Water Disinfection Update: Mixed Oxidants

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One of the major problems in disasters (or backcountry hiking, or wilderness search and rescue) is the bacteriological purification of water ("disinfection"). Yes, water can be contaminated with poisons such as pesticides or other chemical agents, or heavy metals from mine drainage. But the big problem is disease-causing microbes. There are many different ways to disinfect water, including boiling, the old chlorine tablets (which didn't kill entamoeba histolytica very well), iodine tablets, and more recently, filters to eliminate Giardia (which just isn't that big of a problem in my mind), and micropore filters with a smaller orifice size to eliminate bacteria, with or without an iodine resin to kill viruses. Some filters include an activated charcoal filter to eliminate any iodine taste, which as a side benefit also tends to eliminate some toxins.

Until recently, I kept a standard iodine-resin backpacking filter with my DMAT (Disaster Medical Assistance Team) gear. (DMAT responses are a lot like backcountry backpacking, so some backpacking and climbing gear works its way into my DMAT pack.) This technology provided a high level of disinfection without leaving much iodine residue in the water. Iodine in the water tastes bad and can cause problems for those with thyroid problems, which is why I've come to reserve iodine tablets as a backup. Though a filter can easily provide disinfected water for a few people, it's simply not fast enough for any larger group of people, such as a DMAT team. There are larger filter devices that can provide water for a larger number of people, but decades I've wanted something I could carry in my pack that was lighter than a filter, and also, in a disaster, could disinfect lots of water, fast, and without iodine residue. Up until now, the best was a big bottle of iodine tables.

For more background on water disinfection—I've scarcely scratched the surface—I recommend you to Howard Backer's definitive and readable chapter on the topic in Auerbach's wilderness medicine textbook.(1)

Over the past decade, commercial water purification has advanced. For example, some hospitals now use a system that injects silver and copper ions into water in trace amounts which provides a high level of disinfection with no significant downside except the cost and size of equipment. But for various reasons, pack-portable versions of this technology never evolved. But, more interesting has been the technology of mixed oxidants. Mixed oxidants, from the electrolysis of salt water, has been used for commercial water supplies, and is extremely effective (even killing cryptosporidium with just a bit of extra contact time, unlike iodine or chlorine), and is tasteless and nontoxic.

This process electrolyzes a salt brine solution to provide a mixed-bag or chlorine-based oxidants--hypochlorous acid, and various chlorine-oxygen combinations. This won't remove heavy metals, sea salt, or various poisons, but it does a just dandy job for bacteriological purification.

See the company's website at miox.com for more.

I finally invested in a MiOx unit ($130 from rei.com). Having gotten it, I've become even more impressed. Here are the bugs it kills:

- Protozoa, including Cryptosporidium, Giardia, Cyclospora, and Entamoeba histolytica
- Bacteria, including Staphylococcus aureus, Clostridium perfringens, Campylobacter, Salmonella, Shigella and E. coli
- Viruses, including those that cause polio and Hepatitis A

Here are the specs:

- Weight:
    - Purifier: 3.5 oz (99 gm)
    - Complete Kit: 8 oz (227 gm)
- Dimensions:
    - Purifier: 7.1" x 1.0" (18 x 2.5 cm)
    - Complete Kit: 7" x 4" x 1.5" (17.8 x 10.2 x 3.8 cm)
- Operating Temp Range: 20 to 130 F (-6.6 to 54.4 C)
- Storage Temp Range: -20 to 160 F (-28.9 to 71 C)
- Water-Resistant to 60' (18 m)
- Maximum Altitude: 60,000' (18,288 m)
- Batteries: 2 x CR123 lithium camera batteries (6v total)
- Battery Life: 200 +/- liters (depends on dosages)
- Required treatment times for:
    - Viruses - 15 minutes
    - Bacteria - 15 minutes
    - Protozoa - 30 minutes (Giardia)
    - Cryptosporidium - 4 hours

Note that it's lighter and faster to use, more effective, and probably more rugged than any filter.

Basically, it's a thick pen with

- batteries in the bottom,
- an about 10-mL chamber with some rock salt at the top, and
- a little 1 mL reaction cell with an electrode just below this.

You take the salt chamber—which you've previously filled with rock salt—off the very top. There is a keeper strap so you won't drop the salt chamber and lose it.

Taking off the salt chamber reveals the reaction cell, a tiny open well with an electrode in the center. Holding the pen upright, you put 1 mL of water in the reaction cell. You can even just dip the pen in some water to fill it if you wish.

You put the salt chamber back on.

You tilt the pen back and forth several times, so the water travels from the reaction cell into the salt, becoming salty, then goes back into the reaction cell.

The salt stays in the salt chamber due to a small mesh of wire screen on the bottom of the salt chamber.

You then press a button, the salt water electrolyzes (fizz! Fizz!), and voila! you have a mL of tasteless but powerful mixed oxidants.

You dump this in your pint/half-liter to gallon/4L water bottle, shake, check with a test strip to make sure the level of oxidants is high enough, splash some on the threads of your bottle, and wait 20'.

The number of times you press the button determines the concentration of the mix: one button-press for 1/2 L, two presses for 1L, three for 4L. It only takes a couple of seconds for the solution to be created.

The nice thing about this process is that is so quick. At about 30 seconds per treatment, that means in 30 minutes you could treat 60 gallons of water. So, in a pinch, you could treat enough water for your DMAT for quite a while, provided you could find a big enough water container and some way to stir it.

The total weight of the pen, spare salt, a bottle of test strips, instruction card (I laminated mine with some clear shelf paper), and four (two sets of) spare 123 lithium batteries in a plastic protective case, is only about 10 ounces.

I got a 123 battery case ($5.99 from inanycase.com, item 1020-UFPCR123). I kept the case but discarded the foam lining as it was too heavy. Instead, I put the four batteries, double-wrapped in tiny zip plastic bags from the hospital pharmacy, in the case along with the small plastic bag of extra salt which works fine as padding.

For carrying in personal gear, collapsable lightweight water containers are inexpensive, and make a nice addition to a disaster pack. For example, a 2.5-gallon watersack ($10.95 from rei.com, item 402147, or $7.99 from

campmor.com, item 22311) weighs only 2 ounces. And, if you carry just the double inner liner of 3 mil food grade polyethylene, without the outer nylon bag, or get a replacement bladder for this (e.g., $2.99, item 22313 from campmor.com), it weighs an ounce, and folds up into something the size of two matchboxes. An added benefit in a disaster is that there is a lightweight shower adapter for these bags ($5.99 from campmor.com, item 22312). I've used these bags backpacking and climbing for decades and can't find enough nice things to say about them, especially at the price.

I hope this has at least spurred you to think more about your own needs for water when the next disaster hits.

I have no connection with either MiOx, REI, Campmor or inanycase.com except as a satisfied customer.

References

1. Auerbach PS. Wilderness medicine. 4th ed. St. Louis: Mosby; 2001.