



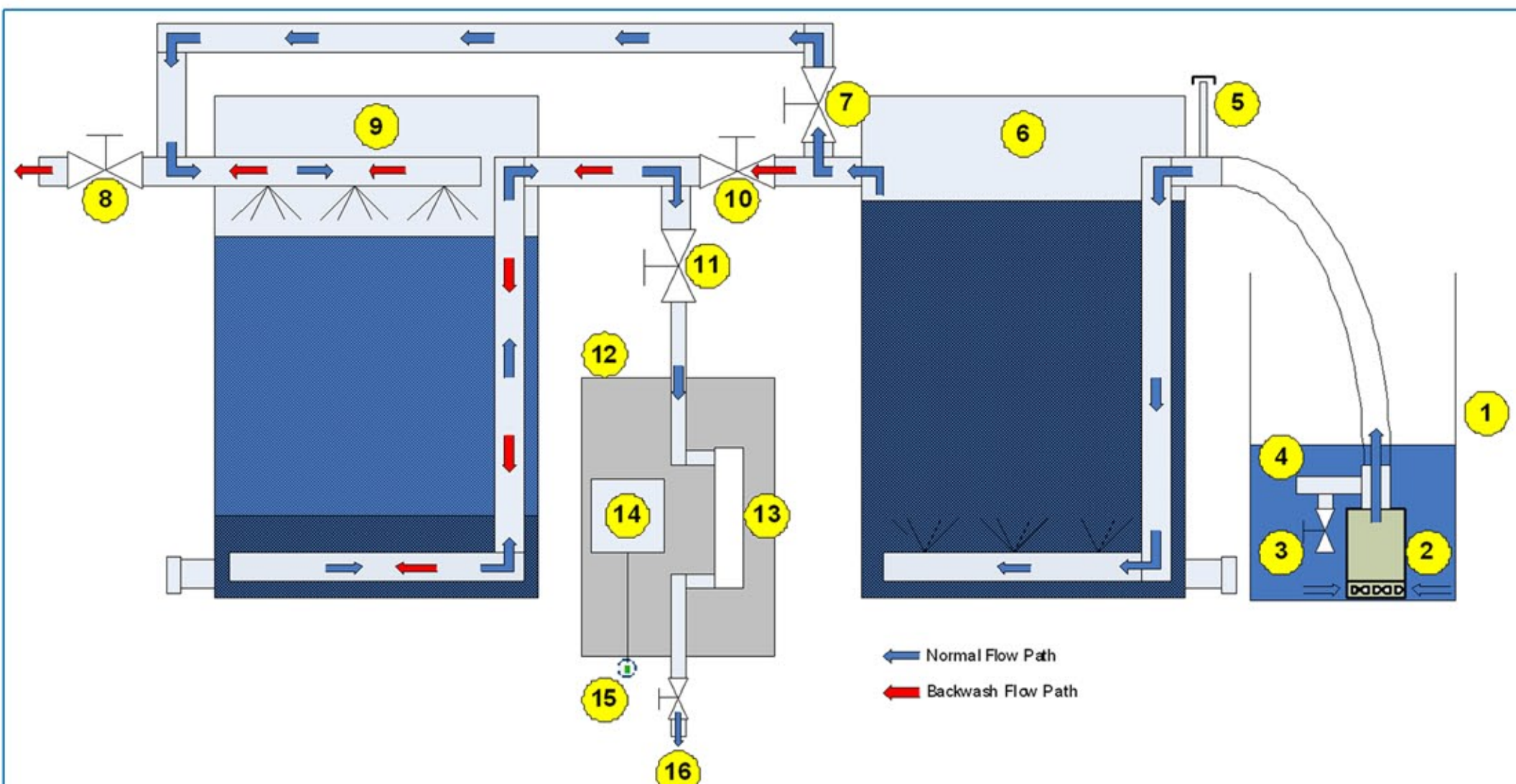
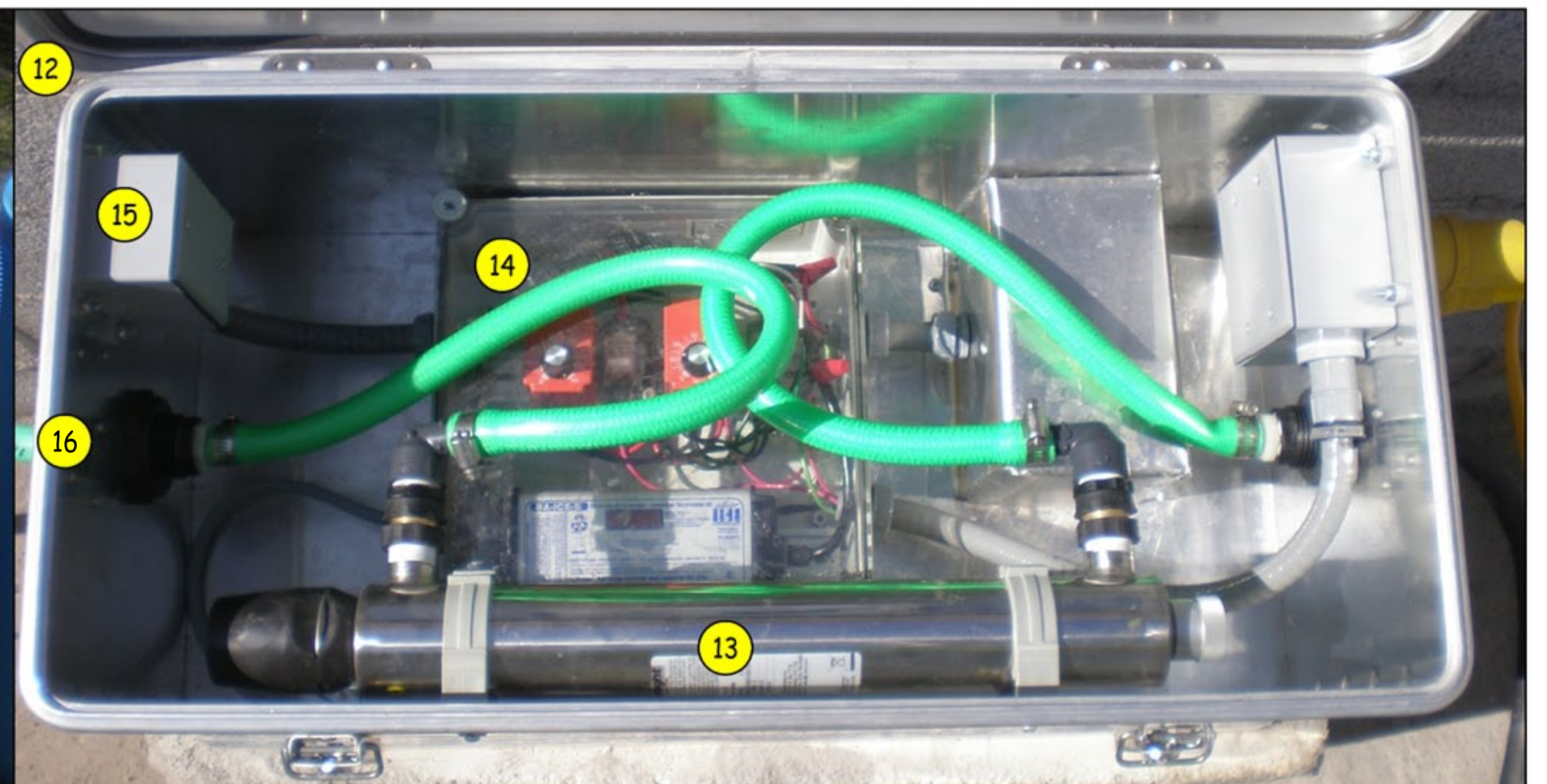
