OA Guide to Water Purification

part of

The Backpacker's Field Manual

by Rick Curtis

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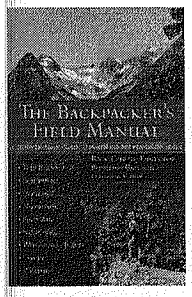

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This material is taken from Chapter 4 - Hygiene & Water Purification from *The Backpackers Field Manual* by Rick Curtis. For more details on this exciting book check out The Backpacker's Field Manual Page.

Water Purification

Dipping your head into a cold mountain stream and taking a long refreshing drink is an experience that has basically vanished from the wilderness areas of America. With the increased use of the wilderness there has also been an increase in the amount of bacteriological contamination of backcountry water supplies. The U.S. Environmental Protection Agency reports that 90 percent of the world's water is contaminated in some way. There are a variety of microscopic organisms that can contaminate water supplies and cause potentially serious, even fatal, illnesses among wilderness travelers. The major danger in the backcountry from these infections is fluid loss due to diarrhea and vomiting, which can lead to hypovolemic shock and possibly death (see Diarrhea or Vomiting, page 315; Fluid Electrolyte Replacement, page 286; Shock, page 238).

In order to drink the water, you should be prepared to treat it. There are numerous methods of water purification, described below in order of effectiveness. Remember, however, that infections can also be spread through poor personal hygiene, something that purifying your water won't prevent.

Biologically Contaminated vs. Toxic Water

Biologically contaminated water is water that contains microorganisms such as *Giardia* (a common microorganism that, if not killed, leads to intestinal disorders), bacteria, or viruses that can lead to infections (see Gastrointestinal Infections, page 316). *Toxic* water sources contain chemical contamination from pesticide runoffs, mine tailings, and so on. Boiling, filtering, or chemically treating water can remove or kill microorganisms, but it will *not* remove chemical toxins. This is also the case when using a solar still (see page 223).

Boiling

Boiling is the most certain way of killing all microorganisms. According to the Wilderness Medical Society, 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 (212° F or 100° C) from 160° F (70° C), all pathogens will be killed, even at high altitude. To be extra safe, let the water boil rapidly for one minute, especially at higher altitudes since water boils at a lower temperature (see page 68.)

Chemical Purification

There are two types of chemical treatment: those using iodine and those using chlorine. There are a variety of products on the market, so follow the directions on the bottle. Be advised that many of the tablets have an expiration date and become ineffective after that point. Also, once the bottle has been opened, the tablets must be used within a certain period. When in doubt, buy a new bottle. Remember that chemical purification methods may only be partially effective, depending on the water temperature.

General Chemical Treatment Procedures

- The effectiveness of all chemical treatment of water is related to the temperature, pH level, and clarity of the water. Cloudy water often requires higher concentrations of chemical to disinfect.
- If the water is cloudy or filled with large particles, strain it, using a cloth, *before* treatment. Large particles, if swallowed, may be purified only "on the outside."
- Add the chemical to the water and swish it around to aid in dissolving. Splash some of the water with the chemical onto the lid and the threads of the water bottle so that all water areas are treated.
- The water should sit for *at least* 30 minutes after adding the chemical to allow purification to occur. If using tablets, let the water sit for 30 minutes *after* the tablet has dissolved.
- The colder the water, the less effective the chemical is as a purifying agent. Research has shown that at 50° F (10° C), only 90 percent of *Giardia* cysts were inactivated after 30 minutes of exposure. If the water temperature is below 40° F (4° C), double the treatment time before drinking. It is best if water is at least 60° F (16° C) before treating. You can place the water in the sun to warm it before treating.
- Chemically treated water can be made to taste better by pouring it back and forth between containers, after it has been adequately treated. Other methods include adding a pinch of salt per quart or adding flavorings (e.g., lemonade mix, etc.) after the chemical treatment period.

Iodine Treatment

Iodine is light sensitive and must always be stored in a dark bottle. It works best if the water is over 68° F (21° C). Iodine has been shown to be more effect than chlorine-based treatments in inactivating *Giardia* cysts. *Be aware that some people are allergic to iodine and cannot use it as a form of water purification.* Persons with thyroid problems or on lithum, women over fifty, and pregnant women should consult their physician prior to using iodine for purification. Also, some people who are allergic to shellfish are also allergic to iodine. If someone cannot use iodine, use either a chlorine-based product or a non-iodine-based filter, such as the PUR Hiker Microfilter, MSR WaterWorks, or the Katadyn Water Filter.

