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Biosand Filter

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Biosand Filters

Contents

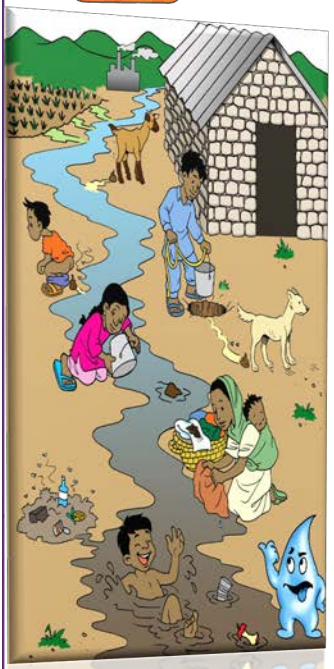
Objectives

- To know the history of the Biosand filter
- To explain how the BSF makes water safe to drink
- To know the parts of a BSF and explain how each part works
- To illustrate what happens to Pathogens and particles in a BSF
- To illustrate what kind of water can be treated in a BFS

Terminology

- Biosand Filter
- Pause Period
- Schmutzdecke·
- Biolayer
- Charge

1 Biosand filters: Why they matter



Millions of people die every year due to diseases associated with a lack of clean water. Nearly 1,000 children die each day, due to preventable water and sanitation-related diarrheal diseases. More than 90 of wastewater is discharged into rivers or sea without treatment. Often people use this water as a source of drinking water.

Having access to clean water is a human right, yet billions of people globally use a source of drinking water that is contaminated especially, in the developing countries. Fortunately, there has been significant progress made in the past decade regarding drinking sources and sanitation, whereby over 90% of the world's population now has access to improved sources of drinking water.

The biosand filter is a practical and affordable method of treating water in developing countries where there are no central water treatment plants. It can be used at the household level, in schools or small communities. It can be constructed with simple and locally available materials, such as concrete or plastic containers.

2 The inventor of the Biosand Filter

- Dr. Manz has trained many organizations on the design, construction, installation, operation, and maintenance of biosand filters.
- He also co-founded CAWST in 2001 to provide the professional services needed for humanitarian distribution of biosand filters in developing countries.
- As of 2013, CAWST estimates that well over 650,000 biosand filters have been implemented in more than 55 countries around the world, benefitting more than four million people.

Dr. David Manz

developed the household biosand filter in the 1990s at the University of Calgary, Canada

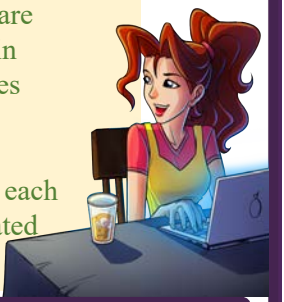
3 What is a Biosand Filter?

It is a technology that purifies contaminated water so that it is safe for consumers. It uses a biological layer that develops at the top of a sand bed to remove small particles (turbidity) and harmful microorganisms (pathogens). The biosand filter is normally abbreviated as **BSF**.

A BSF is filled with layers of sand and gravel that are carefully selected to meet certain specifications.

4 How Does it Make Water Safe?

A BSF removes almost all of the small particles and up to 99% of pathogens from water. Pathogens are disease causing microorganisms that are found in many drinking water sources such as rivers, lakes and groundwater wells. If not treated properly, pathogens in drinking water can cause severe diarrhea. Worldwide, nearly 1,000 children die each day due to preventable water and sanitation-related diarrheal diseases.



5 Why Biosand Filters?

The BSF is a simple technology that does not require highly advanced knowledge to build and operate. It is a low-cost option compared with other water treatment technologies. BSFs can be used to purify water from different sources such as well water, pond or river water or rainwater. Therefore, consumers can use BSFs for different water sources that are closest to home.

