Household water treatment and storage

Almost all water sources are open to contamination and many unprotected sources are very highly contaminated. Some water sources, especially surface water sources such as rivers or streams, may also have mud or silt in them making the water cloudy. To have clear water with no pathogens in it, a household must treat or purify the water. This does not require expensive chemicals or equipment ; household treatment systems can often be made with local materials to keep costs low.

Where local water supplies are known to be contaminated or have not yet been tested, household treatment should be recommended. Contaminated water can be purified in the home by using the following methods ;

- boiling,
- filtration,
- chlorination/disinfection.

Boiling

Boiling drinking water is a simple way of killing pathogens. Boiling, however, has some disadvantages :

- It uses a lot of fuel. About 1 kilogram of wood is needed to boil 1 litre of water. The cost of fuel may prevent people boiling water in many areas.
- It can give an unpleasant taste to the water.
- Water can be contaminated again when it has cooled.
- Hot water can cause serious accidents in the home.

Water must be brought to a rolling boil for at least one minute. Where turbid water is used, it should be boiled for at least five minutes. Small bubbles in the water or steam above the water does not mean that the water is boiling. Water should be boiled, cooled and stored in the same container to avoid re-contamination. Ideally water should not be cooled by pouring from one container to another as this may allow pathogens to get into the water. Because this is a good way of improving the taste of boiled water which sometimes tastes " flat ", it is, however, commonly used. If it is practised, then care should be taken to ensure that both the containers are clean and disinfected.

Simple household filters (for turbid water)

There are several types of household filter :

Candle filter - this type of filter allows contaminated water to filter slowly through a porous ceramic material (see Figure 1). Most pathogens are left in the outer layer of the filter material and must be washed away once every month by gently scrubbing the filter under clean, running water. Viruses such as hepatitis A are not removed by candle filters. Candle filters have to be made commercially and their quality carefully controlled. They are often expensive. Some types of candle filter have silver in them which helps to kill pathogens.

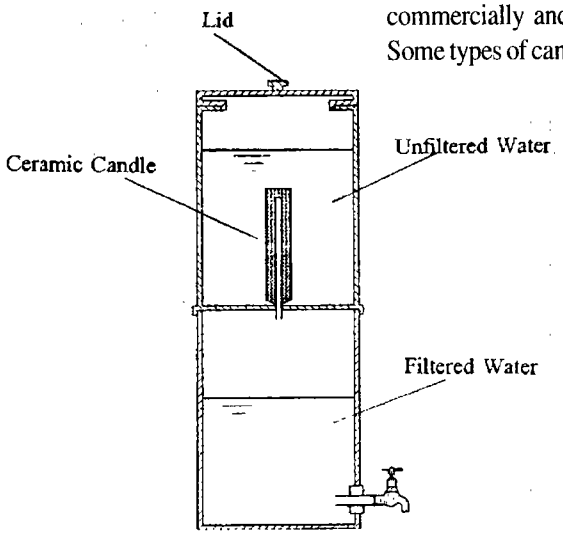

Figure 1. Candle filter

Stone filter - similar to the candle type filter, but carved from porous local stone (see Figure 2). This type of filter is difficult to clean and heavy to lift, but is usually quite cheap if the type of stone used can be found locally. The efficiency of these filters varies widely, however, and they often only remove turbidity but not germs.

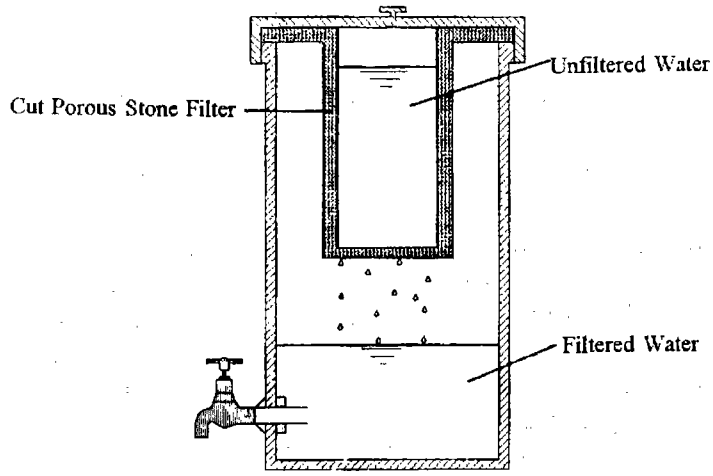

Figure 2. Stone filter

Household sand filter - this type of filter will remove solids and silt, and some pathogens, including guinea worm larvae, from water. It does not, however, remove all pathogens. Figure 3 shows household filters made from local materials.

