

BIOSAND WATER FILTRATION SYSTEM

HOW IT WORKS

This system removes bad bacteria and some other impurities from water, to produce clean drinking water.

Water contains bacteria (germs). Some bacteria are good for us (in digestion); but other bacteria are bad for us, and will make us sick (especially vomiting and diarrhoea). This filtration system works by creating a biolayer of good bacteria which kills the bad bacteria, and then filters the water through sand to remove other impurities.

THINGS YOU MUST DO

1. After building the system, you must not drink the water for the first 30 days.
It takes 30 days for good bacteria in the system to work properly, so that the water is purified. During the first 30 days, you can use the water for boiling rice or for washing clothes, but not for drinking.
2. You must pour at least one bowl of water into the system every day.
The good bacteria kills and 'eats' the bad bacteria. The good bacteria needs 'food' every day, otherwise it will die too, and the system will not purify water.
3. You must get the water from the same water source (eg a well/bore) all of the time.
If you mix water from a different source (eg river or government supply) into the system, even once, it will introduce different bacteria into the system, and they will kill the good bacteria.
4. The top of the sand (and the biolayer of 'good' bacteria) must be level (flat), and must be 40 to 50 mm (1½ to 2 inch) below the bottom of the outlet pipe. Therefore, when water is not flowing out of the outlet pipe, the water level inside the drum will be between 40 to 50 mm (1½ to 2 inch) deep.
This is the perfect depth for oxygen in the water to reach the 'good' bacteria, so that it can survive.

**If any of these rules are broken, the water will not be purified,
and you must start the 30 day process again.**

WHAT YOU NEED

- You can use any drum (eg PVC) or tank (eg concrete). In this example, we will use a 200 litre (44 gallon) blue PVC plastic drum. This will purify enough water for a family.
- A shallow 9 litre (2 gallon) plastic bowl.
- Some 20 mm (¾ inch) PVC pipe and fittings:
 - 1500 mm (5 feet or 60 inches) of pipe
 - 1 x closed end (to block the bottom end of the pipe)
 - 2 x 90 degree elbows (with two push on fittings)
 - 1 x 90 degree elbow (with one push on fitting and one female threaded fitting)
 - 1 x straight fitting (with one push on fitting and one male threaded fitting) to screw through the hole in the drum.
- PVC glue to join the pipe and fittings.
- Silicon or a rubber washer (with a ¾ inch hole) to make sure the drum does not leak.
- About 3 gallons (13 litres) of larger stones, about 6 mm to 12 mm (¼ to ½ inch). This must be enough to cover the pipe in the bottom of the drum.
- About 3 gallons (13 litres) of smaller stones, up to 6 mm (¼ inch)
- About 28 gallons (130 litres) of sand, up to 1 mm (1/32 inch).
- Two mesh screens, one with holes between the mesh about 1 mm (1/32 inch), and one with holes about 6 mm (¼ inch). These will be used to separate the sand, smaller stones, and larger stones. (See diagram on page 4)
- A large bucket or container to wash the sand.

BIOSAND WATER FILTRATION SYSTEM

Important Notes:

The system takes 30 days to establish. Do not drink the water during the first 30 days.

Every day, at least one bowl of water must be added to the system.

Always use water from the same water source (eg well/bore). If you use water from a different water source, it will kill the 'good' bacteria in the drum, and the filter system will not work.

Cover

You must have a cover to keep dust, dirt and insects out of the system.

Bowl

Drill 60 x 1½ mm ($\frac{1}{16}$ inch) holes in the bottom of a bowl, so that water can drip into the system.

Air Gap

There must be a gap of at least 20 mm ($\frac{3}{4}$ inch) between the bottom of the bowl and the water.

Water Level

Dirty water will slowly filter down through the system. When the system is not flowing into the outlet container, the water must be 40 to 50 mm (1½ to 2.0 inch) deep. This depth is just right to allow oxygen to reach the good bacteria in the system (see below.)

Biological Layer

After 30 days, a layer of sticky, red-brown scum will form on top of the sand. This is the layer of 'good' bacteria which kills and eats the 'bad' bacteria.

Coarse Sand

Up to 1 mm ($\frac{1}{32}$ inch) in diameter.

When making the system, sand must be washed, and clean of mud before putting into the drum.

Add water first, then put the clean sand into the water, so that the sand settles properly in the drum.

The top of the sand must be level, and must be 40 to 50 mm (1½ to 2.0 inch) below the bottom of the outlet pipe.

Smaller Stones

Up to 6 mm ($\frac{1}{4}$ inch).

