Challenges CDC Summer 2010

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Objectives

Improve on current dose controller design.

- Convert as practically as possible to locally available materials
- Eliminate components that have small pieces that can easily be lost (i.e. no more compression fittings)
- Convert to materials that are suitable for both alum and chlorine dosing
- What can't be obtained locally to be made of high quality, reliable components that will reduce down time / lead time resulting from component failure
- Add sedimentation trap and calibration column between stock tank and constant head tank to improve testing, calibration and performance testing of dose controller
- Modify administering tube so that a positive visual indication of flow can be seen

Validation testing of orifice

- Test precision of orifice. Will drilling technique play a roll in dosing reliability? Will $K_{orifice}$ chan ge with different materials, or for that matter, different drilling techniques? Understand and accommodate surface tension issue. Is the triple scale the solution? Is there are simpler solution available? Perform literature survey of alum and chlorine to see if these fluids would have a different effect.
- Clogging experiments. Check with Antonio and Sarah to determine if sediment is still a problem at Agalteca or if the sediment trap has solved the problem. Determine if they are stirring the alum stock tank every few hours based on the myth that they are keeping the alum in suspension. If they are, that could be the source of the sediment. We have not yet discovered the cause of the clogs in Honduras - precipitation or sediment. Run a series of gravity fed experiments to determine if alum precipitation is a potential problem. If we cannot prove alum precipitation then we can assume the problem is sediment. Sediment will be much easier for us to deal with as a simple strainer or sedimentation trap can be used to solve these problems.
- Analyze any possible error caused by moving the slider to higher or lower concentrations. This movement shifts the moment around the pivot point and effects dosing

Future Objectives

- Automate selection of orifice and design of scale. From a given plant flow rate, we should be able to produce the two (or three) orifice sizes and the two (or three) scales.
- Incorporate rotameters in design between stock tank and constant head tank to allow quick and accurate visual indication of dosages. Determine the effect on the location of the stock tanks. Note that this will require the stock tanks to be elevated to accommodate head loss in the rotometers.
- Generate a parts list of all components. Work with engineers in Honduras to determine which components need to be compromised to allow local material access.

- Work with the design team to create a float valve database of the Kerick valves that we will use for larger plants. Also, find different fittings for valve so that we are using a barbed connection instead of compression Create the design algorithm that will choose the correct float valve
- Create a poster and presentation to display P3 competition and award
- A second acrylic model plant needs to be constructed. Also modifications need to be made to the first one: a larger manifold in the bottom of the sed. tank.

Research Areas

Material selection

Survey peer-reviewed journals of the materials listed below to determine their suitability for use with alum and chlorine. Please note that although Wikipedia is a great source for initial information gathering, it is generally not considered peer-reviewed.

- Components:
  - PVC and CPVC
  - Acetal
  - Polpropylene
  - Polyamide (Legris)
  - PVDF (Kynar)
- Piping / Tubing
  - PVC / CPVC rigid pipe
  - PVC flex tubing
  - PEX rigid tubing

Materials suitable for our application will then be analyzed for cost and ease of availability. We will not be able to readily determine which materials are available in Honduras but we do have two people in Honduras who can suss out materials for us.

In addition to material selection, we will discuss different fitting styles and select the most appropriate:

- Barbed
- Compression
- Quick-Connect

Once material and component selection is made, we will create a standardized material list for installation of the chemical doser.

Validation Testing of Doser I – Precision

Determine the precision of the dosing orifice. Suggest starting with 5 each of 3 different sizes. If there is no variance demonstrated, no further testing is needed. If variance is documented, we need to continue testing and determine what amount of variance exists and what amount of variance is acceptable to us.

Validation Testing of Doser II – Accuracy

Using data from first validation test, describe the accuracy of the doser, e.g. compare measured vs calculated values. Our preliminary results show that there exists some inaccuracies at the low range that are attributable to surface tension. Ensure that no other inaccuracies exist.

Validation Testing of Doser III - Material Selection

Determine if material selection will play a roll on orifice performance. Validation test I will be performed using the polyamide Legris Caps. Repeat the experiment with acetal caps. This test need not be completed with the same rigor as Validation Test I. Collect enough data to determine if a relationship exists.

Validation Testing of Doser IV - Surface Tension

Validation test II will show inaccuracies in the low range that we attribute to surface tension. The current solution to this problem is to add yet another scale and orifice to the system. Evaluate whether or not this is the best solution. Research liquids used in plant (alum and chlorine) and determine if we may see a smaller degree of error when using these fluids.

Validation Testing of Doser V – Clogging

At this point, we will postpone clogging experiments. I have discussed this issue with the engineers in Honduras and it appears this problem has been reduced with the addition of a sedimentation tap. Addition al clogging results from precipitant forming along the walls of the tubes, which builds up until a small piece breaks of and leads to clogging. They will be playing with a preventative maintenance program that may improve or eliminate this problem.

Validation Testing of Doser VI - Moment Errors

The above experiments will be performed without using the float and lever arm. This will allow us to keep any possible errors isolated. The sixth validation test will be done using the lever arm and float to ensure that no other errors are incorporated into the chemical doser. Use aquarium to simulate water level changes in entrance tank. Compare readings with those from previous Validation Test I and from calculated values.