

UNICEF's upward-flow water filter

by Laurie Childers and Frans Claasen*

This inexpensive water filter provides clean water for about 10 people.

THE UPWARD-FLOW water filter is a family-size filter suitable for removing suspended particles of soil or organic matter which discolour or pollute drinking water. It is particularly useful in rural areas where surface water of doubtful quality is often used.

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

How does it work?

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

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

Making the tanks

The method of constructing the cement tanks is explained in the UNICEF leaflet on cement jars (available free from the UNICEF Technology Support Section, address below). 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 a filter tank.

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which will guard against the entry of unwanted insects and dirt from outside.

- The opening at the top of the filter should be of a size suitable to allow the base of the untreated water storage tank to fit tightly and securely within.

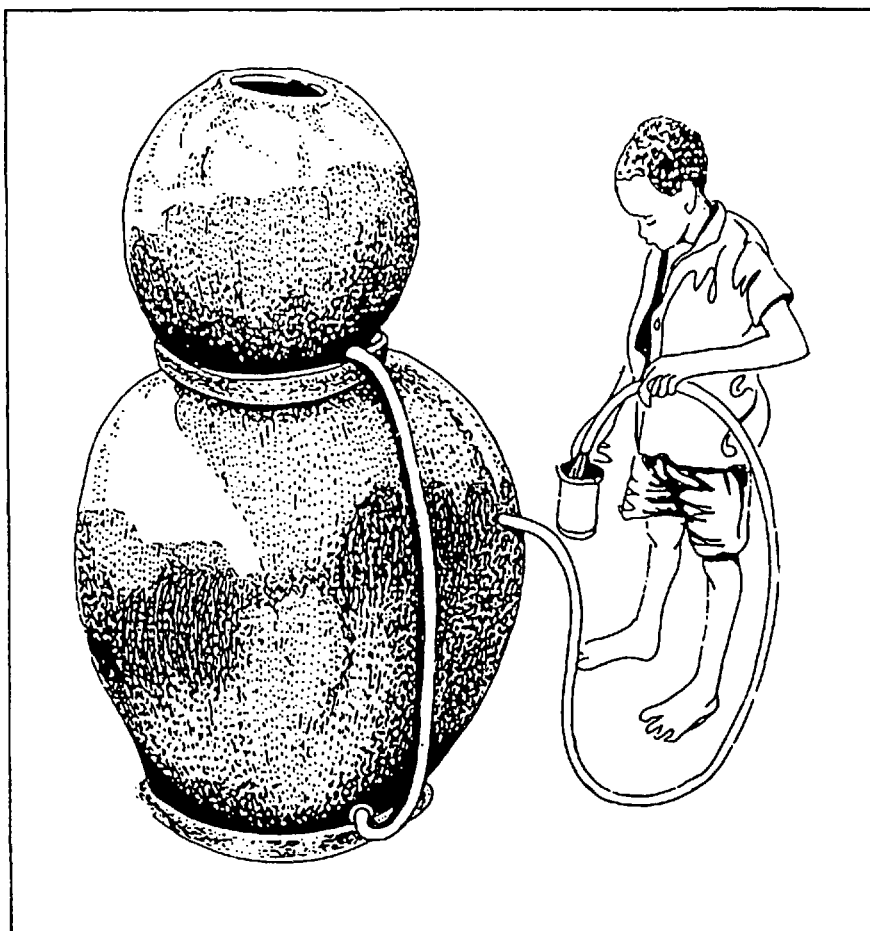
- The base of the jar requires strengthening because of the additional weight of the filter media. This is done by building a concrete foundation 5cm deep which extends 10cm from the side of the jar's 60cm base. The jar can then be built on top of the foundation in the usual way.

- While the cement mortar of the jar is still wet, two short pieces of 1.25cm diameter galvanized iron water pipe are inserted to form the inlet and outlet. The pipes are wrapped loosely with wire to strengthen the joint formed with the mortar of the wall. The outlet pipe is curved downward slightly to maintain a constant water-seal on the outlet,

Selecting the filter media

A few stones, 5cm in diameter, are required to prevent the inlet pipe from becoming blocked. Sufficient gravel to form a layer 5cm-deep is needed. The stones and gravel should be washed in water to remove loose surface dirt and allowed to dry in the sun on a clean surface.

