

Pretreatment of turbid water to produce drinking water during protracted emergencies



Figure 1
raw turbid
water

Figure 2
chitosan
pre-treated
water

John W. Macpherson, CPESC
Natural Site Solutions, LLC Albuquerque NM
(206) 730-5370

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NATURAL SITE SOLUTIONS, LLC

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Water Purification Theory

During a prolonged emergency when services shut down your first critical need is safe drinking water. A family of four needs about 5 gallons of water per day. That's almost 2,000 gallons in a year (should the emergency extend that long). Since it is impractical for most people to store that much water you will need a way to purify water from a variety of sources; rainwater, ditch runoff, stream water, lake water, etc. Unless you live next to a clear bubbling brook or spring you will likely be dealing with turbid water and you need to be prepared to convert this into safe drinking water. Many believe that their backpacking ceramic water filter will do the trick and with clean enough water they will work well. With turbid water they will fail, however, because they will quickly become clogged with dirt (I know because I sacrificed one doing testing on turbid water – it lasted about 15 minutes and ½ gallon of water before it was rendered inoperable) These ceramic hand pump filters work well and will last nearly forever IF you feed them pre-treated water. This manual describes how to pre-treat turbid water so that whatever secondary treatment system you chose will work long and effectively.

Chitosan-Enhanced Capillary Siphon Filtration

Regardless of the type of advanced filtration/purification system you have (or are planning on acquiring), the chitosan pre-treatment filtration process will allow you to start with almost any type of water – even mud puddle water! Don't worry how muddy or dirty the water is; we will make it safe enough for your baby to drink!

Note of Caution: Sewage water, industrial wastewater, nuclear-contaminated water, seawater, and other sources of highly contaminated water should never be consumed. Stick to streams, rivers, lakes, drainage ditches, irrigation canals, rainwater, and snowmelt. Runoff from metal or tar roofs should not be used as a source for drinking water.

About Chitosan: The chitosan is what makes this system work. Chitosan is made from crab shells and it just happens to have the ability to coagulate (bind together) submicron-sized sediment particles, metals, oils and debris that would take weeks to settle out naturally. It also makes small particles large enough that they can not be transported through the capillary filter media so all you get is clean water. Chitosan is a 100% natural polysaccharide (simple polymer sugar) so it's completely non-toxic to people and pets. Even so, the chitosan binds to the sediment and does not pass through the filter system.

Natural Site Solutions:

We are Natural Site Solutions in Redmond, WA, Albuquerque, NM, and Sacramento, CA and we develop water treatment technologies for purifying construction stormwater, mine drainage, dredging wastewater, industrial stormwater and wastewater and just about any kind of water that needs to be purified. We are currently working in Africa and Asia to support technologically-appropriate drinking water solutions for resource-limited communities. We love to network so feel free to call John in Albuquerque at (505) 238-5986 or in Seattle at (206) 730-5370.

Our company is in the process of patenting several aspects of this technology so we ask that this technology be used for personal applications only, no commerce please. At this time and we are working out a distribution network for the chitosan.

Chitosan-Enhanced Capillary Siphon Filtration Materials List:

