JERRY L. ANDERSON, PE

September 18, 2016

Mr. Mark Hogg
WaterStep CEO & Founder
625 Myrtle Street
Louisville, KY 40205

Dear Mr. Hogg,

The purpose of this letter is to report and document the results of a sodium hypochlorite (bleach) generator test conducted on July 19, 2016 at the WaterStep headquarters located at 625 Myrtle Street, Louisville, KY. A team of volunteers working at WaterStep, designed and developed a device that generates sodium hypochlorite through an electrochemical activation process. Brine is used as the feedstock and a 12-volt battery powers the device, both typically provided by the user. All other accessories to make and test the sodium hypochlorite are shipped with the device, shown in the photo (Attachment A). Following the operating instructions (Attachment B), the apparatus is capable of generating 5 liters of sodium hypochlorite at a minimum concentration of 5,000 milligrams per liter [mg/L]), or 0.50 percent, in 75 minutes.

Using the hypochlorite generator (Serial No. 129) we conducted the bleach generating test according to the operating instructions in Attachment B as follows:

1. Safety glasses were used.
2. The 5-liter jerrycan was filled approximately one-half full of water.
3. Table salt (350 milliliter [mL]) was poured into the jerrycan.
4. The jerrycan was shaken hard until the salt was dissolved.
5. Water was added to the jerrycan to the "fill line," resulting in a total volume of 5 liters.
6. The generator electrode package was inserted into the jerrycan to create an electrolytic cell.
7. The red lead was connected to the positive (+) side of battery and the black lead to the negative (–) side.
8. The elapsed time was recorded as soon as the battery was connected. Bubbles coming from the bleach generator electrodes and a bleach scent were confirmation that the generator was operating.
9. The bleach generator was operated for 75 minutes.
10. After 75 minutes elapsed, the generator leads were unhooked from the battery, and the electrode package was removed from the jerrycan.

The initial water temperature was 77 degrees Fahrenheit (F). The temperature at the completion of the test was 109 degrees, F, an increase of 32 degrees.

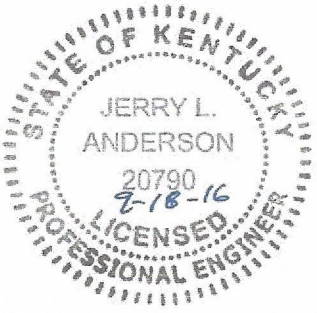
The chlorine residual field tests were then conducted on site to quickly determine the approximate chlorine residual concentration of the product. The test samples were prepared to 1,000:1 dilution ratio to place the chlorine concentration of the samples within the range of the testing equipment. The dilution procedure was to fill the measuring cup provided in the kit with 1,000 mL of distilled water, then using a syringe provided in the kit, exactly 1 mL of bleach product was extracted from the jerrycan, discharged into the distilled water, and mixed thoroughly.

The first test used a chlorine residual color comparator, manufactured by Taylor Technologies with R-0600 orthotolidine reagent, normally used for testing chlorine residual in swimming pools and spas. The sample was placed in the color comparator with its reagent and a dark orange color resulted, indicating that the concentration of the bleach product was at least 5,000 mg/L.

The second test used a HACH Pocket Colorimeter II with DPD reagent to measure free chlorine residual. Two diluted samples were tested and the results were 8,200 and 8,600 mg/L.

Finally, a sample was collected and sent to Beckmar Environmental Laboratory, 3251 Ruckriegel Parkway, Jeffersontown, KY, for independent analysis. The 100 mL sample container was completely filled with sample to avoid airspace in the container. The free chlorine residual concentration test result was 7,880 mg/L (Attachment C). This exceeded the minimum 5,000 mg/L concentration the manufacturer claims the apparatus is capable of generating.

Sincerely,



Jerry L. Anderson, PE
7106 Green Spring Drive
Louisville, KY 40241
PHONE 502-718-1744
EMAIL jerry.l.anderson.11@gmail.com


BLEACH PRODUCTION
SOLUTION TESTING
SALT
Always Save

WATERSTEP'S BLEACH GENERATOR INSTRUCTIONS
7/21/16

Overview:

WaterStep's bleach generator makes a bleach solution to be used as a general purpose disinfectant. The production of a strong effective disinfectant made on site, easily and at low cost, will promote improved sanitation and hygiene. This will reduce diarrheal diseases, which are a major health problem of the developing parts of the world.

