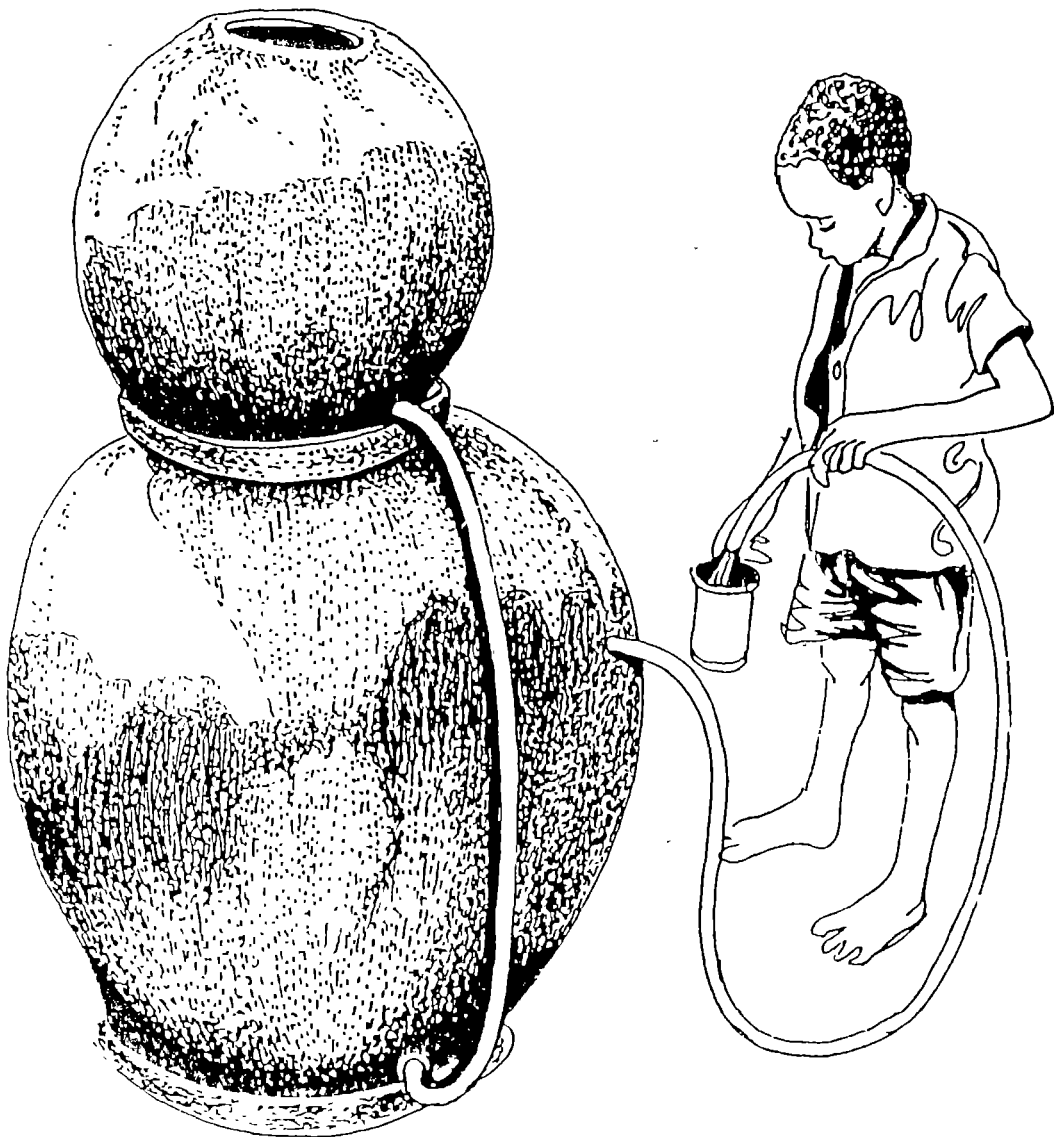


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The Upward Flow Water Filter



The Upward Flow Water Filter is an easily built family size water filter suitable for removing suspended particles of soil or organic matter which discolour or pollute drinking water. The filter is particularly useful in rural areas where surface water of doubtful quality is often used. The use of clean water can contribute significantly to improving family health.

The filter is inexpensive to construct, simple to use and will provide the clean water requirement for a family or a group of about 10 people. Depending on the quality of the water source, it will operate up to one year before cleaning is required.


