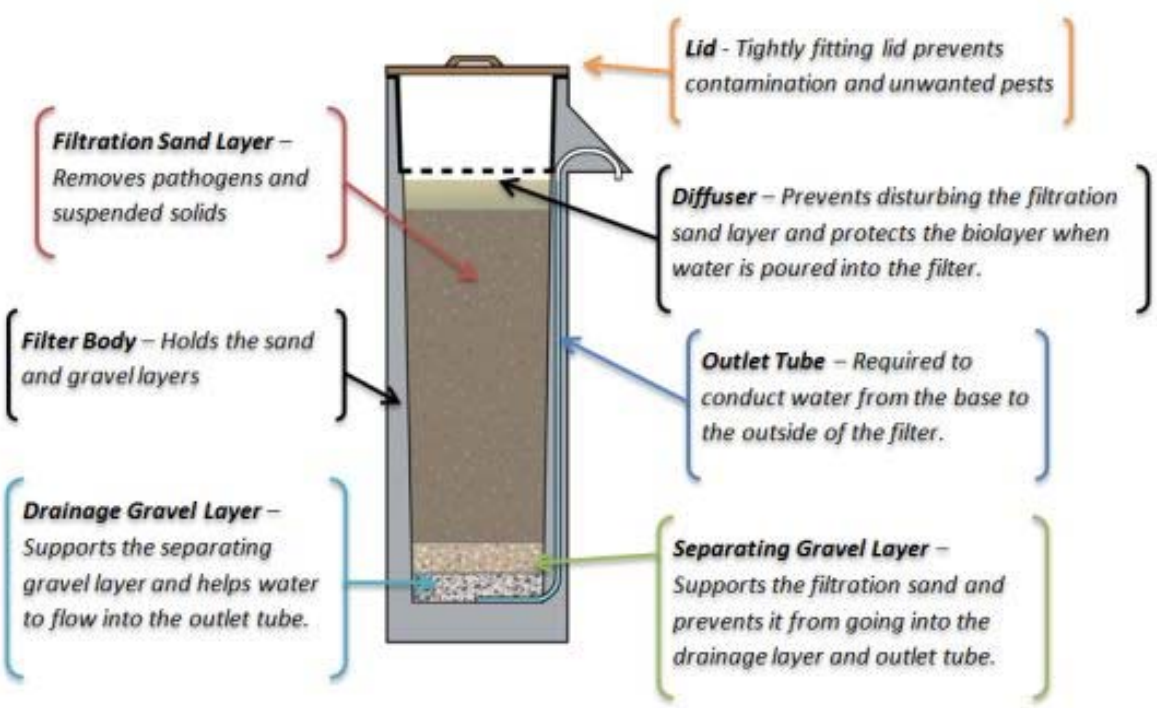
SEEDS OF HOPE
INTERNATIONAL PARTNERSHIPS

BIOSAND FILTER

What is it?

The BioSand filter is an innovation on traditional slow sand water filters, having been specifically designed for intermittent use.

Slow sand filtration has been used for centuries. The filter can be produced locally anywhere in the world because it is built using materials that are readily available. It is simply a concrete container, enclosing layers of sand and gravel whose purpose is to eliminate sediments, pathogens and other impurities from the water. It is in use in homes in over 70 countries around the world.



How does it work?

Water is poured into the top of the filter as needed, where a diffuser plate placed above the sand bed dissipates the initial force of the water. Traveling slowly through the sand bed, the water then passes through several layers of gravel and collects in a pipe at the base of the filter. At this point, the water is propelled through plastic piping encased in the concrete exterior, and out of the filter, for the user to collect.

How does it remove contaminants?

As with all slow sand filters, the removal of pathogens occurs in the BioSand filter due to a combination of biological and mechanical processes.

When water is poured into the top of the filter, the organic material it is carrying is trapped at the surface of the fine sand, forming a biological layer or 'schmutzdecke'.

Over a period of one to three weeks, micro-organisms colonize the schmutzdecke, where organic food and oxygen derived from the water abounds.

Four processes remove pathogens and other contaminants in this filter:

- Predation
- Natural death
- Adsorption
- Mechanical trapping

Predation

The schmutzdecke micro-organisms consume bacteria and other pathogens found in the water, thereby providing highly effective water treatment. It mirrors the process that is used in nature to purify water around the world.

