Chemical Dose Controller ↑

Skills: welding (useful),

Introduction

The dose controller is an excellent technology, but it needs further refinement before it is widely deployed. The goals of this team are to refine the design of the constant head tank, work with the design team to create labels and scales for the various components, and work with AguaClara LLC to determine if the dose controller will be packaged and sold by AguaClara LLC or built in country.

There are two recent designs of the lever system. The most recent design created by the Cornell team is modular and can have 1 or more levers with each lever system made identically. The design currently used in Honduras is a 2 lever system. Evaluate these two designs and in collaboration with AguaClara LLC select the best design.

Create a new constant head tank. The ideal constant head tank has the following properties

- transparent walls
- flat side where float valve bulkhead fitting can tightened to create a seal
- sufficiently long so that the original float that comes with the float valve can be used
- chlorine resistant! (PVC is likely the best material)
- Consider fabricating the tank using PVC welding from flat clear PVC stock.
- Captures sediment and doesn't send the sediment into the dosing tubes

Floc Hopper probe ↑

- Make it smaller so that it easily fits into 2" PVC pipe
- make it more robust and as simple as possible
- Provide labels to indicate location of the weir and location of the bottom of the floc hopper.
- Explore options to move the battery and a switch to the top of the probe so that the light can easily be turned off.

OStaRS fabrication ↑

Develop improved fabrication methods for OStaRS filter

Big question to answer

1. Can we invent an OStaRS filter assembly method and associated hardware that will make it easy to assemble and disassemble the internal filter components?

Introduction

Assembly of the OStaRS internal plumbing has been a major challenge. Our initial designs required extreme agility and were time consuming to assemble or they didn't provide adequate support to the manifolds. The assembly requires having one person in the filter box who is capable of receiving an entire injection or extracion manifold, supporting themselves on the walls while lowering the manifold into place and then working on top of the manifold to lock it into place. To simplify this operation we would like two major changes to the filter design. The first is a movable platform that can be positioned above the manifold that is being installed so that the installer can sit or lay on the platform to easily reach the hose clamp that tightens the Fernco fitting and to secure the manifold in place. The second is a manifold support system that secures the 4 corners of the manifold and prevents any moment in the vertical direction. THe 3rd improvement would be a support system for the dead end of the trunk lines. The trunk lines at San Matias are clamped to stainless steel brackets that are embedded in a concrete column in the filter wall. This system is very effective, but is somewhat tedious to fabricate in the construction phase of the filter. It would be ideal if a simpler method could be invented

The requirements for the components used to assemble the filter are...

- corrosion resistant (if both stainless steel and aluminum are used it must be verified that they are compatible in a corrosive environment)
- if stainless steel is used it must be designed to not bend around tighter radius than specified.
- The support systems must be strong and secure in both tension and compression. The deflection in a transition between compression and tension should be less than 1 mm per manifold layer (7 mm total max).
- The anchor system to the concrete must be capable of withstanding an uplift force equivalent to the pressure of about 0.5 m of water acting over the surface area of the filter.
- The assembly should require a minimum of tightening or threads because these are easily damaged by the sand.
- If possible, the spacers between manifold layers should be installed without requiring any tools.

The current best technology is the PVC pipe spacer and stainless steel cable assembly used at San Matias. The deficiencies of that system are potential weakness in the point contact between the spacers and the 2" PVC pipe dead end and the need to thread the cables through the spacers.

Evaluate the possibility of designing a custom fabricated stainless steel or aluminum spacer that provides support around each 2" PVC pipe and that connects and locks to the spacer below it without requiring any tools. This would substantially accelerate filter assembly. These spacers should be sufficiently stable that they can be placed for the next manifold and that they remain in position while the manifold is lowered into place. It is critical that the spacers not be able to disconnect and fall into the filter because it is very difficult to retrieve pieces from the bottom of the filter.

Design a method of anchoring the spacers to the filter floor. This assembly system should allow flexibility in placement of the anchor so that small construction errors don't cause assembly problems.

Work with Jonathan Christensen at APP to design a method to construct slots in the filter walls that would make it possible to insert a folding board perpendicular to the trunk line. The slots would make it easy to slide the board along the length of the filter. The board would be hinged with strong stops to prevent the board from bending at the hinge when weight is applied.

Devise a simpler spacer system for the end of the trunk lines and compare with the current system used at San Matias to assess if a better option is possible.

DOM Meter ↑

Skills: fabrication, electrical engineering, sensors, computer science

We need the ability to measure dissolved organic matter DOM. One of the goals for our DOM detector is to be useful in setting coagulant dosages. We hypothesize that the required coagulant dose is set by a combination of the DOM concentration, the suspended solids surface area, the target settled water turbidity, and the reactor properties for the floc/sed system. It appears that commercial systems for measuring UV are designed for treated water and not for raw water. Thus they would be ill suited to provide any guidance for setting the coagulant dose.

Ideally we would either find a suitable meter that can be connected to ProCoDA or we design and build a DOM sensor with a flow cell. DOM can be measured based on absorbance of UV light and could possibly be measured by absorbance of blue light. UV LEDs are now available with wavelengths down to 240 nm (http://www.s-et.com/uvtop.html) and those UV LEDs could be used as a light source for a DOM spectrophotometer. YSI also sells a sensor for fluorescent DOM (http://www.ysi.com/productsdetail.php?EXO1-Water-Quality-Sonde-89). Here is a discussion of measurement methods. If a UV based sensor is built it will need to use a special flow cell that does not absorb UV light.

Low cost turbidimeter verification ↑

Water quality monitoring is an important feedback mechanism for water treatment. In the United States and in most developed countries, turbidity -- the clarity of water -- is a key parameter for real-time water quality monitoring. The EPA, for example, requires that surface water providers in America check the turbidity of every filter effluent stream, every fifteen minutes. While turbidity itself is simply an optical property, the parameter serves as a quick-and-dirty indicator of suspended sediment load, chlorine demand, and pathogen risk.

Commercial turbidity meters (aka turbidimeters) tend to have high upfront costs ($700+ for handheld models, $2000+ for inline models) but basically no per-test cost. My group at Hopkins is currently developing low-cost handheld turbidimeters. A low-cost inline turbidimeter with wireless data transmission capabilities would be a huge advance for water quality monitoring in poor and rural areas, as it could help us to assess treatment efficacy globally in a way that is currently infeasible.

I hope to enlist the talents of a team of AguaClara students to test prototype inline turbidimeters against a commercial inline model, contribute to hardware and software development efforts, and develop ways to interface low-cost inline devices into an AguaClara plant (considering both the physical setup, and the operating procedures).