Emergency treatment of drinking-water at the point of use

Normally, drinking water supplies need to be treated during and after an emergency to make them safe and acceptable to the user. Treatment at the point of use is generally quicker and less expensive to implement than a centralized system, but it can be more difficult to manage. Only water used for drinking and preparing food needs to be treated. Nevertheless, this still amounts to about five litres per person per day. This technical note describes some of the most common and simple treatment options suitable for use during an emergency.

Pre-treatment

There are a wide variety of technologies for treating water at the point of use. The methods described below will remove physical and microbiological pollution, but not chemical contamination.

Water is made safe to drink through a process of disinfection. To be effective, most disinfection processes require the water to be pre-treated first so that it is free from suspended particles.

Aeration

Aeration brings water into close contact with air which increases the oxygen content of the water.

This will:

- remove volatile substances such as hydrogen sulphide and methane which affect taste and odour;
- reduce the carbon dioxide content of the water; and
- oxidize dissolved minerals such as iron and manganese so that they can be removed by sedimentation and filtration.

Water can be aerated in a number of ways. One simple method for householders is to rapidly shake a container part-full of water for about five minutes (Figure 5.1), leave it standing the water for a further 30 minutes to allow any suspended particles to settle.

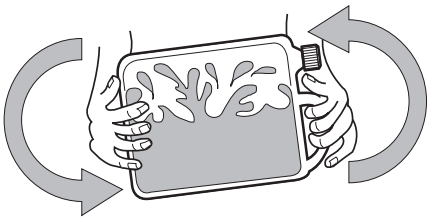
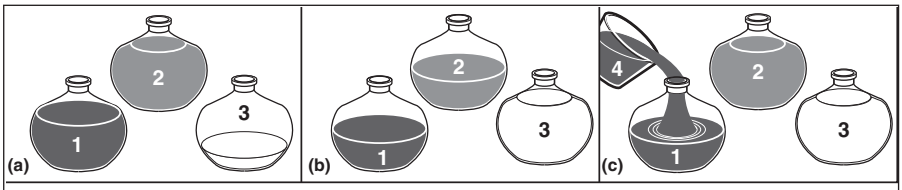


Figure 5.1.
Aeration by vigorously shaking water

Storage and settlement

When water is allowed to stand undisturbed and in the dark for a day, more than 50 per cent of most harmful bacteria die. Additionally, the suspended solids and some of the pathogens will settle to the bottom of the container, removing further risk. Storage for two days reduces contamination further still, and also reduces the number of organisms which act as intermediate hosts for diseases such as Guinea worm infection (dracunculiasis). Households can maximize the benefits of storage and settlement by using a simple three-pot system as illustrated in Figure 5.2.



Always draw water for drinking from Pot 3. This water has been stored for at least two days, and the quality has improved. Periodically this pot will be washed out and may be sterilized by scalding with boiling water. Each day when new water is brought to the house:

(a) Slowly pour water stored in Pot 2 into Pot 3, wash out Pot 2.
(b) Slowly pour water stored in Pot 1 into Pot 2, wash out Pot 1.
(c) Pour water collected from the source (Bucket 4) into Pot 1. Strain it through a cloth.

Using a flexible pipe to siphon water from one pot to another disturbs the sediment less than pouring.

Figure 5.2. The three-pot system for storing water

Filtration

A filter removes contamination by physically blocking particles while letting the water pass through.

Straining

Straining is a simple method of filtration. Pouring water through a clean piece of cotton cloth will remove some of the suspended silt and solids (Figure 5.3). It is important that a clean cloth is used as a dirty cloth may introduce additional contaminants into the water. Especially-made monofilament filter cloths may be used in areas where Guinea worm disease is prevalent. Cloths should be cleaned using soap and clean water.

Sand filters

Household filters may be assembled inside clay, metal or plastic containers. The vessels are filled with layers of sand and gravel and pipework arranged to force the water to flow upwards or downwards through the filter. Figure 5.4 shows a simple upward rapid flow filter.

Ceramic filters

Water passes slowly through a ceramic or 'candle' filter (Figure 5.5). In this process, suspended particles are mechanically filtered from the water. Some filters, for example, are impregnated with silver which acts as a disinfectant and kills bacteria, removing the need for boiling the water after filtration.