Larger Stones

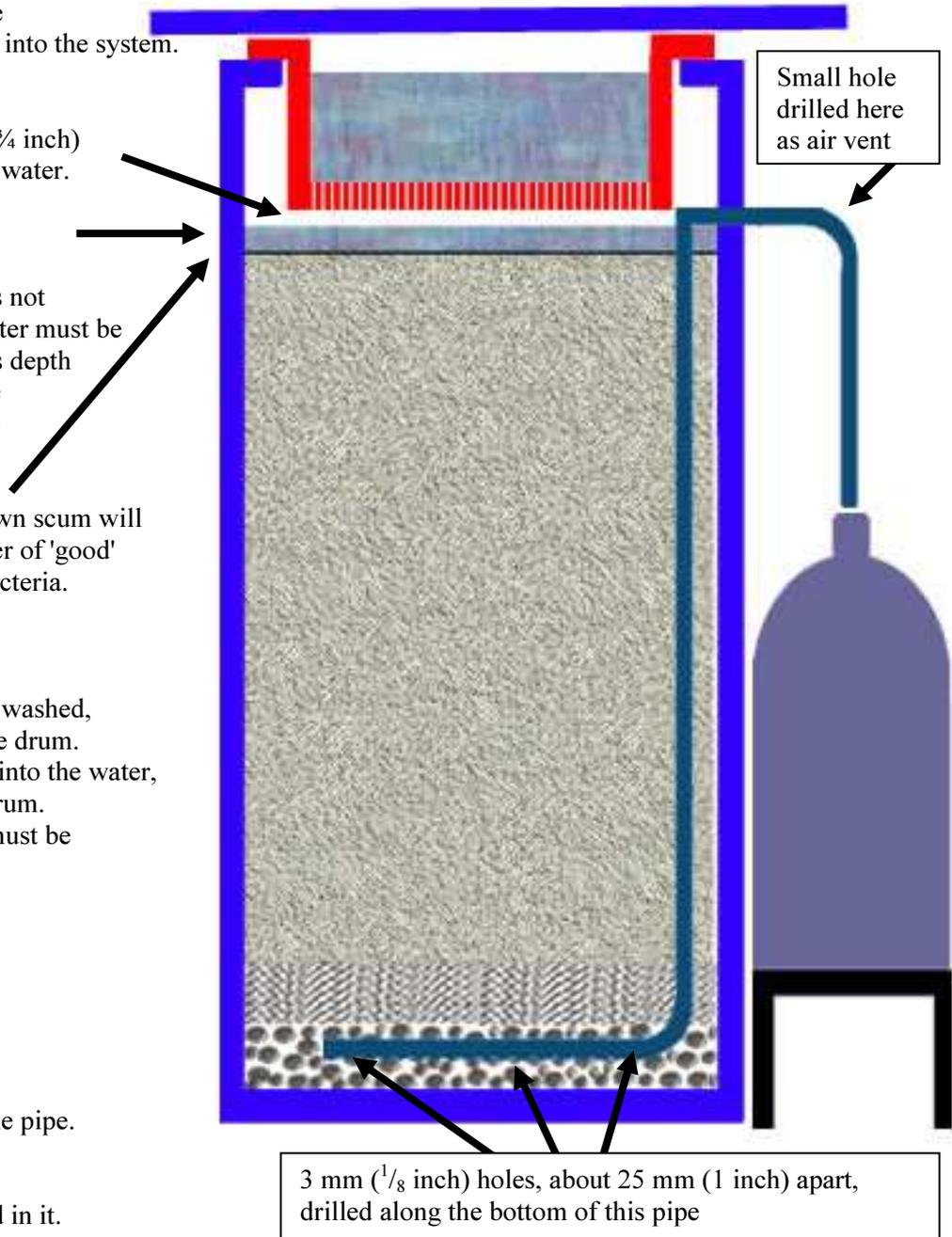
From 6 to 12 mm ($\frac{1}{4}$ to $\frac{1}{2}$ inch).

Just enough stones to cover the top of the pipe.

Pipe

The bottom of this pipe has holes drilled in it.