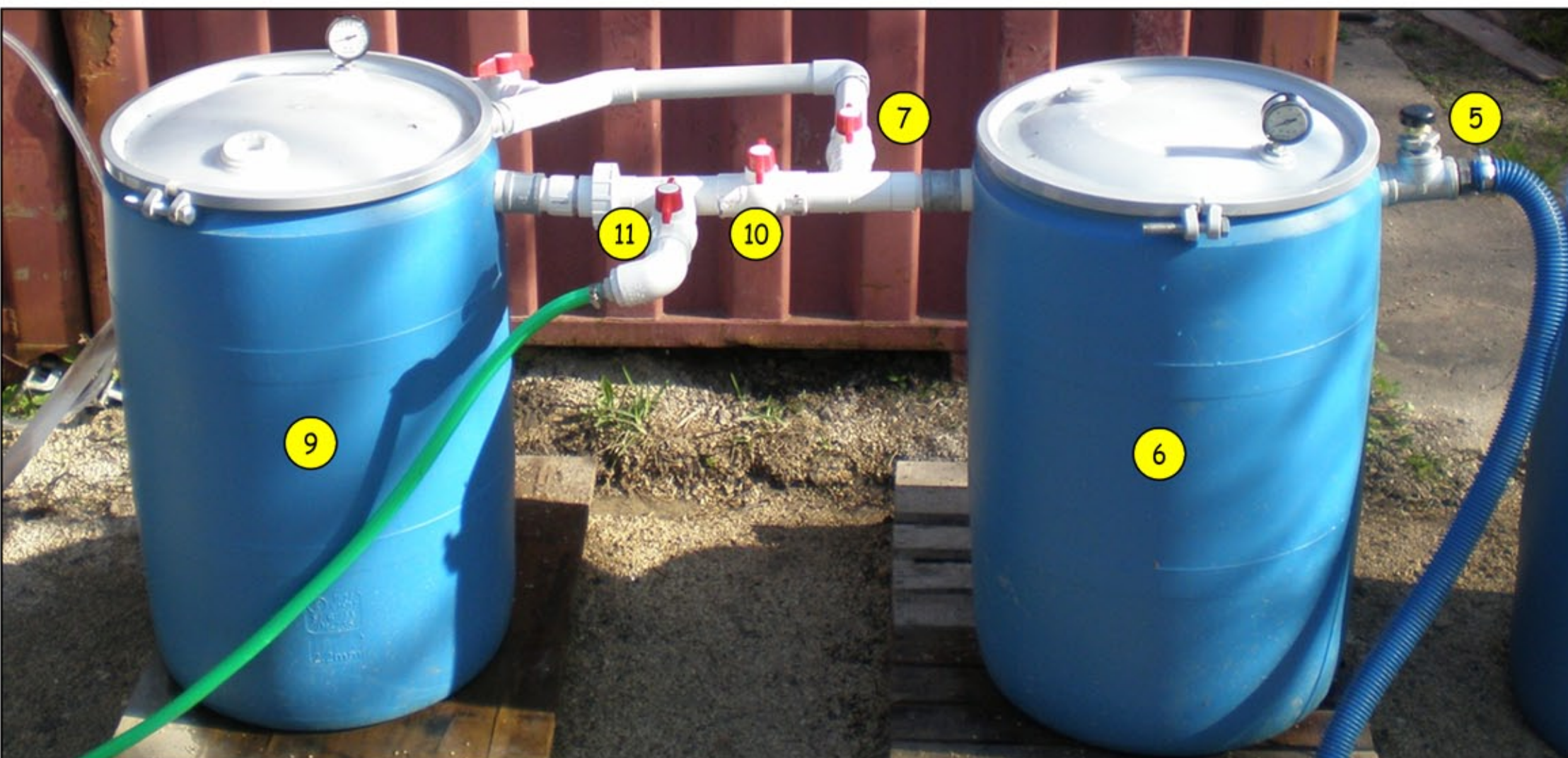
ENGINEERS WITHOUT BORDERS - USA JOHNSON SPACE CENTER PROFESSIONAL CHAPTER