Figure 5.3. Straining water through a cloth

Ceramic filters can be manufactured locally, but are also mass-produced. They have a long storage life so can be stored in preparation for future emergencies.

Impurities retained by the surface of the candle need to be brushed off under running water at regular intervals.

Disinfection

Disinfection destroys all harmful organisms present in the water, making it safe to drink.

Boiling

Boiling is a very effective method of disinfecting water, but it is energy consuming. The water should be brought to a 'rolling' boil and held there for between 1 minute at sea level and 3 minutes at high altitudes. Apart from the high cost of the energy involved in boiling, the other disadvantage is the change in taste of the water. This can be improved by aeration, by vigorously shaking the water in a sealed container after it has cooled.

Chemical disinfection

Many chemicals can disinfect water but the most commonly-used is chlorine. When used correctly, chlorine will kill all viruses and bacteria, but some species of protozoa and helminths are resistant to chlorine. There are several different sources of chlorine for home use; in liquid, powder and tablet form. They vary in size and strength (i.e. in how much chlorine they contain) so different quantities are required depending on the formulation. Always follow the manufacturer's instructions for use. To prevent misuse, clear instructions must be given to all users (see Figure 5.6).

Chlorine compounds should not be given out to users outside of the container they are supplied in by the manufacturer. People cannot tell how much of the product to use or how to use it simply by looking at it!

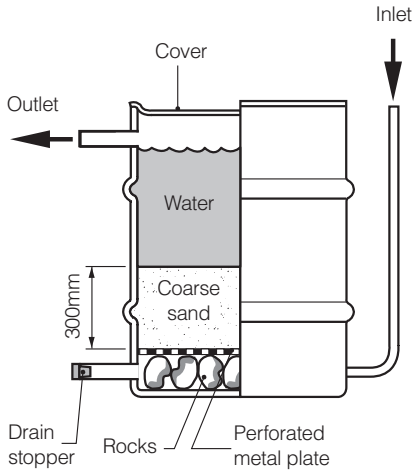
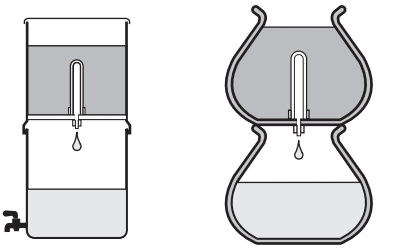
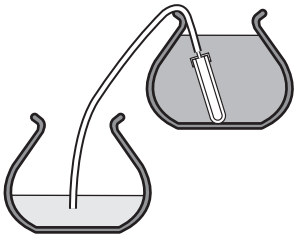


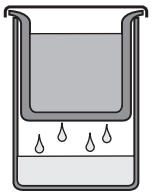
Figure 5.4. A simple upward, rapid flow filter



