Membrane processes on water-energy nexus

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Abstract: Food and water scarcity are among the most serious long-term challenges in the world. To an increasing degree, maintenance of a sustainable water supply depends on the use of water of impaired quality, particularly in water-stressed areas such as the American Southwest. Water of impaired quality includes brackish groundwater and reclaimed water. Reverse Osmosis (RO) or Nanofiltration (NF) are the methods in prevalent use for desalination of brackish groundwater and water reuse. Despite recent advances in membrane materials, fouling, brine management and low recoveries remain some of the biggest drawbacks of RO and NF.

On one hand, NF membranes, when properly designed, have the advantage of low energy input, low O&M cost, and simplicity in operation. With low water recoveries, these units can be operated without expensive, operationally complex addition of anti-scalant chemicals or pH control to avoid frequent membrane cleaning and abridged membrane life. On the other hand, Membrane Distillation (MD), a thermodynamically-driven process, can achieve complete salt rejection and recover valuable compounds, with lower fouling effects due to no need of applied high mechanical pressures for operation compared to RO. MD can be operated with low-grade, thermal energy sources, and thus, energy demands can be offset by using waste heat. A mathematical model was developed to predict water production as a function of membrane characteristics and operational variables, and the resultant numerical simulations provide guidance for the selection of membrane characteristics for optimal permeate production. The simulation tool can then be used to analyze membrane characteristics that have an effect on scaling up MD membranes.

Bio: Dr. Vicky Karanikola is a postdoctoral associate at the Chemical and Environmental Engineering department at Yale University. Prior to her postdoctoral appointment, she was an assistant research professor at the Chemical and Environmental Engineering department at University of Arizona (UA). Dr. Karanikola has an interdisciplinary engineering background combining a BS in Mechanical Engineering from Aristotle University, Greece, a MSc degree in Civil Engineering from San Diego State University (SDSU), and both MSc and PhD degrees in Environmental Engineering from the UA. Prior to her graduate studies, she worked in the industry for 3 years as a mechanical engineer, leading her to graduate school for a civil engineering degree. As a PhD and Postdoctoral associate, her research interests involve solar water desalination, through hybrid thermal processes (Membrane Distillation), and Nanofiltration (NF). Alongside with her academic career, she is very strongly involved with Engineers without Borders (EWB), an organization that works on engineering projects in developing communities. She serves as the mentor of the UA chapter, currently working at the Apache Reservation and the Dominican Republic, and as a Vice president of the EWB Mountain Region Steering Committee. Dr. Karanikola's research work with marginalized communities at The Navajo Nation was recently recognized with the Agnese Nelms Haury Program in Environment and Social Justice Faculty fellowship.