5% IODINE = 3 DROPS PER QUART IF CLEAR
5 DROPS ← ← IF CLOUDY
1 QUART = 32OZ 50 5DROPS ÷ 32OZ × 8OZ = 1.25 DROPS PER CUP

Generally, the procedure is as follows:

- **Liquid 2% Tincture of Iodine** Add 5 drops per quart when the water is clear. Add 10 drops per quart when the water is cloudy.
- **Polar Pure Iodine Crystals** Fill the Polar Pure bottle with water and shake. The solution will be ready for use in one hour. Add the number of capfuls (per quart of water treated)

listed on the bottle, based on the temperature of the iodine solution. The particle trap prevents crystals from getting into the water being treated. It is important to note that you are using the iodine *solution* to treat the water, not the iodine crystals. *The concentration of iodine in a crystal is poisonous and can burn tissue or eyes.* Let the treated water stand for 30 minutes before drinking. In order to destroy *Giardia* cysts, the drinking water must be at least 68° F (20° C). The water can be warmed in the sun before treating or hot water can be added. Refill the treatment bottle after use so that the solution will be ready one hour later. Crystals in the bottle make enough solution to treat about 2,000 quarts. Discard the bottle when empty.

- **Potable Aqua** This is an iodine tablet product. Follow the manufacturer's instructions for use.

Chlorine Treatment

Chlorine can be used for persons with iodine allergies or restrictions. Remember that water temperature, sediment level, and contact time are all elements in killing microorganisms in the water. Halazone is an example of a chlorine tablet product. To use, follow the manufacturer's instructions.

Tricks of the Trail
• **Backups** Always have at least one backup method for water purification in case one fails. This can be any combination of methods. I'm the cautious type, so I always have two backup methods: water filter and 2% tincture of iodine or Polar Pure iodine crystals. And I can always boil the water. If boiling is your backup method, make sure you have enough fuel. • **Fix the Taste** Adding vitamin C (about 50 milligrams) to iodized water completely eliminates any taste or color of iodine. You must wait until the iodine has purified the water before adding the vitamin C. The vitamin C in drink mixes like Tang™ has the same effect.   <

Filtration

There are a number of devices on the market that filter out microorganisms. A water filter pumps water through a microscopic filter that is rated for a certain-size organism. The standard size rating is the micron (the period at the end of this sentence is about 600 microns). Depending on the micron rating of the filter, smaller organisms (like viruses) can pass through. Be cautious when selecting a filter. You should know what potential organisms you need to treat for. You don't want to go to an area where a virus like hepatitis A is present in the water (a problem in some developing countries) with a filter that will handle only a larger organism like *Giardia.*

Common microorganisms and the filter size needed:

Organism	Examples	General Size	Filter Type	Particle Size Rating
Protozoa	*Giardia, Cryptosporidium*	5 microns or larger	Water filter	1.0–4.0 microns
Bacteria	*Cholera, E. coli, Salmonella*	0.2–0.5 microns	Microfilter	0.2–1.0 microns
Viruses	Hepatitis A, rotavirus, Norwalk virus	0.004 microns	Water purifier	to 0.004 microns

There are two basic types of filters (descriptions of several popular models begin on the facing page).

- **Membrane Filters** use thin sheets with precisely sized pores that prevent objects larger than the pore size from passing through. **Pro:** Relatively easy to clean. **Con:** Clog more quickly than depth filters. **Example:** PUR-Hiker.
- **Depth Filters** use thick porous materials such as carbon or ceramic to trap particles as water flows through the material. **Pro:** Can be partially cleaned by backwashing. Activated carbon filters also remove a range of organic chemicals and heavy metals. **Con:** Rough treatment can crack the filter, rendering it useless. **Examples:** MSR WaterWorks II, Katadyn.

Note: There is a difference between a water *filter* and a water *purifier.* Filters do not filter out viruses, but there are water purifiers, like the PUR Scout, that pass the water through both a filter and an iodine compound that kills any smaller organisms that have passed through the filter. These purifiers kill all microorganisms down to 0.004 microns; however, the filter should not be used by people who are allergic to iodine.