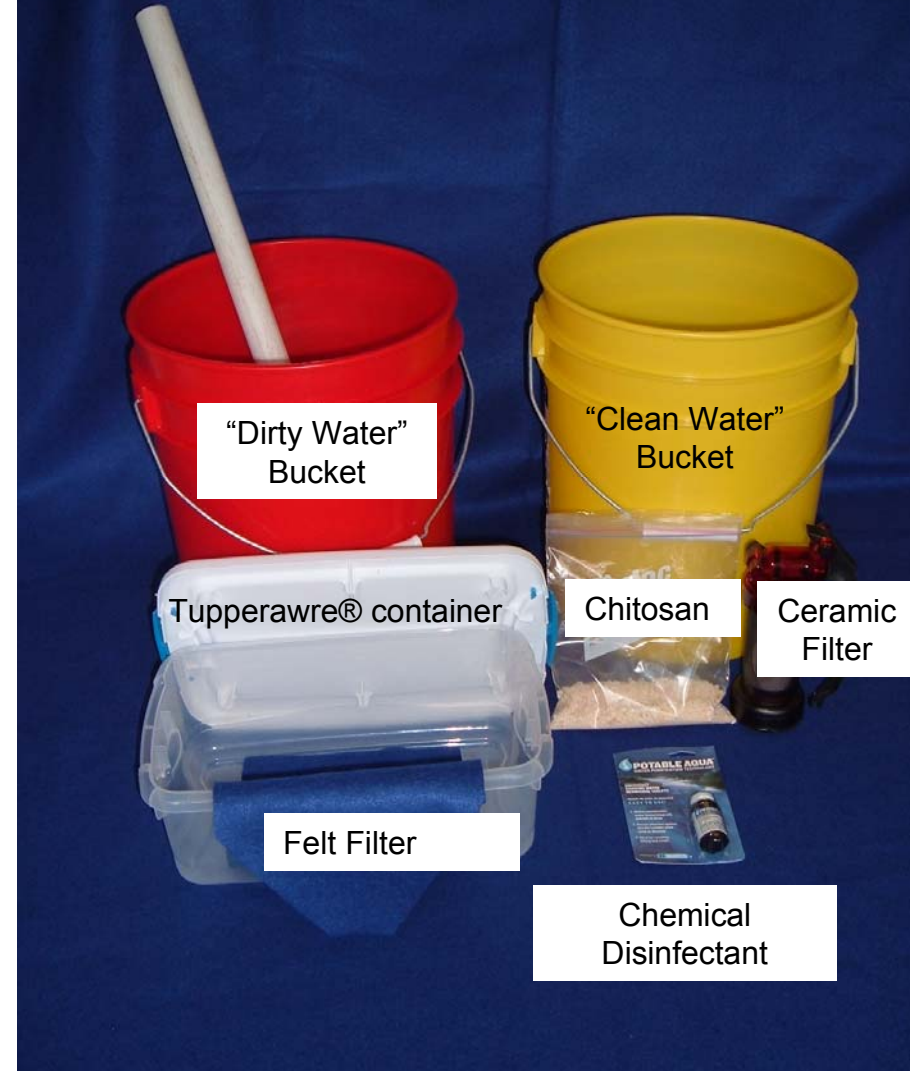


Figure 3 Materials Lists

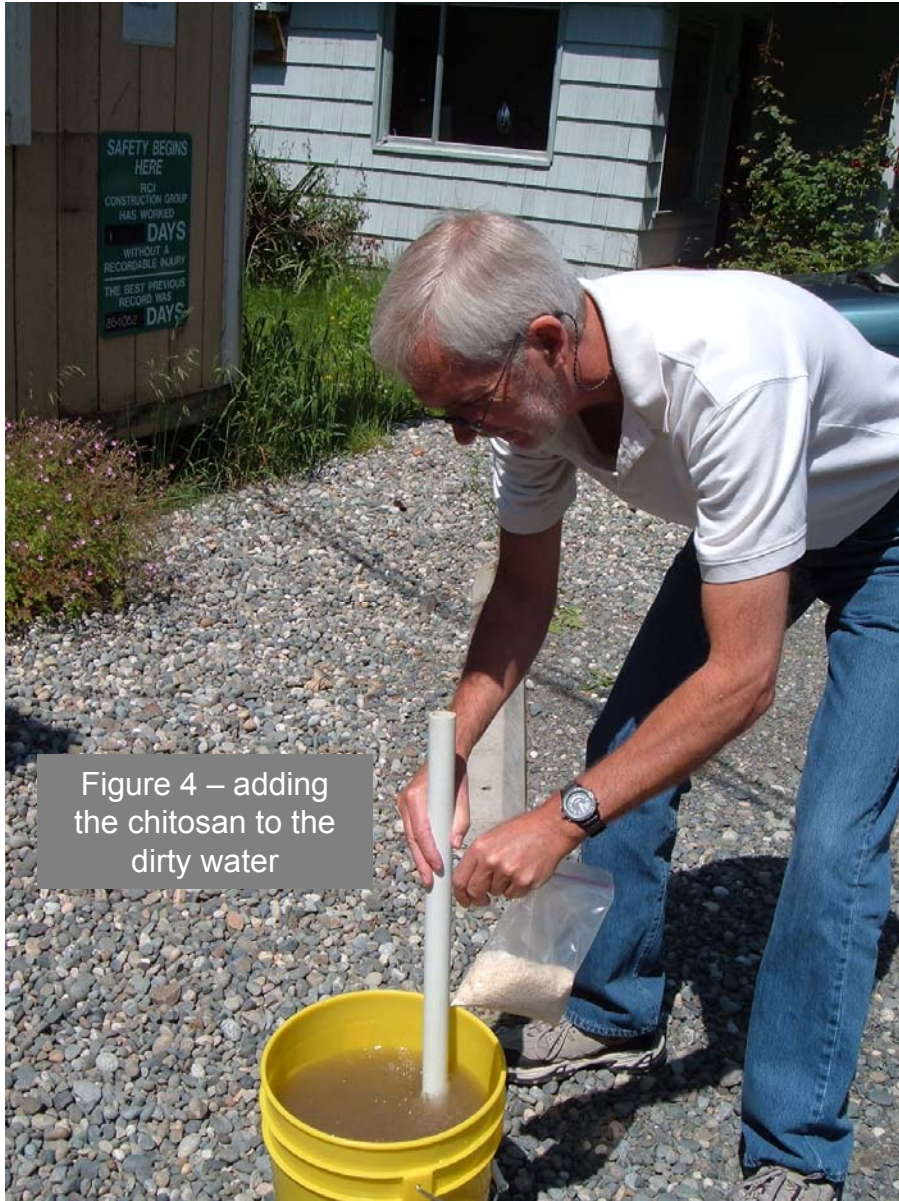


Figure 4 – adding the chitosan to the dirty water

STEP ONE: COLLECTING TURBID WATER

Collect about 5 gallons of water in the DIRTY-water bucket (please review the types of water that will not work with this system).

Next add a pinch (about a gram) of the chitosan and stir for two minutes. Dirtier water may take a little more stirring.

What you should see is the coagulation (granulation) of the sediment particles.

Now, let the bucket sit for about an hour to allow most of the sediment to settle to the bottom of the bucket. Don't worry if the water is still somewhat turbid. If the water does not respond to chitosan treatment check with standard pH