Stacked Rapid Sand Filtration - Bench Scale

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Abstract

Our goal is to update the current stacked rapid sand filtration so that it represents newly developed technologies in the Agua Clara water treatment process. Uneven flow among layers of the stacked filter would be a significant operational problem. The hydraulic design and sand media selection for a stacked filter must account for proper distribution of flow in the filter but there is little data to support design guidelines for either of these. We hypothesize that uneven sand gradation will lead to coarser and finer layers of the filter, and we would like to know how much of a problem this will be and how quickly it may correct itself.

These experiments will be conducted with a 2.5 cm diameter lter column with full process control for chemical feeds, backwash, and turbidity measurements. It may be possible to install a two layer stacked lter in the small diameter lter column. The process flow diagram below (figure 1) illustrates the setup of the experimental apparatus.

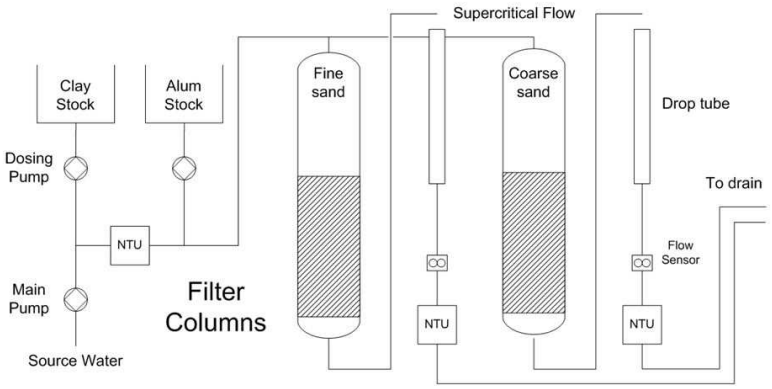

Figure 1: Process Flow Diagram

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

Calibrate two column stacked rapid sand filtrations

Time frame: 2 weeks

Use the same sand grand size to run in the two column under the same condition. Figure out the difference process effciency between the two columns.

Part II

Evaluate the feasibility of using smaller size sand grain

Time frame: 3 weeks

Evaluate the possibility of using smaller sand grain size and determine if there would be advantages to making this change.

Because smaller sand size potentially changes backwash velocity, filtration velocity, filter manifold slot size, required layer depth, and lter solids capacity.

Part III

Determine the solids loading capacity

Time frame: 3 weeks

Determine the solids loading capacity of the lter and ideally develop a mechanistic explanation for the solids capacity that would help us understand the inuence of bed depth and approach velocity.

Part IV

Run in whole system with low coagulant dose

Time frame: 4 weeks

Explore addition of a very low PACl dose (perhaps $100\frac{\mu g}{L}$ as aluminum) to improve filtration performance. This can only be reasonably tested if a full occulation/sedimentation step is provided upstream of the filter. Then the effect of PACl addition prior to the filter could be measured. The currently used test system of metering clay and PACl into the lter inuent is incompatible with these test objectives.