The Prepper's Guide To Emergency Water Purification

We all know that water is essential for life. But do you know how to make it safe to drink? Drinking untreated open ground water or contaminated municipal water can be a catastrophic mistake with serious health consequences. As a survivalist or prepper you should strive to know everything there is to know about making water safe to drink and this guide will set you well on your way to becoming an expert at water purification / disinfection / sterilizing, etc.

As you will see in the material below no one method of water purification *guarantees* that your water will be safe to drink. In many instances it may be necessary to combine at least two methods to ensure the highest degree of safety.

According to the World Health Organization:
*"Waterborne Disease is World's Leading Killer. The World Health Organization says that every year more than **3.4 million people** die as a result of water related diseases, making it the leading cause of disease and death around the world."*

There are several types of contaminants that can possibly make water unsafe to drink. Bacteria, Viruses, Cysts, Parasites and Protozoa are the most common types of waterborne pathogens. Additionally, there are other things that can make water equally unsuitable for consumption such as salt, petroleum products, Volatile Organic Chemicals (VOCs), oils, chemicals, pesticides and heavy metals.

This guide will address both wilderness survival and home disaster preparedness water purification techniques. There are essentially four primary ways to make water safe to drink. Through the application of heat, ultraviolet light, filtration or by chemically treating it. We will go into each method in great detail in the paragraphs to follow.

It should be noted that there are technical differences in the meanings of purification / disinfection / sterilizing. However, the differences are not important for this guide and I will use them interchangeably throughout. For the purposes of this guide all three mean to make the water potable for human consumption.

The Prepper's Guide To Emergency Water Purification

PURIFYING WATER THROUGH THE APPLICATION OF HEAT: BOILING WATER

Boiling water is universally recognized as the best way to make water safe to drink for most situations. The Center for Disease Control (CDC) recommends boiling water (at a hard rolling boil) for one minute if you are at 6562 feet (2000 meters) or less in elevation. If you are above 6562 feet (2000 meters) then you should boil it for three minutes.

Boiling water that is acquired from a backcountry open ground water source will likely make it safe to drink. If you are acquiring your water from an urban open water ground source or an open water ground source that is close to agricultural areas then you may need to consider combining both boiling and filtering in order to remove chemicals, pesticides, petroleum based products, heavy metals, etc.

Important Note: Boiling brackish or salt water will not make it safe to drink. Also, if you suspect the water to be contaminated with chemicals, pesticides, or petroleum based products or extremely high levels of heavy metals, boiling will likely not be effective as a stand alone method. You should pre-filter the water through a manufactured water filter that incorporates an activated charcoal filter element that is designed to remove those types of materials in order to remove those harmful elements.

In a backcountry setting water can be boiled in any metal container, pot, bottle, bowl, or pan, etc. Be sure to leave the container lid loose or completely off so as not to build up dangerous amounts of pressure that could cause the container to rupture.

In an emergency when a metal container cannot be located it is possible to boil water in a plastic water bottle. However, you should *do so at your own risk* because the water could possibly become contaminated with chemicals from the bottle during the boiling process. It would likely still be somewhat safe to drink in small quantities but you would not want to use this method on a regular or ongoing basis. Make sure the cap is off or loose if you decide to try this method.

You can also boil water in an emergency by digging a hole in the ground and lining it with a tarp or heavy plastic sheet, animal skin (hair side down) or some other water proof material and then filling the lined hole with contaminated water. Then one at a time place rocks that have been heated up in a camp fire in the water until it starts to

boil. **Note:** *Be sure not to heat up rocks that contain a high amount of moisture as it may be possible for them to explode (I use that term loosely) and injure someone if they get too hot.* You should also make sure to use a set of tongs or thick leather gloves to move the rocks from the fire into the water. Obviously it makes sense to make sure that the rocks are as clean and debris free as possible before adding them to the fire and water. You may also want to consider post-filtering the water through an improvised water filter (handkerchief or shemagh, tee shirt, etc) in order to make it more palatable.

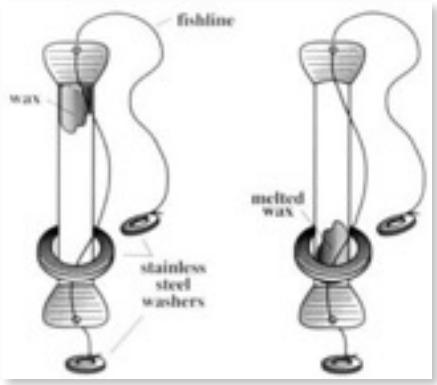
The Prepper's Guide To Emergency Water Purification

PASTEURIZING WATER

Believe it or not boiling water is a bit of overkill but it is a good method of water purification because the person can visually see the water boiling in order to be able to confirm that the water is safe. Pasteurization is another method of making water safe to drink through the application of heat. To pasteurize water you must bring the temperature of the water up to 149 degrees Fahrenheit or 65 Degree celsius according to the National Center For Biotechnology Information (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC91110/).

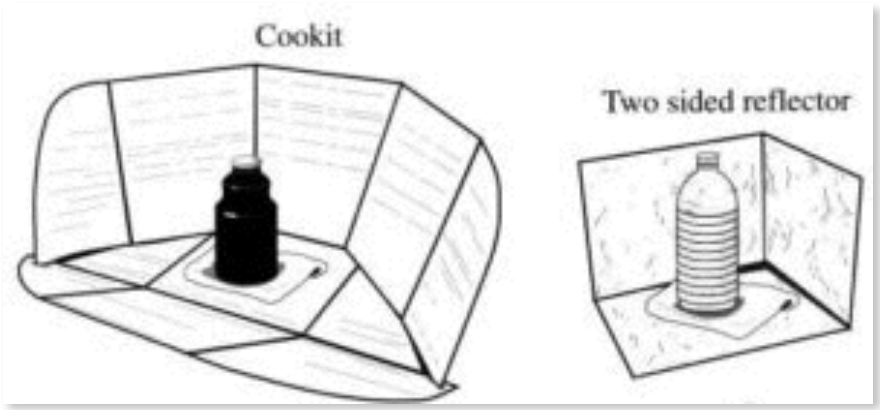
However, one of the big down sides to pasteurization is that you cannot visually verify that the water has reached the appropriate temperature to know that it is safe to drink. Therefore to use this method safely and reliably the person must either have a thermometer for measuring the water temperature or they have to utilize a Water Pasteurization Indicator (WAPI).

