

StaRS FInE (flow injection and extraction) [↑](#)

Skills: fluids, fabrication, Process Controller, Mathcad

Big questions to answer

1. Can water be extracted from a sand filter bed using a gravity exclusion FInE System without risk of sand leaking into the extraction piping?
 - a. Not with current system
2. Can the extraction system work with a single set of wings rather than the double set of wings as shown below?
 - a. NO
3. Does the extraction system prevent sand from entering the injection system even during the transition from backwash to filtration?
 - a. During transition, yes. During filtration, no.
4. What are the design requirements and fabrication methods for a flow extraction system?
 - a. Design a system that works. Build it.
5. How does the backwash initiation head loss vary with design of the FInE system? Specifically, does the increased flow blockage caused by the wings of the FInE system increase or decrease backwash initiation head loss?
 - a. Ummmm?

Introduction

The AguaClara StaRS filter uses slotted pipes to inject water into and extract water out of the sand bed. The slots must be designed to be smaller than the smallest sand grains. The slots in the OStaRS (Open Stacked Rapid Sand Filters) in Honduras and in the EStaRS (Enclosed) in India are currently using 0.2 mm wide slots. These slots gradually clog especially if the water from the sedimentation tanks isn't very clean. The StaRS Theory team has demonstrated that the coagulant precipitate clogs the inlet slots. In India one of the water treatment plants with EStaRS had trouble because the well pump was pumping mud from the bottom of the well into the filter. The inlet manifold piping and slotted pipes clogged with the mud and then the filters couldn't be backwashed. In Honduras they added purge valves on all of the inlet and outlet pipes so that the slots could be at least somewhat hydraulically cleaned.

Tasks and Goals

See our [EPA P3 proposal for more details](#). The goals for this team are to explore and invent alternatives to slotted pipes that would be less prone to clogging.

Our design has evolved rapidly over the past year and we now are exploring simple vertical wings on the injection tubes and single sloped wings on the extraction tubes.

Resources

[Lecture notes from CEE 4540 \(2014 syllabus\)](#)

There are four critical design constraints for the FInE system

1. The flow must be distributed uniformly into the gravity sand exclusion zones by keeping the total orifice area small compared with the pipe cross sectional area
2. The wings that create the sand exclusion zones must not block too much of the filter cross sectional area. This constraint is not yet understood and will require experimentation to determine the effect of FInE on backwash initiation head loss.
3. The wings must create a large enough sand water interface area to prevent fluidization of the sand during water extraction.
4. There should be minimal settled stationary sand on top of the FInE system during backwash.