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ISBN: 6062
CO: 255.3 87UP

HOW DOES IT WORK?

As untreated water is poured into the storage tank on top of the filter, it flows down the plastic tubing and into the base of the filter. The water in the storage tank pushes the water upward through the filter media and out the delivery tube at the top.

The filter traps the suspended particles in three filter beds consisting of fine sand and crushed charcoal. A fourth bed consisting of gravel is placed on the bottom of the filter to allow entering water to spread evenly across the base. The filter will deliver the same volume of water as is poured into the storage tank. The maximum recommended daily capacity is, however, approximately 40 litres per day.

HOW DO YOU MAKE AN UPWARD FLOW WATER FILTER?

A. MAKING THE TANKS

The method of constructing the cement tanks is explained in the UNICEF leaflet "cement jars" which is available from UNICEF Technology Support Section, Nairobi. The recommended volume of the filter tank is between 175 to 200 litres while the untreated water storage tank holds about 40 litres.

Modifications to the cement jar design are required to make it suitable for use as filter tank.

Filter tank

1. *Base reinforcement* – The base of the jar requires strengthening because of the additional weight of the filter media. This is done by building a 5 cm deep foundation which extends 10 cm out from the side of the 60 cm diameter base of the jar. The foundation should be carefully made with well-mixed concrete. The jar is built on top of the foundation in the usual manner.

2. *Inlet/Outlet Fittings* – While the cement mortar of the jar is still wet, two short pieces of 1.25 cm (½ inch) diameter galvanized iron water pipe are inserted to form the inlet and outlet. The pipe pieces are wrapped loosely with wire to strengthen the joint formed with the mortar of the jar's wall. The outlet pipe is slightly curved downward to maintain a constant water seal on the outlet which will prevent the entry of insects and dirt from outside.

3. *Filter opening* – The size of the opening at the top of the filter should be suitable to allow the base of the untreated water storage tank to sit in it tightly.

Untreated Water Storage Tank

The tank requires no modification except for fitting one short curved piece of pipe at the bottom as an outlet for untreated water. The tank should have a tight fitting lid to prevent insects and dirt entering the tank and should fit tightly in the opening of the filter. In general the untreated water tank can be built by taking 1/12th of all dimensions used for the 500 litre cement jar.



B. SELECTING THE FILTER MEDIA

Gravel/Stones

A few stones 5 cm diameter (to prevent the inlet pipe from being blocked) and sufficient gravel to form a 5 cm deep layer are required. These should be washed in water to remove loose surface dirt and allowed to dry in the sun on a clean surface.

Sand

The lower sand bed is made from clean unsifted river sand. The sand should contain a range of particle sizes (0.3 to 1.3 mm) and little or not plant material. Sufficient sand is required for a 20–25 cm deep layer across the jar. The sand should be washed and spread on a clean surface to dry in the sun.

The upper sand bed consists of sifted clean river sand. The screen used to sift the sand has to be as fine as mosquito mesh. The sifted sand is also washed to remove soil and plant matter and spread on a clean surface to dry in the sun.

Charcoal

Charcoal is pulverised to very small chips or grains of about 5 mm diameter. This can be done using a double walled hessian sack half-filled with charcoal which is hit with a stick. Sufficient charcoal is required to form a 25–30 cm deep layer when tightly compacted. The charcoal must be washed and the charcoal dust removed by immersing the grains in a bowl of water and tipping off all-floating matter.

