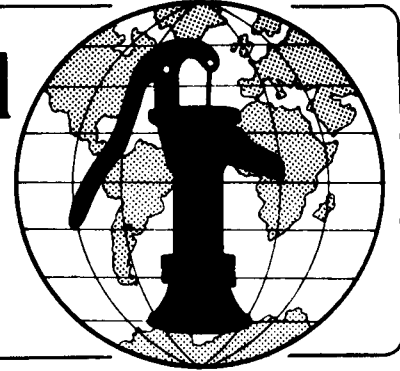


Water for the World



Water Treatment in Emergencies Technical Note No. RWS. 3.D.5

The treatment of water supplies in emergency situations is important to protect people's health. When natural disasters, drought, or social unrest cause a loss of supply of potable water or when, for any other reason, a water supply is disrupted or a supply change is necessary, measures should be taken quickly to provide for a safe water supply.

This technical note discusses the use of several methods for emergency water treatment. Many are similar to simple household purification methods which are described in "Designing Basic Household Water Treatment Systems," RWS.3.D.1. Community members should be instructed in the best methods to use to make water potable during emergencies. Read the entire technical note to evaluate the type of treatment most appropriate to local circumstances.

The design process for emergency water treatment should result in a list of materials needed to provide the appropriate disinfection of water during the time potable supplies are cut off. A sample list for a water boiler appears in Table 1. A list of sources of chlorine and their strengths is in Table 2.

Table 1. Sample Materials List for Boiler System

Item	Description	Quantity	Estimated Cost
Labor	Emergency workers Unskilled labor	___	___
Supplies	200-liter steel drum 20mm pipe nipple Valve Large funnel Cement blocks or bricks Filler plug Solder	___ ___ ___ ___ ___ ___ ___	___ ___ ___ ___ ___ ___ ___
Tools	Drill or punch	___	___

Total Estimated Cost = ___

Useful Definitions

CLARIFICATION - The process of removing suspended matter and other forms of turbidity from water.

CONTAMINANT - An impurity which makes water unfit for human consumption or domestic use.

DISINFECTION - Destruction of harmful microorganisms present in water through physical (such as boiling) or chemical (such as chlorination) means.

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

When dealing with a disruption in the water supply, the major effort should go toward getting the system back into operation as quickly as possible. Until operation can begin again, emergency treatment measures should be undertaken.

Usually a source of water that must be used in an emergency is contaminated. Therefore, the water should be disinfected before people drink it. Various methods are available for disinfection during emergencies. The choice of methods will depend on the resources available in each community or region.

Boiling

Boiling destroys all forms of disease organisms in water. It can be used whether water is clear or turbid and even if it contains a large amount of organic matter. For boiling to be effective, water must be brought to a rolling boil; that is, the water must be bubbling rapidly. Boiling water to disinfect it is a very good method of disinfection if fuel is available to heat the water. Individuals can boil