The Prepper's Guide To Emergency Water Purification



A WAPI is a polycarbonate tube that is weighed on one end and has a small amount of soy wax inside the tube. It also usually has a string connected to it to make it easier to pull out of the water. The WAPI is inserted into the water vertically and when the soy wax melts and slides to the bottom side of the tube you know the water has reached 158 degrees Fahrenheit or 70 degrees Celsius which means that the water is now safe to drink (because it is hotter than the 149 degree requirement to pasteurize water).

You can then remove the WAPI and allow it to cool again and flip it over and it is ready to reuse. The great thing about pasteurizing water is that it takes about 50% less fuel than boiling. In most regions it is also possible to pasteurize water by combining a solar oven or reflector oven and the heat from the sun. There are multiple popular commercial Solar Ovens that will cook food and pasteurize water even on colder days by reflecting the suns light into the center of a darkened box that contains the food or water. For more information on Solar Ovens and water pasteurization click this link (https://www.realitysurvival.com/american-sun-oven-review/).



Important Note: Pasteurizing brackish or salt water will not make it safe to drink. Also, if you suspect the water to be contaminated with chemicals, pesticides, or petroleum based products or extremely high levels of heavy metals, pasteurizing not be effective as a stand alone method. You should pre-filter the water through a manufactured water filter that incorporates an activated charcoal filter element that is designed to remove those types of materials in order to remove those harmful elements.

The Prepper's Guide To Emergency Water Purification

DISTILLING WATER

Distilling water is another way that you can make water safe to drink through the application of heat. In this process you will need to build or purchase a distiller (AKA a "still") (Amazon Link: https://amzn.to/2NZUuwg). There are multiple different types of manufactured water distillers on the market. Some like the one pictured above run off of electricity and others like the *Survival Still* (Amazon Link: https://amzn.to/2X6qK5e) can be used with an open heat source.

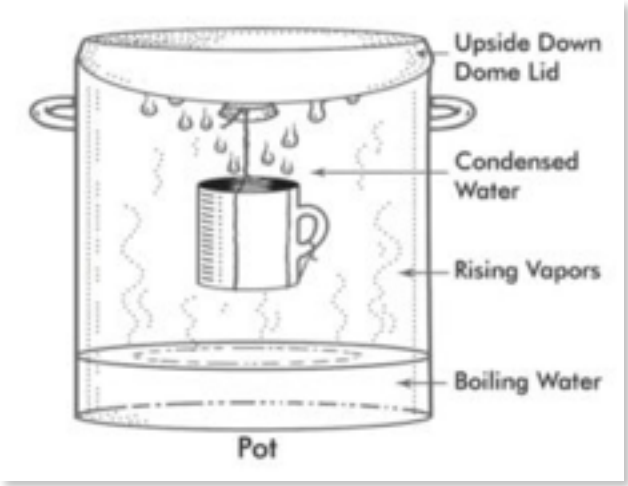
Essentially what happens in this process is that you apply enough heat to get the water to boil and then evaporate, then you force the evaporated air out through a cooling tube and cause it to condense back into precipitation and then you capture that now pure water to drink.

Note: If there are chemicals in the water that have a lower boiling point than water it is possible that those chemicals could also evaporate and re-condense in the recaptured "pure" water. While this is fairly unlikely it is worth noting especially if you were gathering the water in area that had chemicals or pesticides used on a regular basis.

To create a DIY still just fill a metal container with a lid that will seal tightly approximately 2/3 full of water and place it over a fire or other heat source. In the lid you will need to attach a copper tube that is approximately 18" to 24" long that will allow the evaporated water / steam to escape through. As you heat up the water it will begin to evaporate and turn into steam, as it escapes through the copper tube in the lid it will begin to cool and condense into solid water again on the sides of the tubing. You can also place a cool moist cloth over part of the copper tube to help keep it cooler which will help expedite the condensation process. The condensed water will then drip out of the tubing into your catch container. The water you have in the catch container will now be safe to drink (*provided there were no chemicals in the source water with a lower boiling point than water*).

The Prepper's Guide To Emergency Water Purification

One of the biggest advantages of distilling water is that you can use salt water as your initial water source and through the process of distilling it will then become safe to drink! Few other water purification methods can make salt water safe to drink.

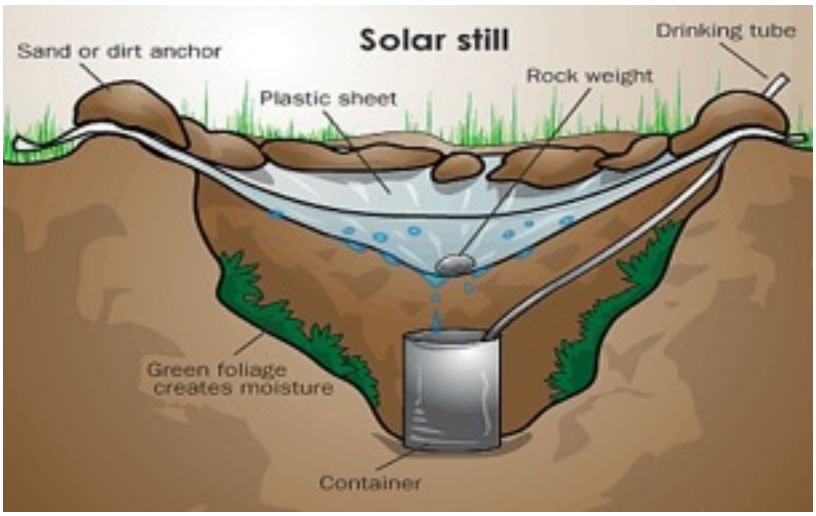


The picture to the left is another method of distilling water with everyday items that can be found in most households.

Note: Distillation should remove all microorganisms, heavy metals, organic compounds, most chemicals and even some radioactive solids or fallout particles. However, if there are chemicals in the water that is being boiled it is possible that some of the chemicals could also evaporate and re-condense in with the good water depending on their boiling point. Additionally, the process of distilling will remove all trace minerals and will essentially be pure H20, which will not be a problem for most people for short term situations as long as you are getting trace minerals through other sources in your diet. If you are drinking distilled water over long periods and are not consuming any other trace minerals this could at some point begin to cause a mineral deficiency. Lastly, though distilling may remove some radioactive fallout particles, if the water has been irradiated with gamma or X-rays the process of distilling it will not make it safe to drink.

