Water for the World

Constructing a Household Sand Filter

Technical Note No. RWS. 3.C.1

A household sand filter can be used to treat water for individual households. There are two different designs for household sand filters. One design simply is used to filter turbidity from water and does not affect the bacteriological quality of the water. This type of filter is easier and cheaper to construct, operate and maintain. The other sand filter design not only removes turbidity but also removes some of the bacteria. However, further treatment may be necessary. The construction, operation and maintenance required for this filter type is more expensive and more difficult than for the first type mentioned.

This technical note describes the construction of both types of slow sand filters. Construction does not require any special skills.

Useful Definitions

INTAKE - The point where water enters a supply or treatment system.

TURBIDITY - Cloudiness in water caused by particles of suspended matter.

Before beginning construction, be sure that the people building the filter have the following:

1. Detailed plans of the sand filter to be constructed as shown in Figure 1.

2. A complete list of all materials that will be needed. A sample list appears in Table 1.

Table 1. Materials List for Household Sand Filter

Item	Description	Quantity	Estimated Cost
Labor	Household members	____	____
Supplies	Steel drum	____	____
	Sand (0.2-0.5mm diameter)	____	____
	Flexible pipe	____	____
	Gravel	____	____
	Pipe glue	____	____
	Nails	____	____
	Framing wood	____	____
	Sheet metal	____	____
	Blocks	____	____
Tools	Shovel	____	____
	Hammer	____	____
	Saw	____	____

Total Estimated Cost =

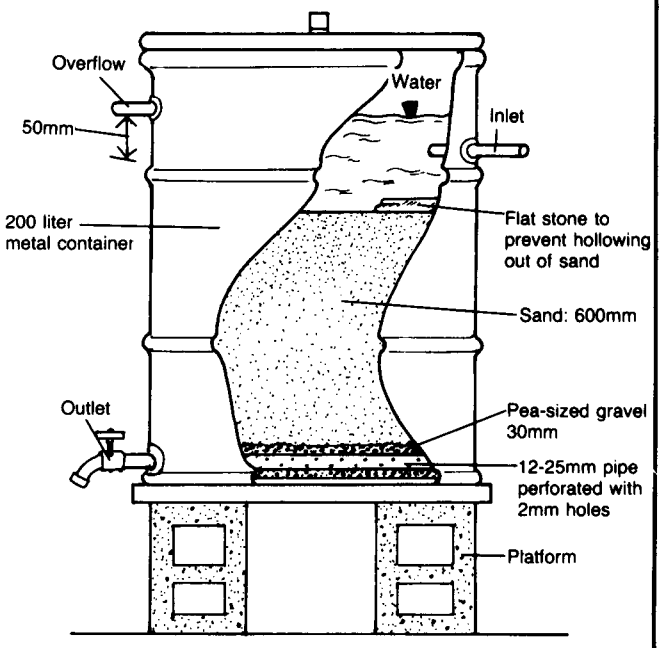

Figure 1. Household Sand Filter

Construction Steps

Follow these steps in building a household sand filter:

1. Prepare a steel barrel approximately 600mm in diameter and 750mm tall to be used for the filter. Remove the top cover and wash the barrel thoroughly and rinse with a one percent chlorine solution to disinfect it. See "Designing Basic Household Treatment Systems," RWS.3.D.1, for information on the preparation of chlorine solutions. Keep the chlorine rinse water in the barrel for at least 30 minutes to ensure proper disinfection.

2. At the bottom of the wall of the barrel drill or cut a 7-10mm hole. This hole will be the outlet for the filtered water. Do not make the hole larger than 7-10mm. Place a pipe joint and pipe in the hole so that water can flow either to storage or further treatment. Seal around the pipe and the barrel with pipe cement if plastic pipe is used. If steel pipe is used and soldering equipment is available, solder the pipe to the barrel. A good seal is needed to prevent leaks.

Another way to make an outlet is to place a perforated pipe in the gravel layer at the bottom of the barrel as shown in Figure 1. Use a small diameter pipe, 12-25mm, and make small holes in it. This method may prove easier because leakage around the pipe is less likely.

3. Line the bottom of the barrel with pea-sized gravel. The gravel layer should be about 30mm thick.

4. Fill the barrel with sand to within approximately 100mm from the top. Approximately $0.2m^3$ of sand is needed for a barrel 600mm in diameter. This will give a sand bed 600mm thick.

To determine the volume of sand needed for a layer of sand 600mm thick in a barrel 600mm in diameter, use the following formula:

Volume of sand = .785 $(\text{diameter})^2$ x height

Volume of sand = .785 $(0.6m^2)$ x (0.6m)

Volume of sand = .785 (.36m) x (0.6m)

Volume of sand = $0.2m^3$

Use fine sand for the filter. To size the sand, make a sieve using window screen and small pieces of wood as shown in Figure 2. The window screen is 16-mesh which has openings of 1.6mm. The sand that passes through the window screen will be less than 1.6mm in diameter and generally a satisfactory size. One problem is that all sand grains less than 1.6mm in diameter will pass through the sieve and an attempt to use the coarser sand should be made. If too much very fine sand is used, the filter system may clog quickly.