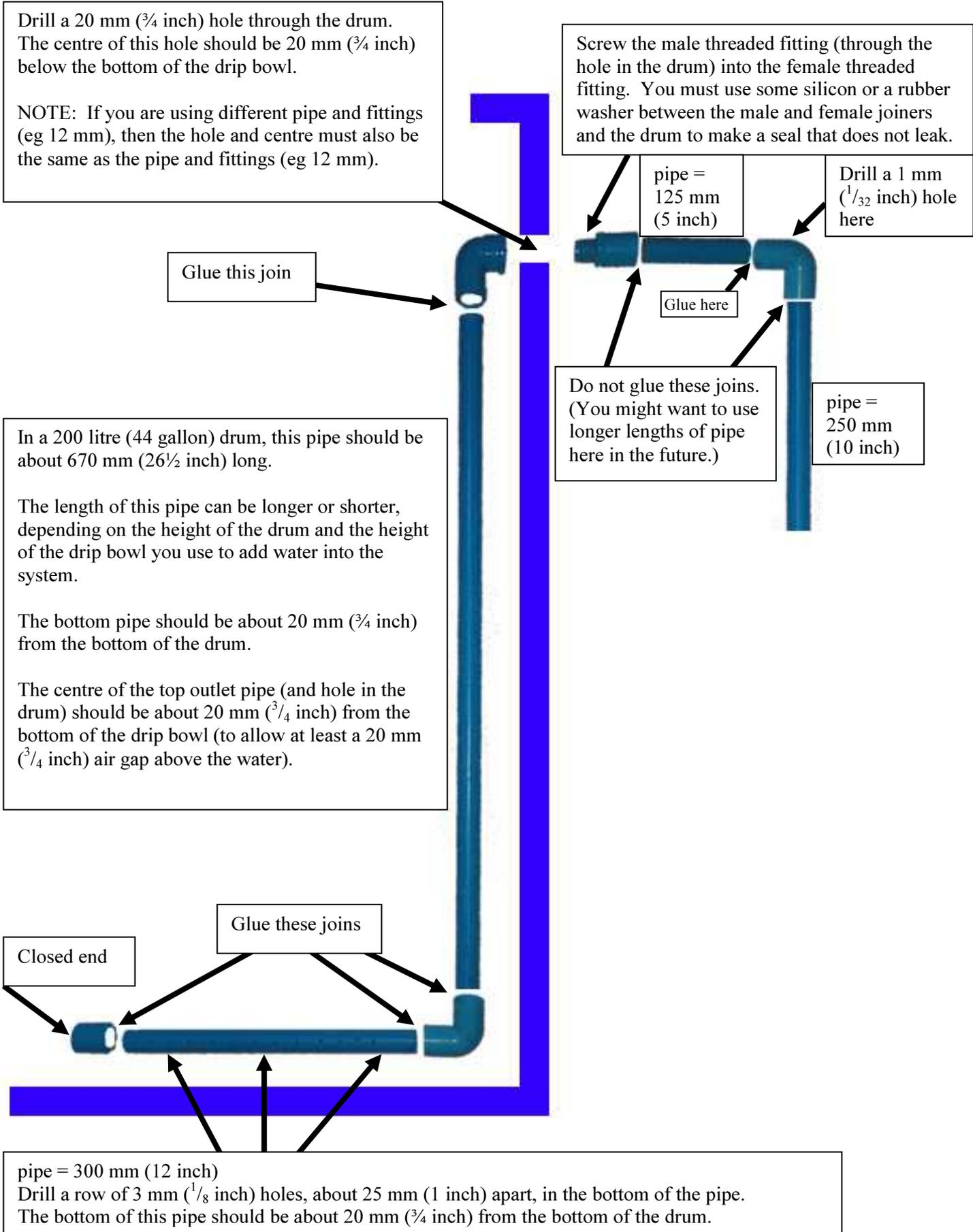
The weight/pressure of water in the system pushes filtered water up through the holes and into the outlet pipe. Filtered water will then flow into a collection container outside the drum.



PREPARATION OF THE PIPE

All pipe and fittings are 20 mm ($\frac{3}{4}$ inch).

The lengths of the pipe are measured before gluing into the fittings.

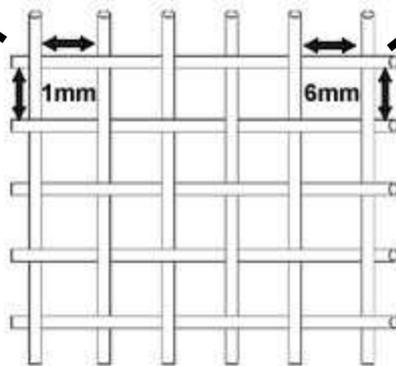


PREPARATION OF THE SAND AND STONES

1. Fill a large container with water.
2. In the container, fill the screen with mesh about 1 mm ($\frac{1}{32}$ inch) with sand. Move the screen through the water. The sand will fall through the mesh into the water; and the stones in the sand will stay in the mesh.
3. Put the mixed stones into the screen with mesh about 6 mm ($\frac{1}{4}$ inch), and shake the mesh. The smaller stones will fall through the mesh; and the larger stones will stay in the mesh.
4. Empty the larger stones from the screen into another container.
5. The sand in the container needs to be washed to remove any mud and sticks. While adding more water to the container, stir the sand. Wash out any mud and sticks over the top of the container. When clean, carefully scoop out the water, and put the clean sand into bags.