Bleach is a proven disinfectant for water. A small quantity of bleach can be added to a container of water and after waiting 30 minutes, the water can safely be consumed. WaterStep's bleach generator can be used most effectively in communities without water storage or distribution systems.

Precautions:

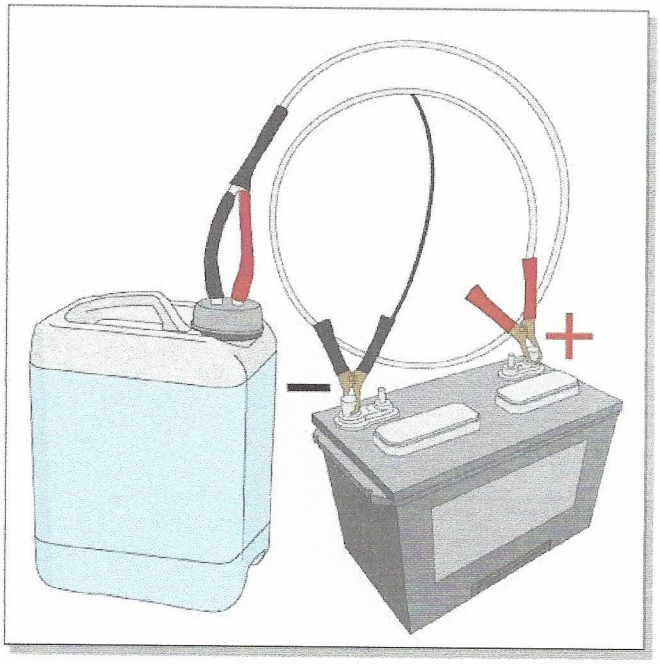
- Use in a well-ventilated area or outdoors. Do not inhale the fumes from the bleach generator.
- Do not drink the bleach solution.
- Keep the bleach solution out of eyes.
- Store the bleach solution in a cool place, out of direct sunlight.
- Discard the bleach solution after 14 days of storage.
- Store the bleach solution away from children

The bleach solution produced by this generator is not as concentrated as bleach purchased in stores.

WaterStep
Save Lives with Safe Water

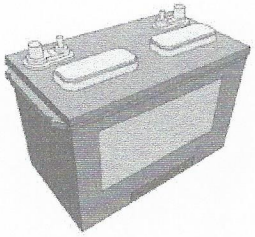
625 Myrtle Street
Louisville, KY 40208

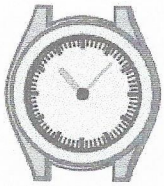
+1-502-568-6342
WaterStep.org



Needed Parts:

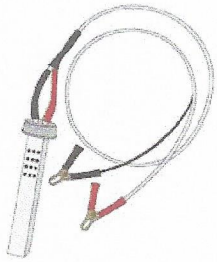
- 12 volt car battery, fully charged
- 6 liters of clean water, at room temperature, approximately 20 degrees Centigrade
- A watch or clock
- 350 milliliters salt (equals 500 grams or 1½ cups)

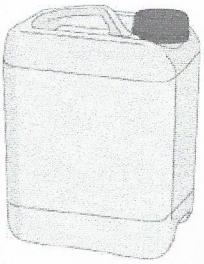


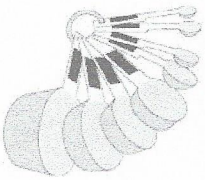


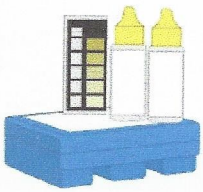
Supplied Parts:

- Three 1 milliliter syringes
- Bleach generator electrode package - device with battery cables attached
- 1 liter measuring cup
- Funnel
- Safety glasses
- Set of measuring spoons and cups
- 5 liter jerrycan with solid cap
- Test kit – includes tester and 2 bottles of reagent



