports of state-of-art polymer membranes. In conjunction with solar energy use, this may lead to viable long-term solutions for environmentally friendly water production worldwide.

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