Announcing the Final Examination of Jayapregasham Tharamapalan for the degree of Doctor of Philosophy

Time & Location: October 18, 2012 at 8:30 AM in Eng 2 211P
Title: Application and Optimization of Membrane Processes Treating Brackish and Surficial Groundwater for Potable Water Production

The research presented in this dissertation provides the results of a comprehensive assessment of the water treatment requirements for the City of Sarasota. The City’s drinking water supply originates from two sources: (1) brackish groundwater from the Downtown well field, and (2) Floridan surficial groundwater from the City’s Verna well field. At the time the study was initiated, the City treated the brackish water supply using a reverse osmosis (RO) process that relied on sulfuric acid for pH adjustment as a pretreatment method. The Verna supply was aerated at the well field before transfer to the City’s water treatment facility (WTF), either for softening using an ion-exchange process, or for final blending before supply.

For the first phase of the study to evaluate whether the City can operate its brackish groundwater RO process without acid pretreatment, a three-step approach was undertaken that involved: (1) pilot testing the plan to reduce the dependence on acid, (2) implementing the plan on the full-scale system with conservative pH increments, and (3) continuous screening for scale formation potential by means of a “canary” monitoring device. Implementation of the study was successful and the annual savings in operating expenditure to the City is projected to be about $120,000.

From the acid elimination study, using the relationship between electrical conductivity in water and total dissolved solids (TDS) in water samples tested, a dynamic but easier to trend approach to evaluate the performance of the reverse osmosis plant was built. This trending uses the mass transfer coefficient principles of the Homogeneous Solution Diffusion Model. Empirical models were also built to predict mass transfer coefficients for solute in terms of total dissolved solids and sodium.

In the second phase of the study, the treatability of aerated Verna well field water by nanofiltration was investigated. The goal was to replace the City’s existing ion-exchange process for removal of hardness and TDS. Different pretreatment options were evaluated for the nanofiltration pilot to remove colloidal sulfur formed during pre-aeration of the groundwater. Sandfilters and ultrafiltration were evaluated as pretreatment. The sandfilter was inadequate as a prefilter to the nanofiltration pilot. However, the ultrafiltration pilot, with and without a sandfilter as a prescreen, has proven to be an adequate pretreatment to remove particulates and colloids, especially the sulfur colloids in the surficial groundwater source. The nanofiltration pilot, on the other hand was shown to be an efficient softening process for the Verna well field water, but it was impacted by biofoulants like algae. The algae growth was downstream of the ultrafiltration process, and so chlorination was used in the feed stream of the ultrafiltration process with dechlorination in the nanofiltration feed stream using excess bisulfite to achieve stable operations. Non-phosphonate based scale inhibitors were also used to reduce the availability of nutrients for biofilm growth on the NF membranes.

Major: Environmental Engineering

Educational Career:
Bachelor's of B.Eng (Civil & Structural), BS, 1994, Nanyang Technological University, Singapore
Master's of MSc (Environmental), MS, 2003, Nanyang Technological University, Singapore

Committee in Charge:
Dr. Steven Duranceau, Chair, CECE
CECE, Dr David Cooper
Chemistry, Christian Clausen
Andrew Randall, CECE
Approved for distribution by Dr. Steven Duranceau, Committee Chair, on October 2, 2012.

The public is welcome to attend.