The lower sand-bed is made from clean, unsifted river sand. The sand should contain a range of particle sizes (0.3 to 1.3mm), and little or no plant material. Sufficient sand is required for a layer 20 to 25cm deep across the jar. The sand should be washed and spread on to a clean surface to dry in



This inexpensive filter can supply clean water to 10 people.

the sun. The upper sand-bed consists of clean, sifted river-sand. The screen used to sift the sand should be as fine as mosquito mesh. The sifted sand is also washed and dried in the sun.

Charcoal is pulverized into very small chips or grains about 5mm in 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 to 30cm layer, when tightly compacted. The charcoal must be washed and the dust removed by immersing the grains in a bowl of water, and then tipping off all floating matter.

Making the filter beds

When the dirty-water storage tank and the filter have been made and allowed to cure, the next step is to make the filter bed. For the lower bed, stones are placed around the inlet to prevent

blockage, and gravel is packed across the base to form a 5cm layer.

It is important to check that this and subsequent filter beds have been properly packed. This is achieved 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. A small quantity of 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 should rise evenly across the bed. This procedure should be 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.

Above the gravel layer, sand is laid and compacted to form a bed 20 to 25cm deep. Following testing, the sand-bed is covered with a thin cloth

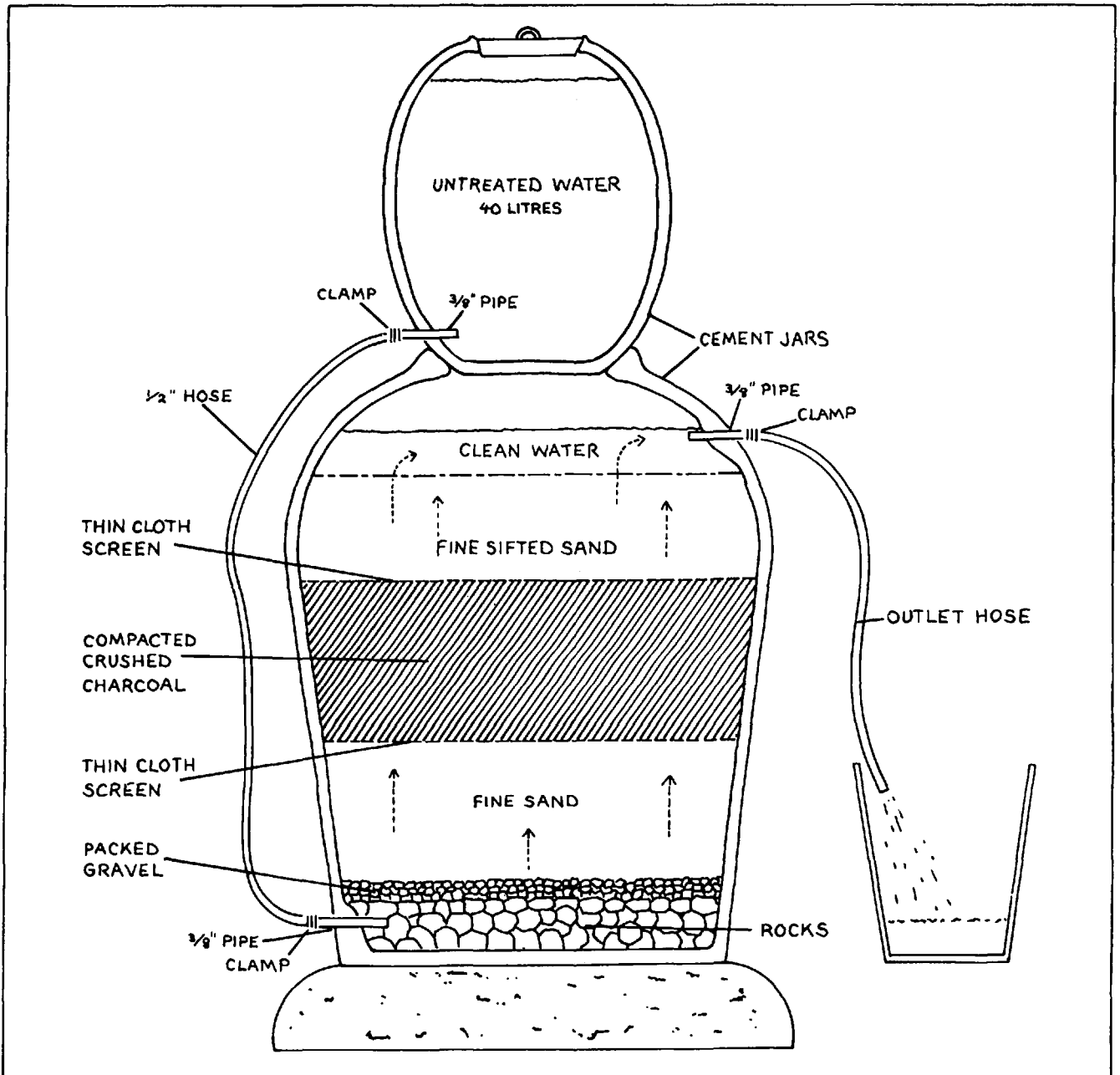
or sheet of fine gauze to separate it from the next layer.