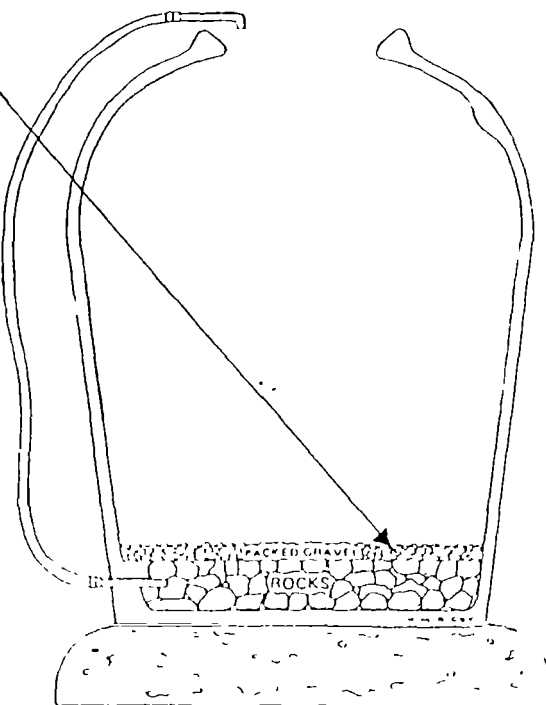
C. MAKING THE FILTER BEDS

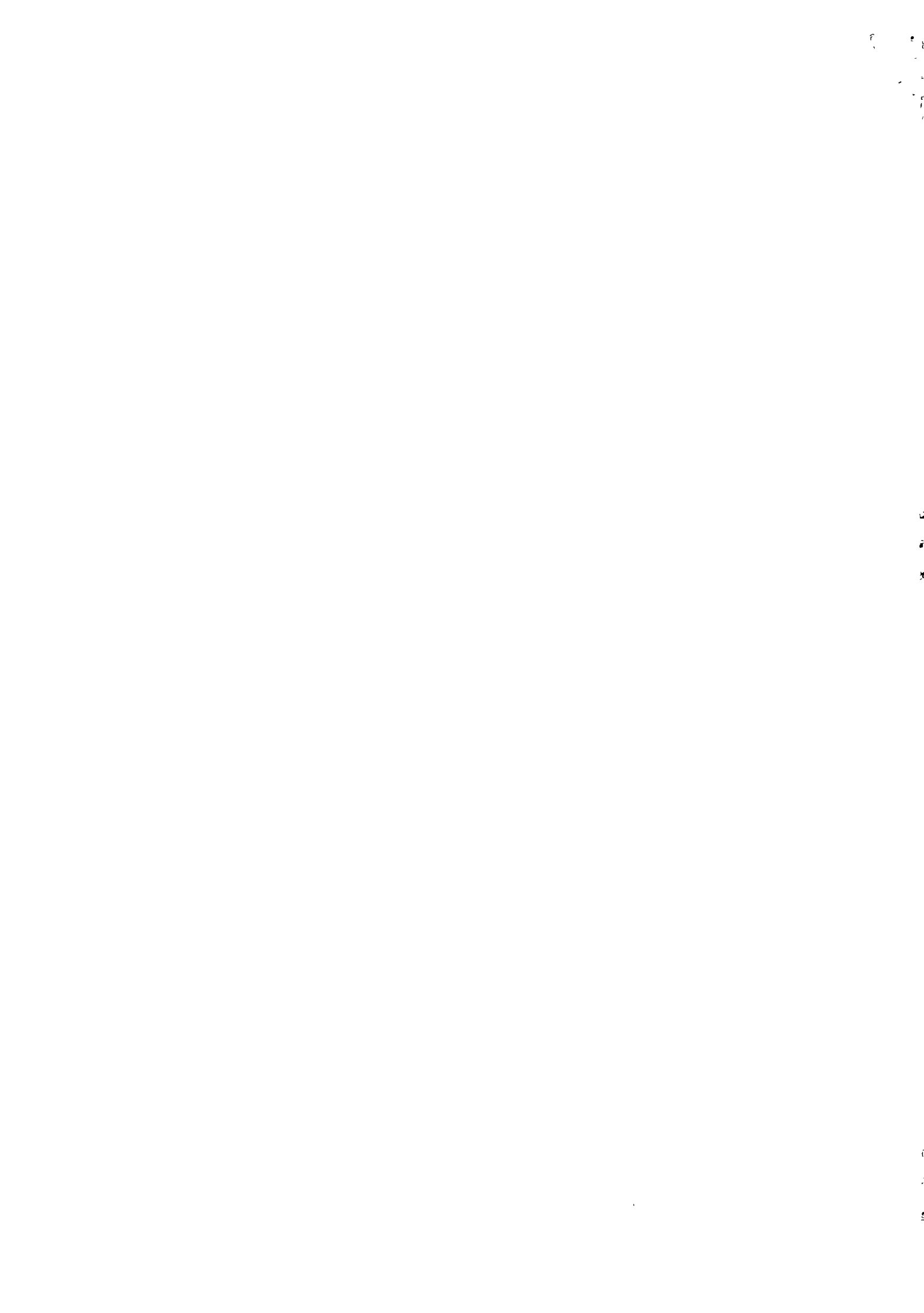
Step 1. Gravel Bed

When the dirty water storage tank and the filter have been made and allowed to cure, the filter beds can be made. For the lower bed, stones are placed around the filter's inlet to prevent blockage and gravel is packed across the base to form a 5 cm deep layer.

