Fall 2010 Foam Filtration Reflection Report 4

Foam Filtration Reflection Report

Primary Authors: Catherine Hanna, Rachel Philipson, Melissa Shinbein, Kevin Wong

Primary Editor: Rachel Philipson

AguaClara Reflection Report

Cornell University

School of Civil & Environmental Engineering

Ithaca, NY 14853-3501

Date Submitted: 05/11/2010

Abstract

Throughout the semester, the foam filtration team has spent most of their time designing a point-of-use foam filtration unit along with writing (and constantly revising) a proposal requesting funding for further research. The goal of our design is to obtain potable effluent water from a relatively small, portable, and sustainable point-of-use device. Currently, our team has obtained head loss results through the foam (without the inclusion of failure) and finally finished setting up the desired experimental apparatus. Future work mainly includes experimental testing of different combinations of foam in order to determine which layering combination leads to optimal filter performance. However, we also plan to determine head loss through the foam at collapse and the range of influent turbidities that produce effluent turbidities below 0 . 3 NTU through this optimal filter column.

Introduction

Previously, the foam filtration team was able to finalize the experimental apparatus for testing the performance of foam. With this, we were able to conduct a series of head loss experiments on the filter. Head loss experiments using no foam, 60 ppi, and 90 ppi foam were done, utilizing a foam depth of 10 inches and an approach velocity of 4 mm/s. An average head loss of 2.0 cm for the 60 ppi foam and 2.7 cm for the 90 ppi foam were measured. These values will enable us to recalculate orifice diameters at the inlet and exit to perfectly obtain constant flow through the filter.

The team began writing the applications for phase one of the EPA P3 competition. Team members individually wrote parts for the first draft of the application and received feedback on it. Design-wise, we updated our work by determining quantitative measures for each component of our filter. We believe that further research into the performance of foam in our filter will allow us to design an effective point-of-use

system to be utilized in Honduras.

Experimental Design

As described in the previous Reflection Report, the head loss was recently calculated for water through the foam and just the tube without foam. This was done by taking the difference between height of the water at an equilibrium position in the foam column (and the height of the water after the end tube was positioned at a particular height, estimated so that the tube was about the height of the foam. Many aspects of our experimental apparatus were not utilized for this experiment. We manually controlled the pump to achieve the desired flow rate, and since we were measuring the head loss visually, process controller was not needed. Additionally, we did not add turbidity to the influent water, so that aspect of our system was not used.

Since we have solved the electrical issues with our experimental apparatus, we are finally able to move onto the next phase of experimentation. For all experiments in the near future our experimental apparatus will be the same. First, we will control the temperature of the water by monitoring water coming in from hot and cold faucets. The temperature controlled water will then be mixed with clay stock (concentration 3 g/L) to achieve the desired turbidity. For the next round of experiments, this will be 5 NTU. The turbid water will then be pumped into the foam column at a constant flow rate of 4 mm /s. There will be a flow accumulator after the pump in order to lessen the pulsing effect from the pump. The effluent turbidity will be monitored to quantify the level of performance of the filter. Additionally, we will also be recording the head loss via Process Controller through the foam so we can see what the relationship is between headloss and length of experiment. A more detailed description of these experiments is outlined in the *Future Work* section.