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

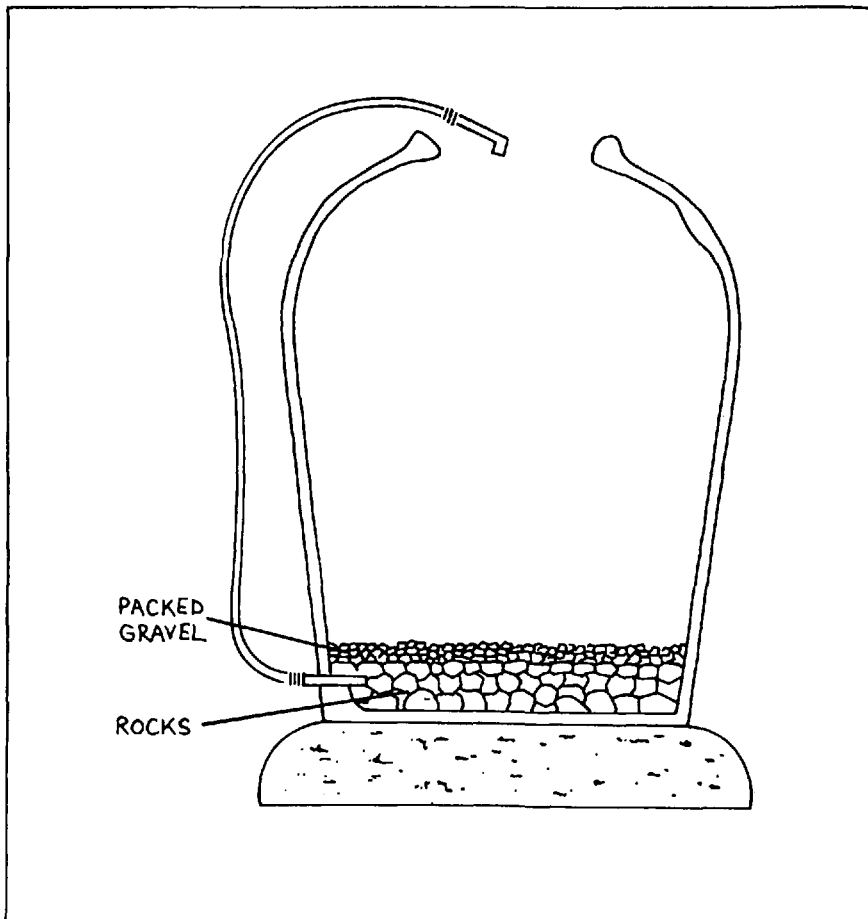
The uppermost bed, above the charcoal layer, consists of a 20 to 25cm layer of finely sifted sand, which should then be tested as before.

