

# Safe Water in an Emergency

Note: None of the methods described here will remove solvents, heavy metals or other inorganic toxins from water. This is for dealing with living organisms only.

In times of emergency, on hiking/camping trips, or in under-developed regions, having access to drinkable water is a top priority. The viruses, bacteria, protozoa, and parasitic worms (in order of size) in contaminated water can be life-threatening in many instances, and certainly make you miserable.

Purification: removes offensive odors, tastes, and colors. Does not kill micro-organisms.

Sterilization: kills all life-forms in the water.

Disinfection: removes or kills disease-causing micro-organisms. When we talk about emergency water purification we usually mean disinfection.

The three general ways of disinfecting water are the application of (1) heat, (2) chemicals, or (3) filtration. Filtration often does not remove viruses, is more technology-dependent, and will not be described in this write-up.

When the purity of water is questionable, use the following steps to make it safe to drink:

**Step 1.**                Clarify cloudy water by (a) adding powdered kitchen alum – approximately 1/4 level teaspoon per gallon. Larger amounts are NOT more effective. Crystals take much longer to dissolve than powder, so you may wish to pulverize it first. The alum reacts with the water, producing a precipitate which slowly settles and adsorbs impurities. After settling is complete (fifteen minutes to two hours, depending on the water quality) pour the clear part of the water into another container, being careful not to stir up the sludge at the bottom. Discard the sludge. The water is ready to be disinfected.

Or (b) if you don't have any alum, filter the water through a tightly woven cloth. Clarification is important; clear water can be purified using less chlorine or iodine than you need for cloudy water. When the water is clear, you are ready to disinfect it.

**Step 2.**                Disinfect the water by one of the following methods, (A), (B), or (C):

(A)    **Boiling**. This is the best method if you have the means. Boil the water at least three minutes after it has come to a rolling boil. A more conservative formula is 3 minutes + 1 minute per 1000 feet of elevation. Some say that at elevations of 10,000 feet or more, water should be boiled for fifteen minutes, because it boils at a lower temperature at higher elevations, and so has diminished lethality to micro-organisms. CDC, on the other hand, says 3 minutes is enough at any altitude, and other professionals say 5 minutes at full boil, at any altitude, to be conservative. One reference assures the reader that once the water is at full boil, it is safe to drink. Let it cool sufficiently before drinking, and aerate to improve taste.

Note!: Method (B) **Iodine** is not recommended for persons with hyperthyroidism, a known iodine allergy, or during pregnancy.

Note: A liter is slightly larger than a quart, and may be treated as equivalent when adding drops.

(B)    Iodine. Method #1: Add three to five drops of a 2% **tincture of iodine** solution (obtainable at most pharmacies) to a quart of room temperature water, and let stand about thirty minutes. Double the dose if the water is cloudy, double the time if the water is cold.

Iodine Method #2: PotableAqua (brand name for tetraglycine hydroperiodide) is iodine in tablet form. Use as directed, but it costs more.

Iodine Method #3: Add 8 drops (=0.4 ml) of Povidone iodine (Betadine is a brand name) per quart at room temperature and wait thirty minutes. As with the other forms of iodine treatment, double the dose for cloudy water, and double the time for cold water.

Iodine. Method #4: Add 3/4 tablespoon (=2.25 teaspoons, =11 cc, =266 drops) of **saturated iodine-in-water** solution to each quart of room temperature water and wait thirty minutes. Alternately, half as much and wait an hour. Double the dose if the water is cloudy, double the time if the water is cold.

Use the solution only; make sure no crystals are transferred. (Alternate source says 10 cc/qt at 75 Fahrenheit, 18 cc/qt at 40 F. with a 15 minute wait, or half as much for 30 minutes.) To make a saturated solution, place 5 grams (about the weight of two pennies or one nickel) of iodine crystals in a two ounce bottle. Add water. Shake or stir for several minutes, until no more will dissolve. Most of it will not dissolve, and the crystals which settle to the bottom can be reused many times. For storage: glass containers only, either dry, or add just enough water to cover the crystals. (The water slows down the sublimation. Refrigeration will also help.)

Berger says iodine kills *Giardia* but not *Cryptosporidium* (both are protozoans), which produces similar symptoms (fever/cramps/diarrhea) and runs its course in 7 to 10 days. Another text says neither iodine nor chlorine are effective against *Crypto*. --tough critter-- but boiling is effective. She also says iodine purification is not healthy to use on a continuous basis, but other books say iodine is completely safe except for certain individuals. See note above. There are also filters, which (the better ones) are effective against bacteria and parasites, but not viruses. Still, you must find a way to drink plenty of water.

Reagent grade (chemically pure, crystalline) Iodine can be purchased from chemical supply houses. In Tucson it is obtainable from Adchemco Scientific, Inc., 3220 S. Dodge Blvd., Suite 6, 790-8485 for \$135 per pound, also available in smaller quantities. Pharmaceutical grade is less pure and probably more expensive – go figure. As you can tell, a few grams would go a long ways. Five grams will treat about 1200 quarts of water. The iodine method is inexpensive, produces less objectionable taste than chlorination, and is said to be more effective. The taste can be masked with lemon juice or powdered drink mix.

Keep iodine crystals away from children. Do not touch them. Iodine is very irritating to the skin and will stain most things it touches, although alcohol will dissolve it. The violet vapors are very corrosive! Label all containers clearly, and take precautions against spills.

(C) **Chlorine.** Use ONLY bleach that has NO OTHER active INGREDIENTS than sodium hypochlorite. Add two to five drops of chlorine bleach (5.25% hypochlorite solution) per quart of room temperature water, wait 30 minutes. Double the dose for cloudy, double the time for cold water. If there is no residual odor of chlorine, repeat the treatment until a definite chlorine odor remains. A small plastic bottle of bleach will purify a lot of water, but the chlorine solution deteriorates with time, so replace your bottle on a yearly basis. **Aquaclear**, **AquaCure** per directions. **Halazone** tablets release chlorine slowly, but they are expensive, have a relatively short shelf life, and are less effective.

#### References:

Byron J. Wilson and H. Smith Broadbent, "Safe Water in Emergencies," Ensign, Feb 1986, p70.

Cresson H Kearny, "Nuclear War Survival Skills." p70.

Karen Berger, "Everyday Wisdom: 1001 Expert Tips for Hikers."

Schimelpfenig and Lindsey, "Wilderness First Aid", Stackpole books, 1991.

Conversion factors: From an eyedropper ~24 drops per cubic centimeter

1 pound(avdp) = 453.59237 grams(wt.) = 16 oz.(avdp) = 7000 grains = 256 drams(avdp)

1 gallon = 231 cu. in. = 3.785411784 liter = 4 quarts = 8 pints = 16 cups = 128 fl. oz. = 256 tablespoons.

1 tablespoon = 3 teaspoons = 14.78676478 cubic centimeters (cc, ml)

1 gallon of water weighs 8.34 pounds. 1 fl. oz. = ~719 drops

Note that drops are not of consistent volume. A single drip from a faucet may be ten times the volume of a drop from an eye dropper, even when only water is considered. Water with additives, and other liquids, have widely varying viscosities, densities, and surface tension. Fortunately great precision is not required to create bacteriologically safe drinking water.

For methods of removing radioactive fallout from water, see Kearny, chapter 8.