kl698

Fall 2012 Contributions

This semester I will be responsible for analyzing and optimizing the Low Flow Stacked Rapid Sand filter. The first task will be data collection including: flow rates, velocities, pipe measurements, and pressure variations. Once the data has been adequately collected we will develop a mathematical model in MathCAD to simulate the current LFSR sand filter. Using this model, I will be able to determine which sections of pipe contribute the greatest amount of head loss. From that point, I will be able to modify the current design, while updating the MathCAD model, to reduce head loss in certain segments. Once we are confident in the MathCAD model, we will introduce the sand into the filter and conduct a trial run.

Update: November 2012

My team and I have completed our MathCAD model for the existing Low Flow Stacked Rapid Sand Filter prototype. We were able to confirm the head losses we determined from the model with the actual losses experienced by the filter. Consequently, we were able to make fabrication modifications to the prototype to reduce head losses. Modifications included:

- Exchanging spring check valves on the outlet manifolds with swing check valves. Our calculations determined this modification would reduce the head loss.
- Complete reconstruction of the backwash pipe by using a 1.5 inch diameter pipe rather than the 1 inch pipe previously used. We determined this would significantly reduce head losses during filter backwash.
- To eliminate losses due to air bubbles, we adjusted fittings and replaced o-rings to make the filter pressurized during backwash. By doing this, we were able to obtain system head losses which matched the losses we calculated with our model.

As for individual work, I took measurements of the existing filter prototype and created a AutoCAD drawing of the LFSRSF. It is a three dimensional illustration with accurate dimensions and orientation. The drawing can continue to be updated as fabrications are made to the filter.

Spring 2013 Contributions

During January 2013, students in the AguaClara program visited Honduras to provide demonstrations for the various new technologies which AguaClara has designed. One of such technologies included the low flow SRSF prototype. However during the demonstration the prototype leaked, was unable to perform backwash, and one of the slotted manifolds broke. Therefore, our initial goals for the semester were to address the problems witnessed in Honduras as well as design a sand drain, improve ease of operation and construction, and create an operator's manual. However at the beginning of the semester we were informed we would be competing at the EPA P3 Expo for a $90k grant; consequently this became the bulk of our focus for the semester.

The tasks which I mostly intensively focused this semester were the design, construction, and testing of a small scale SRSF to demonstrate for the EPA Expo, and the creation of an Excel mathematical model to generate a preliminary design for a sand drain based on user inputs.

For design of the small scale SRSF I completed many of the calculations required; such as head losses, flow rate requirements, and velocity requirements. As a group we were able to construct the frame to display the small scale filter and the filtration column itself. I focused my attention on the constant head tank, where I performed calculations to determine flow rate requirements, completed fabrication work, and performed hydraulic testing. I experimented with using an LFOM in the constant head tank to control the flow rate to the filter; however I found that the LFOM size calculated was not sufficient for the prototype because of head losses throughout the system. Consequently I needed to increase the flow rate, which I accomplished by increasing the height of the overflow pipe and switching the LFOM out for a simple orifice. Simply put, I used the "hole in a bucket" approach.

As a group, one of our goals for the semester was to design a sand drain for the low flow SRSF. Unfortunately much of our time was devoted to the design and construction of the EPA small scale filter; however we still did manage to complete some sand drain design work. As a group we did calculations by hand to obtain a design for a sand drain based on various user inputs. After completion of these calculations, I created a simple excel model which allows the user to manipulate various inputs; such as drain angle, pipe length from filter column, diameter of drain, and etc. Consequently, the model performs the calculations based on the inputs and determines whether or not the design is adequate. I specified the primary criteria for adequacy of the design by specifying a vertical height at which the sand drain must be above the ground; thus allow the operator to easily use a bag to remove the sand as it exits the drain.