The AguaClara LFSRSF: An Improved Design

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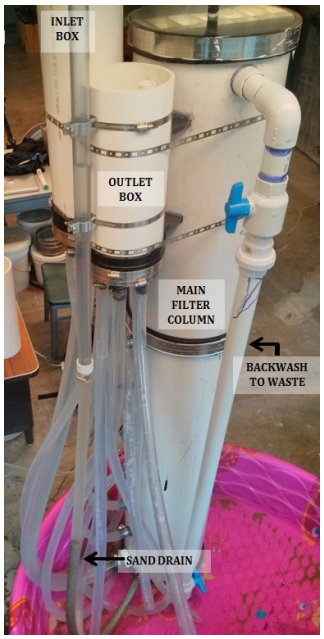

Fig 1. *The AguaClara LFSRSF with major components highlighted.*

The AguaClara Low Flow Stacked Rapid Sand Filter (LFSRSF) is a municipal-scale filter designed for communities of about 500 people (See Fig. 1). Adapted from the AguaClara Stacked Rapid Sand Filters (SRSFs) deployed in Honduras, these filters are designed to treat a flow rate of 0.8 L/s. The filter operates in two modes (See Fig. 2): forward filtration, in which water flows in parallel through six vertically stacked sand beds, and backwash, in which all of the filter's flow is diverted to the bottom inlet, fluidizing the sand bed and carrying all of the dirt accumulated during filtration up and out of the filter through the backwash-to-waste pipe.

Current LFSRSFs, such as those in Gufu, Jharkhand, use multiple valves to switch between the two filtration modes. This makes it an involved task for the operator to switch between modes—something that might happen as often as daily. More importantly, the more valves that must be operated simultaneously, i.e., the greater the number of moving parts, the higher the probability that one of those moving parts will fail.

Motivated by the goal of easy operation and low maintenance, the AguaClara team at Cornell University has recently adapted the SRSF hydraulic controls to the LFSRSF. The new controls use a set of pipe stubs in the entrance and exit tanks of the filter to simplify the operation of the filter to a single valve on the bottom of the backwash pipe. The team is presently working on further optimizing the pressure dynamics of this system via a lab prototype.

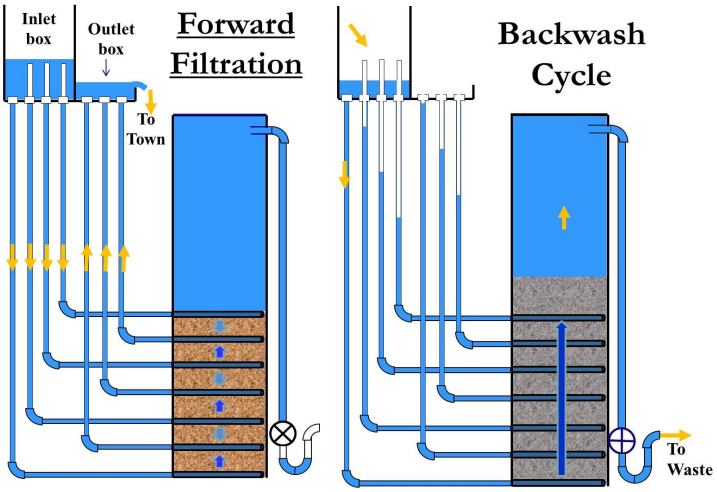

Fig 2. *Hydraulic Controls: One valve is all the filter needs to switch between modes. Note the differing water levels in the inlet and outlet boxes, and water path through the filter during each mode.*

In addition, the team has advanced LFSRSF technology by completely redesigning the filter's sand drain, an outlet which allows the filter to be emptied of sand and water. Previous sand drain designs featured a ball valve that failed whenever the valve was shut mid-draining-process. The new sand drain is a length of flexible tubing attached to the bottom of the filter that extends the filter column's length; its open end is supported at a height greater than that of the entrance tank. When the filter needs to be drained of sand, the filter is set to backwash, the tube is lowered and sand exits the filter through the drain pipe. To stop the flow of sand and water, the tube is simply raised to its original position above the water level. This allows control of flow through the sand drain without the possibility of valve failure.

The latest filter design is also easier and cheaper to fabricate than previous LFSRSF designs. Since the main filter column is divided in four pieces for ease of fabrication (two halves and two caps), the team has developed a method of joining these column components using only a gasket, stainless steel shim stock, and hose clamps (See Fig. 3). Tightened by a torque wrench, this mechanism achieves a strong, airtight, watertight connection, better those achieved in previous filter incarnations using expensive flanges. This improved design also guarantees that the filter is easy to dismantle if necessary.

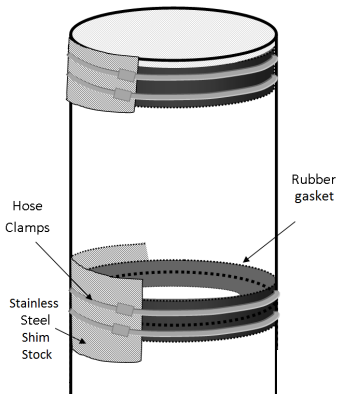

Fig 3. *Joining filter column components with a gasket, stainless steel shim stock, and hose clamps.*

AguaClara's innovative filtration technology is not only electricity-free and powered entirely by gravity, but compact at only one-sixth of the size of conventional rapid sand filters. Recent LFSRSF team innovations improve the filter's performance by simplifying operation and fabrication. The Cornell AguaClara team hopes that communities using the LFSRSF will be empowered by its ease of operability, its reliability, and the quality of water it provides.