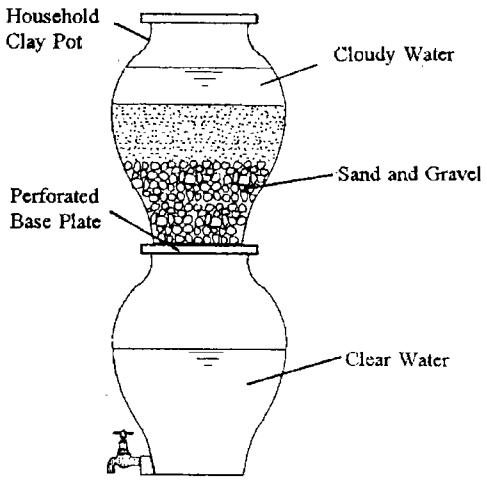

Figure 3. Examples of household filters

To make a household sand filter :

- *Find two containers made of fired clay or plastic and adapt them so that one fits on top of the other.*
- *Make some small holes in the base of the upper container either during the process of manufacturing the pot or by hand, drilling into the base of the pot to allow the water to pass through to the lower container.*
- *Make a hole near the bottom of the lower container to fit a tap and fix the tap with a short length of galvanized iron or plastic pipe and cement if necessary as shown in Figure 4. A tap will help prevent contamination of the stored water as it will reduce contact of hands and dirty objects with the treated water.*

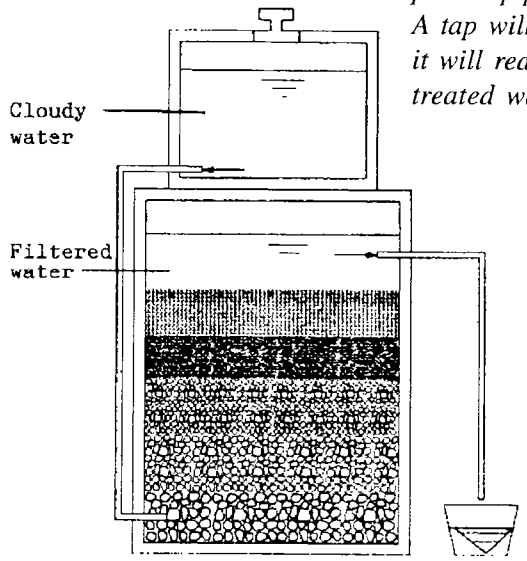

Figure 4. Fixing a tap to a clay jar

- *Allow five days for the cement to become fully hardened before using the filter.*

- *Collect and wash enough small stones to cover the bottom of the upper container to a depth of about 5 to 7 centimetres. The stones should be big enough not to fall through the holes in the base of container.*

- *Collect some clean sand, preferably from a river bed, and wash it well. Add the sand to the upper container on top of the stones to a depth of 75 centimetres. Leave a 5 to 10 centimetre space at the top of the sand to allow water to stand on top.*

- *When the filter is finished, add water slowly to the top of the sand and allow it to filter through into the lower container.*

- *Try to add water several times a day to the filter so that there is always plenty of water in the lower container.*

- *When the lower container has filled above the level of the tap, water can be drawn from the filter (see Figure 5).*

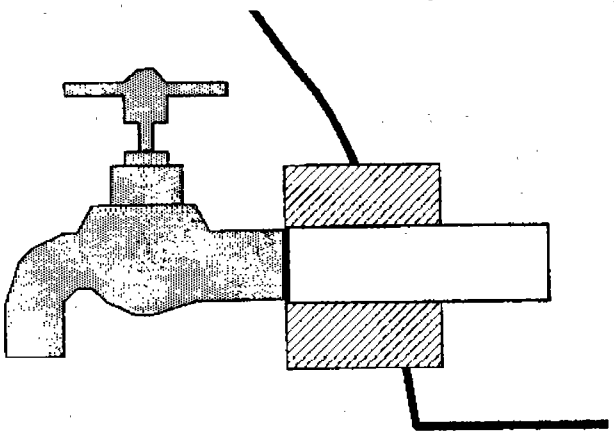

Figure 5. Drawing water from the filter

- *When the filter is to be used for the first time, it is a good idea to throw away the first two gallons of water that have filtered through the sand to make sure that the sand has settled properly.*