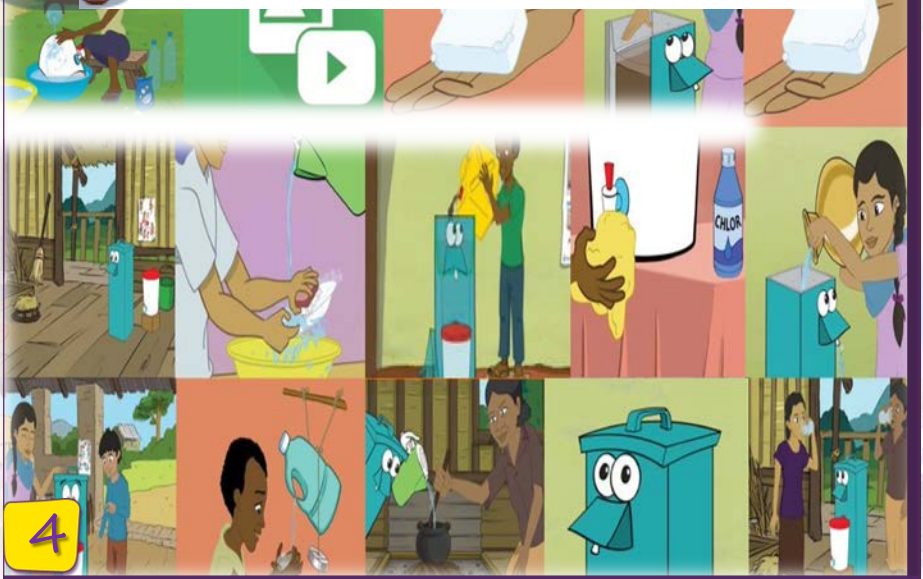
6 Limitations of Biosand Filters

BSFs are effective for removing suspended solids, organics and pathogens. It is not, however, effective for the removal of many dissolved chemicals in water, such as nitrate, lead, arsenic and fluoride. Also, during the start up period or after cleaning, a BSF is less effective since the biological layer needs time to develop.

What is the most important part?

The most important part of the BSF is the biolayer (Schmutzdecke) that develops at the top of the sand bed. Most of the contaminants are removed in this layer.

It is important that the biolayer is well developed for the BSF to effectively remove contaminants. It is also important that the right size distribution and depth of sand bed is used for the BSF to work properly.