Important Note

To check that this, and subsequent filter beds, have been properly packed a small quantity of water is fed into the filter tank to observe if it rises evenly across the bed. This operation is done by placing the untreated water storage tank on the ground (or on a low table) and connecting it by hose with the inlet of the filter. Water is allowed to flow from the storage tank to the filter tank until it reaches the top of the filter bed being checked. It is important that this procedure is repeated after





each bed has been inserted and compacted. If this is not done, the air trapped around the filter media will bubble out when water is added and the filter beds will be disturbed.

Step 2. The Sand Bed

Above the gravel layer sand is laid and compacted to form a bed 20-25 cm deep. The bed is tested as in step 1. The sand bed is then covered with a thin cloth or fine gauze sheet to separate the sand from the next bed.

Step 3. The Charcoal Bed

The compacted charcoal bed is laid to a 25-30 cm depth and is also covered with a thin cloth or gauze sheet. The cloth is weighted down with a small amount of fine sand to prevent the charcoal from shifting during the flow testing.

Step 4. The Fine Sifted Sand Bed

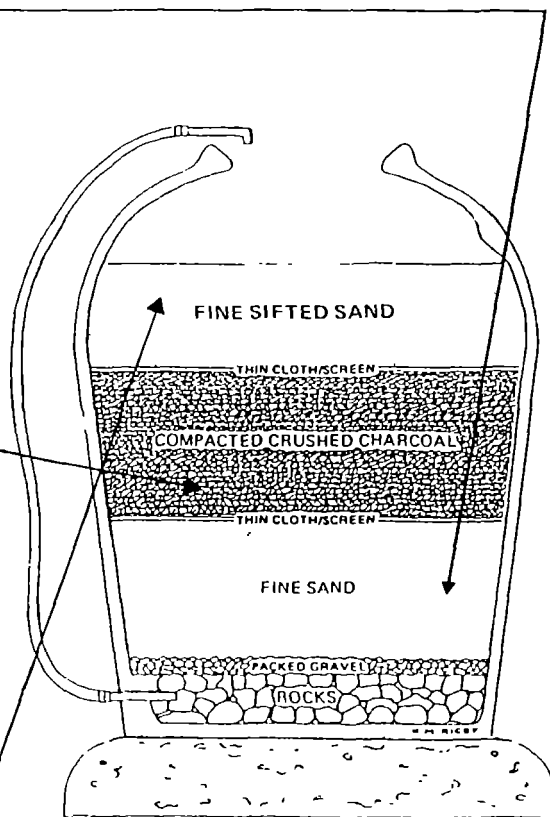
The topmost bed consists of a 20-25 cm deep layer of fine sifted sand which is tested like the other beds.

If the filter beds have been correctly inserted in the tank, they should already be completely immersed in water. In use, the filter beds should remain immersed as this ensures the survival of a layer of bacteria which develops on the charcoal chips. These bacteria are helpful in removing certain types of disease carrying micro-organisms from the water.

D. OPERATION OF THE FILTER

Establishing the filter

Water has to be passed several times through the filter to establish the filtering action of the filter beds. To do this, the same water is allowed to flow through the tank some 10 to 20 times until the outlet water begins to clear. The untreated water inlet hose is then disconnected from the filter tank for a short time to allow the worst sediments to flow back out at the bottom. When this backwash water stops looking dirty the pipe is reconnected. The top 5 to 10 cm of the upper sand bed must be removed and replaced with clean sifted sand. Water is then passed through the filter several more times to re-establish the filtration action and the filter is ready for use.





Maintenance of the filter

To maintain the proper action of the filter, the pipe between the untreated water tank and the filter should not be removed. Frequent back-washing of the filter will damage the filter beds. It is best to seal the untreated water storage tank to the top of the filter tank with a mud/cement collar. The top surface of the layer of fine sand must be checked regularly to see if the filter beds needs cleaning. When sediment shows, the top 5-10 cm must be removed and replaced with clean sifted sand. When changing the top layer of sand no longer has the effect of re-establishing good filtration, all the filter beds must be removed and replaced.