It should also be noted that while distilling water for emergency use is not illegal in most states, owning an alcohol still that is capable and manufactured for the purposes of distilling alcoholic spirits is illegal or at least requires a permit in 42 states. If you are going to purchase a still that is capable of distilling alcohol you should check your states laws and federal laws before purchasing.

The Prepper's Guide To Emergency Water Purification



Many survival manuals give examples of how to make a solar survival still like the one pictured above and they do make water. Albeit a very little bit of water. Based on my experience with these types of solar survival stills I am not sure that the benefit outweighs the expenditure of energy that a person has to use to construct it. Generally speaking you will likely get less than 1/2 cup of water in good conditions. In extremely hot and dry conditions you will get much less water than 1/2 cup. So if you are going to use this method just be sure the risk is worth the gain for your situation.
You can also learn about another type of DIY Solar still in this post: https://www.realitysurvival.com/build-solar-survival/.

The Prepper's Guide To Emergency Water Purification

TRANSPIRATION BAG

Getting water through transpiration is another method that you can gather drinkable water through the application of heat / sunlight. This process is called a Transpiration bag. To make a transpiration bag locate a non-poisonous tree, shrub or plant that is situated in direct sunlight. Then take a clear plastic bag and put a small pebble in one corner of the bag and then carefully place the bag around the branch of a tree and tie it off tightly. Be sure not to have any holes in the bag or this method will not work. Then let the bag sit in the sun for several hours. The heat from the sun will pull moisture from the plant, shrub or tree out into the bag and the water will condense on the sides of the bag and then drip down into the lowest spot of the bag near the pebble.

Be sure to pull the transpiration bag down before the sun begins to go down, because the tree, shrub or plant will begin to reabsorb the moisture when the temperature starts to drop. Also make sure that the tree, shrub or plants, leaves are not touching the water because it may also reabsorb the water through them as well.

This method is quite similar to distilling, however one thing that should be noted is that if the tree, shrub or plant is a poisonous plant the water that it produces in this method could also have poisonous characteristics or be poison and make you sick. So be sure to ***only use nonpoisonous plant, shrubs or trees!*** Also the water that is produced using this method can potentially have a lot of tannin in the water which could cause some people to have an upset stomach or even diarrhea. So this method is really a method of last resort to be used in emergencies only.

The Prepper's Guide To Emergency Water Purification

PURIFYING WATER THROUGH THE APPLICATION OF ULTRAVIOLET LIGHT

Ultraviolet light is another method of making water safe to drink, though like all of the other methods listed it does also have some limitations. Ultraviolet light is used in large scale water purification, in households and in portable back country methods as well. In all of the methods the science is essentially the same.

WaterPurifier.Org (www.waterpurifier.org/ultraviolet-water-purifiers/) explains how the process works below:

"Ultraviolet (UV) light is invisible and is emitted by different light sources, including the sun. At certain intensities, UV light emits enough radiation to kill the DNA in bacteria and other microorganisms. An ultraviolet water purification system typically consists of a UV light source with an output of around 254 nanometers which produces radiation of a significantly greater intensity than the radiation produced by sunlight.

The UV light source is mounted in front of a flow chamber through which water passes. The water is exposed to the UV light source as it passes through the chamber. Any harmful microbes and bacteria that are present in the water are rendered sterile by the exposure to the germicidal radiation.

UV radiation is so effective that it can eliminate up to 99.99% of bacteria and viruses, including those associated with water-borne illnesses such as Typhoid, Gastroenteritis, Hepatitis, Flu and Cholera.

UV water purification can be used to treat water whether it's from a municipal water supply, a drinking-water well, lake or a spring.

As remarkable as the technology is, ultraviolet water purification by itself is not enough to render water completely safe for drinking purposes. That's because UV radiation works only on microorganisms such as bacteria and viruses. UV light is of little use in eliminating other contaminants in water such as chlorine, heavy metals and VOC's (Volatile Organic Compounds)."

Important Note: Using ultraviolet light to sterilize water will not make brackish or salt water safe to drink.

The Prepper's Guide To Emergency Water Purification

SOLAR DISINFECTION (SODIS)

The Solar Disinfection (SODIS) method of purifying or more technically accurate sterilizing water is a simple process that uses the ultraviolet rays of the sun to sterilize the microorganisms in the water.

To use the SODIS method just follow these easy steps:

1 Locate a plastic bottle or glass bottle that is 3 liters or less in size. If plastic make sure it is a recycling code of "PETE 1".

2 Make sure the bottle is clear not tinted and not too heavily scratched or marred.

3 Pre-filter the water through a couple of layers of cloth to remove as much turbidity as possible. You want the water as clear as possible.

4 On a clear and sunny day the bottle will need to stay out in direct sunlight for at least 6 full hours.

5 If it is a partly cloudy day (more than half the sky covered in clouds) the bottle will need to stay out in the sunlight for two full days.

6 The ambient temperature does not affect the process however, the water cannot be frozen.

NOTE: This method does not make brackish or saltwater safe to drink.
Also, if you suspect the water to be contaminated with chemicals, pesticides, or petroleum based products or extremely high levels of heavy metals you should pre-filter the water through a manufactured water filter that incorporates an activated charcoal filter element that is designed to remove those types of materials in order to remove those harmful elements.

Below is a video that describes the SODIS process that is outlined above as well.
Reality Survival's Video on SODIS: https://youtu.be/Kd1aUrQxgIE

The Prepper's Guide To Emergency Water Purification

PORTABLE ULTRAVIOLET WATER PURIFIER: STERIPEN

Another popular backcountry method of water sterilization with ultraviolet light is to use a Steripen (Amazon Link: https://amzn.to/2CqXdeW). A Steripen is a small and portable ultraviolet light that is designed for hikers and backpackers to purify small amount of water usually one liter at a time. Of course this product could also be used in a household during an emergency.

One of the benefits to this device is that it is capable of killing up to 99.99 of bacteria, viruses and protozoa. There are very few if any water filters on the market today that are truly capable of killing or filtering out water borne viruses, even though so many manufactures seem to make claims to the contrary. To use the Steripen just turn the unit on and gently stir it around in the contaminated water (ideally in a 1 liter or qt container) for at least 90 seconds and you are done! It is very simple and easy to use.