- *If very cloudy river water is to be filtered, this will block the sand filter. The water must be left to stand in a closed container for 3 to 4 hours to settle out the earth or mud in the water (see Figure 6).*

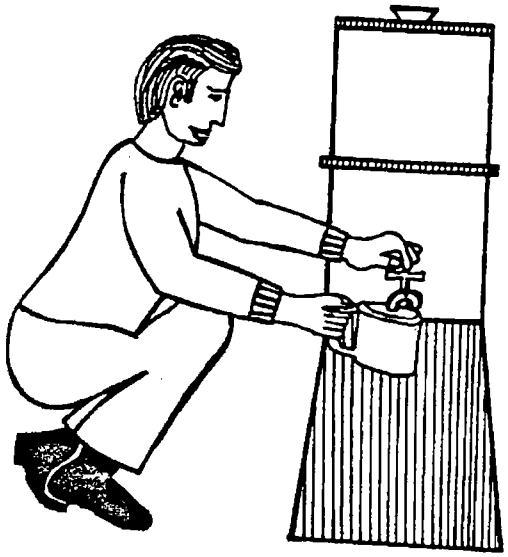

Figure 6. Settling cloudy water

- Eventually, the filter will block and the flow of water will become slower. When the filter no longer produces enough water, remove most of the sand from the filter, wash the sand thoroughly in clean water and then replace it in the filter.

It is very important to clean a household filter regularly. If it is allowed to get very dirty, the filter can make the water more contaminated than it was before.

Some more complex filters, such as slow sand filters, are very efficient at removing germs. Slow sand filters are generally difficult to operate in small households because a constant flow of water must be maintained. They are, however, useful for small community water supplies and a description of them is given in Fact Sheet 2.12.

Coagulation

When the water from a river or stream is very turbid and carries a lot of suspended mud or silt, it can block a household filter. This tends to be more of a problem in the wet season. To make the water less turbid, local plants are often used to make the small particles of silt stick together and then fall to the bottom of the water container. This is a form of coagulation. The clear water can then be poured into the household filter without blocking it.

Many different plants are used for coagulation of turbid water in different parts of the world and it is difficult to provide general recommendations. It is important to investigate and build on local experience and practice.

Disinfection

Household water which is contaminated but fairly clear can be disinfected to make it safe to drink. There are various ways of disinfecting household drinking water, such as using iodine, but the most common method is by chlorination. Normally, a one per cent solution of chlorine should be made up using either sodium hypochlorite (liquid bleach), calcium hypochlorite (powdered chlorine) or HTH (high test hypochlorite - a high strength powdered chlorine).

CAUTION Chlorine is a hazardous substance. In solution it is highly corrosive and splashes can cause burns and damage the eyes.

All containers in which chlorine is stored should have a label showing what type of chlorine is in the container and a warning that chlorine is dangerous. Places where chlorine of any type is kept should be locked. Chlorine solutions should be kept in a cool, dark, dry place in closed corrosion-resistant containers such as plastic, ceramic, dark glass or cement.

Household drinking water should not be disinfected with chlorine before filtering, as the disinfectant will be neutralized by the filter.

Disinfection does not work well in turbid or cloudy water, as the chlorine is absorbed by the suspended particles in the water. Chlorine disinfectant is available in several forms as follows :

Sodium hypochlorite or liquid bleach - liquid bleach is normally bought in bottles or sachets. Check that the contents are sodium hypochlorite and water only. The normal concentration of chlorine in household bleach is one per cent, but this may be lower if the bottle or sachet has been opened or stored for a long time.

