Oak Creek Groundwater Lab Internships

Ben Garcia and Danelle Bertrand
Oregon State University

These are columns used in a experiment to determine microbial growth based upon the usage of nutrients such as nitrate, sulfate, and ethanol. Each set of three columns were given a set amount of magnesium and calcium chloride and varying amounts of nitrate, sulfate, and ethanol. Each column has had 8 weeks worth of treatments and is waiting to be analyzed for microbial growth. Nitrate and sulfate consumption was analyzed using an ion chromatographer.

This is an ultrasonic cleaner which was bought to help make cleaning of the IC machine's injection valve easier and more complete. It functions by alternately creating low pressure zones and high pressure zones. The low pressure zones cause cavitation while the high pressure zones cause the bubbles to pop. This releases large amounts of energy, which allows the solution to clean many objects that could not otherwise be cleaned.

The DX-120 is an ion chromatographer that measures specific inorganic anions. This summer I learned how to run samples using the AS40 auto-sampler, clean the injection valves, clean the columns, and replace the guard and analytical columns. I also used this machine to analyze chloride, nitrate, nitrite, and sulfate in microbial growth columns.

The following experiment was conducted to investigate the effects of precipitating aqueous aluminum solids into a flowing groundwater system. When aqueous metals such as aluminum precipitate, they capture uranium. The coprecipitation of uranium with aluminum is being considered as a method to clean contaminated groundwater.

These 3 similar limestone soil columns were built to investigate the effects of precipitating aluminum solids into a horizontally flowing groundwater system. The columns were initially flowing with deionized water and manometers were installed at each end to measure the inlet and outlet fluid pressures. Hydraulic conductivities were measured for each column using the manometer measurements.

Bromide Solution

Tracer Test

Tracer tests were conducted to determine the initial porosities and dispersivities for each column. A 100 ppm bromide solution was pumped through the columns for 3 residence time then deionized water was pumped through the columns for another 3 residence times. Samples were taken every 5 minutes and analyzed for bromide concentration.

A computer program, Cxtfit, was used to fit the observed data from each tracer test to the dispersion equation. This linear regression gave us approximate numerical values for initial column dispersivities and porosities.

Column flowing with water

Synthetic groundwater with aqueous aluminum and pH~3

Column after 3 days of aluminum precipitation

We created a synthetic groundwater with aqueous aluminum and calcium at a pH~3 to simulate a particular contaminated site. Pumping the acidic solution through the limestone columns raises the pH, causing the aluminum to precipitate out of solution into the soil matrix. We are interested in the changes in hydraulic conductivity and dispersivity caused by the aluminum precipitation. Approximately 70 grams of aluminum is to be precipitated in each column (taking about 20 days) and the experiment is still in progress. A sharp increase in hydraulic conductivity was seen early on. The orange stickers attached to the manometers in the above photos show the fluid pressure levels in each column. After only 3 days of aluminum precipitation, the head loss across the column increased considerably.

This column was used to determine the precipitation of uranium. An acidic groundwater solution of a pH~3 containing uranium was injected through the limestone column where the pH was neutralized causing the uranium to precipitate out of solution. No analysis has been done on the column due to the fact that we are still waiting to receive more groundwater from the site.

Monitoring Wells

The Cove

Failed Tree Replanting

McCormick and Baxter is an old creosoting site that is now a superfund site. There is a retaining wall built around most of the site to try to contain contaminants and keep them from leaching into the river. Despite the wall, many plants still do not grow around the site and the contaminants have been found in the local fish. During our field research we performed Push-Pull tests on various wells, both inside and outside of the wall in attempt to find wells with suitable flow rates. To do these tests we loaded 200L carboys filled with chloride and bromide tracers and siphoned them into a well. On the following days we took samples of the well water to monitor changes in tracer concentrations. This part of the experiment will be going on for the next couple of weeks, and then suitable wells will be chosen to analyze bacterial degradation of contaminants.

These two photos represent some of the lab equipment that I have helped to construct or repair for Dr. Istok's CE 547 lab class. Building equipment, as well as performing the labs has helped to give me some hands on experience with fluid mechanic concepts that I did not receive during my undergraduate classes.