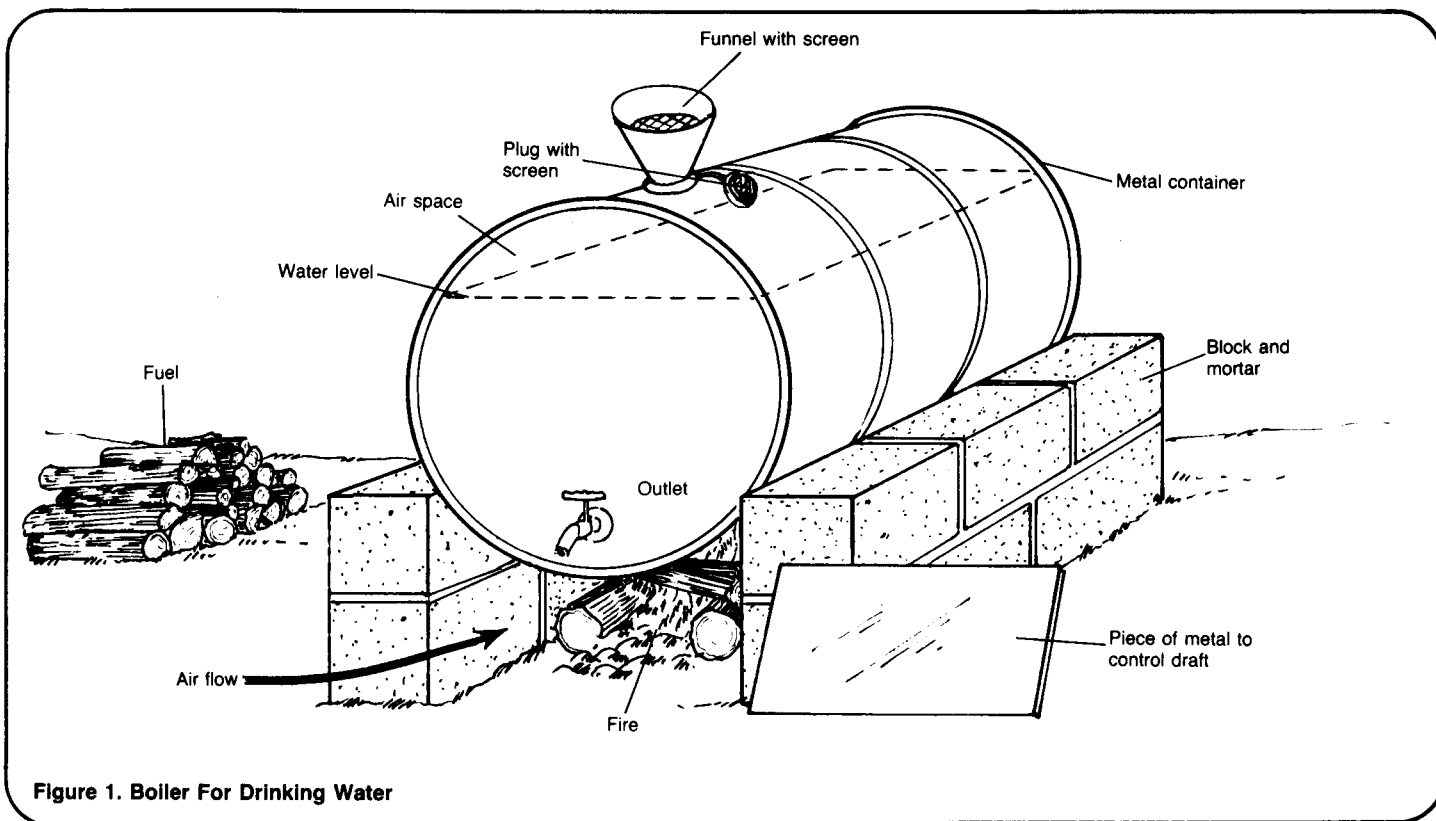


Figure 1. Boiler For Drinking Water

water in small containers. Water should be stored in the same container in which it is boiled to prevent any contamination that could occur from pouring water into a different container.

To boil a large quantity of water that can serve a large group of people, a boiler similar to that shown in Figure 1 can be built. For the boiler, build a simple brick or concrete block fireplace and position it so that the prevailing wind goes between the bricks from the front to the back of the tank. Then, place a 200-liter steel drum or another suitable tank over the fireplace. Laying the tank on its side, make a hole approximately 20mm in diameter on the top side close to the outlet edge as shown. This hole will serve as the inlet. Use a funnel with a small filter screen placed in the hole to fill the tank with water.

Place a valve on the front of the tank. Use a metal valve that can withstand the heat of the boiling water. A small plug should be placed in the inlet hole when the funnel is removed. The plug should fit loosely so that steam can escape during boiling.

The boiler system is good not only for boiling but also for storage. A large amount of fuel is needed, however, to boil the large quantities of water in the tank. Where fuel is abundant, this method is a very good form of disinfection for two or three days. Where fuel is in short supply, another method must be chosen.