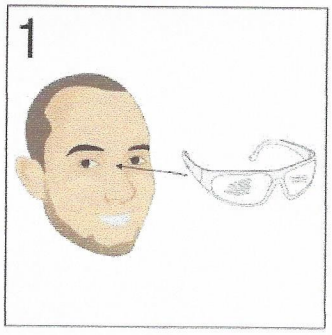


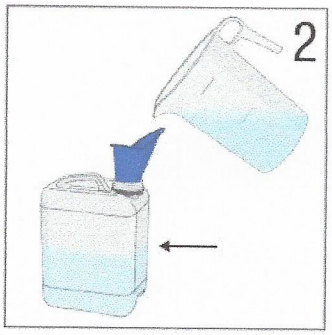


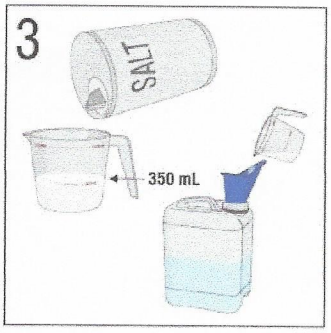


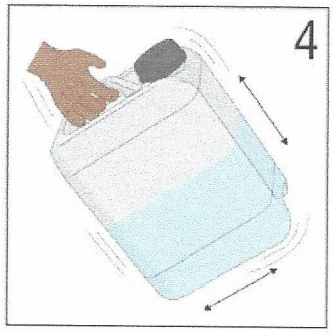
BLEACH PRODUCTION - How to make the bleach:

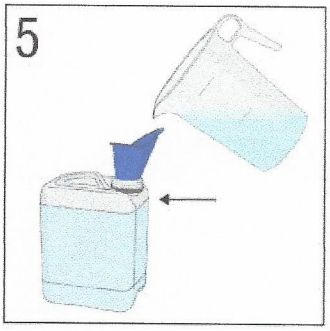
1. Put on safety glasses.
2. Using the funnel, fill jerrycan approximately ½ or more full of water.
3. Fill the measuring cup with salt to the 350 milliliter line and pour it into the jerrycan, using the funnel.
4. Screw on solid cap and shake container hard until the salt is dissolved.
5. Remove solid cap and using the funnel, fill the jerrycan to the "fill line" with water, 5 liters.
6. Insert generator electrode package and screw on the ring.
7. Connect red lead to positive (+) side of battery and connect black lead to negative (–) side.
8. Record the time, starting as soon as the battery is connected. Observe bubbles coming from the bleach generator electrodes. If you can't see bubbles, hear a bubbling sound or smell chlorine see "troubleshooting". Run the bleach generator for 75 minutes.
9. Unhook bleach generator leads from the battery. At this point you should have made 5 liters of bleach solution. Remove the electrode generator package from the jerrycan.

