

9. WATER PURIFICATION

9.01 Introduction:

During times of emergency, when normal sanitation methods of food, water, garbage, trash, and sewage may be disrupted, it is critical that rules and procedures be established to safe guard proper health or disastrous results may be experienced. Water storage and purification is essential.

9.02 Water:

It is impractical to attempt to store a year's supply of potable water. An emergency supply for two or three weeks, however, is an achievable goal for most people. Store two gallons of water per person per day for emergency use - one gallon for drinking and cooking, and the other for bathing and other needs. Store the water containers in a cool dark area on pieces of wood (not directly on concrete or dirt). Record the date of storage on the water container.

When rotating your water supplies, rinse and purify the containers before re-filling.

A good water filter is quite expensive, but is essential to survival. Do not purchase inexpensive filters. They most likely will not produce quality water. Choose a brand that will filter to .2 micron or less. Look for the quality that Katadyn First-Need or Seagull filters provide. Ultraviolet light units require electricity, and cannot guarantee effectiveness against certain spores and viruses.

9.03 Storage containers:

Containers should stack well and have a lining that won't rust or affect flavor. Containers of Choice are:

- 30-55 gallon FDA approved food grade plastic barrels
- 5-gallon plastic jugs
- Two-liter soda pop bottles (preferably tinted)

Plastic milk cartons should not be used for water storage.

A good water container is airtight, breakage resistant, and heavy enough to hold water. Bacteria growth will be discouraged if the container is both airtight and opaque, as bacteria needs both air and light to grow.

Water weighs over eight pounds per gallon; do not store more than fifteen gallons (about 125 pounds) in any container meant to be portable.

Before placing water in the container, carefully wash and rinse the container. After draining the rinse water, rinse the container with full strength bleach, making sure to roll and tip the container to reach every area. Leave the lid slightly loose to reach around the bung and threads. Leave the bleach in the container for about 20 minutes. Wear rubber gloves, old clothing and eye protection during this process. Use about 1-quart bleach for a 55-gallon drum. Recover the bleach into a bucket and use for the next drum. Lightly rinse the bleach from the container with water.



9.04 Water Storage:

Add household bleach (5.25 percent hypochlorite with no additives) to the fresh water in the container. This is not meant to purify the water, but to keep bacteria from later growing in previously purified water.

The following amounts should be added to the full clean container:

- 1- teaspoon bleach for 5 gallons
- 4 Tablespoons bleach for 55 gallons
- 8 drops bleach for two-liters

Purchase a good water filter to be used when obtaining drinking water from unproven sources. Obtain a three-day supply of water per person for 72-hour kits in small, portable containers. If stored in clear containers, rotate the water monthly.

Large water barrels are great for water storage, and can be purchased from 15 gallon to 55 gallon sizes. Please note a 55 gallon barrel will weigh several hundred pounds and be unrealistic to tip even slightly to access the water. Obtain a siphon pump designed for your barrel to remove the water when needed.

All water obtained outdoors (lakes, streams, etc.), is subject to pollution and contamination from dirt, bacteria or other pollutants, and requires purification consisting of a two-step process. It must first be clarified or cleansed of all physical impurities such as dirt and debris. After clarification it must be disinfected (sterilized) or made biologically safe to drink.

Please understand that NO home method of water treatment can guarantee the safety of the water. Certain water treatment methods described below can reduce the risks involved, but emergency treatment of water cannot guarantee the same quality water as normally comes into our homes.

9.05 Water Forage:

Once the stored water has been depleted, people will be driven to forage for more supplies. Storage supplies can be temporarily stretched by utilizing the water in the hot water heater, toilet tanks (not the bowl) and water lines.

Open faucets on the upper floors and drain water from the pipes from the lower faucets. An anti-siphon should be installed on the water inlet to keep the water from flowing back out of the house when water pressures fall.

Hot water heaters should be drained on a regular basis to eliminate the rust and sediment from the bottom of the tank.

Fortunate are the families that live near natural water sources or have access to wells. Wells less than 300 feet deep can be hand-pumped. Amish catalogs feature well built hand-pumps.



9.06 Water Clarification:

Water foraged from natural sources is often contaminated with dirt, debris and suspended particles. Water should be clarified before placing it into the water filter or purifying it by other methods.

