Prepared by D. Frydenlund, Paratus Institute, 2009 from various sources.

Water Purification Quick Primer

These methods only address biological pathogens in the water. They do not address chemical impurities.

Generally, all water is better if it is free of sediment. Coarse filtering the water to remove suspended particles will improve the results of all purification processes. Coarse filtering can be accomplished using screens, clean cloth, coffee filters, nylons, etc. If there is time, allowing water to settle will often take most of the sediment to the bottom.

The taste of the treated water can be improved by aerating the water. The easiest way to do this is to pour it back and forth between a couple of (uncontaminated) pots.

Heating

The safest method of water purification is heating. There are two levels of "purification" we are interested in, sterilization (all organisms dead) and pasteurization (all organisms harmful to humans dead). For pasteurization it is generally accepted that water need only reach 155° - 160° F (65° - 70° C) to kill all harmful organisms.

Sterilization takes hotter temperatures. Water temperatures above 160° F (70° C) kill all pathogens within 30 minutes and above 185° F (85° C) within a few minutes. So in the time it takes for the water to reach the boiling point from 160° F (70° C), all pathogens will be killed, even at fairly high altitude. Water boils at ~ 85° C at about 4575M or 15,000 feet of altitude. Below that altitude, if you bring water to a full rolling boil, it will kill all of the pathogens.

If you are in a time or fuel critical situation it is important to understand this so you waste neither time nor fuel on achieving purified water.

Governmental authorities, understanding that many people will not have a thermometer and do not know how to recognize true boiling water recommend longer boiling times. The current U.S. EPA recommendation for clear (sediment free) water is to boil for one minute below one mile (1600M) in altitude and three minutes above.

Remember that water used for First Aid must be cooled before application.

Filtration

Filtration is a highly effective method of purification if the correct filters are chosen for the pathogens in the water. The porosity of the filter must be smaller than the pathogens to be removed. Some pathogens (notably viruses) are too small to be filtered and the filtration system is augmented with an iodized filter or post treatment which is intended to kill them. In some cases activated charcoal is added to the filtration system to remove selected heavy metals and organic chemicals. Always read

carefully the specifications of the filter system you intend to employ and match them to threats you expect to encounter. In the North American back country, the primary threats are protozoans which are fairly large (5 microns) and one micron filtration is often adequate. In urban areas, bacteria like salmonella, E. Coli and cholera become a threat. They are typically > 0.2 microns and 0.1 micron filters are often used. Prefiltering or multistage filtering dramatically increases filter life.

Although viruses are much smaller, many of them are removed by filtering systems because they tend to attach themselves to larger bodies in the water. However, if you must be certain with viruses, you are looking at heating, chemistry or ultra violet radiation.

Chemical

For field use there are two practical chemical approaches to water purification, chlorine and iodine. Neither is 100% effective. Some people have allergies to iodine. Both chlorinated and iodized water have taste issues. Both chlorine and iodine approaches have limited shelf life. Neither work well in cold water.

Vitamin C, if added to iodized water (after the process is complete) will remove the iodine taste and color. Powdered beverages with Vitamin C (like Tang) work well.

Chlorine Bleach

Typically, fresh household chlorine bleach will be about a 5% solution. The percentage goes down with age. For fresh bleach, the Clorox Corporation recommends the following ratio of Clorox Bleach to water for purification:

2 drops of Regular Clorox Bleach per quart (liter) of water
8 drops (1/8 teaspoon) of Regular Clorox Bleach per gallon (4 liters)of water
1/2 teaspoon Regular Clorox Bleach per five gallons (20 liters) of water
If water is cloudy, double the recommended dosages of Clorox Bleach.

Only use Regular Clorox Bleach (not Fresh Scent or Lemon Fresh). To insure that Clorox Bleach is at its full strength, rotate or replace your storage bottle minimally every three months.

If the bleach is old or if it is less than a 5% solution try:

10 drops of Bleach per quart (liter) of water
40 drops (1/2 teaspoon) of Bleach per gallon (4 liters) of water
2 teaspoon Bleach per five gallons (20 liters) of water
If water is cloudy, double the recommended dosages of Bleach.

Let stand for 30 minutes (an hour if the water is very cold). There should be a faint smell of chlorine. If not, add more chlorine and let stand again.

Clorox Bleach Sanitizing Solution

To sanitize containers and utensils, mix 1 tablespoon Regular Clorox Bleach with one gallon of water. Always wash and rinse items first, then let each item soak in Clorox Bleach Sanitizing Solution for 2 minutes. Drain and air dry. Avoid exposure of bare skin to this level of bleach solution.

Granular calcium hypochlorite

Add and dissolve one heaping teaspoon of high-test granular calcium hypochlorite (approximately ¼ ounce) for each two gallons of water, or 5 milliliters (approximately 7 grams) per 7.5 liters of water. The mixture will produce a stock chlorine solution of approximately 500 milligrams per liter, since the calcium hypochlorite has available chlorine equal to 70 percent of its weight. To disinfect water, add the chlorine solution in the ratio of one part of chlorine solution to each 100 parts of water to be treated. This is roughly equal to adding 1 pint (16 ounces) of stock chlorine to each 12.5 gallons of water or (approximately ½ liter to 50 liters of water) to be disinfected. To remove any objectionable chlorine odor, aerate the disinfected water by pouring it back and forth from one clean container to another.

Chlorine tablets

Chlorine tablets containing the necessary dosage for drinking water disinfection can be purchased in a commercially prepared form. These tablets are available from drug and sporting goods stores and should be used as stated in the instructions. When instructions are not available, use one tablet for each quart or liter of water to be purified.

Tincture of Iodine/Povidone Iodine

Common household iodine from the medicine chest or first aid kit may be used to disinfect water. Add five to eight drops of 2 percent U.S. or your country's approved Pharmacopeia tincture of iodine to each quart or liter of clear water. If Povidone Iodine (Betadine) add three or four drops. For cloudy water add ten drops and let the solution stand for at least 30 minutes. Iodine is much less effective in cold water.

Iodine tablets

Purchase commercially prepared iodine tablets containing the necessary dosage for drinking water disinfection at drug and sporting goods stores. Use as stated in instructions. When instructions are not available, use one tablet for each quart or liter of filtered and settled water to be purified.

Iodine can build up in the body and cause toxicity. It should be used as a last resort.

Halazone tablets

These are convenient and inexpensive, but have several disadvantages. Due to its chemical formulation, reliable disinfection in all conditions requires 6 tablets per liter for 1 hour contact, resulting in poor flavor. The tablets rapidly lose effectiveness when exposed to warm, humid air.

Ultra Violet Purification

Solar Cooking

Use a clear plastic or glass bottle and fill it up with the clearest water available. Leave the bottles in direct sunlight, preferably on a highly reflective or black surface for at least six hours. If the weather is cloudy, leave the bottles out for two days. If the temperature of the water is raised above 45 C the process happens in half the time. A highly reflective surface increases the UV effectiveness. A black surface will heat the water. (World Health Organization).

Ultra Violet Purifier

Acquire a battery powered UV purifier and carefully follow the manufacturer's instructions.