02 Bio-Sand Filter Pot – Use and Maintenance

How a Bio-Sand-Filter works

Sand filters remove viruses, bacteria and chemicals more effectively than many modern filtration systems.

The principle filtration takes place in the top 4 inches of sand due to the action of the Bio-Mat and the Bio-Layer. Good bugs live in the top 16" sand. Filtration takes place in a number of ways:

1. A Bio-Mat forms on the surface of the sand and forms a physical barrier to many very small organisms and particles.
2. A Bio-Layer forms in the top 4" of sand to which toxins and pathogens (bad-bugs) stick.
3. Pathogen bacteria and viruses are killed below the bio-layer by toxins released by the bio-layer.
4. Water remains in the filter for at least 2 hours which is long enough for Cholera and other pathogens to die of old-age.

A Bio-Sand filter is alive!

Most of the filtering is does by the bio-mat and the bio-layer. These consist of living organisms – good bugs that eat up the bad ones. These good bugs come from the water you put into the filter. They occur naturally in all streams and rivers. It takes about a month for these good bugs to get established in your filter when you first start using it. For any given water source, the good bugs that live there are the best ones for getting rid of the bad bugs in that water, so it is best to consistently use the same water source to ensure the highest treatment efficiency.

The good bugs live in water and cannot survive if they dry out. So the sand in the filter must be kept covered with at least 1 inch of water at all times. It is most important that the sand is never exposed to air as this will kill the Bio-Mat and Bio-Layer. If

evaporation is found to reduce the water covering to less than ½ inch before more water is added, then the sand layer should be reduced appropriately, so that the top of the sand never dries out.

These good bugs eat and breathe and breed just like all other living things. To keep your water pure they need to be looked after, but thankfully that is very easy. However, they do need two essential things, just like you and me:

- Oxygen to breathe
- Food to live on

The good bugs get their oxygen and their food from the water, but when the oxygen and food in the water gets used up they need more water put into the filter to give them a fresh supply of oxygen and food. So water must be added at least every other day. When water is added care must be taken not to disturb the bio-mat on the surface of the sand.

Remember: The bio mat takes 2 days to die and one month to re-grow.

What water sources are suitable?

The best water source is an underground spring. If you take the water directly from where it comes out the ground it is likely to be pure and safe to drink without filtering.

The next best is a high stream above any human habitation. That water is also probably safe to drink without filtering.

After that any clear flowing stream or river will provide water that is good for filtering.

After rains or in larger rivers the water may be cloudy with silt. The filter will not work well if the water added to the filter is more than slightly cloudy when viewed in a drinking glass. The MAXIMUM cloudiness a filter can tolerate is when the water looks like fresh squeezed lemon juice.

If the water is cloudy then it is best to let it settle in a jerry can for a few hours before carefully pouring it into the filter.

Lake water is good for a filter if it is clear and there are streams flowing in and out of the lake.

A stagnant pond or swamp should only be used where flowing water is unavailable. NEVER USE WATER FROM A SOURCE THAT CONTAINS ANY VISIABLE SIGNS OF ALGAE. This normally only occurs in still water and occurs as green, red or brown slime in the water making it smell and taste bad. It can make the water surface thick like paint or motor oil. Algae will clog the filter, is difficult to get rid of, and can produce toxins that the filter may not remove.

The poorest water is from a drainage channel contaminated with sewerage. It is best to pre-filter such water through a bag of sand before putting into a bio-sand filter.

How can you know it is working?

Assuming you have followed the instructions above and the bio layer is established the most important factor is the rate at which water flows through the filter. If it is too fast, the bad germs can get through before the good bugs can stop them. If the flow rate is too slow, the filter won't produce enough water for your requirements.

A new filter will take about a month for the bio layers to get established. While this is happening you must keep feeding it by adding water four times a day. While the bio layer is growing you can use the water that comes from the filter, but you should assume it is not yet safe without boiling or treating in some other way. As the bio-layer grows the flow-rate will slow down, and this is the key to checking if the filter is working.

When the filter is brand new, you must measure how long it takes to fill a bottle.

Add water to within 3 inches of the top of the pot and time how long it takes to fill a coke bottle with water. The flow rate is OK if it is within the following ranges:

Filter Age	330ml bottle	500ml bottle
New	45 secs to 2 minutes	70 secs to 3 minutes
4 weeks old	60 secs to 4 minutes	90 secs to 6 minutes

If the flow rate of the new filter is too fast you need to user finer sand in the top 8 inches (20 cm) or use a top-pot with a small drip-hole to reduce the flow rate.

If you want to test the filter you can use a Coliform/E.Coli petrifilm, obtainable from good pharmacy suppliers.

Filter Maintenance

When used with clear water sources bio-sand filters will give good service without any maintenance for several years. With cloudy water maintenance will be required sooner.

If the flow rate drops below a useful level (say more than 6 minutes to fill 500ml) try the following in turn:

1. Remove the top-pot, fill the filter pot with water. Swirl the water over the top-stones to stir up the silt and scoop out the muddy water with a cup. Repeat until the water remains clear. Continue to use the pot as usual.
2. If this does not restore the flow rate, remove the layer of top-stones then use your fingers to very gently scrape the surface of the sand to free the Biological Mat. Gently add plenty of water then stir the water to disperse the mat into the water and then remove most of the water. Wash the stones and replace them. The filter should produce safe water again in less than a week.
3. In the very rare cases where this does not restore the flow rate, remove the layer of top-stones and the top 2 inches of sand. Wash the sand and stones and replace. The filter will need

water adding 4-times daily for one month before it is safe to drink without boiling. If you have to do this, it is likely that you have been pouring silty water into the filter or have got algae contamination. Cloudy water should first be left to settle before pouring into the filter.

4. If you have algae clogging the filter you will need to completely empty it, roast all the stones and sand over a fire until you have burned off all the algae, then wash thoroughly before replacing.

A Top-Pot

The Bio-Sand Filter is much improved if you have a top pot. This can be any water vessel that sits on top of the filter. Usually it is a large clay pot or home-made concrete pot. But a plastic or metal pot or basin or even a jerry-can will do fine. Whatever you use, it needs to have a single small hole near the bottom to let water trickle through. The hole should be about the size of a tooth-pick.

The main advantage of a top-pot is that you can pour water into it from your water carrier (jerry can) without having to be careful not to disturb the bio-mat. A second function is to reduce the flow-rate if the sand in the filter is too coarse. Both of these are important to ensure your filter reliably produces pure water.

General hygiene

If you want to keep healthy, you must use filtered water for all your cooking and drinking and **also for washing your hands and face and cleaning your teeth.** You must wash your hands before preparing or eating all food and after going to the toilet. You must be careful not to get unfiltered water into your mouth when washing or bathing. You must keep the area around you water filter clean and replace the cloth on top if it tears or rots.

Protection from flies

Flies like to feed on excrement and they are also attracted by food you have prepared, especially if it is hot food giving off a pleasant aroma!

When flies land on your food or your water carriers, the excrement sticking to their legs is left behind on your food. If you don't want to eat other people's excrement and catch their diseases then you must protect your food and water from flies. If you are filling a basin or jerry can with water trickling out of the filter, cover the basin or the mouth of the jerry can with a cloth. Keep your filtered water protected from filthy flies. Drink from clean cups, not directly from your clean-water container. Give children clean water to take to school or when they visit neighbours so they do not get ill from other people's dirty water.

The next article explains in detail how to turn a suitable container into a bio-sand filter.