The downsides to the Steripen are that you may need to pre-filter the water because this method does not work well with water that has a lot of turbidity in it. Steripen sells a small inexpensive pre-filter (Amazon Link: https://amzn.to/2CIYOIS) you can get as well.

Note: A Steripen will not make brackish or salt water safe to drink and it does not remove any heavy metals, chemicals, volatile organic chemicals, etc. All it does is kill / sterilize the microorganisms that are present in the water. Using a steripen in conjunction with a high quality water filter like a Katadyn pocket water filter (Amazon Link: https://amzn.to/2BRHDYA) with the Katadyn Carbon Cartridge (Amazon link: https://amzn.to/2GO9Mzg) will give you outstanding results!

The Prepper's Guide To Emergency Water Purification

WHOLE HOUSE ULTRAVIOLET WATER PURIFIERS

There are also a wide variety of whole house or under the sink mounted ultraviolet water filters on the market that can be installed in your home. These units are typically installed in line with the plumbing of the home and require electricity from the grid to be functional in most cases. The prices on these systems vary widely depending on what model you choose. Be very careful which system you chose because the quality of these items seems to vary a great deal from manufacturer to manufacturer. These items are not the best to rely on in an emergency situation since they require electricity to be operational but if you have a viable way of making electricity during a grid down situation then they could of value to you.

The Prepper's Guide To Emergency Water Purification

PURIFYING WATER BY FILTRATION

Using a water filter to purify or filter water is a very popular option especially for people who like to go hiking, camping, hunting, etc. But they are also popular for use in homes, especially those with water wells on the property. When filtering water we are essentially passing water through smaller and smaller areas in order to keep the harmful pathogens, bacteria, protozoa and cysts from coming through the filter with the clean water. The water filtering industry at large uses a measurement called a micron to explain the filtering capability of a particular filter.

A micron is a unit of measure in the metric system equal to 1 millionth of a meter in length (about 39 millionths of an inch). The average cross-section of a human hair is 50 microns. A micron rating is used to indicate the ability of a liquid filter to remove contaminants by the size of the particles.

Bacteria, Viruses and Cysts all range in size so lets take a look at what the Water Quality Association (https://www.wqa.org/Learn-About-Water/Common-Contaminants/Bacteria-Viruses) says about the sizes of all three:

"*Although some waterborne microbes can cause illness, many microbes are harmless or even beneficial. Very small levels of microbes are naturally present in many water supplies, but some are more dangerous than others. Some of the more dangerous microbial contaminants, such as E. coli, Giardia, and Cryptosporidium, can cause gastrointestinal problems and flu-like symptoms commonly attributed to undercooked or improperly stored food. They include:*

Bacteria: *Single-celled organisms lacking well-defined nuclear membranes and other specialized functional cell parts which reproduce by cell division or spores. Bacteria may be free-living organisms or parasites. Bacteria (along with fungi) are decomposers that break down the wastes and bodies of dead organisms, making their components available for reuse. Bacterial cells range from about 1 to 10 microns in length and from 0.2 to 1 micron in width. They exist almost everywhere on earth. Some bacteria are helpful to humans, while others are harmful.*

Viruses: *Parasitic infectious microbes, composed almost entirely of protein and nucleic acids, which can cause disease(s) in humans. Viruses can reproduce only within living cells. They are 0.004 to 0.1 microns in size, which is about 100 times smaller than bacteria.*

Cysts: *Capsules or protective sacs produced by many protozoans (as well as some bacteria and algae) as preparation for entering a resting or a specialized reproductive stage. Similar to spores, cysts tend to be more resistant to destruction by disinfection. Fortunately, protozoan cysts are typically 2 to 50 microns in diameter and can be removed from water by fine filtration."*

The Prepper's Guide To Emergency Water Purification

So when you are buying a water filter for backcountry and emergency usage you want to ensure that you get a filter that is at least capable of filtering out all substances that are .2 microns or larger. Also any water filter that claims that it can remove 99.9% of viruses is not being truthful unless it has a filtration capability of .004 microns!

Now lets take a look at some of the different types of water filters that are commonly available on the market today.

The Prepper's Guide To Emergency Water Purification

GLASS FIBER FILTERS

Glass Fiber water filters are made using a small cartridge that has a multiple layers of glass fiber material that only allows particles through that are smaller than .2 microns. They will filter out bacteria, protozoa, cysts, algae, spores and sediments.

They will not remove viruses or salt. In camping and hiking water filters these are typically a little cheaper in cost (About $50 to $80) and usually have a shorter shelf life because the cartridges cannot effectively be cleaned of an re-used. Once the cartridge is clogged it will need replaced. Using pre-filters and a porous micro-screen over the cartridge can help to extend the life of these types of filters. They will typically filter about 200 gallons of water before they need a new cartridge.

The benefits to these filters is that they are fairly lightweight at around 11 ounces and the flow rate is pretty good as well at about 1 liter per minute and they are easy to pump. They also don't clog easily which eliminates the need for constant back flushing like some of the other filters out there. The Katadyn Hiker (https://amzn.to/2FKQoDL) and Katadyn Hiker Pro (Amazon Link: https://amzn.to/358gT1s) are two basic examples of water filters that use glass fiber filtering technology, they also incorporate activated carbon granules to help improve taste, remove bad odors, etc.

The Prepper's Guide To Emergency Water Purification

CERAMIC BASED FILTERS

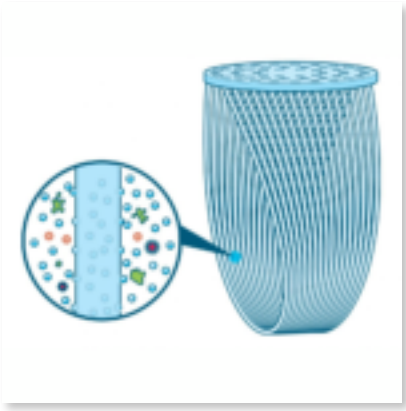
These are my personal favorite types of water filters. Ceramic based filters are usually constructed with a more heavy duty body and are not as fragile as some water filters like the Sawyer line of filters. The other great thing about most ceramic filters is that they are field cleanable. If they get clogged up, just take a small piece of Scotch Brite pad and scrub the ceramic element until it is clean and it is good to go again! Ceramic water filters also usually have a fairly long life span, many will filter over 10,000 gallons! Their flow rate is comparable to most other units at 1 liter per minute as well. The downside is that they tend to weigh a little more than Glass Fiber units. The Katadyn Pocket Water filter comes in at about 20 ounces, so nearly twice the weight of the Katadyn Hiker or Hiker Pro water filters. The other downside is that they are pretty expensive. The Katadyn Pocket comes in at around $280.00 retail. But these filters will last you a lifetime!