paper and be sure that the pH is within 7.0 to 9.0. (you can get pH paper at any pool and spa store or aquarium outlet.

For low pH conditions add a pinch of baking soda and for high pH conditions add a small amount of lime juice.

Pour the chitosan-treated water into the Tupperware container – fill right to the top.

Place the “Clean” bucket directly under the felt filter.

Watch to make sure the filter begins working (it should begin dripping in 1 to 3 minutes).

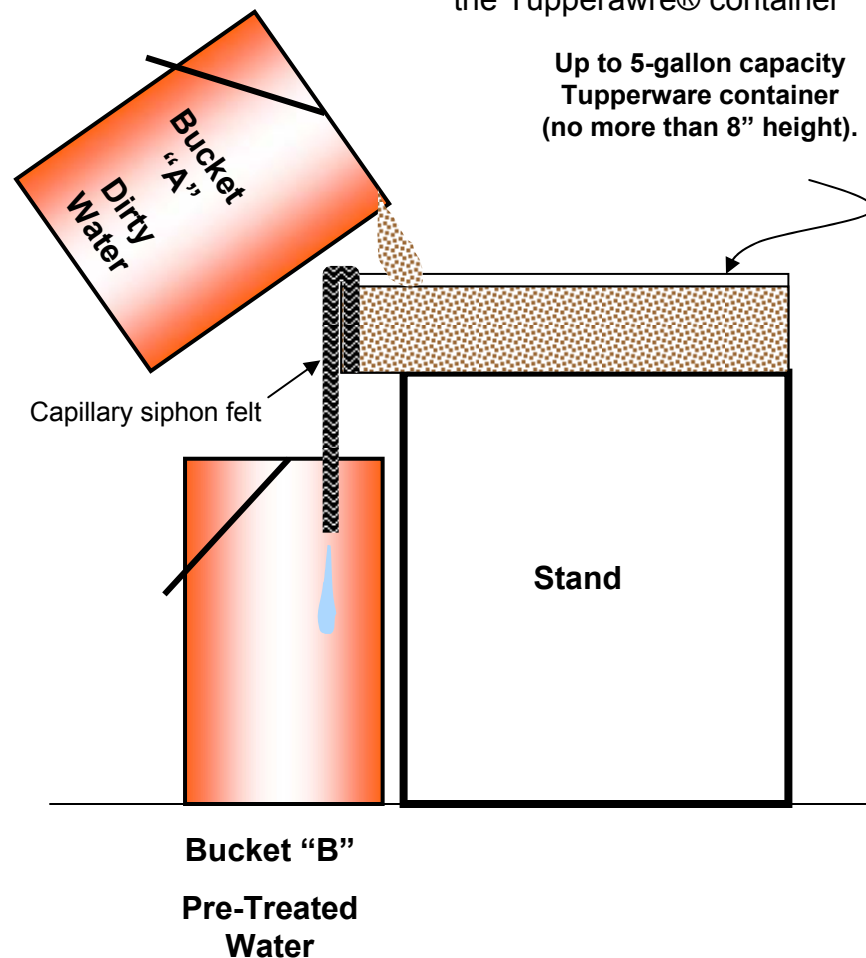
To start a stubborn filter submerge it in clean water first and/or pour a little clean water over the felt to encourage it.

Now, just let it do its work. In about an hour the “clean” bucket will be full of clear, pre-treated water.

But don't drink it yet!

