

SURVIVAL PAPER

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MAKING LIQUID CHLORINE BLEACH INSTRUCTIONS FOR MAKING LIQUID CHLORINE BLEACH FOR EMERGENCY WATER
SANITATION AND SANITIZED DILUTE SALT SOLUTIONS FOR TREATING CHOLERA

<http://www.waterpot.org/BLEACH_HOW_TO/>.

STEP 1 Four 75 mm X 150 mm plates of graphite or titanium - titanium sheet metal can be quickly sheared and flattened.

Do-It-Yourself[®] liquid chlorine bleach for sanitizing and/or protecting drinking water is made using salt, cells costing about \$20.00 in US. and 12 Volt DC electric power from a car battery. Recharging may be by a battery charger, or solar cells, or a car alternator belt-driven by a bicycle wheel

STEP 2 Plates assembled 6 mm with wood or plastic spacers and clamped or bound in position with twine.

STEP 3 Assembled Electrolysis Cell - Plastic or glass container with salt water or one part sea water with two parts freshwater containing one teaspoon of salt per liter of water.

THE ELECTRODES ARE SUSPENDED ONLY 75 MM INTO THE SALT WATER SO THAT THE

POWER IS JUST RIGHT FOR A 12 V BATTERY. (deeper immersion may draw too much

power for a home style battery charger.)

STEP 4 Connected to a 12 V battery and battery charger. Example of Bicycle battery charger <<http://www.waterpot.org/Exercise/exercise.html>> for use where electrical power is not available.

RESULTS- USUALLY, THIS SETUP PRODUCES BLEACH OF ABOUT 5000-6000 PPM CHLORINE

AT THE RATE OF 1 LITER /30 MINUTES. IF THE CELL CONTAINS 2 LITERS IT TAKES

AN HOUR.

IT WORKS EVEN BETTER AT HIGHER pH FROM ADDING 'just a little bit' OF LIME

OR

CAUSTIC SODA IN THE SALTY WATER BEFORE HOOKING UP THE POWER.

THE ADDITION IS

SO SMALL THAT THE ADDITION TO DRINKING WATER IS HARMLESS.

Using the Dilute Bleach

In the USA, household bleach is 5.5% chlorine. A great many people of all educational levels, in large quantities use it, and one rarely hears of accidents damaging to users or their children. The bleach generated in the cells described herein is usually 0.5-0.6% chlorine, only a tenth of the strength of household bleach.

For use in sanitizing water, instrumentation for testing for residual chlorine is of great help.

In the absence of test kits, another way is available. The US Navy' has used bleach on ships for many years and much information is available on the Internet under the name of sodium hypochlorite, If in doubt, check the EPA site from which the following information is condensed as;

For water sanitation, one typically adds so many drops of bleach to a gallon of water, waits 30 minutes, and smells the water. If the bleach is detectable by smell then there is enough residual chlorine that bacteria in the water were killed, (but not parasites which must be filtered out or killed by pasteurization or boiling.) If the smell is too strong, dilute the treated water by a measured amount, mix. Wait 30 minutes. and try the smell again. If there is no chlorine smell, add another measured amount of the bleach, mix. Wait another 30 minutes, and smell again.

This trial procedure establishes a safe level by experience without the use of instrumentation or test kits, and even when the initial strength if the bleach is not known. It is tedious and boring at any time and can be very' irritating if one is thirsty', but it works. When, after that 30-minute wait period, the residual chlorine is detected by smell, then there is enough residual chlorine to give all of the benefits possible.

For removal of parasites, building and using slow sand filtration units is well within the skills of at least some inhabitants of most villages.

Notes For Emergencies

A rounded teaspoon of table salt weighs about 10 grams. Dissolve this amount in a liter of water to make an (approximately) 1% salt solution.

Sea water contains about 2.75% by weight of sodium chloride, plus other salts. Sea water may be used directly but dilution of sea water with twice its volume of fresh water makes a solution much like the 1% salt solution.

This works well for sanitation of glass, plastic, metal surfaces, and clothing and bedding, but caution is advised when considering continuous use in drinking water.

Cholera - Emergency Saline Solution.

Diarrhea causes massive loss of fluids and salts. Drinking one to two liters, per person, of a saline solution containing about 0.9% sodium chloride is often used in replacement of these losses. While standard saline solutions contain ingredients in addition to salt, in an emergency, plain

salt water is better than nothing at all.

Two liters of a 0.9 to 1% salt solution made with filtered water may be sanitized in a minute or less by using the cell. Remember to "smell test" the solution just like drinking water. Wait the full 30 minutes for the chlorine to act and see if the chlorine smell persists. If there is no smell, treat it more, and repeat the smell testing. If the smell and taste are too strong, dilute with more of the solution, mix, wait 30 minutes, and smell again.

Electric Power Sources

The objective is to have equipment and operations requiring skills comparable with those of bicycle and auto mechanics, and to use commonly available materials to the full extent possible. Cell dimensions were matched to the capabilities of a 12-volt car battery. Sodium hypochlorite forms when salt water is electrolyzed using Direct Current (DC). The theoretical voltage drop across a single cell is below 3 volts but in operation it is about 3.3 to 4.0 volts depending on resistance losses in the wires and electrodes, the salt concentration and temperature of the solution, and the spacing of the electrodes. The 10-12 volt drop for a 3-cell electrolysis unit fits well with the 12 volt D.C. battery typically used in cars.