Settling: Settling is the easiest method for clarifying and removing debris and suspended particles from the water. If the water is muddy or murky, settling it before filtering will extend the life of the filter. To let water settle merely let it stand in a large container, totally undisturbed for 12 to 24 hours. This will allow any sediment (including radioactive particles) to sink to the bottom. A handful of clay soil in each gallon of water will help speed this process. After settling is complete, pour, dip or siphon the clean water into another container, being careful not to stir up the sludge at the bottom.

Can Filters: Clean a large can (#10 or a large juice can, etc.), and using a nail, punch several holes in the bottom of the can near the center (avoid making holes near the edges of the can). Place an inch or two of washed, crushed charcoal in the bottom of the can (purchased at any pet shop or taken from a fire). Cover the charcoal with 3 or 4 inches of glass wool or polyester aquarium filter. In an emergency, paper towels, toilet tissue, pieces of cloth or even dried grass will suffice. Be sure to pack the material tightly against the sides of the can so that no water can leak around it without being filtered. Suspend the can above a clean container. Pour the polluted water into the can, and allow it to drip into the clean container below. This type of filter will clarify up to 2 gallons of water per hour.

Earthen Filters: Clay binds to radioactive particles. If radioactive fallout has contaminated the water supplies, earth filters utilizing clay type soil, will effectively remove the radioactive particles from the water. This method is better than distillation, ion-exchange filters, or charcoal filters for this purpose.

Perforate the bottom of a 5-gallon can or wastebasket with holes punched within 2 inches of the center. Place a two-inch layer of washed pebbles on the bottom of the can. Cover the pebbles with one thickness of terry cloth towel or other porous cloth. Scrape the top 4-5 inches of soil off the ground to get below the fallout, and dig enough clay-type soil to fill the can to a depth of 8 inches, packing it tightly against the sides. Cover the soil in the can with another thickness of toweling and another one or two inches of pebbles. Suspend the can over a clean container and pour the contaminated water into the top. Clear (but unpurified) water will come out the bottom at the rate of about 6 quarts per hour.

Hose Siphoning: Take a six to eight foot section of garden hose and push two cotton balls into the end. Place that end of the hose into a bucket or



container of muddy water. Suck on the other end until water begins to come through. Place the free end of the hose into another container placed below the muddy container. Gravity will pull the water from the higher container into the lower container while trapping the sediment in the cotton balls and allowing only clear water to flow through the hose. When the cotton balls become clogged, simply remove them and replace with clean ones. This filter will clean approximately one quart of water in thirty minutes. However, if the water is very muddy, the cotton balls will have to be replaced very frequently.

Capillary Siphoning: This filtration method will eliminate most particles and silt from the water. Elevate a container of polluted water above another container and run a piece of braided yarn, strips of cloth (cotton works best), or terry-cloth towel between the two containers as a filtering medium. It helps to soak the material in clean water first, to get the process started. Dirt and debris will not be pulled into the filter, but will remain in the top container. Clean water will pass through the medium and drip into the container below. Capillary action filters are quite effective, but are very slow, clarifying only about one cup of water per hour.

Coffee Filters: Coffee filters are an excellent filtering medium. Place three or four of them (one inside the other) into a mason jar and let the edges protrude over the rim of the jar. Screw on a jar ring to hold them in place and pour the muddy water into the filters. The water will pass through the filters and drip into the jar. When the filters become clogged, simply replace them. This type of filter will clarify approximately one quart of very muddy water in two hours.

9.07 Purification of Water:

After the water has been clarified, it is ready for step #2, purification. Water should not be consumed until it has been purified.

Boiling: Water sterilization by boiling is preferred over ANY method of chemical disinfection, because disease-causing microorganisms cannot survive the heat from a sterilizing boil. If the water is cloudy, heat sterilization is the only method that can be fully relied upon to assure complete destruction of these organisms. These organisms can "hide" by burrowing into the microscopic particles that cause cloudiness in water, thereby escaping the action of disinfecting chemicals, and remaining capable of producing disease. Water that is boiled vigorously for five minutes will usually be safe from harmful bacterial contamination. One additional minute should be added for each 1,000 feet of altitude. The use of a pressure cooker (bring the water up to 15 pounds and then remove from the source of heat), conserves the most amount of fuel, if that is a concern. This guarantees that all bacteria, protozoa, and viruses have been killed. To improve the taste of boiled water,



add a little charcoal from the fire to absorb odors. Pour it back and forth between two clean containers to mix the water with air.