Operation of the filter

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 help to remove certain types



All of the media needed for the filter are readily available and most are free.

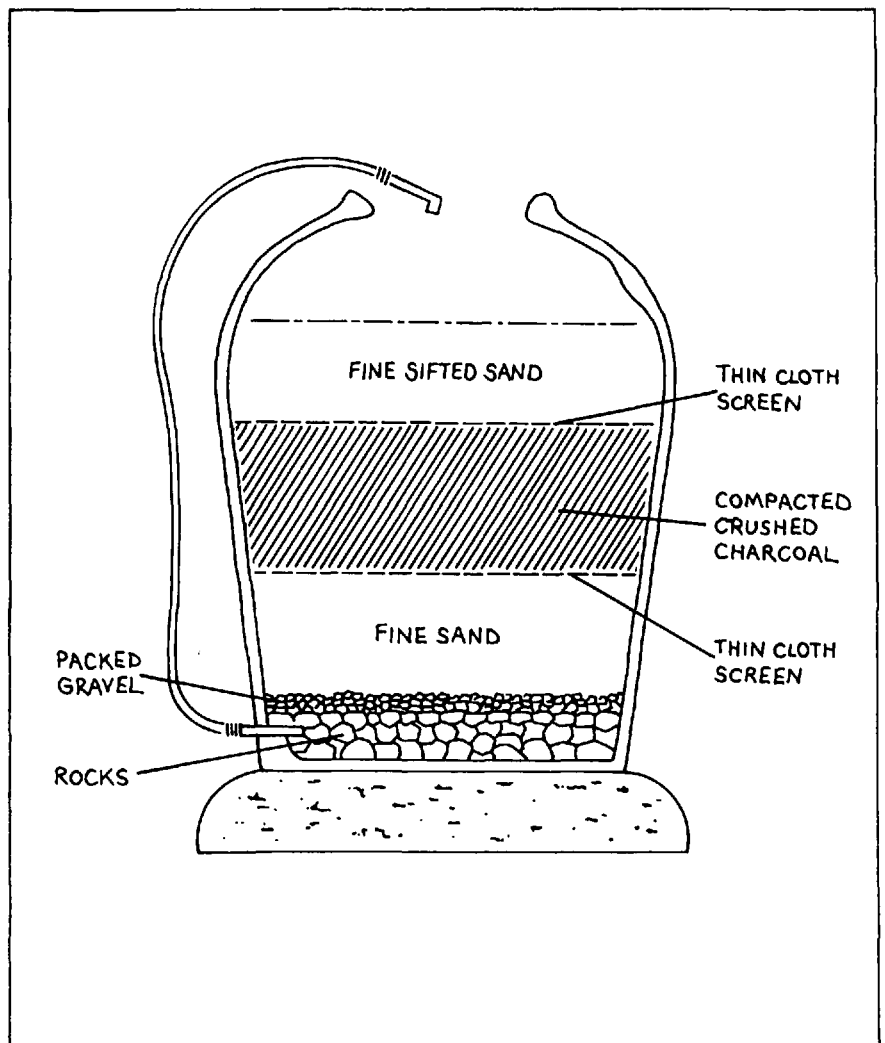


Two beds are made with stones and gravel.

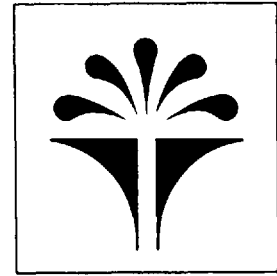
of disease-carrying micro-organisms from the water.

To establish the filtering action of the filter beds, 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 of the sediment to flow back out at the bottom. When this water no longer looks dirty, the pipe is reconnected. The top 5 to 10cm of the upper sand-bed must be removed and replaced with clean sifted sand. Water is passed through the filter several more times to re-establish the filtration action and the filter is then ready for use.

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 or cement collar. The top surface of the layer of fine sand must be checked regularly to see whether the filter beds need cleaning. When sediment shows, the top 5 to 10cm must be removed and replaced with clear 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.



Above the gravel and stones, sand and charcoal is packed.



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