1 mm ($\frac{1}{32}$ inch) mesh
for sand



6 mm ($\frac{1}{4}$ inch) mesh
to separate smaller and
larger stones

PREPARATION OF THE DRIP BOWL

1. Using a $1\frac{1}{2}$ mm ($\frac{1}{16}$ inch) drill (or a small nail or hot needle), make 60 holes in the bottom of the bowl. This is so that the water can drip through the bowl into the drum slowly, without disturbing the water already in the drum.

PREPARATION OF THE DRUM

1. Wash the inside of the drum until it is clean.
2. Cut a hole in the lid of the drum. This should be large enough so that the drip bowl can fit into the hole, but not fall through into the drum.
3. Using a drill (or a knife), carefully cut a 20 mm ($\frac{3}{4}$ inch) hole in the side of the drum. The centre of the hole should be about 20 mm ($\frac{3}{4}$ inch) from the bottom of the drip bowl.

PREPARATION OF THE OUTLET PIPE

- Note: Depending on the height of the drum and the height of the drip bowl you use, the length of the 670 mm (26¹/₂ inch) pipe will be different!
 - The bottom pipe should be about 20 mm (³/₄ inch) from the bottom of the drum.
 - The centre of the top outlet pipe (and hole in the drum) should be about 20 mm (³/₄ inch) from the bottom of the drip bowl (to allow at least a 20 mm (³/₄ inch) air gap above the water).
- Cut the pipe into lengths of 125 mm (5 inch), 250 mm (10 inch), 300 mm (12 inch)
- In the 300 mm (12 inch) pipe, drill a row of 3 mm (¹/₈ inch) holes, about 25 mm (1 inch) apart, in the bottom of the pipe.
- In one of the 90 degree elbow fittings, drill a 1 mm (¹/₃₂ inch) hole as an air vent (see previous page).
- Assemble the pipes and fittings (as shown on the previous page), and test the lengths inside the drum.
- If the measurements are correct for the size of drum you are using,
 - Cut the long length of pipe. For a 200 litre (44 gallon) drum, this should be about 670 mm (26¹/₂ inch).
 - Glue the pipe and fittings which go inside the drum (as shown on the previous page).
- Using some silicon or a rubber washer, screw the male fitting into the female fitting through the hole in the drum. The silicon or rubber washer make sure that the hole does not leak.



FILLING THE DRUM

- Gently pour the larger stones into the bottom of the drum. Be careful not to damage or push or bend the pipe. Level out the stones. The stones need to just cover the pipe.
- Gently pour the smaller stones into the drum. Level out the stones.
- Pour lots of water from the source (eg well/bore) into the drum, to about half full.
- Slowly pour the sand into the drum. The water must always be above the sand, so that the sand settles properly. If necessary, add more water before adding more sand.
- Scoop out any dirty water from the top of the drum.
- Level the sand in the drum. The sand must be 40 to 50 mm (1¹/₂ to 2 inch) below the bottom of the outlet pipe.
- Keep some spare sand in a bag or clean container. From time to time, check the level of the sand. Add sand if necessary.



ESTABLISHING THE SYSTEM

1. Put the drip bowl in place.
2. Keep pouring water into the drip bowl. At the beginning, dirty water will come out of the outlet pipe, while any remaining mud in the sand washes out. Eventually, clean water will start flowing out of the outlet pipe.
3. Remember, you must add at least one bowl of water into the drip bowl every day.
4. Remember, you cannot drink the water during the first 30 days.

MAINTENANCE OF THE SYSTEM

1. If the system slows down, so that only a little water flows through, it may be necessary to clean the system.
2. To do this, gently rub the top 20 mm ($\frac{3}{4}$ inch) of sand with your fingers. This will cause the water to go muddy.
3. Scoop out and throw away the muddy water, being careful not to scoop out sand.
4. Put more water in the bowl and refill the system.
5. Make sure the sand is level, and 40 to 50 mm ($1\frac{1}{2}$ to 2.0 inch) below the bottom of the outlet pipe.



Remember to put a large cover over the top of the drum and drip bowl to stop dirt, dust and insects falling into the system.

If possible, seal this join (maybe with a clean rag), so no dirt, dust and insects fall into the clean water.