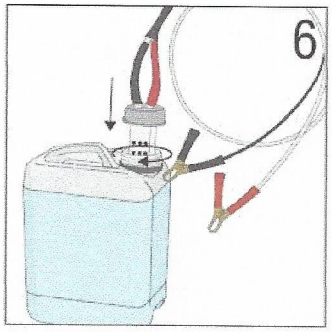


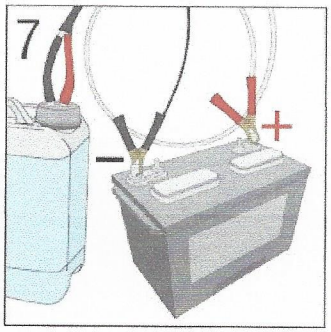


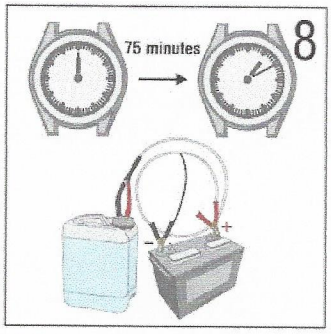


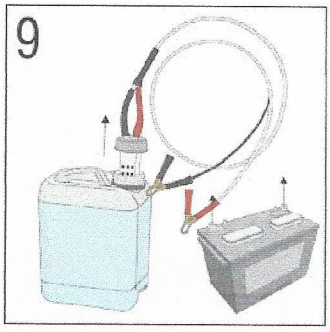










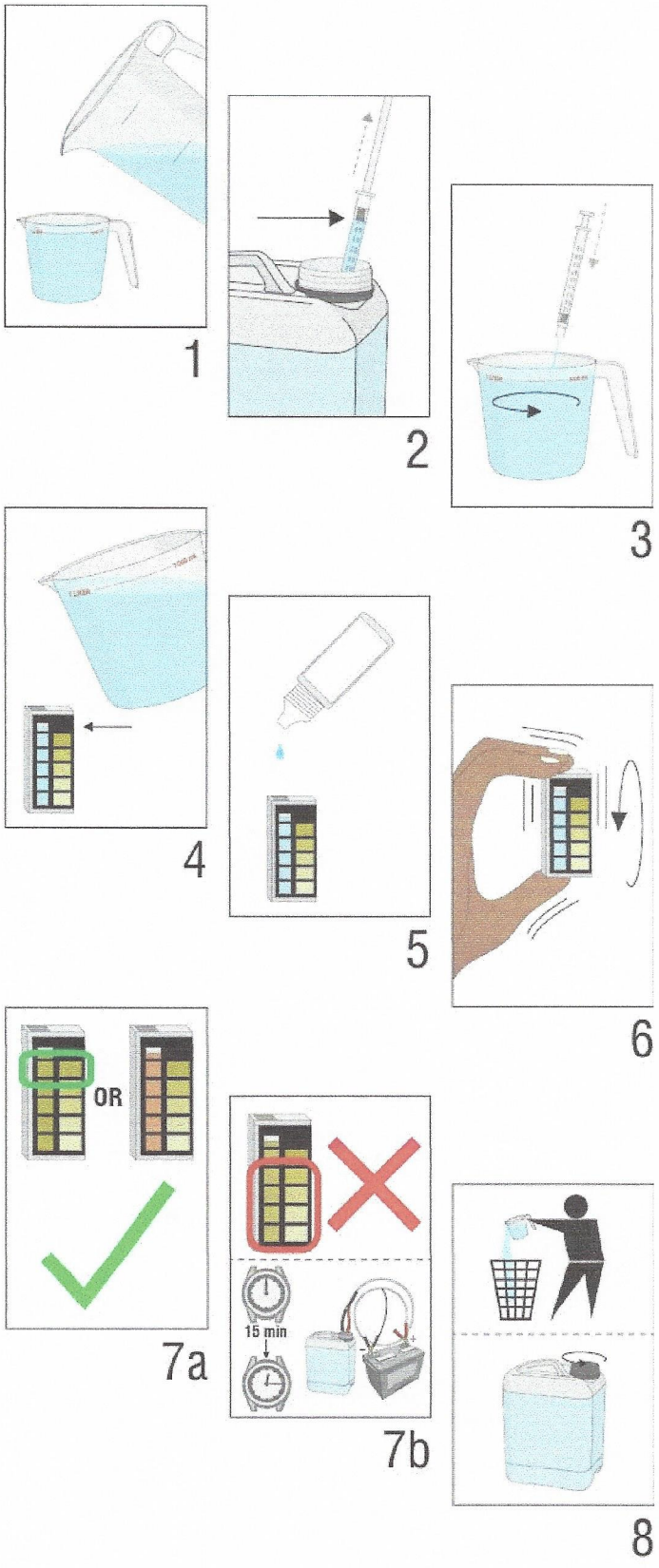


SOLUTION TESTING - How to confirm the bleach is the proper strength:

1. Fill measuring cup with clean water, to the 1000 milliliter line.
2. Stick the end of the syringe in the bleach solution. Pull the plunger back, filling the syringe to the 1 milliliter mark.
3. Push the 1 milliliter of bleach solution from the syringe into the 1000 milliliters of water in the measuring cup. Using the syringe, thoroughly stir the mixture.
4. Fill tester's water column with the mixture from the measuring cup.
5. Add 1 drop of reagent, from the test kit bottle, to the tester's water column.
6. Place your finger over the top of the tester's water column and gently rotate three times.
7. Compare the color of the water column to the color scale on the tester.
   a. If the water column's yellow color matches the yellow on the tester for 5 ppm or if it is orange, then the bleach solution is the required strength and ready to use.
   b. If the water column color is a lighter yellow and matches 4 ppm or less on the tester, the bleach solution is too weak. Run the generator for an additional 15 minutes and retest. If the solution is still reading less than 5 ppm after the additional 15 minutes, see "Troubleshooting".
8. After producing bleach of the required strength, dispose of the water in the measuring cup. Close the jerrycan with the solid cap to transport and store the bleach solution

The bleach solution must be tested if it is to be used for sanitation purposes, to confirm that it is strong enough.