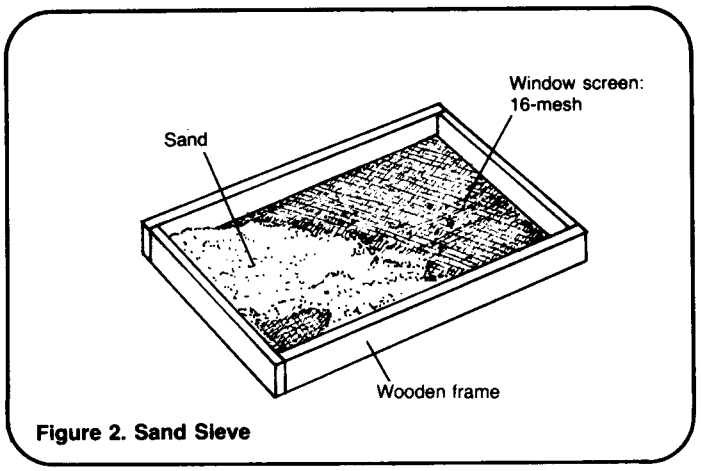

Figure 2. Sand Sieve

Grain sizes larger than 1.6mm should not be used because filtration may not be adequate in coarser sand. When choosing the sand to use in the household sand filter, only use sand that passes through the screen and from this sand, try not to use the finest grains.

To ensure effective operation, be sure that the sand is clean. Washing the sand before placing it in the filter drum is recommended. Wash the sand by placing it in a box and slowly pumping water in at the bottom. Continue this process, raking the sand to distribute it evenly, until water overflowing the box is clean.

5. If water is poured into the filter from a bucket, an overflow is not necessary. However, if water flows into the filter from an intake pipe, an overflow should be installed. For the overflow, make a 50mm hole near the top rim of the barrel and install a pipe. Locate the overflow approximately 50mm above the inlet.

6. Cover the filter. Provide a cover for the intake that adequately protects the filter. The cover should be easy to remove in order to clean the filter.

For the cover, use a piece of sheet metal nailed to a wooden frame. The frame should fit tightly over the barrel and have an overhang of about 20mm to prevent dust and rain from getting into the filter. Make the length and width of the cover frame 20mm greater than the outside diameter of the barrel. Hammer nails into the wooden form as shown in Figure 3 so that some air can circulate under the filter cover.

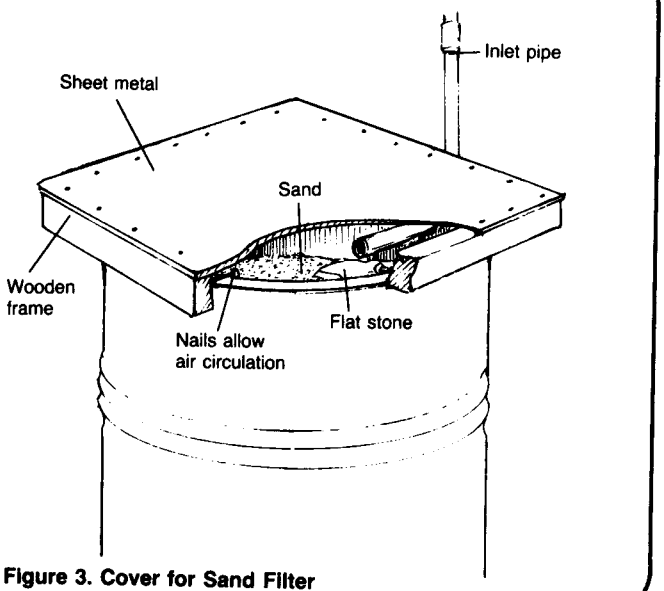

Figure 3. Cover for Sand Filter

7. When water is simply poured into the filter, no inlet other than removing the cover is necessary for filling the filter. However, if water is supplied from a cistern or other type of storage tank, an inlet can be provided. Place the inlet in either the cover or the side near the top of the barrel. Connect flexible pipe from the water source to the filter. Under the inlet pipe, place a small flat stone so that water hits it without disturbing the sand layer.

For easy access to the filtered water, place the sand filter on at least three blocks so that water can be easily collected from the outlet pipe. When constructing a household sand filter in which the sand will always be covered, a gravity flow system like the one in Figure 4 can be installed. Wooden or brick platforms can be constructed so that water flows from the pre-treatment storage to the filter and to the filtered water storage by gravity. This structure is more complicated and expensive to build and the sand layer must constantly be under water. If this system is used, taps should be installed on all outlet pipes so that water flow can be controlled.

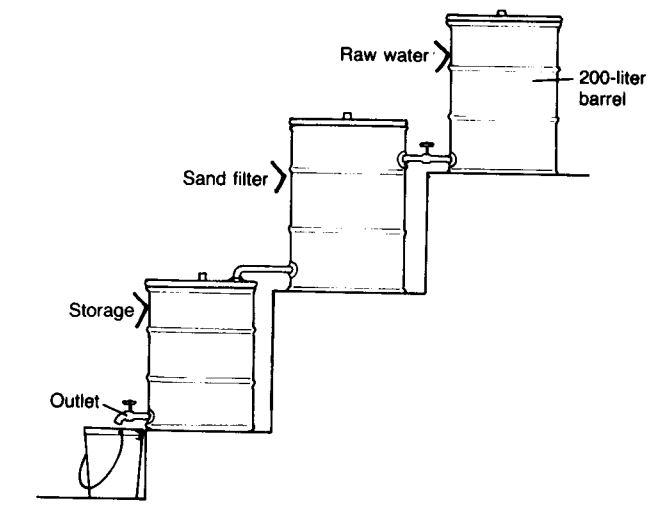

Figure 4. Gravity Flow Filter and Storage System

Caution!

If water is bacteriologically contaminated, further treatment may be necessary. The household sand filter removes bacteria if care is taken to keep the filter bed under water and if sand is fairly uniform in size. However, the sand filter may not remove all bacteria and the quality of the water should be determined before it is used. In some cases, water must be chlorinated after filtration to be of acceptable quality.

Summary

Household sand filters are a good way to remove turbidity and some bacteria from water. They can be constructed at a low cost and with locally available materials and labor. In fact, a household sand filter can be made wherever there is good sand available. Sand filters work very well if they are properly maintained.

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.

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