Household Water Treatment Options in Developing Countries: BioSand Filtration

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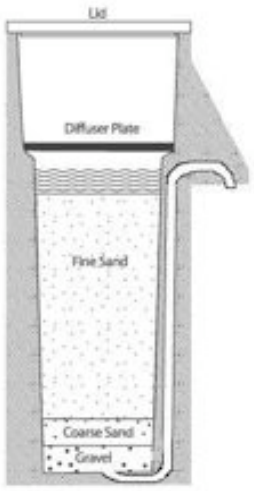
Household water treatment and safe storage (HWTS) interventions are proven to improve water quality and reduce diarrheal disease incidence in developing countries. Four of these HWTS options – chlorination, solar disinfection, ceramic filtration, and flocculation/disinfection – are proven to improve microbiological quality and reduce diarrheal disease in developing countries. Other options – including BioSand Filters – are widely implemented but are not yet specifically proven to reduce diarrheal disease incidence in peer-reviewed research. Organizations wanting to develop HWTS programs are often faced with the difficult decision of selecting which option or options are appropriate for their particular circumstances, and how to choose between proven and unproven options. The most appropriate HWTS option for a location depends on existing water and sanitation conditions, water quality, cultural acceptability, implementation feasibility, availability of HWTS technologies, and other local conditions. This series of fact sheets is designed to assist organizations in comparing, and ultimately selecting, the appropriate HWTS option or options. For more information on household water treatment, please visit www.who.int/household_water. For more information on BioSand Filtration, please visit www.cawst.org or www.bushproof.org.

BioSand Filtration

The BioSand Filter (BSF) is a slow-sand filter adapted for use in the home. The version of the BSF most widely implemented consists of layers of sand and gravel in a concrete or plastic container approximately 0.9 meters tall, and 0.3 meters square. The water level is maintained to 5-6 cm above the sand layer by setting the height of the outlet pipe. This shallow water layer allows a bioactive layer to grow on top of the sand, which contributes to the reduction of disease-causing organisms. A diffuser plate with holes in it is placed on the top of the sand layer to prevent disruption of the biolayer when water is added to the system. To use the BSF, users simply pour water into the BSF, and collect finished water out of the outlet pipe into a bucket.



BioSand Filter Schematic (CAWST, www.cawst.org)

Lab Effectiveness, Field Effectiveness, and Health Impact

In laboratory and field testing, the BSF consistently reduces bacteria by 81-100% and protozoa by 99.98-100%. Initial research has shown that the BSF removes less than 90% of indicator viruses. Although the data has not yet been published, initial data from the first diarrheal disease impact study on the BSF, conducted by the University of North Carolina, documented an estimated 40% reduction in diarrheal disease in users of the BSF. Three more health impact studies, in Ghana, Cambodia, and Honduras, are currently being planned.

Benefits, Drawbacks, and Appropriateness

The benefits of BioSand Filtration are:

- Proven removal of protozoa and the majority of bacteria;
- Acceptability to users because of high flow rate, ease-of-use, and visual improvement in the water;
- Production from locally available materials;
- One-time installation with low maintenance requirements; and,
- Long life.

The drawbacks of BioSand Filtration are:

- Low inactivation of viruses;
- Absence of post-filtration residual protection so that if water is filtered into an open or unclean bucket there is potential for contamination;
- The current lack of studies to prove health impact; and,
- The difficulty in transporting a 100-350 pound item and the high initial cost that make scalability more challenging.

BioSand Filtration is most appropriate in areas where there is external funding to subsidize the initial cost of the filter, education for users, locally-available sand, and a transportation network capable of moving the buckets and sand.

The locally-made Pure Water for the World concrete BSF design (Pure Water for the World)

The locally-made Pure Water for the World plastic BSF design (Pure Water for the World)

Implementation Examples

The BSF has been implemented using a variety of different strategies, including:

- Initially, the BSF was designed by Dr. David Manz and his students at the University of Calgary. The plastic container version of the BSF was patented, and sold by the company Davnor. The concrete container version was open-sourced, and used by non-governmental organizations (NGOs).
- The NGO Samaritan's Purse has been and remains one of the principal implementers of the concrete BSF, responsible for installing about 30,000 filters, including 15,000 in Cambodia. Samaritan's Purse works with local partners in Cambodia who hold informational meetings for potential BSF users. Attendees interested in receiving a BSF are invited to a second training meeting, where they sign up to receive a BSF, are asked to contribute a small amount to their ownership of the BSF (about $3), attend focus group trainings on use of the BSF and hygiene, and send one family member to assist with the construction and transportation of the BSF. Samaritan's Purse has developed an implementation manual and has technical support staff to assist BSF projects across the world.
- Recently, Dr. Manz has licensed the plastic version of the BSF to the non-governmental organization (NGO) International Aid. International Aid manufactures the plastic containers in Michigan and Honduras, and works with local implementing organizations to import the plastic containers, create the sand filter, and educate users. Pure Water for the World (PWW) is another NGO working with a different plastic container model, made locally using rotational molding in Haiti and Honduras. PWW works with local implementing organizations as well.
- The non-governmental organizations (NGOs) Centre for Affordable Water and Santitation (CAWST) and BushProof both offer training on concrete BioSand Filter construction, and implementation manuals and assistance, to NGOs interested in starting BSF programs.

For more information on BioSand Filter programs, please contact www.davnor.com, www.purewaterfortheworld.com, www.internationalaid.com, www.cawst.org, www.bushproof.org, or www.biosandfilter.org.

Economics and Scalability

The main cost of the BSF is for the initial materials (container, sand, gravel) and the transportation of those materials to the users' homes. To date, almost all BSF programs are dependent on external donor funds to subsidize the initial cost of the filter. The initial cost of the filter varies by program, with the International Aid filter installed at a cost of $32 for the container and $18 for transportation and education, for a total of $50. The full cost of installation and education of the Samaritan's Purse concrete version is $67. Some NGOs have worked to train local craftspeople to manufacturer, promote, and sell the BSF within their communities, although this has met with limited success due to the expense of the filters and the difficulty in identifying a local entrepreneur who can both manufacturer and promote the BSF.

The International Aid BSF Filter Design (www.internationalaid.org)