Date: February 16th

Time: 11:00 AM

Location: Maryland Hall 110

Speaker: Dr. Shankar Chellam
University of Houston

Title: "Temperature effects on permselectivity of porous nanofiltration membranes"

Abstract

Pressure-driven membrane separation processes are capable of removing particles, microorganisms, macromolecules, and dissolved substances from contaminated water supplies. For this reason, they are being increasingly employed to purify municipal drinking water. This presentation will mainly focus on the mechanisms of solute removal by one class of membranes, viz. "nanofiltration" membranes, which are defined as those removing solutes smaller than approximately 2 nm. Additionally, given CEAFM's interest in airborne pollutants, I will also briefly talk about our on-going research in characterizing metals comprising atmospheric fine particulate matter and determining their sources.

Even though polymeric nanofiltration membranes often operate on surface waters and surficial groundwaters whose temperature varies over time and with season, very little detailed mechanistic information on temperature effects on membrane selectivity is available to date. Hence, a study was undertaken to systematically and rigorously investigate the effects of operating temperature (5 – 41 ºC) on the permeation of water, sugars, alcohols, and electrolytes. Data on membrane selectivity to these solutes were used to deduce changes in the morphology, structure, and charge characteristics of two commercially available thin film composite nanofiltration membranes.

Non-viscous contributions to activation energies of pure water permeation across these polymeric membranes were calculated to be 3.9 and 6.4 kJ/mol. Additionally, increasing temperature increased mean pore radii and the molecular weight cutoff suggesting changes in the structure and morphology of the polymer matrix comprising the membrane barrier layer. Increasing temperature appears to cause structural changes in network pores by increasing its pore size while simultaneously decreasing pore density. These increases in pore sizes partially explain reported reductions in contaminant (e.g. arsenic, salts, natural organic matter, hardness, etc.) removal by nanofiltration and reverse osmosis membranes

with increasing temperature. Consistent with the free volume theory of activated gas transport, activation energies of neutral solute permeability in aqueous systems also increased with Stokes radius and molecular weight indicating their hindered diffusion in membrane pores.