Calcium hypochlorite and HTH - calcium hypochlorite and HTH are sold as white granules and can often be bought from a local ministry of health office or from commercial warehouses and pharmacies. Calcium hypochlorite is much stronger than liquid bleach and does not lose strength so quickly. Calcium hypochlorite comes in various forms which can have from 20 to 70 per cent chlorine. The best type to use is high test hypochlorite (HTH or HTHC), as this normally contains 50 to 70 per cent chlorine. Always check with the supplier or on the side of the container to be sure of the percentage chlorine content.

Disinfecting household drinking water

When disinfecting household drinking water the one per cent chlorine is added to the water and left for 20 minutes to allow sufficient contact time for the chlorine to work. It is important to use the correct amount of chlorine, as too little will not kill all the germs present and too much may make the water unpalatable and cause consumers to reject the water. As a general rule, three drops of chlorine solution should be added to every litre of water. This can be done using a simple dropper tube or a syringe.

If sodium hypochlorite is used, it can be added directly from the bottle, as it comes with a chlorine concentration of one per cent. If calcium hypochlorite or HTH is used, they will need to be diluted to one per cent before being added to the water. The quantity of powder used will depend on the concentration of chlorine present. Check on the container or with the manufacturer's instructions.

A one per cent chlorine solution can be prepared from chlorine powder in various ways. These are covered in more detail in Fact Sheet 2.19. Strict attention should be paid to the manufacturer's instructions when preparing chlorine solution. Local materials can be adapted to measure chlorine powder or quantities of water to make up chlorine solution. Figure 7 shows an example of this.

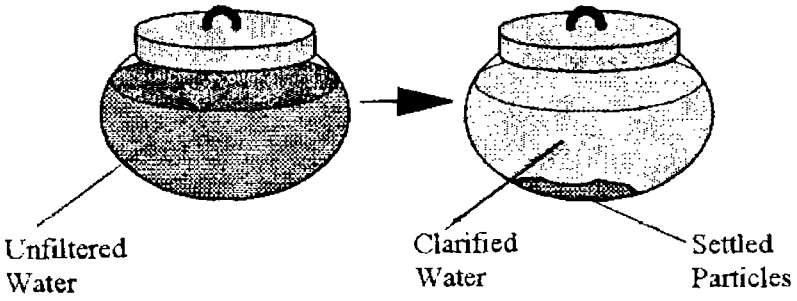

Figure 7. Local method for preparing chlorine solution

When disinfecting water on a household basis, it is important to make sure that easily available local materials can be used to prepare the chlorine solution so that all households can chlorinate their water.

Chlorine demand and residual

When chlorine is added to drinking water, some chlorine is used up immediately by the water. This is the chlorine demand of the water. The chlorine demand of a particular water source does not normally change much over many years.

When chlorine is added to water, there must be enough chlorine to satisfy the demand and also to leave a small amount of chlorine residual to kill the germs left in the water and help prevent re-contamination.

If the water has a high chlorine demand, 3 drops of chlorine solution in every litre of water may not be enough to leave a residual, and more chlorine will need to be added. A simple test to check that there is enough chlorine in the water, is :

- *Taste the water. You should be able to taste the chlorine slightly.*
- *If there is no chlorine taste, add one more drop of chlorine solution for every litre of water in the storage container and leave for 20 minutes.*

- *Taste the water again. If there is a slight chlorine taste, there is enough chlorine in the water.*

- *If there is still no chlorine taste, add one more drop of chlorine solution for every litre of water, wait 20 minutes and taste again. Repeat this operation as often as necessary.*

Some people do not like the taste of chlorine and will refuse to drink water with chlorine in it. This can mean that these people will then drink from unsafe water supplies. Adding lemon or other fruit juices to the water will help to hide the taste of the chlorine and make the water more acceptable.

Storage

Good storage for the water is probably the most important way of keeping household water clean. It is a waste of time purifying water or collecting water from a clean source and then storing it where it can easily become contaminated. Storage containers therefore need to be well designed and should protect the water from contamination. The two most important factors influencing contamination of water storage containers are whether there is a lid or cover and the means of drawing the water from the container.

Storage containers without a lid or a cover will allow water to become contaminated rapidly because :

- Children or adults with dirty hands can put their fingers in the water and pass germs into it.

- Animals, such as cats or chickens, can drink directly from open containers and so pass on germs.