A common misconception with some silver impregnated ceramic water filters like the Katadyn Pocket is that the silver will kill viruses as the water is filtered but that is not actually the case, the silver impregnation in the filter is to kill any organisms in the filter when it is in storage to prevent bacteria or micro logical growth when it is not in use. Like other water filters these units will not remove viruses, salt and some chemicals or radiation. It is best to use water filters in combination with a chemical water purification pill or other chemical treatment that will kill or render viruses unharmful or a Steripen or other commercially available ultraviolet light source to kill off any possible viruses. You can also pair ceramic based water filters with an activated carbon / charcoal unit to also remove bad odors, and tastes as well as any chemicals or VOCs.

Katadyn pocket water filter (Amazon Link: https://amzn.to/2BRHDYA) with the Katadyn Carbon Cartridge (Amazon link: https://amzn.to/2GO9Mzg) will give you outstanding results!

The Prepper's Guide To Emergency Water Purification

HOLLOW FIBER MICRO-TUBE FILTERS



These types of filters have become quite common in recent years and there are some very good reasons for their popularity! Many of these types of filters claim to be able to filter ridiculous amounts of water. The Sawyer Mini Water filter boasts the ability to be able to filter 100,000 gallons of water! The reason they have an ability to filter such high amounts of water is that they are built in such a way that enables them to be backwashed quite easily in the field.

Most of these units will come with a backwash pump so that the user can do this often and frequently in the field. One reason they will need to be backwashed frequently is that they offer filtration down to .1 microns which is twice as small as a .2 micron filter. So these filters are fairly easy to clog if you are filtering water with a high amount of turbidity. But back flushing is easy so no big deal. These units are also very lightweight. The Sawyer mini weighs in at about 2 ounces. The Sawyer Mini can also be utilized in a variety of ways that make it very practical. They can be placed in line with your hydration bladder or you can screw them to many types of water bottles or you can just use the included pouch.

The downsides to this filter however are pretty significant. If the hollow fiber micro-tubes become damaged during backwashing and develop holes in them there is no way to know that they are broken because the unit is sealed up and you cannot inspect it in any way.

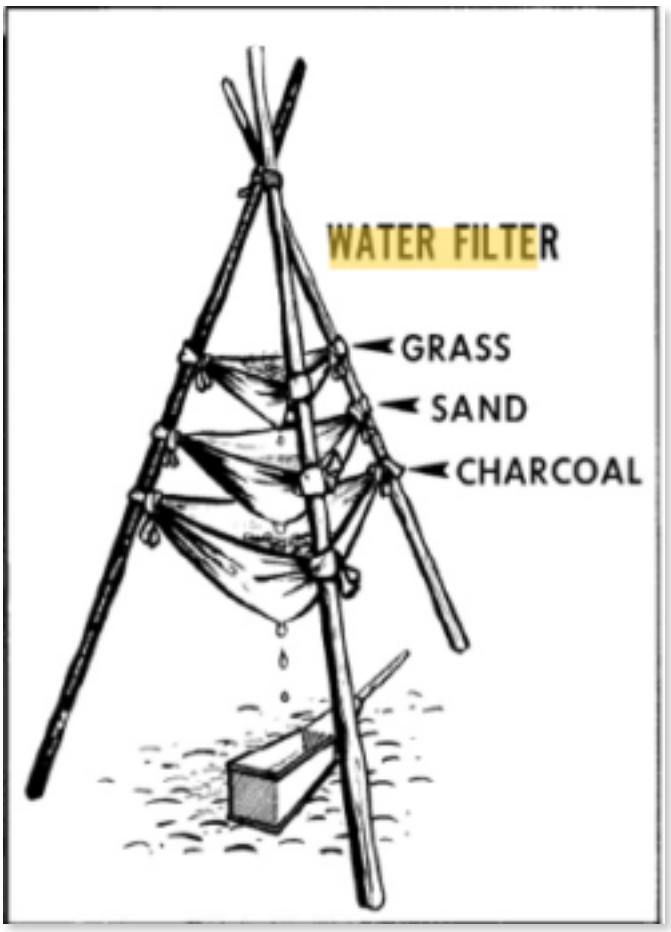
Similarly if the filter freezes after it has had water in it Sawyer (https://sawyer.com/products/mini-filter/) says this "*While there is no definitive way to tell if a filter has been damaged due to freezing,* ***Sawyer recommends replacing your filter if you suspect that it has been frozen.***"

With other types of filters like a ceramic filter or a Glass fiber filter you can at the very least do a visual inspection of your filter element. Though it is not a good idea to let any water filter freeze if it has water in it, because the expansion of the freezing water can damage it. As Sawyer indicates with the Hollow Fiber Micro-Tubes there is not a way to visually verify anything inside of the unit.

At a minimum you should replace all hollow fiber type water filters at least once per year. Lastly, these types of filters should be stored in a cool dry place. If they are stored in a place with high temperatures the micro tubes can also become dried and brittle over the span of several years. Be careful with them and don't back flush too forcefully and whatever you do, do NOT let them freeze!

The Prepper's Guide To Emergency Water Purification

DIY ACTIVATED CARBON OR CHARCOAL FILTERS



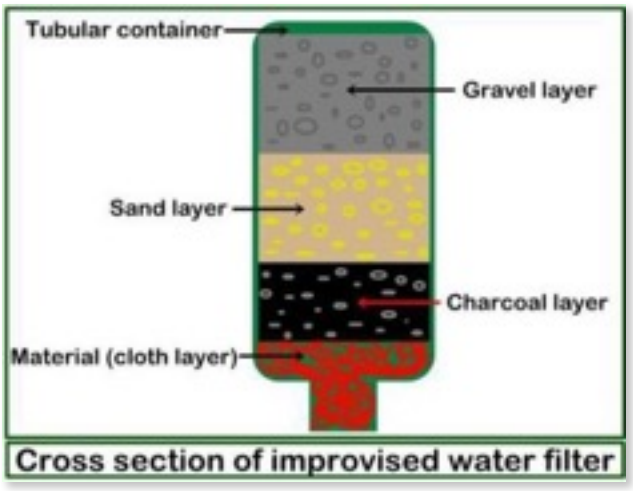
Many survivalists and preppers will likely associate activated carbon or charcoal filters with a type of DIY filter that can be made using grass, pebbles, sand, and a layer of charcoal all separated by three layers of cloth and set up in a teepee fashion. This is an iconic picture that many people have seen over the years and it is also typically associated with military survival manuals. The only problem is that while that type of filter does make water "safer" to drink it does not guarantee that it is 100% safe to drink.

