Enclosed Stacked Rapid Sand Filtration

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Enclosed Stacked Rapid Sand Filters (EStaRS) are an adaptation of stacked rapid sand filters (StaRS) optimized for flows less than 3 L/s. StaRS is an innovative technology invented by the AguaClara team that is significantly simpler to operate than conventional rapid sand filters. EStaRS are currently being built in AquaClara plants in India to treat flow rates of around 0.8 L/s.

Fall 2016

The overall team goal for this semester is to design and fabricate a new EStaRS for use in the 1 L/s plant. The team aims to reduce the filter height and make improvements based on problems reported by previous teams, including issues with flexible tubing and the inability to visually confirm backwash fluidization. After researching the design and construction methods of the original EStaRS, the team will create an updated version using MathCAD and AutoCAD.

Spring 2016

This semester, the team will be working to design a system to measure headloss in the filter during forward wash and find a way indicate if the bed if fluidized during backwash. At this point in the semester, a manometer system has been set up to indicate headloss in the entire tank and a way to measure fluildization in the sand layer. The rest of the semester, we will be researching the relationships within our data collection and implement our findings into the field. The team will also continue to test the filter's performance while running with PACL and clay to view how the filter would perform in similar field situations.

Fall 2015

The team's major goal this semester is to test and evaluate the new inlet system developed and installed last semester. This task includes operating the filter during forward filtration and during backwash to confirm the team's theory that the new orifices can replace the slotted pipes in the inlet manifolds. During testing, the team will be looking for movement of sand into the inlet manifolds and tubing and for successful back washing. If the inlets test successfully, the team will move onto continuing to make the filter easier to operate in the field, while developing a way to gauge how well the filter is fluidizing during backwash. If the inlet system proves problematic, the team will work with the FInE subteam to find a solution.

Spring 2014

This semester, the team aims to complete fabrication of the 30 cm diameter LFSRSF, which includes a simplified hydraulic control system. The team will add slotted pipes and sand to the filter column, as well as pipe stubs to the inlet and outlet tanks. They will also build a water recycling system to facilitate hydraulic testing of the filter. Testing will involve evaluating the headloss necessary to fluidize the sand bed of the filter during clean and clogged conditions, determining the head required to initiate backwash, and measuring the flow distribution between filter layers. The team will also simplify the sand drain design and and develop a better method to open and shut it. Finally, the team will optimize pipe sizes and elevation of the inlet and outlet tanks to improve access and efficiency.

Fall 2013

The Low Flow Stacked Rapid Sand Filter team seeks to design and build a 30 cm diameter filter that will accurately model the filters being constructed in India by AguaClara, LLC and to use the existing 10 cm diameter filter to quantify the effects of incorporating a backwash initiator and to construct an improved sand drain. The 10 cm team has constructed a constant head device, run the filter, and determined that the backwash initiator does not actually aid in the initiation of backwash, and is in practice a fluidization indicator. The 10 cm team has also constructed an alternative sand drain, but has not yet utilized it. The 30 cm diameter team has constructed a filter column, an inlet tank, and an exit tank. They have developed and implemented new methods to assemble these components, and they have documented their progress to facilitate the construction of new filters.

Spring 2013

In January 2013, the Low Flow Stacked Rapid Sand Filter was tested in Honduras. Although the filter worked, it quickly failed due to structural weaknesses. The primary tasks this year included improving the durability of the filter and increasing the ease of operation. New manifold and sand drain designs are in the process of being implemented. Additionally, the stacked rapid sand filter went to Washington, D.C. in April for the EPA P3 competition. A written approval for the P3 grant was written and submitted. To demonstrate the design and effectiveness of the LFSRSF, a fully operational unit was designed. The prototype underwent hydraulic and performance testing and operated well at the competition.

Fall 2012

This semester we were responsible for analyzing and optimizing the Low Flow Stacked Rapid Sand filter. Work for the semester began with an existing filtration unit which did not contain sand, due to predicted failure from large head losses in filtration and backwash. The existing design was modeled in AutoCAD 2013 to provide an illustration of the system. Updates to this drawing were completed and will continue to be as fabrication phases occur. One of the primary tasks was to develop a mathematical model in MathCAD to calculate the flows and head losses throughout the system. The model was completed for filtration and backwash, and includes calculations for both cycles with and without sand present.

Hydraulic testing was completed to determine the head losses in filtration and backwash, risk of sand transport through the backwash pipe, and flow rates. These measurements and observations were compared with the mathematical model to determine its validity. According to head loss values obtained from the mathematical model, several changes were made to the filter prototype. Such fabrications included complete reconstruction of the backwash pipe, changing of valve types, and installation of NPT fittings and ball valves. Finally performance testing was completed to determine the effectiveness of the prototype in regards to decreasing effluent turbidity. Overall, it was determined that the filter prototype is highly effective at decreasing turbidity for several influent concentrations at the designed flow rate.

This system was tested in Honduras in January 2013.

Members

Susan McGrattan

Anna Doyle

Juan Guzman

Lilly Mendoza

Felix Yang

Documents

	Challenges	Tasks	Symposium	Final Presentation
Spring '17				
Fall '16			EStaRS Mid-semester Symposium	? Unknown At
Spring '16			EStaRS Symposium 2016.pptx	? Unknown At ? Unknown At
Fall '15				? Unknown At
Spring '15				? Unknown At
Fall '14				? Unknown At
Summer '14	? Unknown Attachment	? Unknown Attachment		
Spring '14		? Unknown Attachment	? Unknown Attachment	? Unknown At
Fall '13	? Unknown Attachment	? Unknown Attachment	? Unknown Attachment	? Unknown At
Summer '13		? Unknown Attachment		
Spring '13		? Unknown Attachment	? Unknown Attachment	? Unknown At

Fall '12		? Unknown Attachment		? Unknown At