Car batteries are charged (recharged) using a source of DC power at about 14 volts. Battery chargers converting AC to DC are common, and there are also solar cell chargers. For a true "do-it-yourself" power unit we chose to use a car alternator, or generator, and to drive it by a Vee belt using the driving wheel on a bicycle. The rate of rotation of the bicycle wheel is matched to the characteristics of a particular alternator or generator. A typical alternator from a mid-sized American car will produce about 7 amperes at 1500 revolutions per minute (rpm) and the power output increases as the rpm are increased. The size of the pulley used on the alternator is chosen to meet the preference of the bicyclist to produce the necessary 1500-2000 rpm. Charging to maintain battery capacity is usually carried out during the bleach making so as to avoid drawing the battery down below the full 12 volts operating capability.

Alternators require voltage regulation. They may have a built-in voltage regulator or they may require a separate one and it is necessary to know which design of alternator is being used. Generators require a separate voltage regulator. We find that producing the 7-10 amps at 14 volts common for battery' chargers is well within the comfort range for even lightly built teenagers. They report that producing a charger output of 7-10 amperes feels comparable to pumping a bicycle on level pavement at about 12-15 miles per hour. Geared bicycle drives allow adjusting the pedaling rpm to an individuals comfort range.

In the USA the cost for all components, including, a rebuilt alternator, and a voltage regulator Vee belt, and used bicycle components is on the order of \$ 100-150 per charging unit. Return to top of page

<<http://www.waterpot.org/Abstract/>>

This "first generation" cell will serve to get the program started. Ingenuity and feed back from practitioners and interested volunteers will bring forth improvements and adaptations to better fit various local conditions. Full success of the program depends on these ideas from the field.

Graphite and/or titanium were chosen for the electrodes because of their known properties, availability, and acceptable costs. Commercial electrolysis units commonly use plated titanium to allow long use before maintenance or replacement is required. This extra expense for coating is not cost effective where labor costs are low and there is a need to minimize the cost of imports.

An assembly of four electrodes is clamped with the faces parallel. Plastic strips that do not conduct electricity, and about 2.5 wide x 7.5 cm long x 6 mm thick, are placed at the top of the electrode assembly to provide a 6-mm spacing between electrodes. A 3-cell unit with a voltage drop of 10-12 volts is formed by clamping 4 electrodes with faces parallel, and with a 6 mm spacing between the faces, as shown in the photo. Power is supplied only to the outside electrodes with the two inner electrodes providing two working surfaces each. If a coating forms on the electrodes, reversing the wires cleans the electrodes. Electrode dimensions of 7.5 cm x 15 cm were chosen to fit the power output ranges of different size batteries. For this assembly the depth of immersion of the electrodes can adjust the amperage required by the cell. Immersion to 7.5 cm. in a 1% salt solution typically draws 9-11 amperes. Of course changing the salt content of the solution also changes the electric characteristics of the system.

The container can be any glass or plastic. A 2-liter plastic soft drink bottle works well. A working capacity of about 1.5 liters is available when the bottle top is cut off just above the label. Active chlorine produced depends on the power source, the strength of the salt solution and the electrode area submerged as well as the length of the time period during which power is applied to the cell.

The hourly chlorine production can be varied within the range of 600 parts per million, (PPM) to 6000 PPM. Even the lower concentration is enough to sanitize and protect several hundred liters of drinking water.

Experience with this simple unit has demonstrated that making usable solutions of bleach is well within the capability of persons having commonly available skills. Return to top of page <<http://www.waterpot.org/Abstract/>>
A rounded teaspoon of table salt weighs about 10 grams. Dissolve this amount in a liter of water to make an (approximately) 1% salt solution.

SALT WATER (10 GRAMS OF SALT /LITER OF WATER) OR SEAWATER DILUTED WITH 2

PARTS FRESH WATER--

NOTE--A LEVEL TEASPOON OF TABLE SALT IN ONE LITER OF WATER IS ABOUT 900-1000

PPM SODIUM CHLORIDE.

A 12 VOLT CAR BATTERY AND CHARGER OR ALTERNATOR AND

A SIMPLE CHEMISTRY CELL PICTURED BELOW
USE EITHER GRAPHITE OR TITANIUM FOR ELECTRODES, USE NOTHING
ELSE--OTHER
MATERIALS CAN PUT DANGEROUS METALS INTO THE BLEACH.
A "CHLORINE TEST KIT " HELPS BUT IS NOT ABSOLUTELY NEEDED BECAUSE
THE PROPER
AMOUNT OF CHLORINE CAN BE JUDGED FROM THE SMELL AND TASTE OF
TREATED WATER.
Because the bleach you make will be only a tenth as strong as household
bleach, for first trial, add about 19 times as much.

This is an overview of the modified exercise machine... The pedals
drive the high ratio pulleys that drive the alternator. The alternator
charges the battery. The battery powers the "Bleach Making Cell" that was
demonstrated at the Third NSF Symposium.

sources for graphite plates on-line:

<<http://www.fuelcellstore.com/cgi-bin/fuelweb/view=NavPage/cat=58>>

<<http://www.acp-composites.com/acp-gp.htm>>

<http://www.andale.com/store?view=CAT_HOME&catId=1259918&sid=176000&mode=1>