Natural death

Pathogens are removed due to food scarcity and less than optimal temperatures.

Adsorption

Viruses are adsorbed (become attached) to the sand grains. Once attached, they are metabolized by the cells or are inactivated by antiviral chemicals produced by the organisms in the filter. Certain organic compounds are also adsorbed to the sand and thus removed from the water.

Mechanical trapping

Sediments, cysts and worms are removed from the water by becoming trapped in the spaces between the sand grains. When precipitated, the filter can remove some inorganic compounds and metals from the water.

How effective is it?

Slow sand filters have been proven to almost entirely remove the disease-causing organisms found in water. The BioSand technological adaptation of slow sand filtration has proven as effective as traditional slow sand filters, in both laboratory and field tests.

In conjunction with the introduction of the technology to communities, the filter has been tested by various government, research, and health institutions, as well as by non-governmental agencies.

Overall, these studies have shown that the BioSand filter removes:

- Up to 98% of fecal coliform
- 100% of protozoa and helminths
- up to 67% of iron and manganese
- most suspended sediments

A *Summary of Field and Laboratory Testing for the Biosand Filter* been published on the internet by partner organization CAWST (Centre for Affordable Water and Sanitation Technology) and can be found at http://www.cawst.org/en/resources/pubs/file/41-field-and-lab-testing-for-bsf.

How easy is it to use and maintain?

Operation

Operating the filter is very simple: remove the lid, pour a bucket of water into the filter, and immediately collect the treated water in a container.

Because of its smaller surface area, the filter can produce up to 36 liters/hour.

The following design features of the BioSand filter ensure its ease of use:

1. The water needs to be filtered only as required.
2. The concrete BioSand filter is devoid of moving parts.
3. The concrete container is small, but extremely stable. Therefore, it can be placed anywhere in the home, in the location most convenient to the user.
4. The plastic piping is encased in concrete and is not easily damaged.

Between uses, a layer of water (5 cms deep) is maintained above the sand at all times. It is this design feature that distinguishes the BioSand filter from other slow sand filters and which allows for both small scale construction and for intermittent use. This layer of water is shallow enough that oxygen can diffuse through the whole layer therefore providing the biological layer with enough oxygen to develop.

The biological layer typically takes one to two weeks to develop to maturity in a new filter. Removal efficiency and the subsequent effectiveness of the filter increase throughout this period. Although the filter does remove more than 90% of bacteria, which means the level is often below the infectious dose, it is recommended for people with infants or elderly relatives that they use disinfection after filtering the water.

Maintenance

Continued use of the filter causes the pore openings between the sand grains to become clogged with debris. As a result, the flow rate of water through the filter decreases.

To clean the filter the surface of the sand must be agitated, thereby suspending captured material in the standing layer of water. The dirty water can then simply be removed using a small container. The process can be repeated as many times as necessary to regain the desired flow rate.

After cleaning, a re-establishment of the biological layer takes place, quickly returning removal efficiency to its previous level.

How much does it cost?

Capital

The cost of a concrete filter has varied from US$ 15 to US$ 50, depending upon the country in which it is being manufactured and the amount of paid/volunteer labor available.

Using concrete to build the container costs less for several reasons:

- Cement is readily available in most developing countries.

- People are familiar with the construction techniques used.
- Household labor or volunteer labor can be utilized in the manufacturing process.
- The concrete container is heavy and durable. It does not need to be replaced as often as a plastic container.
- The plastic piping is located inside the filter. Consequently, it is less prone to damage than a plastic filter, which has piping on its exterior.

Operation

As consumables are not required for successful filter operation, the operating costs are negligible.

Advantages and Limitations

Advantages

- Removes up to 98.5% bacteria, 99.9% parasites
- Removes turbidity, some iron, manganese
- Quality of water improves with time
- Costs US $85.
- High flow rate - 24 liters/hour
- No on-going costs - no replaceable parts
- Durable & robust- lasts forever
- Fabricated from local materials
- Opportunity for local businesses
- Water tastes & looks good
- Easy to maintain

Limitations

- Heavy - difficult to move
- Biological layer takes 1-2 weeks to develop to maturity
- High turbidity (> 100 NTU) will cause filter to clog and require more maintenance
- Requires that the filter be used periodically on a regular basis
- Cannot remove color or dissolved compounds