

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 proven HWTS options – chlorination, solar disinfection, ceramic filtration, and flocculation/disinfection – are widely implemented in developing countries. 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. 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 proven HWTS option or options. For more information on household water treatment, please visit www.who.int/household_water. For more information on ceramic filtration programs in developing countries, please visit www.pottersforpeace.org.

Ceramic Filtration

Locally manufactured ceramic filters have traditionally been used throughout the world to treat household water. Currently, the most widely implemented HWTS ceramic filter is the Potters for Peace design, which is flowerpot shaped, holds about 8-10 liters of water, and sits inside a plastic or ceramic receptacle. The filters are produced locally at ceramics facilities, and then impregnated with colloidal silver to ensure complete removal of bacteria in treated water and prevent growth of bacteria within the filter itself. There are also numerous other locally-made and commercial HWTS ceramic filters widely available in developed and developing countries.

Most ceramic filter HWTS systems are based on a filter/receptacle model. To use the ceramic filters, families fill the top receptacle or the ceramic filter itself with water, which flows through the ceramic filter or filters into a water storage receptacle. The treated, stored water is then accessed via a spigot embedded within the water storage receptacle.



*The Potters for Peace filter,
locally produced in Nicaragua
(CDC / D. Lantagne)*

Lab Effectiveness, Field Effectiveness, and Health Impact

The effectiveness of ceramic filters at removing bacteria, viruses, and protozoa depends on the production quality of the ceramic filter. Most ceramic filters are effective at removing the majority of the larger protozoal and bacterial organisms, but not at removing the smaller viral organisms. Studies have shown significant removal of bacterial pathogens in water filtered through high quality locally-produced and imported ceramic filters in developing countries. A 60-70% reduction in diarrheal disease incidence has been documented in users of these filters. Studies have also shown significant bacterial contamination when poor-quality locally produced filters are used, or the receptacle is contaminated at the household level. Because of the lack of residual protection, it is important that users be trained to properly care for and maintain the ceramic filter and receptacle.

Benefits, Drawbacks, and Appropriateness

The benefits of ceramic filtration are:

- Proven reduction of bacteria and protozoa;
- Acceptability to users because of the simplicity of use;
- Proven reduction of diarrheal disease incidence in users;
- Long life if the filter remains unbroken; and,
- A low one-time cost;

The drawbacks of ceramic filtration are:

- Lower effectiveness against viruses;
- Lack of residual protection that can lead to recontamination if treated water is stored unsafely;
- Variability in quality control of locally produced filters;
- Filter breakage over time, and need for spare parts;
- The need to regularly clean the filter and receptacle clean, especially when using turbid source waters; and,
- A low flow rate of 1-3 liters per hour in non-turbid waters.

Ceramic filtration is most appropriate in areas where there is capacity for quality ceramics filter production, a distribution network for replacement of broken parts, and training for users on how to correctly maintain and use the filter.



A family using a PFP ceramic filter in a ceramic receptacle (CDC, D. Lantagne)



An example commercially available ceramic candle filter system (replacement cartridge and container) (<http://www.stefani.com.au>)

Implementation Examples

Ceramic filtration programs have been implemented in over 20 countries using a variety of strategies, including:

- Potters for Peace (PFP) is a United States and Nicaraguan-based non-governmental organization (NGO) that promotes the flower-pot ceramic filter design by providing technical assistance to organizations interested in establishing a filter factory. PFP has assisted in establishing filter-making factories in 17 countries. Once the filter factory is established, the factory markets the filters to NGOs who then incorporate the filter into their own water and sanitation programming. www.pottersforpeace.org
- The first PFP filter factory, in Managua, Nicaragua, was constructed using private donations. From 1999-2005, the filter factory was a self-financed recognized micro-enterprise in Nicaragua. NGOs paid 10 USD per filter, and transported the filters themselves to project locations. Despite the fact that 23,000 filters were made and sold in Nicaragua from 1999-2004, the factory was not financially sustainable, and was sold in 2005 to a private investor who increased the price of each filter to 17 USD.
- One of the largest ceramic filtration programs is in Cambodia, where the NGOs IDE and RDI both worked with PFP to establish filter factories. RDI distributes the filters through unsubsidized direct sales, distribution through local vendors, and community-based subsidized programs. IDE distributes the filters nationally through vendors. Both NGOs sell filters to government agencies and other NGOs. The project has successfully distributed over 200,000 filters and has been extensively studied. Study results can be found at http://www.wsp.org/filez/pubs/926200724252_eap_cambodia_filter.pdf.

Economics and Scalability

Locally manufactured ceramic PFP-design filters range in cost from \$7.50-30. Distribution, education, and community motivation can add significantly to program costs. Ceramic filter programs can achieve full cost recovery (charging the user the full cost of product, marketing, distribution, and education), partial cost recovery (charging the user only for the filter, and subsidizing program costs with donor funds), or can be fully subsidized such as in emergency situations. If a family filters 20 liters of water per day (running the filter continuously) and the filter lasts 3 years then the cost per liter treated (including cost of filter only) is 0.034-0.14 US cents.

Commercially available ceramic filter systems range in cost from tens to hundreds of US dollars, depending on where they are manufactured and purchased, and the quality of the ceramic filters. The economics and the sustainability of commercial product based projects depend on donor funding and subsidy, as well as follow-up to ensure replacement parts are accessible to the population using the filters.

Placing the ceramic pot into the receptacle (PFP, Ron Rivera)