Activated carbon does do a great job at removing many bad tastes and odors as well as potentially removing volatile organic chemicals and even some heavy metals and radio nuclides. It does this through the process of adsorption and catalytic reduction. You can learn more about that process by clicking on this link: (all-about-water-filters.com/guide-to-charcoal-water-filters/). One problem is that an improvised filter of this nature will not necessarily do a great job at removing bacteria, cysts, protozoa or viruses. It may remove some or even most but it is not a guarantee that you will have 100% safe water. So use with caution and understand the risks.

Another problem with homemade Charcoal is that it does not have the same porous nature and large surface area that manufactured Activated Charcoal does, so the point here is that homemade activated charcoal is still somewhat effective but not as effective as the manufactured type. This means that if you construct your own DIY filter using homemade activated charcoal you will want to do two things. First, use more than you think is needed (as much as is practical). Second, make sure you use a pestle to crush the charcoal into very small granules to help increase the surface area as much as possible. My point here is not to discourage the use of homemade Activated charcoal but just to make you aware that you may need to use more of it than you expected and that the *purity of the water is not guaranteed.*

The Prepper's Guide To Emergency Water Purification

While there are some very effective activated carbon based filters that are manufactured as a stand alone filter, we most often see them added on to another type of filter or combined with another method of filtering to ensure better water quality and purity. As noted above you can get an activated carbon attachment (https://amzn.to/2DZnmxy) that can be hooked inline to many portable water filters.



Cross section of improvised water filter

Another type of DIY filter that is essentially the same as the one outlined above is using a one or two liter bottle with the bottom cut off and a small hole put in the cap and layering pebbles, sand, charcoal and some folks even separate the layers with a coffee filter or put a small amount of cloth in the bottom which helps considerably to reduce the amount of turbidity. Another version of the same thing can also be made by doing the same thing on a larger scale with stacked 5 gallon buckets. This is particularly useful in a group setting where you are needing to filter a larger amount of water daily. These improvised methods are a good option when there is no manufactured filter available, however it is highly advisable to make sure that you boil the water after it if run through the filter or add a chemical disinfectant if possible to make sure that the water is safe to drink. *Because these types of improvised water filters will not guarantee that the water is safe to drink.*

The Prepper's Guide To Emergency Water Purification

REVERSE OSMOSIS

By in large most Reverse Osmosis (RO) filters are designed as whole house filter or a drinking water filter that is mounted under the kitchen sink in a home. However, there are some handheld reverse osmosis water filters available. Typically these are utilized by mariners, the military (in survival kits) or campers who spend a lot of time close to salt water.

The model I am most familiar with is the Katadyn Survivor 6 (Amazon Link: https://amzn.to/2GcmfRb). The great thing about a reverse osmosis water filter is that they will make salt water safe to drink and they do remove viruses as well. The downsides are three fold. First, they can be prohibitively expensive for most folks. The Katadyn Survivor 6 ranges from $900 to $1000 dollars depending on the source. Second, size is usually a factor for many people who want to be able to carry their filter in their backpack. The Katadyn Survivor 6 is the smallest RO filter in the world and it weighs about 2.5 pounds! Third, in order to function properly a reverse osmosis filter needs a high degree of pressure. Consequently the user has to pump a lot to get a small amount of water. The Survivor 6 only produces about 30 ounces per hour! Here is a look at what Katadyn says about how a reverse osmosis filter works:

"To remove dissolved salts from seawater with reverse osmosis, part of the salt water is filtered through a semipermeable membrane. Only 10% of the water passes through the membrane. The remaining 90% flows past the membrane and at the same time cleans the membrane (self-cleaning effect). The small size of the "membrane

pores" ensures extremely pure drinking water, but extremely high pressures must be generated – normally 55 bar."

So while RO filters do an great job filtering water there are some significant downsides to them as well. Lastly, RO filters do require the source water to be clear or they will get clogged quickly. So if you decide to utilize an RO type filter make sure pre-filter the water so that it is clean and clear before running it through the pump.

Note: I could not find any information on how well RO does in removing chemicals, VOCs and heavy metals. However, since it will remove viruses I imagine that they will remove those other items quite well.

The Prepper's Guide To Emergency Water Purification

SEEPAGE WELLS

A seepage well is basically a hole dug in the ground in a low lying area (preferably several feet from a water source). You dig down until you hit the water table and then water will begin to gradually seep into the hole and fill the void. You may be asking why would I get water from a muddy hole instead of taking it straight from the water source? Well that is a great question and there is a good answer.

Essentially this is a method of last resort and what you are attempting to do is to let the earth filter out the water. A good rule to thumb is to allow about four feet of separation from the edge of the water source to the location of your seepage well. Four feet of earth is said to be sufficient to make water "safer" to drink. Notice I said safer. *Not safe*.

One way that you can make this water even more safe is by boiling the water by adding hot rocks to it. This obviously assumes that you are in an emergency survival situation and you do not have a pot to put the water in. If you have a pot or a metal water bottle by all means put the water in them and boil it. But if you don't have a container you can just add hot rocks (heated up by a camp fire) to the water until it starts to boil. It may take several rocks depending on their size and how hot you get them. Once the water comes to a good hard boil it should be even more safe to drink. But since there is water still seeping into the seepage well as you are boiling it and afterwards it is still not a 100% guarantee that it will be safe.