(a) Manufactured unit (b) Candle with jars



(c) Using candle with siphon



(d) Porous jar

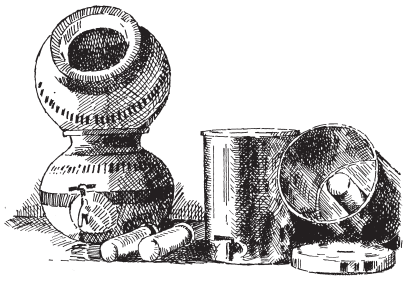


Figure 5.5. Ceramic or 'candle' filters

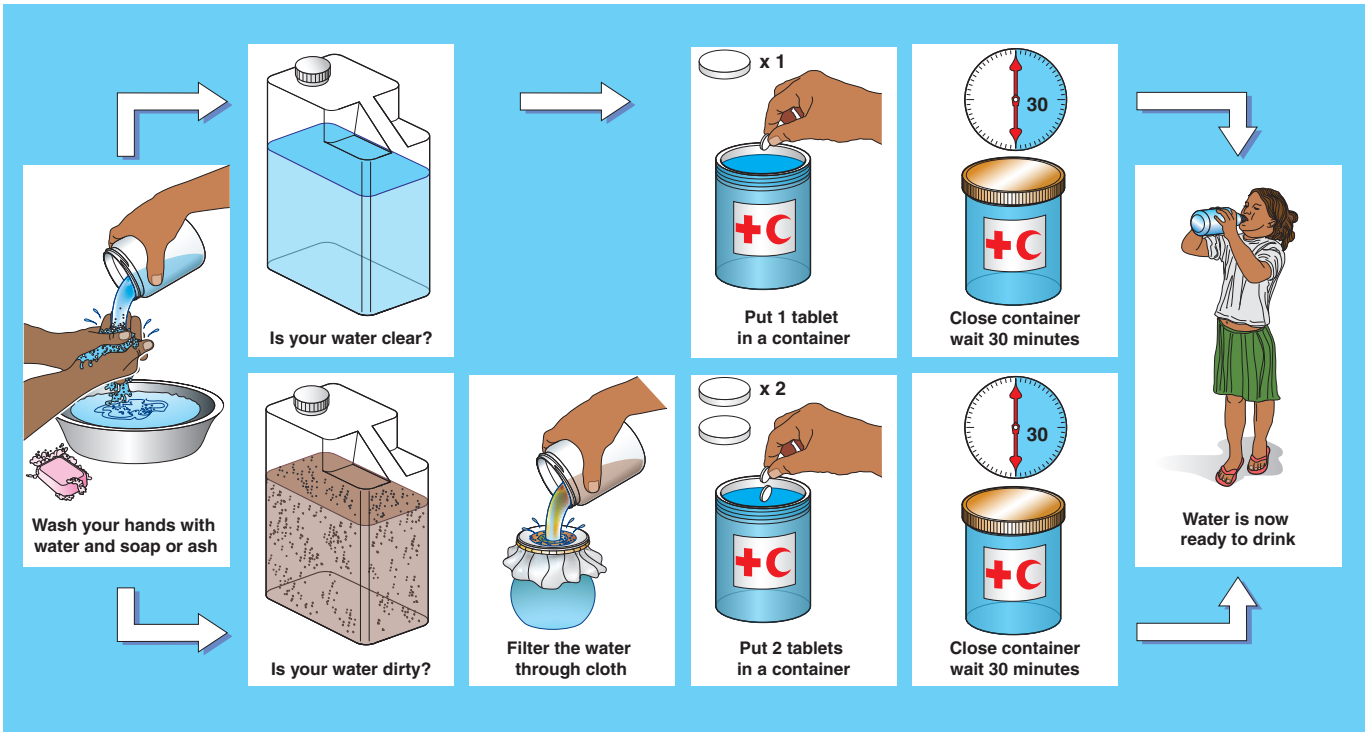


Figure 5.6. How to treat water with chlorine tablets (adapted from IFRC, Geneva)

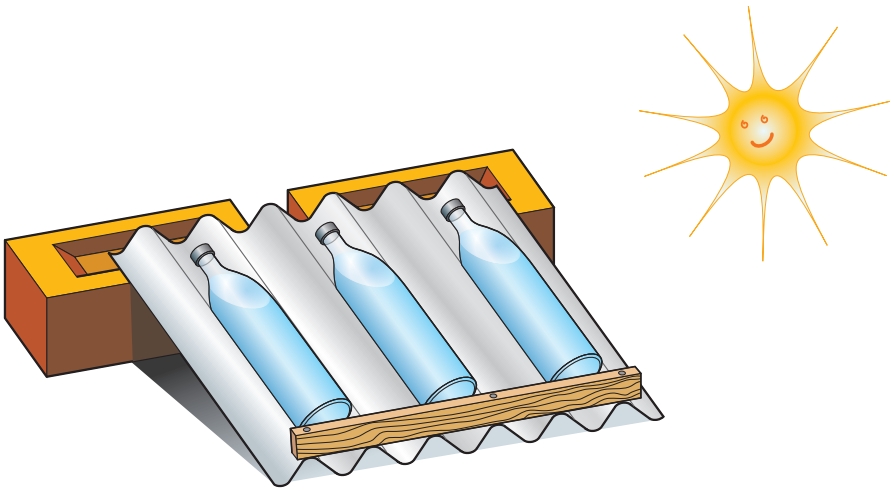


Figure 5.7. Solar disinfection (SODIS)

Solar disinfection (SODIS)

Ultra-violet rays from the sun will destroy harmful organisms present in the water.

Fill transparent one- or two-litre plastic containers with clear water and expose them to direct sunlight for about five hours (Figure 5.7), or for two consecutive days under 100% cloudy sky).

Cool the water and shake vigorously before use.