Storage containers should always have a lid, as shown in Figure 8

Figure 8. Water storage container

When water is taken out of the container there are many ways that pathogens can get into the water, for instance :

- When a dirty cup is dipped into the water container it will pass germs into the water.
- Water should be drawn from the container by a ladle or scoop, as shown in Figure 9. To prevent contamination, this ladle should not be used for any other purpose and should be kept in the water storage container with a small hole cut out in the lid to allow the handle of the ladle to stick out.

- If a ladle is left lying outside the water container flies can land on it and animals or humans with dirty hands can touch it. This will pass on germs to the ladle and so to the water the next time it is used.

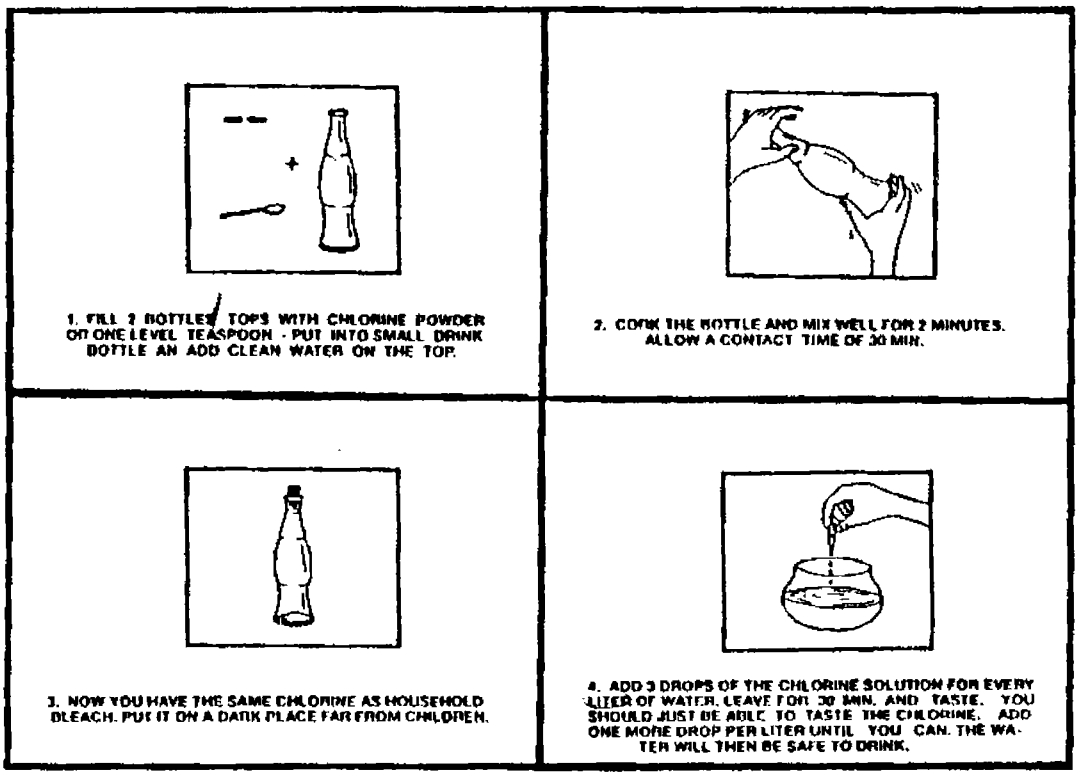

Figure 9. Using a ladle to draw water

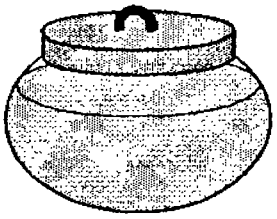

Figure 10. Water container with a narrow neck

Another good way of preventing water in the storage container from getting contaminated is to pour the water from the container into a cup or to make water containers with narrow necks (see Figure 10).

This way, fingers or cups never come into contact with the clean water and cannot contaminate it. In some areas, local ceramic water storage containers are made with taps so that water can be drawn from the tap.

In some countries, water is stored on the floor to keep it cool. This makes water more accessible to children and animals, and increases the risk of contamination. Water should be stored above the reach of children or animals. Earthenware jars or pots are good water storage containers, as they allow some water to evaporate thereby keeping the water cool. This does not present any problem of contamination, provided the water is covered and a sanitary means of water withdrawal is used.