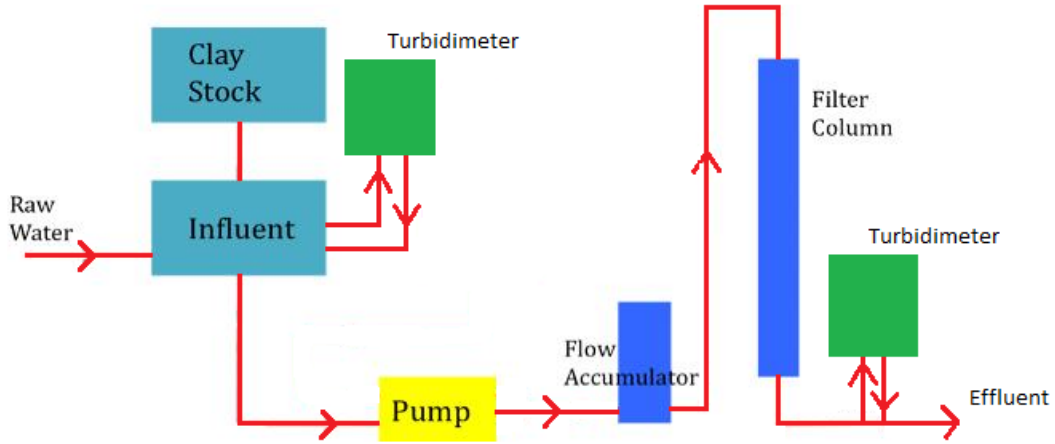

Figure 1: Experimental Apparatus

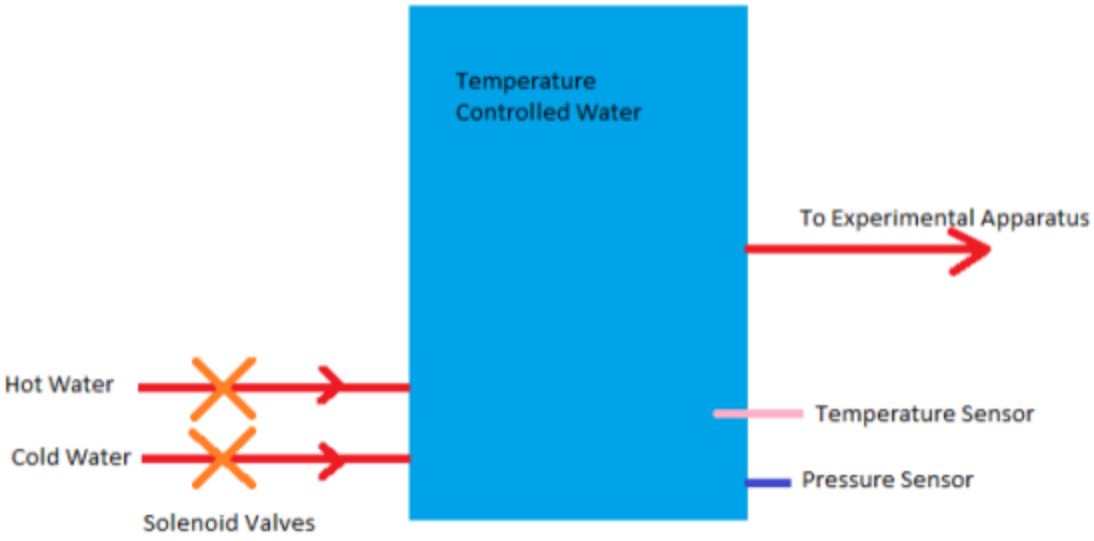

Figure 2: Water Distribution System

Results and Discussion

In the past two weeks, we have not been working on updating the designs of our foam filter unit. Instead, our primary focus has been the writing, editing and compiling of the first draft of the EPA P3 proposal. As soon as this is finished, it will free up a lot of time so that we can continue with the design aspect of our project this semester. However, there has been a little discussion about possible updates and changes to the design. We are considering changing the flow control method. Currently, we are planning on using a screen of selectively sized orifices to monitor the flow in the filter. After running our head loss experiment with the effluent tube used to monitor water height, we are considering a similar approach for flow control. We propose possibly using the same tube to monitor height in the filter, and an additional small influent tank (the size of the flow accumulator used in the experimental apparatus) with an orifice to control the flow rate through the filter. After the completion of the EPA draft, we will further discuss this design idea to see if it is a better way to design the filter.

Additionally, we have been working with our experimental apparatus. Unfortunately, much of this work has involved troubleshooting, as we have had

issues with turbid imeters, temperature sensors and wiring. However, the experimental apparatus is now complete and free of any errors both in

the process controller file and the apparatus itself. Over the course of the next two weeks we will be able to run the experiments these problems have pre

ven
ted
us
fro
m
run
nin
g
in
pre
vio
us
we
eks.

Future Work

In the next two weeks (now that our experimental apparatus is finally set-up), our team's goal is to experiment with high influent turbidity values to determine the head loss at which failure occurs and foam collapses. While running this experiment, a camera will be set-up so that we can visually document the collapse.

In addition, we will be layering different types of foam (30, 60, and 90 ppi) to find an optimal combination for maximum filter performance. A full column of 60 ppi foam will be the control experiment for our tests. Our approaches to layering will be based on a trial and error method. Our first experiment will be with a random combination of layering. The layering will be done in a manner similar to conventional filtration with a smaller ppi, 30 ppi (which corresponds to a larger void space) on the top and the larger ppi foam, 90 ppi on the bottom with 60 ppi foam in the middle. Proportions of the three pore sizes will be varied over different experiments to achieve optimal filter performance. .

These experiments will not include alum. If time allows, we will also test different influent turbidities to determine the range under which the optimal filter configuration performs to the EPA standard of .3 NTU. In these experiments we will use alum.

Team Reflections

In the past two weeks, our main focus has been on writing the first draft of our EPA P3 proposal. The first draft is completed, and we are currently in the process of editing and compiling it . Because we would like to finish with the proposal as soon as possible, we have not been focusing as much on the design aspect of the team's work. We feel it is important to submit this proposal before making any more progress in refining the design of the point of use filter. In addition to working on the proposal, we have also been working to get our experimental apparatus up and running. Over the course of the semester we have encountered many problems with this apparatus, mainly with wiring and communication with the computer. This has been a large obstacle in the progress of our team. However, we have finally solved all of the issues plaguing our apparatus, and we believe we can successfully run an experiment and collect necessary data without any problems. The next few weeks will be very experiment-heavy, with the first experiment starting today (Friday 11/5/2010). We are hopeful that all of the work we put into making the experimental apparatus as fail-proof as possible will pay off in the upcoming weeks. We would like to collect as much experimental data as possible with as little alterations to the current experimental apparatus as possible.