Chemical Disinfection

Chlorination of water is one of the most widely accepted methods of chemically disinfecting water under emergency situations. Before chlorinating water from an emergency supply, water may need to be filtered. Chlorine is ineffective against organisms embedded in solid particles. Before turbid water is chlorinated, it should either be poured through a clean cloth or stored to permit the settling of particles. The clarified water can then be disinfected. In some cases, a small temporary dam can be built across a small stream. The reservoir formed can provide adequate settling. The reservoir will provide easy access to the water either manually or through installation of an intake and a pump. Whenever possible, choose an emergency source that is not subject to high

levels of contamination. Water collected from an emergency source should be stored in clean containers after clarification. Small storage tanks, cisterns or barrels are appropriate for this. Chlorine is then added to the stored water.

Chlorine is available in liquid, powdered and tablet form. For emergency situations, especially when water is highly contaminated, use a dosage of about 50 parts per million (ppm), sometimes called 50 milligrams per liter (mg/l). To determine the amount of chlorine to add to a given quantity of water to make a 50ppm dosage use the following formula:

$$\text{Amount of chlorine} = \frac{\text{Dosage (ppm)} \times \text{Quantity of water}}{\text{Percent available chlorine}}$$

For example, the amount of chlorinated lime, 35 percent available chlorine, that must be added to 100 liters of water to provide a dosage of 50ppm is:

$$\text{Amount of chlorine} = \frac{50\text{ppm} (0.05) \times 100 \text{ liters}}{0.35}$$

Amount of chlorine = 14 grams

In this example, 14 grams of chlorinated lime must be added to 100 liters of water to make a 50ppm dosage. Dosage can be reduced for cleaner waters to avoid high residuals and strong taste and odors. Table 2 lists various types of chlorine and their percentage available chlorine.

After dosing, let the chlorine stay in the water for 30 minutes. After that time, a check for chlorine residual should be done if equipment is available. There should be a residual of approximately 1.0ppm. Where no testing equipment is available, make sure that the treated water has a slight chlorine odor and taste. If the test shows no chlorine residual, or if there is no chlorine taste or odor, repeat the dosage and wait 15 minutes.

Table 2. Chlorine Strengths

	Percent Available Chlorine
<u>Calcium Hypochlorites</u>	
High Test Hypochlorite	70%
Percloron Powder	70%
B-K Powder	50%
Chlorinated Lime	35%
<u>Sodium Hypochlorites (Liquid)</u>	
Chlorox	5%
Purex	3%
Zonite	1%

If the treated water has too strong a chlorine taste, allow it to stand for a few hours. Contact with the air offsets the taste and smell of the chlorine.

Chlorine is available in tablet form and can easily be applied to contaminated water. Chlorine tablets are available in many areas. To use them, follow the instructions on the package. If no instructions are listed, use one tablet for each liter of water to be treated.

Iodine is another chemical which can be used for disinfection in an emergency situation. Iodine is available in liquid form from pharmacies or small stores, and is used generally for first aid purposes. Most liquids contain two percent iodine. To disinfect clear water, add about five drops of iodine to each liter of water. When treating turbid water, add 10 drops per liter and allow the water to stand for 30 minutes. Reduce the dose if the iodine taste is strong.

Iodine tablets are made commercially and may be available in many areas. For water disinfection, follow the instructions on the packets. If instructions do not come with the iodine, a general rule to follow is to add one tablet to each liter of water.

Summary

Water which is used for drinking, cooking or brushing teeth should be properly disinfected to prevent sickness. Therefore, adequate planning is necessary to ensure that sufficient quantities of potable water are available for all who need it. The guidelines below should be followed when attempting to provide water for people in emergency situations.

1. Restrict the use of the available potable water to basic needs. People may have to bathe less often and ration

the amount of water used for cooking and drinking. Never let supplies fall to a dangerously low level if possible.

2. Attempt to either put the old system into operation quickly or else search for a new source. If a new source is chosen, make sure that it is either well-protected from contamination or can be protected, and that water can effectively be delivered to those who need it.

3. If a protected source is not available, dig a temporary well or choose a source which is accessible and can be easily treated. Before choosing a source, make sure that there is a way to disinfect it. Water must either be boiled or chemically disinfected before it can be drunk.

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.