The Engineers Without Borders Johnson Space Center (EWB-JSC) chapter is an association of JSC employees, contractors and other professionals in the Houston/Clear Lake area who volunteer their time to participate in projects that improve public health in the developing world.

The EWB - JSC Chapter plans to provide clean water solutions to rural communities in Nuevo León, Mexico. Members traveled to the South of Nuevo León to identify specific villages in need, assess public health challenges, and cooperate with local groups such as the Institute of Technology of Linares. The team completed water quality testing, geographical surveying, and community surveys. Water samples showed considerable amounts of harmful bacteria and pathogens. Geographical surveying revealed a non-feasible source of underground water due to high salinity in the region. Health surveys indicated most of the population was affected by gastro-intestinal diseases, which are the major causes of illness and death in infants.

The Bring Your Own Water (BYOW) treatment system was developed by EWB-JSC and EWB-CU as a sustainable water purification system capable of treating contaminated water from multiple sources. It consists of a pump that feeds contaminated water through a roughing filter, a rapid sand filter to remove fine particles, and a UV light to kill any remaining bacteria or microorganisms. Three systems have already been installed, two in Rwanda and one in Mexico, with others planned for the future.

Bring Your Own Water



BYOW Schematic: (1) Dirty source water, (2) Positive displacement pump, (3) Backwash throttle valve, (4) Pump recirculation port, (5) Vacuum relief valve, (6) Roughing filter, (7) Sand filter inlet valve, (8) Backwash outlet valve, (9) Rapid sand filter, (10) Backwash inlet valve, (11) Sand filter outlet valve, (12) UV sterilization box, (13) UV light, (14) UV electronics box, (15) System start button, (16) Collection tap

How to Clean Water - With Dirt?

Normal Operation - The outlet of the pump is plumbed to a recirculation port (4), which ensures that if all the valves are closed the maximum system pressure is not exceeded. The pump is placed in the source water container with the backwash throttle valve (3) open. This valve has been sized to obtain maximum flow rate through the system (approximately 5 gpm) that the UV light can handle. The sand filter inlet valve (7), sand filter outlet valve (11), and UV outlet valve (16) are open. The backwash inlet valve (10), backwash outlet valve (8), and UV bypass valve (14) are closed. Pressing the system start button (15) on the UV box begins a one minute timer to warm up the UV light, at which point the pump (2) is started.

Water follows an up-flow path through the roughing filter (6) where flocculation occurs in the gravel bed to remove larger suspended particles. Water then enters the rapid sand filter (9) where smaller particles and bacteria are removed through the physical straining process. The final treatment step in the process directs the flow into the UV sterilization box (12) where the water is exposed to ultraviolet light which achieves a 99.99% reduction of bacteria, viruses, and protozoa. The clean water is collected at the collection tap (16).

Backwash Operation - Periodic backwashing of the rapid sand filter is required to remove collected particulates and increase flow. A minimum of 50 gallons is required to adequately fluidize the filter bed and purge the system. The pressure backwash throttle valve (3) is closed to maximize flow through the system and fluidize the sand bed. The sand filter inlet valve (7) and sand filter outlet valve (11) are closed. The backwash inlet valve (10) and backwash outlet valve (8) are open. The pump (2) is turned on and allowed to run until at least 50 gallons have been pushed through the system.

