Demo Plant Team Detailed Task List

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Our goal is to update the current demonstration plant so that it represents newly developed technologies in the Agua Clara water treatment process. The current demonstration plant is sufficient for showing the principles behind the sanitation process, namely a coagulation process that occurs in modular fashion. Additionally, the demo plant should be small enough to travel with and easy to set up.

Prior to attempting to make additions to the demonstration plant, the team will have to meet up and attempt to get the current instantiation working correctly and become well versed in setting up and taking apart the model. This will be done at our next meeting on Tuesday 9-13-2011 during class time. Our approach to this challenge has been put into segments because we felt that some parts had priority over others. However, this task list has been created to achieve the new design by the end of the fall term.

Part I

Flow Measurement and Dose Control

The different modules included on the current demonstration plant are two jars for holding both a coagulant solution (poly aluminum chloride, PACl, or aluminum sulfate, alum) and raw water that has yet to be treated. Water and solution start from the two initial jars and are then, controlled through a dosing process, moved into an additional jar where the initial reaction occurs between the alum and the raw water with clay mixed into it. This is where the primary update will occur. Furthermore, we need to consider implementing a linear flow orifice meter (LFOM) or a laminar flow tube to control the flow rate and height of water relationship. We would like the demo plant to clearly demonstrate how an AguaClarachemical dose controller works.

Tasks

- Research the novel dosage method and come up with a conceptual design
- Perform engineering calculations to methodically understand the specifications for the new dosage module
- Correctly size and design the new dosage module.
- Fabrication
- Incorporate the module into the current model

Deadlines

- Research : by 9/23/11
- Design : by 10/7/11
- Fabrication : by 10/14/11

Part II
Sedimentation Tank

The goal for the sedimentation tank is a design that allows for even upflow and settling between all lamella, to ensure enough settling time and to include lamellar separators since they provide a large surface area onto which particles may fall down and become captured. The other major goal is to understand how floc blankets work and possibly incorporate one into the new demo plant. We have yet to understand floc blankets on a small scale so this will present a challenge. We need to keep in mind that the unit process needs to be small, yet a larger sedimentation tank will be more effective for sludge removal. The sedimentation tank will set the total flow rate for the demo plant, therefore we will choose a flocculator design that works for the flow rate in the sedimentation tank.

Tasks

- Conceptual design of sed tank.
- Required Pipe diameter to be calculated given a target floc diameter, keeping in mind the sedimentation velocity.
- Calculate flow rate.

- Including tube settlers to prevent the floc breakup problem, as the tube settlers return the flocs they capture.
- Since the flocs in the floc blanket may grow in size, they tend to have very high sedimentation velocities and the plate settlers desgined by us should have the correct capture velocity.
- The floc blanket should have a depth between 30 and 60 cm.
- Inlet conditions for the flocculated water in the sedimentation tank should be carefully considered.
- The optimal configuration is a jet that eneters through the bottom of the tank so that no jet reverser is required.
- The sedimentation tank should consist of a transparent PVC pipe with a vertical section for the floc blanket and then an angled section for a tube settler.

Deadlines

- Research : by 10/25/11
- Design : by 11/1/11
- Fabrication : by 11/8/11

Part III
Tube Flocculator

After the water has been correctly dosed with the coagulant it then is moved down to the current installation of a flocculator channel. Flocculation is important to the process because the particles of organic and inorganic contaminants tend to have a negative charge on their surfaces and therefor will electrostatically repel one another. Flocculation transforms the negatively charged particles to allow them to attract one another and create large dense flocs which settle more easily. The flocculator in the current design achieves this. The current module works well to show the way that flocs (which are dense compounds of precipitate) form, however it does not show how the current Agua Clara plants have now updated their technology for better performance. Theoretically the new method is to use a tube flocculator which yields a higher rate of success for clearing the water by increasing the collision potential for the coagulation process. This is done by changing the module geometry in order to increase the collision potential by increasing hydraulic residence time and optimizing

energy dissipation rate. Instead of using the channel/baffle system currently installed, a coiled tube system is planned to be incorporated into the design. This scaled down version will aid in testing the effectiveness of changing to the Tube Flocculator system through comparative analysis.

Tasks

- Research both the current flocculator and the tube flocculator to understand the difference between them, particularly their ranges of flow rates.
- Research the mathematics behind the improvements with using the tube flocculator.
- Correctly size and design the module.
- Fabrication
- Incorporate the design into the current demonstration plant.
- Perform comparative analysis using turbidity tests; the flow rate constraints will lead to our decision on which flocculator design to use.
- Decide on which performs better and is better for educational purpose.

Deadlines

- Research : by 11/15/11
- Design : by 11/22/11
- Fabrication : by 11/29/11

Part IV
Stacked Rapid Sand Filter

Currently, the old demo plant does not have a filter component, this would be a useful tool in the new demo plant both to learn more about how filtration works at bench scale and so plant operators in Honduras can see a model of stacked rapid sand filtration. We plan to incorporate a filter into the new demo plan, and use the SRSF Mathcad design file as a starting point.

Tasks

- Possibly use 4 instead of 6 filter layers (to reduce elevation)
- Scale depth of filter layers down from 20cm to 2cm (to reduce elevation)
- Vertical drop tubes on inlet side of filter need to be large enough to accommodate counter air and water flow, tubing inner diameter (ID) needs to be approximately 9mm
- Angle the vertical drop tubes slightly (from the vertical) to allow for easier water flow down the bottom of the tube and easier air flow up on the side of the tube
- Build stainless steel tubes with tiny orifices for the inlet and outlet manifolds, try to keep as much as possible transparent so the hydraulics and water flow can be observed
- Coordinate the flow rate of the SRSF with the rest of the plant which will set the area of the filter
- Design controls for inlet and outlet boxes (possibly use several to maximize amount of water filtered per area)
- Design controls for weirs (overflow dams used for flow measurement)
- Possibly use smaller diameter sand than in full scale plant; if so, need to reduce backwash and filtration velocities; communicate with SRSF team for any insights
- Make sure piping components are sized so there is sufficient flow distribution between layers

Deadlines

- Research : by 11/15/11
- Design : by 11/22/11
- Fabrication : by 11/29/11