CE 890 Graduate Seminar

SPEAKER: Paul Owings, M.S. candidate (Advisor: Dr. Alexander Mathews)

TOPIC: "High Gradient Magnetic Separation of Nano-scale Magnetite"

DATE: April 27, 2011

TIME: 4:00 p.m. (refreshments at 3:45 p.m.)

PLACE: 2144 Fiedler Hall

ABSTRACT

Nano-scale magnetite is being examined for possible uses as an adsorbent of heavy metals and for the enhancement of water treatment process such as the degradation of trichloroethylene (TCE). Methods for separating Nano-scale magnetite must be developed before the particles can be used in water treatment process. This is necessary because expelling high amounts of particles into the environment will be costly, if captured they can be reused; additionally, they could potentially cause environmental impacts due to there stability in solution. Magnetite is ferromagnetic, so it has a high magnetic susceptibility; hence it is very attracted to magnetized materials. Utilizing the magnetic properties of magnetite may be one possible means of separating the particles out of solution. High gradient magnetic separation HGMS has been thoroughly studied for the separation of micron and even tenths of a micron size particles, but there is little experimental data for HGMS of nanoscale magnetite. This research looks to filter nanoscale magnetite through a HGMS and determine concentration of the particles passing through the filter. Subsequently, the filter will be backwashed to see if the particles can be recovered. The flow rate will be adjusted to determine the particle capture efficiency dependency on cross sectional velocity through the filter. This is a very important parameter since the capture of the magnetite particles may be a rate limiting process. Additionally, particles have been filtered in the presence of sodium polyphosphate, a dispersant, and nanoscale magnetite silica composite particles have been filtered. Capture efficiencies around 98% have been found for magnetite at a velocity of 1 cm/s and 97% for 2.7 cm/s. Capture efficiencies for nanoscale magnetite dispersed with sodium tripolyphosphate are significantly lower around 46%, and capture efficiency for magnetite-silica composites was found to be somewhat lower at around 75%. Thus far, the most successful backwashes have taken place with magnetite in the presence of dispersants due to added colloidal stability. Increasing the pump capacity is showing promise for the successful backwash of particles that are not in the presence of dispersants.