Stacked Filtration Team
Detailed Task List, Fall 2011

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Pilot scale flow distribution study

The pilot scale apparatus uses six layers of sand 10 cm in diameter. Thus far, the flow through each layer is assumed to an even fraction of the total flow. It is necessary to test this assumption:

1. Install two pressure sensors in each sand layer spaced evenly along the vertical axis.
2. Determine the hydraulic conductivity and Darcy's constant for the porous sand media.
3. Monitor pressure drop between the sensors and apply Darcy's law to determine the flow through each layer during filtration

Point people:
Time frame: 2 weeks at the beginning of the semester

Control system hydraulics study

The current full-scale stacked rapid sand filter (SRSF) includes a siphon/air valve system to set the mode of operation of the filter. This system controls the level of water over the sand in the filter, and thus allows the SRSF to switch between filtration and backwashing without the need for valves on all of the inlets and outlets. We have built a lab-scale system to test the hydraulics of the siphon and to gain some insight into how it works. Important tasks include:

1. Perfect the effectiveness of preventing flow through the siphon during filtration mode by forming an air trap.
2. Determine the time required for the air valve to remain open to switch between modes.
3. Identify physical parameters that are important to improve the siphon.
4. Work with the design team to re-design the siphon system if simple changes cannot be made to prevent flow during filtration.

Point people:

Time frame: 2 weeks at the beginning of the semester

Bench scale upflow/downflow performance study

Up to now we have only measured the total performance of the filtration layer at the aggregation exit channel. We will set up seven turbidimeters at each of the input and output of the pipes. We need to monitor each individual of the layer.

1. Install turbidimeters with a sampling system to each of the input and output pipes.
2. Record data from the turbidimeters simultaneously for each of the input and output pipes during a typical filtration cycle
3. Analyze the data to see the performance of each of the layer.

Point people:
Time frame:

Sand media analysis and preparation

The SRSF has been designed and tested using a single sand grain size typical to conventional rapid sand filtration, and the implications of using another sand grain size have yet to be investigated. Sand of a larger or smaller grain size may prove more effective for turbidity removal than that which is currently in use. Furthermore, the effect of sand grain size on filtration and backwash velocity as well as required filter bed depth has yet to be fully investigated. Important tasks include:

1. Determine the relationship between sand grain size and the filter bed depth required to adequately remove turbidity.
2. Determine the relationship between sand grain size and head loss through the filter bed, and relate this finding to expected filter run time.
3. Determine the relationship between sand grain size and backwash velocity.

4. Determine the optimal sand grain size to adequately remove turbidity while minimizing backwash water use.

Point People:

Time Frame: 5 weeks

Filtration Cycle Endurance Study

Up until now we have been experimenting only with suspended clay particles and monitored the filter's performance under that sole input condition. We would like to understand how the filter performs under the conditions found in the field that involve dissolved organic matter (DOM). We'd like to determine what combination of flow, turbidity, and DOM can be accommodated with either a 12-hour or a 24-hour interval between backwash cycles by doing the following:

1. Utilize data from the field to model the turbidity and DOM conditions typical of sedimentation effluent water, and apply those conditions to our bench scale model of the filter.
2. Experiment to find the best flow rate to accommodate the conditions that we can expect in the field.

Point People:
Time Frame: 4 weeks

PACl Residual Study

Residual levels of a coagulant improve performance of a rapid sand filter. We would like to explore the addition of a very low PACl dose to improve filtration performance. This will be done by doing the following:

1. Perform a full flocculation/sedimentation step upstream of the filter so that the dosage is reasonably tested.
2. Vary the dosage to determine optimization.
3. Compare results to what is typical of a sedimentation effluent.

Point People:

Time Frame: 2 weeks

Construction Implementation Survey

The construction of the first SRSF at Tamara is on the way and has been monitored by team members. Take lessons learned from construction and feedback from the plant operators to create recommendations for changes to the design.

1. Review the first design
2. Take field feedback
3. Coordinate for future correspondence

Point people:
Time frame

Scaling to Smaller Flow Rates

We would like to develop new construction methods that would make it possible to fabricate a SRSF at dimensions that are not large enough for a human to enter the filter box. It is important that AguaClara maintain versatility to the filtration processes that are used. There are different options and methods that can be applied to extend the flow rate to less than 6 L/s.

1. Reduce the sand grain size so that the filter and backwash velocities are reduced and the area of the filter is larger.

2. Construct the filter box of large diameter PVC pipe and assemble manifolds inside this pipe to be reaching in from above and from below prior to connecting the section of the filter with the manifolds to the rest of the filter box.

Point People:

Time Frame: 2 weeks