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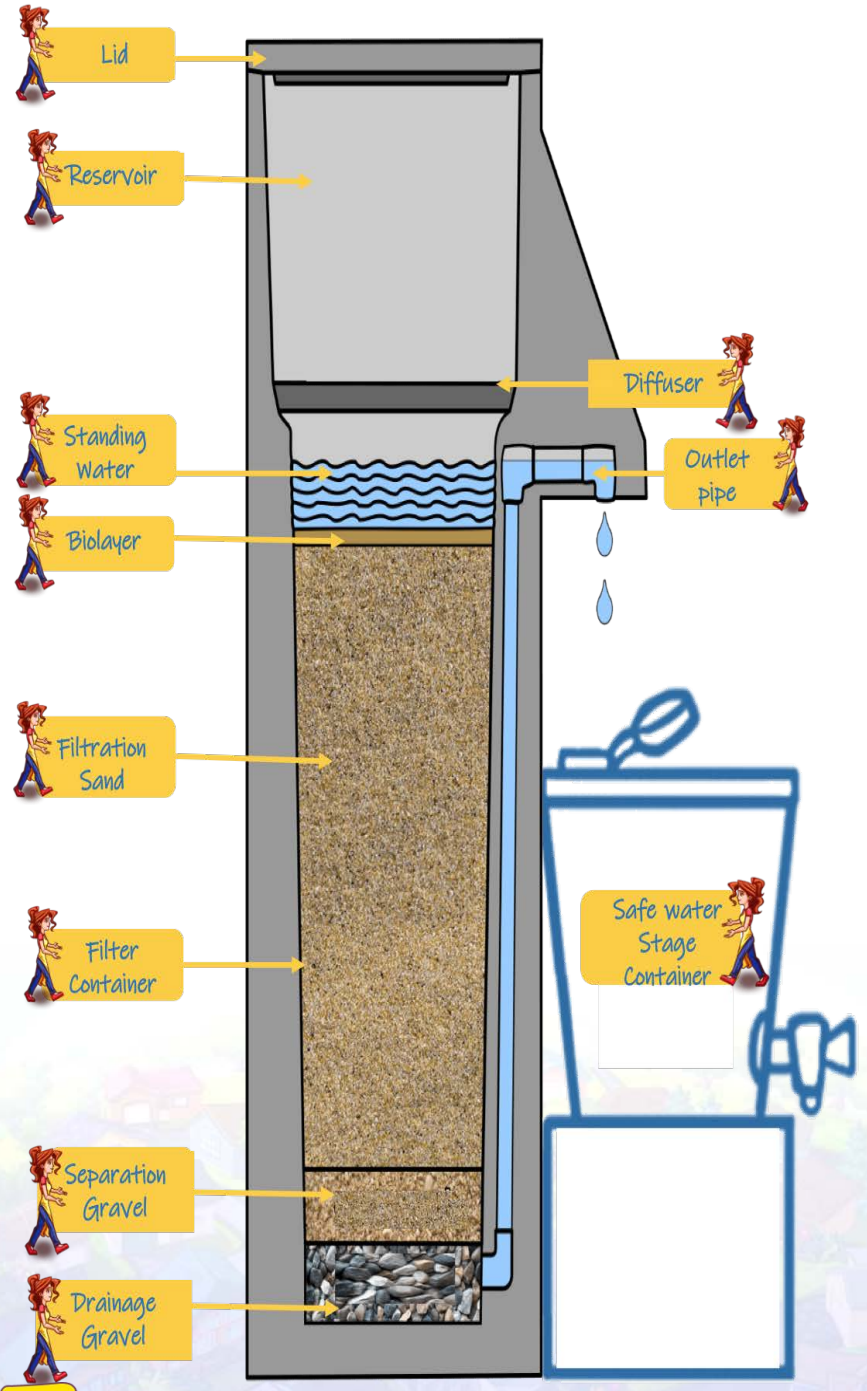
The Components of Biosand Filter



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The purpose of each component

The lid should be tight to prevent contamination and entry of unwanted pests.

The top of the filter that holds water poured during each charge. The reservoir capacity should be equal to the pore volume in the sand bed. For a regular household BSF the reservoir can hold 3 gallons .

A box or a plate that has small holes in it, so that the water slowly drips through to the sand. It is used to avoid disturbing the top sand layer and protects the biolayer from damage when the water is poured into the BFS.

When the water stops flowing (idle period), there should be 5 cm (~2") of water on top of the sand to keep the biolayer moist. Without this standing water the biolayer will dry and the good microbes in the biolayer will die.

The container houses the sand and gravel. It can be made out of concrete or plastic and it can be square or round.

The biolayer forms naturally at the top layer of sand (1-2 cm or 0.8" deep) during the first few weeks of use. This process is called "ripening". Microbes in the biolayer produce a sticky slime layer that helps to trap small particles and pathogens.

The large gravel pieces stop the small gravel from moving and blocking the outlet pipe because they are too big to get inside the outlet pipe.

The sand helps to remove pathogens and small particles from water. However, if the sand is too fine the water will drip very slowly out of the outlet pipe, so people won't want to use it.

The small gravel stops the sand from moving down and blocking the outlet pipe

The pipe, where the clean water will come out., can be made out of plastic or metal. It is raised above the top level of the filter bed to maintain a 5 cm (2") layer of standing water above the sand.

The purpose of the water storage container is to collect and store clean and safe water as it flows out of the outlet pipe.