Common Practices for Using a Water Filter

- Filter the cleanest water you can find. Dirty water or water with large suspended particles will clog your filter more quickly.
- Prefilter the water either through a prefilter on the pump or strain it through a bandanna.
- If you must filter dirty water, let it stand overnight for particles to settle out.

Tricks of the Trail
Some water filters come as sealed cartridges, making it impossible to inspect the actual filter cartridge. If the filter takes a serious fall, it could crack internally. If the filter inside cracks, unfiltered water can flow through the crack. Treat your filter with care, and if it takes a significant impact, throw it away. Remember, any intake hose from a water filter has been submerged in unfiltered water. Treat this hose as "contaminated" and keep it in a separate plastic bag.

How To Disinfect Water With Household Bleach

February 9, 2012 By Creek

I've been getting a lot of questions about this topic lately and I thought it would be a good idea to do a more lengthy post on the subject.

As everyone knows, many municipal water systems use chlorine to disinfect water. Often, the use of chlorine is combined with other purification systems such as filtration and ultra violet treatments. All you have to do is sniff your water tap water – it's no secret. Why chlorine? Simple – it works.

It just so happens that Sodium Hypochlorite is the active ingredient in common household bleach. Sodium Hypochlorite is the source of chlorine in bleach. Most 'off-the-shelf' bleach products will contain in between 4 and 6% available chlorine. It is in this range that all of the below information and ratios are based. You will want to read the label and verify this first – otherwise you are just guessing.

It's important that you only use regular bleach – nothing fancy with flowers, fresh mountains and little teddy bears on the label. No frills – standard – unscented bleach. The label should look like below:

When it comes to disinfecting water, it seems there is a different ratio and percentage for all kinds of different purifying agents and it can get really confusing. It can be hard to keep these ratios and solutions straight but it is very important that we do. All of the liters, quarts, drops, gallons, mL, cups and percentages are very easy to loose track of. I have a very simple memory phrase when it comes to disinfecting water with bleach. Once you read this phrase, you will never forget how to disinfect water with bleach again. The phrase is:

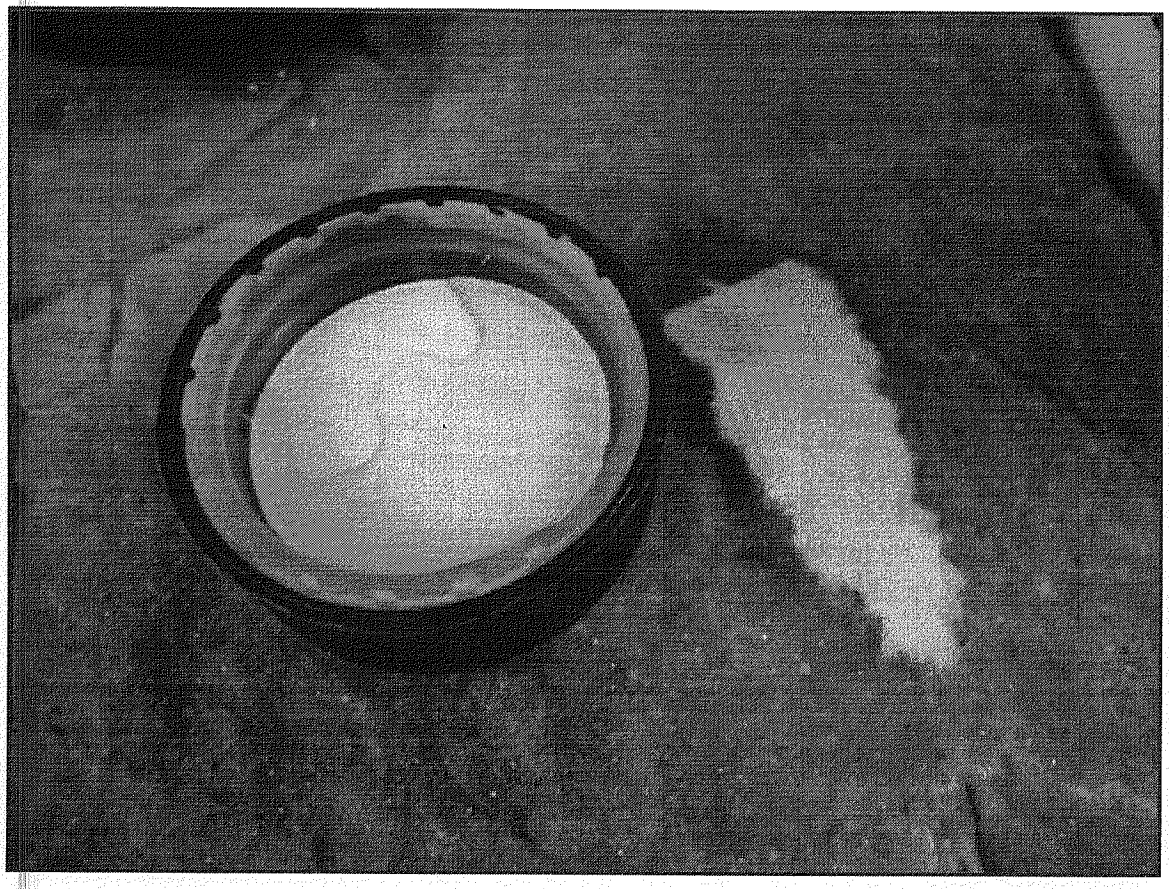
You must be 21 to drink.