The Prepper's Guide To Emergency Water Purification

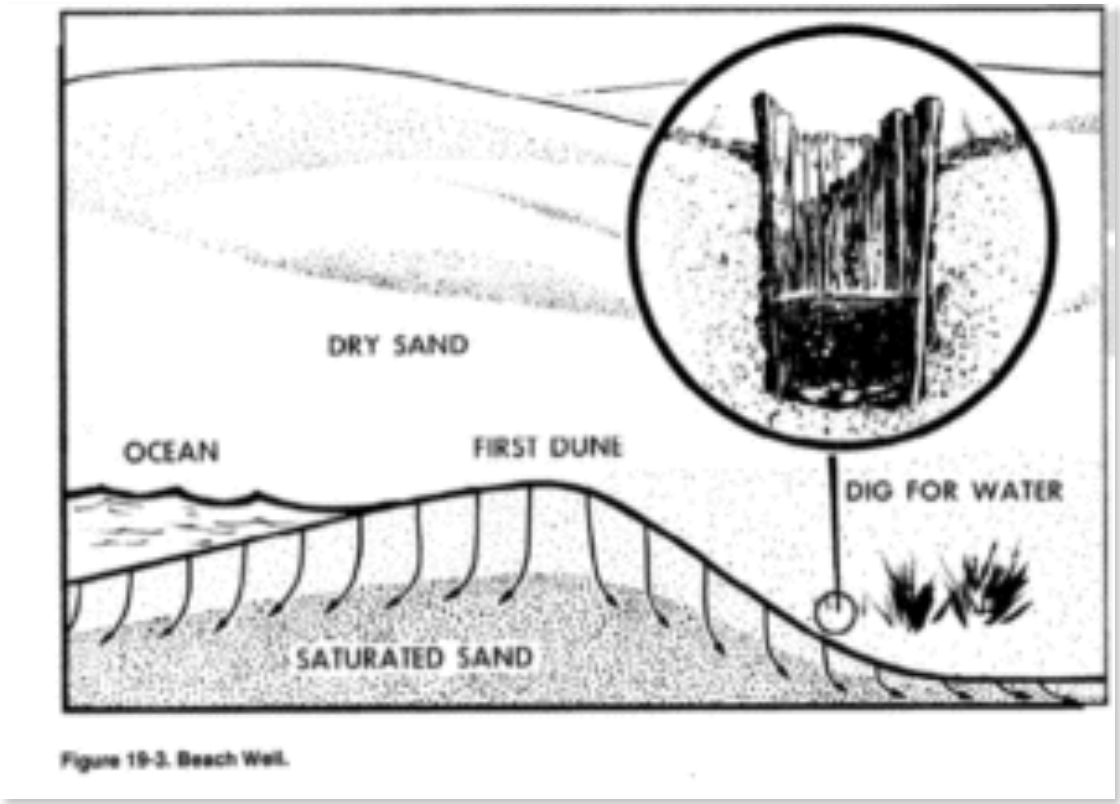


Figure 19-3. Beach Well.

Another variation on the seepage well is a beach well. Essentially you are doing the same thing but on a beach. You just go back behind the first pressure ridge on the beach and dig a hole down to the water table. As long as you are back behind the first pressure ridge you should be far enough inland that the water should be salt free. Obviously taste it and if it is still too salty move back another pressure ridge. Due to the loose nature of sand it may be necessary to line the sides of the beach well with drift wood to keep the sand from collapsing down on to itself and filling in the void. Beach wells can take a considerable amount of effort to dig because you may be required to dig several feet down to hit water. Again like a seepage well this is a method of last resort and if possible you should boil it to make sure it is safe.

The Prepper's Guide To Emergency Water Purification

PURIFYING WATER THROUGH CHEMICAL APPLICATIONS

CHLORINE – Household Bleach

There are various different forms of chlorine that are on the market that can be used to purify water. One very common one is regular household bleach. You can use regular unscented household bleach that is between 6% to 8.25% of sodium hypochlorite as the active ingredient to make water safe to drink. Do not use scented or color safe bleach.

Use the table below to help understand the dosages needed to make water safe to drink. Also if the water is cloudy or has a lot of turbidity in it you should allow the water to settle and then pre-filter it through a cotton cloth or a paper towel or a coffee filter before adding the bleach. Once you add the bleach wait at least 30 mins before drinking it. The water should have a very slight chlorine odor. If the water does not have a slight chlorine odor repeat the dosage and let stand for another 15 minutes before use. Do not repeat the dosage more than once! Additionally if the water is very cold you should allow double the amount of time for it to be ready to drink (1 hour).

Volume of Water	Amount of 6% Bleach to Add*	Amount of 8.25% Bleach to Add*
1 quart/liter	2 drops	2 drops
1 gallon	8 drops	6 drops
2 gallons	16 drops (1/4 tsp)	12 drops (1/8 teaspoon)
4 gallons	1/3 teaspoon	1/4 teaspoon
8 gallons	2/3 teaspoon	1/2 teaspoon

One additional important thing to remember about bleach is that your typical household bleach only has a shelf life of about 12 months if it has been stored at room temperature. After that it will begin to loose potency. Also getting too much bleach in your water can make you ill, give you the runs or potentially make you very sick or kill you if you ingest too much. So be very careful to follow the guidelines from the EPA (https://www.epa.gov/ground-water-and-drinking-water/emergency-disinfection-drinking-water) that are listed above.

Important Note:
Treating saltwater with bleach will not make salt water safe to drink. It will not remove ot her harmful chemicals or pesticides or remove heavy metals or other harmful substance s. Adding bleach will only kill or render harmless water borne pathogens such as bacteri a, cysts, protozoa and viruses. *The CDC has reported that Chlorine based products will not effectively kill Cryptosporidium.* If you suspect that the water has other contaminates in it you may need to combine this method with another method listed here to make the water completely safe.

The Prepper's Guide To Emergency Water Purification

Chlorine – Granular Calcium Hypochlorite – (AKA – Swimming Pool Disinfectant)

There are three primary benefits to using Granular Calcium Hypochlorite (HTH) for emergency water purification. The first benefit is that the shelf life is pretty much unlimited provided that it is stored in a dry environment, in a sealed plastic container at room temperature. The second benefit is that it is easy to store up a significantly larger amount of the solution for extended disasters. One five gallon bucket would be enough to purify tens of thousands of gallons of water. The third benefit is that HTH will kill all bacteria and viruses, cysts and protozoa. However, the CDC reports that Chlorine based water purification alone is not effective at killing Cryptosporidium. Combine this method with a manufactured water filter is recommended.