Combined treatment systems

A few large companies have developed compounds that both remove suspended particles and disinfect the water. One such compound contains a chemical that helps suspended particles join to make larger, heavier ones that will settle to the bottom of the container. It also contains chlorine that disinfects the water after settlement has occurred. The compounds have been proven to be effective but not all relief agencies approve their use because they are expensive and it can be difficult to ensure that they are used correctly.

Looking after clean water

There is no point in treating water if it becomes contaminated again afterwards. The storage and use of treated water is just as important as the treatment process.

Water storage

Water should be stored in clean, covered containers and kept in a cool dark place.

Figure 5.8. Tap fitted to a water bucket

Wide-necked containers such as a bucket fitted with a tight fitting lid are the best as they are easy to clean between uses.

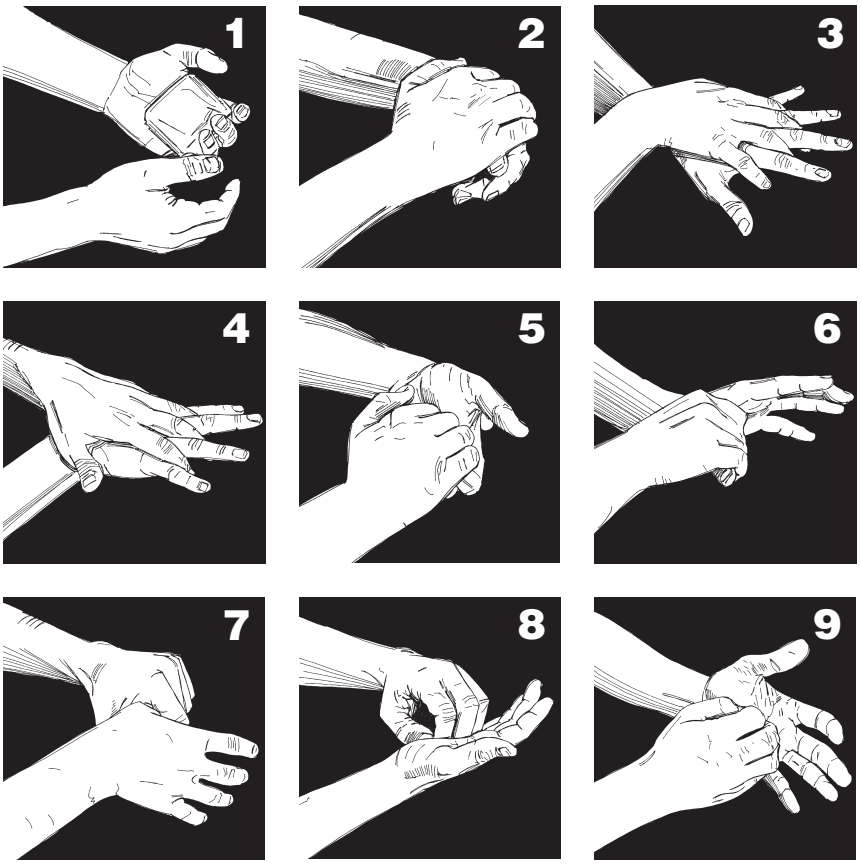
Contamination can also occur as the water is taken out of the storage container. Hands and utensils may come into contact with the water so it is important to encourage users to wash their hands with soap before handling drinking water; and to fit a tap to the storage container so that water can be poured directly into a cup or bowl (Figure 5.8).

Hygiene promotion

The benefit of providing safe drinking-water will be lost if users do not know *how* they will benefit. Changing unhygienic behaviour is just as important as the provision of clean water. Emergencies can provide a good opportunity to introduce new hygienic practices. As users settle into a new environment, they are more likely to accept changes to their normal behaviour. For water supply and sanitation, the most important practice to change relates to handwashing. Don't assume everyone knows how to wash their hands properly. Show them.

Box 5.1. Handwashing

Everyone should wash their hands with soap or ash after using the toilet; before handling food or clean water; and before eating.



Further information

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IFRC (2008) *Household water treatment and safe storage in emergencies* http://www.ifrc.org/Docs/pubs/disasters/resources/responding-disasters/142100-hwt-en.pdf

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SODIS (Undated) *How do I use SODIS?* http://www.sodis.ch/Text2002/T-Howdoesitwork.htm

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