4 DROPS PER QUART IF WATER IS CLOUDY

How simple is that? It is a simple reminder that you need ***2 drops of bleach per 1 liter or quart of water*** – hence 21. And, that just happens to be the legal drinking age in the US so it's very easy to remember. Now, you will never forget it. If you don't have a 1 liter or 1 quart container in which to measure an exact amount of water, it's OK. Just remember that there are 4 quarts in a gallon and you can guesstimate the amount from there. Everyone knows about how much is in 1 gallon. Think about 1 gallon of milk and divide into fourths. You do need to wait a while before drinking, though. The wait time is 30 minutes. I remember this with: 2 + 1 = 3.

Using 5.25% Standard Household Chlorine Bleach	*Drops per Quart/Gallon of Clear Water*	*Drops per Liter of Clear Water*
5.25% Household Chlorine Bleach	2 per Quart – 8 per Gallon (1/8 teaspoon)	2 per Liter

Have you ever tried to get a couple drops out of a gallon of liquid. It's actually not the easiest thing in the world to do. Here is how I do it. You just need the cap to the bottle and a little piece of paper – toilet paper works great.



Then, place your 'paper wick' into a full cap with one end hanging over and it will begin to wick up the liquid and when turned at a slight angle will provide you with nice steady consistent drip that you can easily count.

A note about the water

It is important that your water be clear and void of debris for the above calculations to be effective. Ideally, you are already beginning with clear water. However, have you ever heard of an *IDEAL* survival situation? Me neither. Consequently, you may need to Pre-Filter your water ***BEFORE*** you disinfect it. You can prefilter your water using a huge variety of items – sock, t-shirt, bandanna, dried grass, feminine hygiene product and the list goes on an on. You may even want to prefilter a couple of times. Chlorine will not disinfect sediments. ***If your water is cloudy, double the chlorine dose and the wait time.***

Don't Forget the Threads

If you are using a bottle with a threaded/screw-on cap, don't forget to unscrew the cap a bit and slosh some of the chlorine treated water into the threads. Otherwise, the water trapped in these threads could contaminate your water all over again.

Using bleach to disinfect water isn't just a back-yard survival tactic. It is even recommended by the Environmental Protection Agency (EPA) as a viable form of disinfecting water in an emergency scenario. You can check out their writings on their web-site here if you wish: http://water.epa.gov/drink/emerprep/emergencydisinfection.cfm They also cover Iodine.

Conclusion

Chlorine bleach is a very common item in our society. It's good to know how we can use it to disinfect water if we needed to one day. As I always say, it's better to know it and never use it than to not know and need it. Hopefully, this has cleared up some questions that anyone has about disinfecting water with bleach. It certainly isn't the only available chemical that we can use to disinfect water but it is a very common and viable option.

Thoughts anyone?

Remember, it's not IF but WHEN,

Creek

Creek recommends these posts!

Someone's Trash Could Save Your Life: How to boil & purify water in a plastic bottle

4 Light-weight Collapsible Survival Water Storage Containers

I'd Tap That! (Maple Tree that is.)

Turn Your Stainless Nalgene Water Bottle Into a Hunting Tool

Filed Under: Featured, General Survival, Water

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