

Stacked Filtration Team

Self-healing Study, Spring 2012

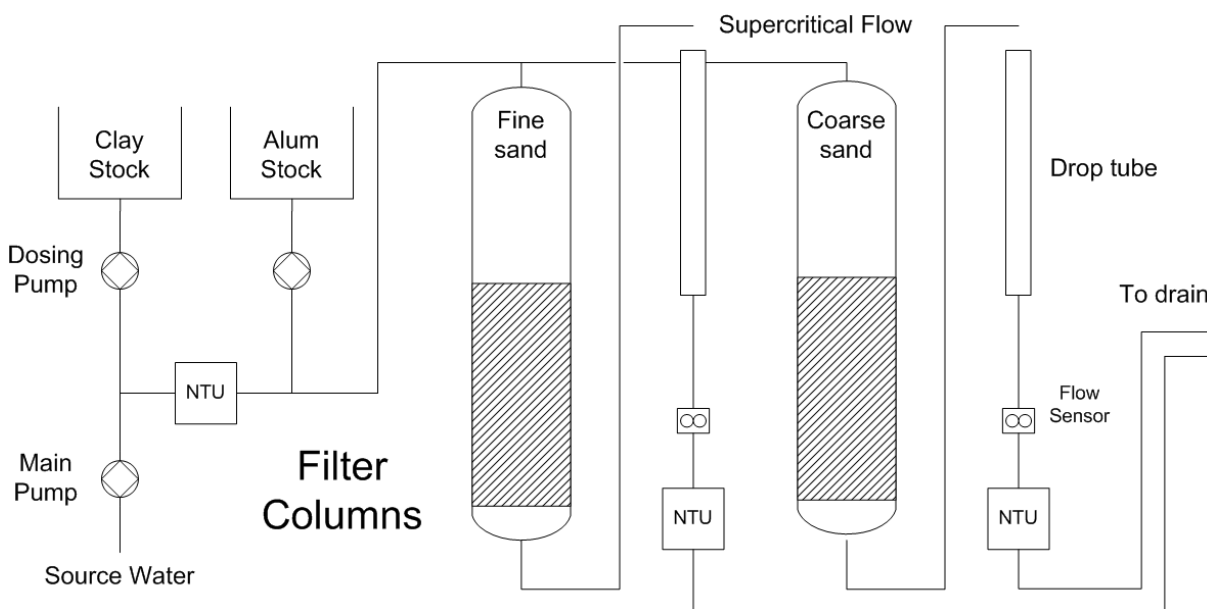
Objective

Uneven flow among layers of the stacked filter would be a significant operational problem. The hydraulic design and sand media selection for a stacked filter must account for proper distribution of flow in the filter but there is little data to support design guidelines for either of these. We hypothesize that uneven sand gradation will lead to coarser and finer layers of the filter, and we would like to know how much of a problem this will be and how quickly it may correct itself.

Experimental Setup

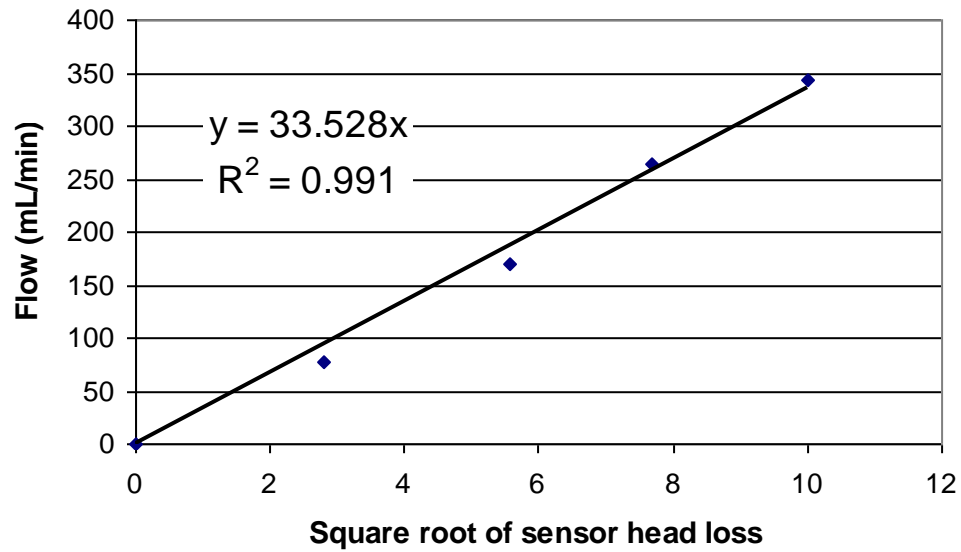
1. Set up two clear PVC pipe columns with proper adaptors and screens
2. Connect plumbing and solenoid valves as shown in the process flow diagram below
3. Install and calibrate flow sensors to log the flow rate in each filter during the course of this test
4. Set up Process Controller to log the experimental data
5. Test the hydraulics of the system by filling the two columns with identical filter sand and verifying that the flow is evenly distributed
6. Sieve sand in the soils lab and add a coarse fraction and fine fraction to the two columns

The process flow diagram below illustrates the setup of the experimental apparatus. Note the supercritical flow to decouple the flow sensors from the filter columns, and the separate lines to the drain so that visual observation can be used to confirm the flow sensor data.



Data Collection and Analysis

The flow sensors in this experiment consist of a small-diameter tube to serve as a head loss element along with an electronic pressure sensor to measure the pressure drop across this tube. A calibration curve can be used to convert from sensor head loss to flow rate in mL/min.



Important questions to answer for the data collection and analysis include:

- What is the initial distribution of flow between the filter columns?
- How does flow distribution evolve over the course of the filtration cycle?
- How does each filter column perform? How does this change throughout the cycle?