Now you have 5 gallons of nice pre-treated water which you can make safe to drink by using any of a number of commercial certified filter systems. We are going to use the ceramic backpacking filter with a chemical disinfectant.

STEP TWO: PREPARING TO FILTER TURBID WATER





Figures 6 & 7 Showing Preparation for filtration



STEP THREE: HELPFUL HINTS

Position the Tupperware® container (remember it should have a depth (height) of less than 8 inches regardless of its volume) with one end extending just over the edge of the table. Fill the Tupperware® container right to the top (within $\frac{1}{4}$ inch).

Now you are ready to use the felt capillary filter to separate the dirt from the water.

We suggest using commercially-available craft felt made from polyester fibers but cotton will also work. In any event be sure to wash the felt before using to remove the chemicals that most modern fabrics are treated with.

The size of you felt filter will depend on how big you system is but we generally use two pieces of felt (placed together) so that they will fit in the Tupperware® and yet fit in the bucket. Feel free to experiment as we have found that more felt increases the filtration rate.

The really important thing is that the felt hangs well below the Tupperware® into the bucket. This, of course, creates the siphon effect.

Remember to use clips of some sort (we use office binder clips) to keep the felt from slipping out of the Tupperware® and into the bucket. Paper clips work also.



Figure 8 Capillary filtration of turbid water

STEP FOUR: LET'S FILTER

Place the CLEAN 5-gallon bucket directly under the felt filter. The trick is to wet the felt filter and immediately place it in the Tupperware® container with the extended end hanging in the CLEAN 5-gallon bucket. This will start the filtration process immediately.

You can also pour a little clean water over the felt to get the process started more quickly.

Now observe the felt filter to see that water is dripping from the felt into the bucket and let it do its work. In about an hour the CLEAN bucket will be full of clear, pre-treated water.

But don't drink it yet!



Figure 9 addition of chemical disinfectant

Step Five Pre-treatment

STEP FIVE - CHEMICAL DISINFECTANT OF PRE-TREATED WATER

The U.S. Environmental Protection Agency has developed strict guidelines on how to treat water that is safe to drink. What we have accomplished so far is to pre-treat turbid water so that these government regulations and procedures will be effective. The preceding chitosan pre-treatment measures will not be effective against a host of viruses, bacteria and biological contaminants such as Giardia. We therefore recommend following standardized protocol available wherever water purification technology is sold (such as REI). Chemical disinfectants including chlorine and bromine are quite effective in inactivating the avian bird flu virus but many people are averse to the after taste of using these powerful and toxic agents.

One of the easiest ways to eliminate these objectionable after tastes is to use a carbon filter which has the ability to absorb these chemicals without compromising the quality of the treated water.

Yes, it adds a degree of complexity to your system but for those of us with chemical sensitivities it can be well worth the effort. A typical carbon filter is a common commercial product sold now at Home Depot, Wal Mart, and most hardware stores. The critical element is to purchase the correct plumbing fittings that will attach to your backpacking ceramic filter device. Remember that you will be pumping your water by hand. I have had excellent help at local hardware stores where I have brought in my components and asked for help in selecting the appropriate fittings for connecting the tubing.

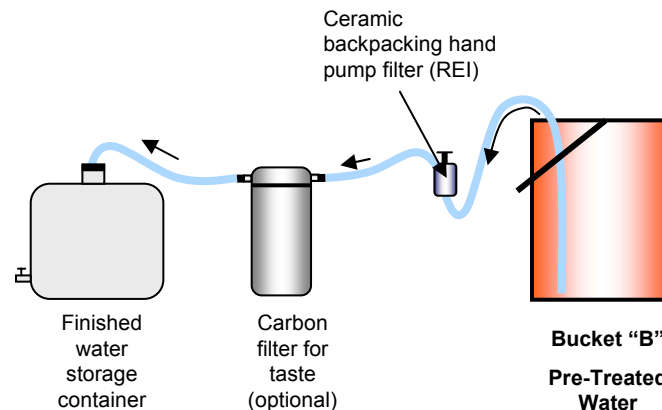


Figure 10 ceramic filtration and carbon filtration for the finished water product

Congratulations, you've done it!

You now have the ability to easily convert mud puddle water into fresh, clean and safe drinking water for you and your family during an emergency.



Final Note of Caution:

Remember that sewage water, industrial wastewater, nuclear-contaminated water, seawater, and other sources of highly contaminated water should never be consumed with or without pretreatment. Stick to streams, rivers, lakes, drainage ditches, irrigation canals, rainwater, and snowmelt.

Metal contaminants and other questionable sources of water should be not considered for use with this technology.

Natural Site Solutions offers these guidelines in the case of catastrophic infrastructural failure and make no claims for the efficacy of its technology.