Using HTH To Purify Water Is A Two Part Process:

Part 1: First you take 1 level Teaspoon of HTH (68% to 73%) and mix it in with 1 gallon of water. (Note: EPA recommends 1 heaping Teaspoon to 2 gallons of water.) I find for the sake of practicality it is easier to use 1 gallon and 1 level Teaspoon as the base mixture. This will also make the solution slightly stronger so it will do a better job of killing off any nasty stuff in the water.

Part 2: The next step is to take a specific amount of the solution you just made and put it into the water you are trying to purify to drink. The EPA states that you are looking for a 1 to 100 ratio. The amounts will differ based on how much you are trying to purify. See the list below for different amounts. For the sake of simplicity I will explain how to purify approximately 3/4 of a gallon here.

Take 2 level Tablespoons of the bleach solution you mixed and put it into one container with 3/4 of a gallon of untreated water. Mix it completely and let it sit a minimum of 30 mins (1 hour with the water is cold or has high turbidity). However, I recommend letting the water sit for 2 hours before drinking (in a survival situation the water may be pretty full of turbidity so letting it sit longer will help to ensure it is fully purified). The added time will also allow the extra chlorine to evaporate. After the water has been mixed and has sat for 2 hours take the water and pour it back and forth between the container it is in and another clean container like a 5 gallon bucket 5 or 10 times. This will help to improve the taste and allow some of the extra chlorine to evaporate off. Once that is done the water is ready to drink.

The Prepper's Guide To Emergency Water Purification

How Much Chlorine Solution To Mix With Untreated Water:

- 16 ounces (1 pint) of chlorine solution will treat 12.5 gallons of water.

- 8 ounces or one cup of chlorine solution will treat 6.25 gallons of water (Note: you can easily round down to 5 gallons and just let it sit longer).

- 4 ounces or half cup of chlorine solution will treat 3 gallons of water.

- 2 ounces or quarter cup of chlorine solution will treat 1.5 gallons or 5.5 liters of water.

- 1 ounce or 2 tablespoons of chlorine solution will treat 3/4 of a gallon or about 2.75 liters of water.

- 1 Tablespoon of chlorine solution will treat 3/8 a gallon or 1.375 liters of water.

- 2 Teaspoons (2/3 rds of a TBL Spoon) of chlorine solution will treat about 1/4 of a gallon or approx 1 liter (.9 liters) or water.

- 1 tea spoon of chlorine solution will treat approx 1/2 liter or a regular size water bottle (500ml) of water.

For more information on this process visit the EPA website: (https://www.epa.gov/ground-water-and-drinking-water/emergency-disinfection-drinking-water)

You can purchase HTH on Amazon here: https://amzn.to/2rOp3h2

CAUTION: HTH is a very powerful oxidant. Follow the instructions on the label for safe handling and storage of this chemical. Please also read the following link for more information on the health risks associated with handling HTH: https://www.cleartech.ca/ckfinder/userfiles/files/MSDS/Calcium%20Hypochlorite%20HTH%20.pdf

Important Note: The Center for Disease Control (CDC) reports that Chlorine based water purification has been shown to be ineffective at killing Cryptosporidium. The CDC states that Chlorine Dioxide has low to moderate success at killing Cryptosporidium so it is always best to use these types of Chlorine based water purification tablets in conjunction with a manufactured water filter if possible.

The Prepper's Guide To Emergency Water Purification

Chlorine Water Purification Tablets

There are several types of chlorine based water purification tablets on the market today but probably the three most popular and readily available are the Katadyn Micropur tablets, Aquatabs and Potable Aqua brands. They utilize either Sodium Chlorite and Sodium Dichloroisocyanurate or Chlorine Dioxide to kill microorganisms including bacteria, viruses, cysts and protozoa in the water. These tablets are highly effective at killing waterborne pathogens and are best used in combination with a manufactured water filter that incorporates an activated carbon element. Chemical purification will not remove dangerous chemicals or heavy metals from water. It will also not remove salt from salt water.

To use these types of tablets follow the manufacturers directions on the packaging for the best results. However, in general most of these types of tablets are sized to treat one liter/quart of water per tablet. Just add the tablet to the untreated water, close the lid and shake the container. Wait at least thirty minutes if the water is at room temperature. If the water is very cold just allow the tablets at least one hour before drinking. Additionally it is best to use these tablets with clear water. Water with a high amount of turbidity will reduce their effectiveness. So pre-filter the water if at all possible.

Prior to drinking the water from the container, loosen the cap and gently shake the container to allow the treated water to run over the edge of the container. This will rinse the contaminated water away from where you may drink from the container.

The shelf life on the Micropur tablets is 4 years and the shelf life on the aquatics is 5 years.

Important Note: The Center for Disease Control (CDC) reports that Chlorine based water purification has been shown to be ineffective at killing Cryptosporidium. The CDC states that Chlorine Dioxide has low to moderate success at killing Cryptosporidium so it is always best to use these types of Chlorine based water purification tablets in conjunction with a manufactured water filter if possible.

The Prepper's Guide To Emergency Water Purification

IODINE TABLETS

Iodine tablets are frequently used by the military as well as hikers and campers. Some people do not care of the taste of iodine based tablets. If that is the case for you fear not, there are also a variety of neutralizing tablets that will help improve the flavor.

Iodine based water purification tablets should only be used for short durations and are not safe for long term water purification solution. They are most effective against bacteria and Giardia Cysts. Additionally, iodine tablets do not kill viruses or Cryptosporidium.

One advantage to the Potable Aqua Iodine Tablets is that if the original container is unopened and it is stored in a cool dry location out of the sunlight then they have a very long shelf life. The manufacturer states that if the tablets are grayish / brown in color then they are good. If they are yellowish / green then they should be replaced.

The instructions for use are basically identical to the Chlorine based water purification tablets.

Important Note: The Center for Disease Control (CDC) reports that iodine based water purification has been shown to be ineffective at killing Viruses & Cryptosporidium. It is always best to use these types of Iodine based water purification tablets in conjunction with a manufactured water filter if possible.

Other means of chemical decontamination:

It should be noted that many websites and resources in the survival community make reference to using potassium permanganate and hydrogen peroxide as a method for making water safe to drink. While it is likely true that these chemicals can be utilized to make water safe to drink, I was not able to find what I consider to be reliable sources of information that provide clear and concise directions on the correct proportions to properly prepare the water for human consumption. So it is for that reason that I did not include those methods within this guide.