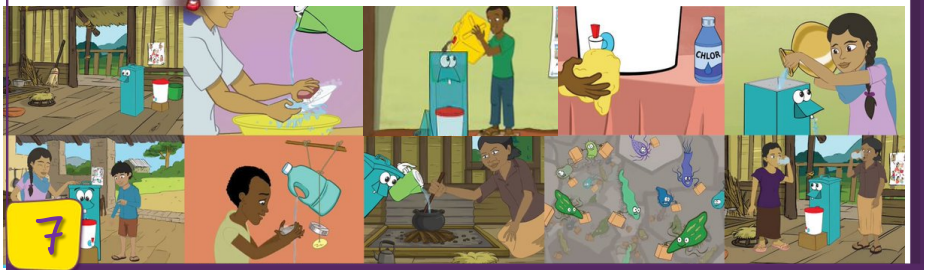
7 How are Pathogens and Particles removed in the BSF?

Some particles are trapped in the pore spaces in the sand bed because of their large size.

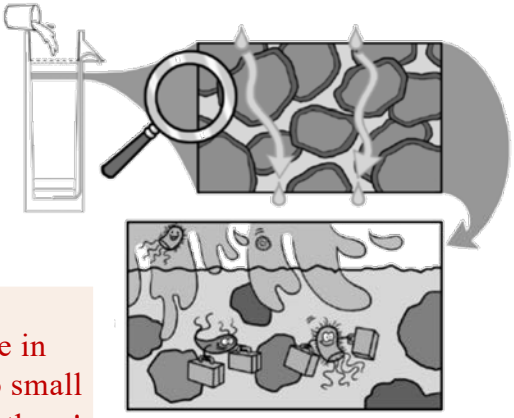
They are trapped in the sticky biolayer. This involves physical and chemical mechanisms of attachment.

Some of the microorganisms, such as protozoa, prey or feed on other microbes, such as bacteria and viruses.

They die as they move down the sand layer because there is not enough food or air deep in the filter bed.



8 The First cycles with fresh sand



D 1

Many microbes live in water. They are too small to see, but they are there! When you pour water into the BSF, the microbes start living in the top of the sand.

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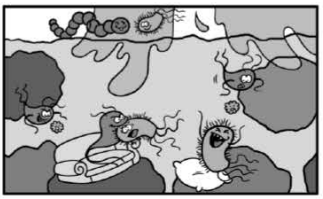
As you keep using the filter, more and more microbes start to live in the sand. The biolayer grows – the Schmutzdecke - becomes ripe. Some of the pathogens die off or become food for other microbes.



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After several weeks the Schmutzdecke becomes so thick that the water flow slows and the BSF needs to be cleaned.

In subsequent cycles, the time for the ripening of the Schmutzdecke will only be a few days.

Operation of Biosand Filter

1

Contaminated water is poured into the top of the BSF at least one time per day then the lid is placed back on the BSF. The BSF can be charged one to four times every day.

The water poured into the top of the filter slowly drips through the holes in the diffuser and flows down through the sand and gravel. This process does not require electricity since it works by gravity. It takes about 1 hour to get about 3 gallons of treated drinking water.

2

After the water stops flowing, the filter must rest for at several hours before pouring more water in. This step is called the **Pause Period.**

3

After several days or weeks of operation, the biolayer clogs the pore spaces in the top sand layer and slows down the flow rate.

4

5

Cleaning of the biolayer is done by mixing the top sand layer by hand or with a stick and scooping out the dirty water. You may need to do this more than one time before the BSF is ready for a new water charge.

10 What Kind of Water Can I Use?

BSFs can treat water from rivers, lakes, ponds and groundwater. Very dirty water is not recommended because the top sand layers can be clogged quickly and reduce the flow rate and increase frequency of cleaning. Do not pour water that has been chlorinated into the BSF. Chlorine will kill the biolayer. However, after treatment with a BSF, bleach should be added to disinfect the water before you drink it. The US EPA recommends adding 8 drops of 6% bleach per gallon of water or ½ teaspoon for 8 gallons.

11 References

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