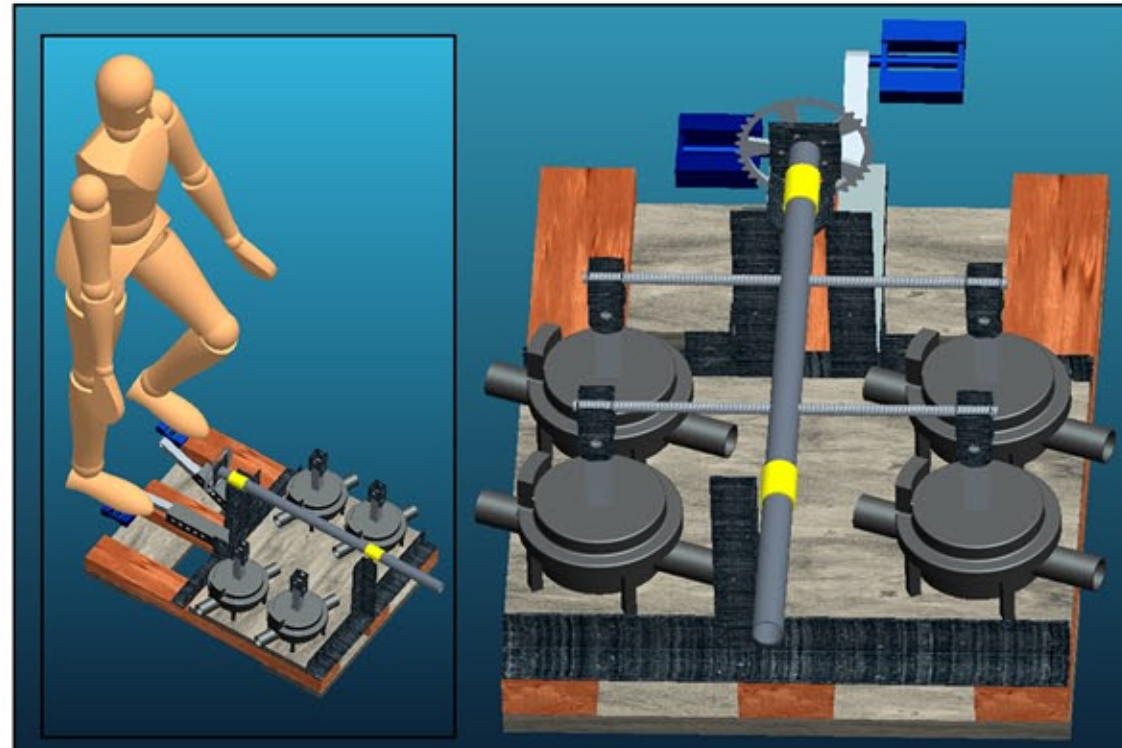
Backwashing intervals are a factor of system use and source water contamination. On the conservative side we recommend backwashing once a month. This can be done with contaminated source water since backwashing does not rely on cleaning the sand. Bed fluidization removes the accumulated particulate, which only requires high pressure and high flow.



It's show time!



In June of 2008, a 13 member team installed the first BYOW water purification system in Mexico. Local labor, provided by the villagers of Aguilar, helped build the platform for the BYOW System. A water committee was formed during the trip and trained on the operations and maintenance of the system. Women and children of the village, the primary persons responsible for obtaining water, were trained to operate the system as well. Once the system was installed, the water was tested. Turbidity was not as low expected due to the fine clay in the region; however no bacteria was detected after BYOW treatment. Contact was maintained with the Water Committee after the trip to monitor the usage and condition of the system.



PUMP IT UP - The primary modification of the BYOW required for implementation in La Joya is the addition of a manual pump system for both pushing water through the system and fluidizing the sand bed when required for filter maintenance. Because electricity is not reliable in La Joya and the cost is extremely high, a manual pump will be used in the BYOW system to extract water from their main source.

Work was kicked off with a trade study between bilge (diaphragm) pumps and rotary pumps using a stairwell for changes in elevation. Based on material specifications, output performance, and durability testing, we chose a commercial bilge pump. Then we calculated the number of

pumps required to achieve acceptable flow rates and system life and began to design the rest of the system.

A treadle style pump infrastructure was chosen for implementation due to design simplicity, ergonomic advantages, and prior success in many similar applications in the developing world. We used a CAD software program to create models of our design, which helped us to dimension components and determine interfaces. After several design iterations, parts were purchased and construction commenced.

Tests are planned in the near future to confirm system performance will meet the needs of La Joya.