Chemical Sterilization: Regardless of the method of chemically disinfecting water, always double the dosage amount if the water is not absolutely clear. If the water temperature is cold (below 45 degrees), wait one hour to allow the disinfectant to work before drinking the water.

- **Iodine Crystals:** Crystalline iodine is the most effective method of chemically purifying contaminated water. In the crystallized form, iodine has an infinite shelf life and is very inexpensive. Great care should be exercised, however, when handling crystalline iodine.

DO NOT TOUCH IODINE CRYSTALS!! They can cause severe skin burns and can be fatal if swallowed in sufficient quantity. Add 4 to 8 grams of USP Grade Re-sublimed Iodine Crystals to a one-ounce glass bottle with a leak proof bake-lite cap. Plastic bottles are not acceptable, since they allow staining and can leak.

After placing the crystals in the bottle, fill the bottle with water, close the cap and shake vigorously for one minute. Allow the bottle to sit for one hour to allow the iodine to dissolve, before adding the solution to the water. Add 3 teaspoons of this solution (1/2 ounce) to a quart of clear water, and let it stand for 30 minutes before drinking. Only a small fraction of the crystals will dissolve.

Take care that NO crystals escape into your drinking water, as they will cause burns to your mouth and digestive tract. Double the amount (6 teaspoons of solution), if the water is cloudy. When the solution in the bottle is used up, just add more water and let it stand one hour before using the solution to treat additional water. Four to eight grams of crystalline iodine should be sufficient to treat up to 1,000 quarts of water.

It is currently difficult to purchase iodine crystals in bulk form. Iodine crystals in small containers, however, can be purchased for approximately \$10.50 from the Polar Pure Equipment, Inc., Saratoga, CA. Ask for the 'Polar Pure Iodine Crystal Kit'. The iodine in this kit is packaged in the proper glass bottle and has a screen fitted over the opening to keep the crystals from escaping when the solution is poured into the drinking water. This particular kit contains enough iodine crystals to purify 2,000 quarts of water.



The following are other options for chemically disinfecting water, listed in order of effectiveness.

- **Iodine Tablets:** Iodine tablets in the form of tetraglycine hyperiodide are very effective against all forms of bacteria. This form of iodine, however, is less effective against the dreaded protozoa, GIARDIA LAMBLIA. Iodine tablets are sold in sporting-goods stores under the names of Coghlan's Globaline, and Portable Aqua. Iodine tablets usually have a relatively short shelf life (losing 20% of their effectiveness in just six months). They are also very sensitive to heat and light. They turn color from grey to yellow as they become less potent. The usual dose is one tablet per quart of clear water, and two tablets for cloudy water. Let the water stand for 30 minutes before using.
- **Tincture of Iodine:** A 2% solution of tincture of iodine, as found in most first-aid kits, can be added to polluted water. Use 32 drops of tincture of iodine per gallon of clear water, or 8 drops for a quart, and let it stand for 30 minutes before using. Double this amount if the water is cloudy. Tincture of iodine is not potent enough to kill GIARDIA.
- **Chlorine:** Hypochlorite must be the ONLY active ingredient in liquid household chlorine bleach intended for use in purifying water. Do not use granular or powdered forms of household bleach, as they are poisonous!! Add 2 drops of liquid bleach per quart of clear water, 8 drops per gallon, or one teaspoon for five gallons. Double this amount if the water is cloudy. Liquid bleach loses strength over time, and in just one year of storage the dosage must be doubled to be effective. Two-year-old bleach must not be used. It is not potent enough to kill disease-causing bacteria. After adding the proper amount of bleach to the water, stir and let stand for 30 minutes before drinking. Liquid bleach will kill most common forms of bacteria, but it is totally ineffective against GIARDIA and other hardy forms of protozoa.
- **Halazone Tablets:** Halazone tablets, the least effective method of chemically disinfecting polluted water, are available at most drug and sporting goods stores. If used, add four tablets per quart of clear water, and eight tablets per quart of water clarified from muddy water. Allow the tablets to dissolve, then shake the water and let it stand for 30 minutes before drinking. The shelf life for unopened Halazone tablets is only 5 to 6 months. If they are left in an opened package, they can lose their effectiveness within only 48 hours.

