**Ant Farm Tracer Test Model**

**Due Date: November 21, 2012**

In this exercise, we’ll evaluate how contaminants and other chemicals move through an aquifer, focusing on the influence of heterogeneity. To do this, we’ll use an aquifer analog model (the Ant Farm). I have four tanks set up, so it’ll be crowded but everyone should try to participate.

**Objectives:**

1. Students will be able to describe the influence of heterogeneity on solute transport.
2. Students will be able to produce a breakthrough curve and interpret the form of the breakthrough curve distribution, reporting how this relates to relative groundwater flow velocities.

You will be putting a fluorescein dye tracer into the ant farm. We’ll introduce the dye at a set concentration at time zero (t0), and see how long it takes for the dye to move through the model. We’ll record breakthrough concentrations at the outflow end of the tank at one minute intervals, measuring the concentrations using the spectrophotometer. We’ll also observe the tracer as it migrates through the heterogeneous ant farm model. Finally, we’ll analyze the breakthrough curve to estimate effective hydraulic conductivity (K) and look at the form of dispersion in heterogeneous aquifers.

Fluorescein is an EPA approved tracer that can be released into drinking water. So, we can pour the leftovers down the drain when we’re done.

**The tasks:**

Each team has an ant farm model. You will have to divide the work up among you. We will conduct the experiment as follows:

1. Be sure the ant farm is at steady state – this means that outflow is relatively constant. You need to watch the inflow bottle to be sure it doesn’t go dry….
2. ***Draw a sketch of the sediment distribution. This should be as close to scale as possible….***
3. Once the ant farm is at steady state, measure the discharge rate at the outflow port.
4. Add fluorescein dye to the input portal to bring it up to a set concentration (we’ll give you the right amount to add), then switch the inflow reservoir bottle to the set concentration of fluorescein (we’ll have a supply of this chemical). Start the timer so you know the start time of the experiment and can record breakthrough results from this time.
5. Observe the front of the tracer as it moves through the model. ***Add this front at different times to your sketch of the ant farm.***
6. As the tracer gets closer to the downgradient side of the model, start collecting samples at one minute intervals. Take the sample to the photospectrometer, run it, and record the time of the sample and the concentration in the sample on your datasheet. ***One of you will have to stir the outlet end so the concentration is uniform and represents the outflow column concentration.***
7. Continue to collect samples and evaluate the concentrations for as long as you can
8. After we finish the test, start flushing fresh water into the model.

**Evaluation of the experiment:**

You should write up a report, following the rubric that includes the following:

1. A qualitative description of how the tracer moved through the model. This should include a description of the influence of the heterogeneity on tracer movement.
	1. Be sure to look at other models that are running too….they’re all a little different.
2. A diagram of the ant farm model, with your tracer front drawn for different times (you can use color for the different times).
3. A graph of breakthrough concentration (as a ratio of C/C0) with time, and a written interpretation about what the different parts of the curve represent (which part of the aquifer is represented by different parts of the curve).
	1. Estimate dispersivity for the breakthrough curve.
	2. Estimate an effective hydraulic conductivity value for the model. This would be the velocity when C/C0 = 0.50. If you have a complex breakthrough where you can distinguish breakthrough from different parts of the aquifer, you may be able to estimate effective K for different zones in the aquifer (note: the lower, coarse grained aquifer may allow breakthrough at a faster time than the upper unit, making a clear double trend in the breakthrough curve).

Record Table for Ant Farm Experiment:

Ant Farm Number: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Qoutflow­ at steady state: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| **Elapsed Time (min)** | **Concentration (ppm)** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
| **Elapsed Time (min)** | **Concentration (ppm)** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

Blank page for your sketch: