Name(s)
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Project Number
S0625

Project Title
A Novel Approach to Increasing the Permeability of Desalination Membranes

Abstract

Objectives/Goals
High costs associated with the desalination process have been the bottleneck that hinders the prevalent usage of seawater for drinking, agriculture, and industry. The goal of my project was to reduce the cost of desalination through maximizing two factors that constitute efficiency: rejection ratio (the percentage of salt filtered out) and flux (the amount of water filtered per unit membrane surface area per unit time).

Methods/Materials
This project explored the addition of cellulose nanofibers (CN) into desalination membranes for seawater NaCl filtration at 800 psi (industrial operating conditions). Fabrication of membranes consisted of using a commercial substrate, integrating a middle CN scaffold using CN solution I created in the lab, and forming the top salt barrier layer via a polymerization reaction. Performance testing involved using the high pressure desalination machine. Characterization tests focused on microscopy.

Results
The results demonstrated that a membrane with CN produced a 26 percent higher flux than the same type of membrane without CN. In addition, the results highlighted that the two membranes achieved comparable rejection ratios, supporting the hypothesis that the addition of CN does not compromise the performance of the membrane barrier layer, which filters out salt from water.

Conclusions/Discussion
Microscopy characterization of membranes revealed that a membrane with a more uniform pattern of ridges tends to have a higher salt rejection ratio. Because CN-based membranes use naturally abundant cellulose derived from plants and have a higher flux with no degradation in rejection ratio, these membranes have great potential in low-cost, commercially viable desalination applications.

Summary Statement
In this project, I explored how to increase the efficiency of seawater purification by integrating cellulose nanofibers into desalination membranes.

Help Received
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