Time & Location: June 29, 2016 at 9:30 AM in Engineering 2 211J
Title: Anthropogenic Organic Chemical Removal from a Surficial Groundwater and Mass Transfer Modeling in a Nanofiltration Membrane Process

This dissertation reports on research related to trace organic compounds (TrOCs) in surficial groundwater supplies and their subsequent removal from nanofiltration (NF) membranes. Routine monitoring of TrOCs from reclaimed water to drinking water point-of-entry (POE) revealed varying degrees of persistence of certain compounds through the environment. To identify the extent of TrOC removal by a split-feed, center-exit NF pilot operating as a two-stage process, an experimental plan was devised to evaluate compound removal over a wide range of spiked feed concentrations. To conduct TrOC studies using the pilot unit, the response time of the unit was needed in order to minimize experimental run time and subsequently reduce chemical costs; consequently tracer studies using sodium chloride were conducted, and it was determined that transient response was described as a log-logistic system with a maximum delay time of 285 seconds for an 85% water recovery and 267 gallon per minute feed flowrate.

Eleven TrOC experiments with the pilot unit were conducted with feed concentrations ranging from 0.52 to 4,500 μg/L. TrOC rejection was well-correlated with compound molecular volume and polarizability, with coefficient of determination (R2) values of 0.94. This concept was demonstrated further by conducting an extensive literature review. Rejection results of 61 additional TrOCs by loose NF membranes (a total of 95 data points) were also well-correlated with molecular volume and polarizability, with R2 values of 0.72 and 0.71, respectively.

The anthropogenic solute caffeine was selected to be modeled using the solution diffusion model (HSDM) and the HSDM with film theory (HSDM-FT). Mass transfer coefficients, K_w (water) K_s (caffeine), and k_b (caffeine back-transport) were determined experimentally, and K_s was also determined using the Sherwood correlation method. Findings indicate that caffeine transport through the NF pilot could be explained using experimentally determined K_s values without incorporating film theory, since the HSDM resulted in a better correlation between predicted and actual caffeine permeate concentrations compared to the HSDM-FT and the HSDM using K_s obtained using Sherwood applications.

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Approved for distribution by Dr. Steven Duranceau, Committee Chair, on April 14, 2016.

The public is welcome to attend.