If the bleach is only used to disinfecting water, the test on this page is not necessary. The water that is disinfected is tested after the bleach is mixed in. See the following pages.

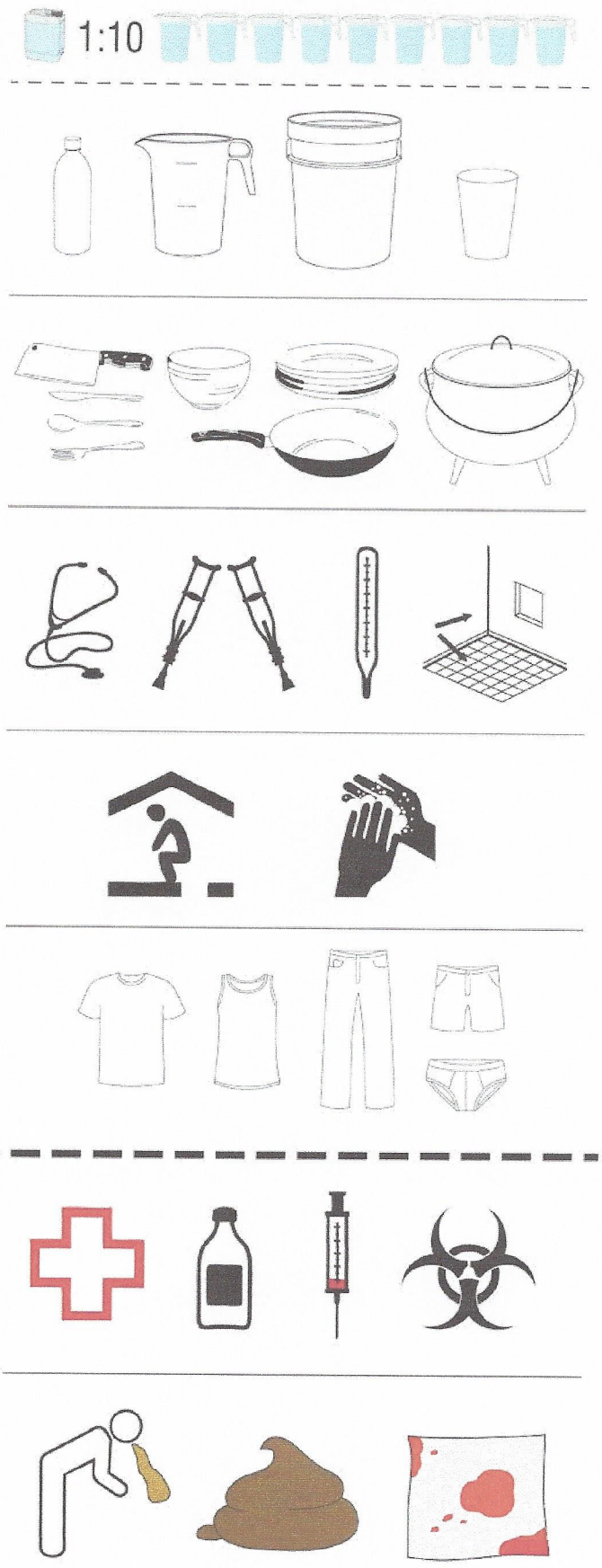


For GENERAL SANITATION dilute the bleach solution 10 to 1 with clean water. Items to be disinfected should be first scrubbed with soap and water then washed in fresh disinfectant and allowed to air dry before use. Suggested items to be disinfected:

- Drinking water containers.
- Cooking pots, pans, dishes and drinking cups.
- Surfaces used in food preparation.
- Floors and walls of hospital room or sickroom.
- Medical equipment—stethoscopes, thermometers, e
- Toilet facilities.
- Hands and skin.
- Protective clothing and bedding.

For MEDICAL SANITATION use the bleach solution full strength. Heavily contaminated surfaces or infectious wastes should have full strength disinfectant poured over them and allowed to remain in contact for 30 minutes before clean up. Suggested items to be disinfected:

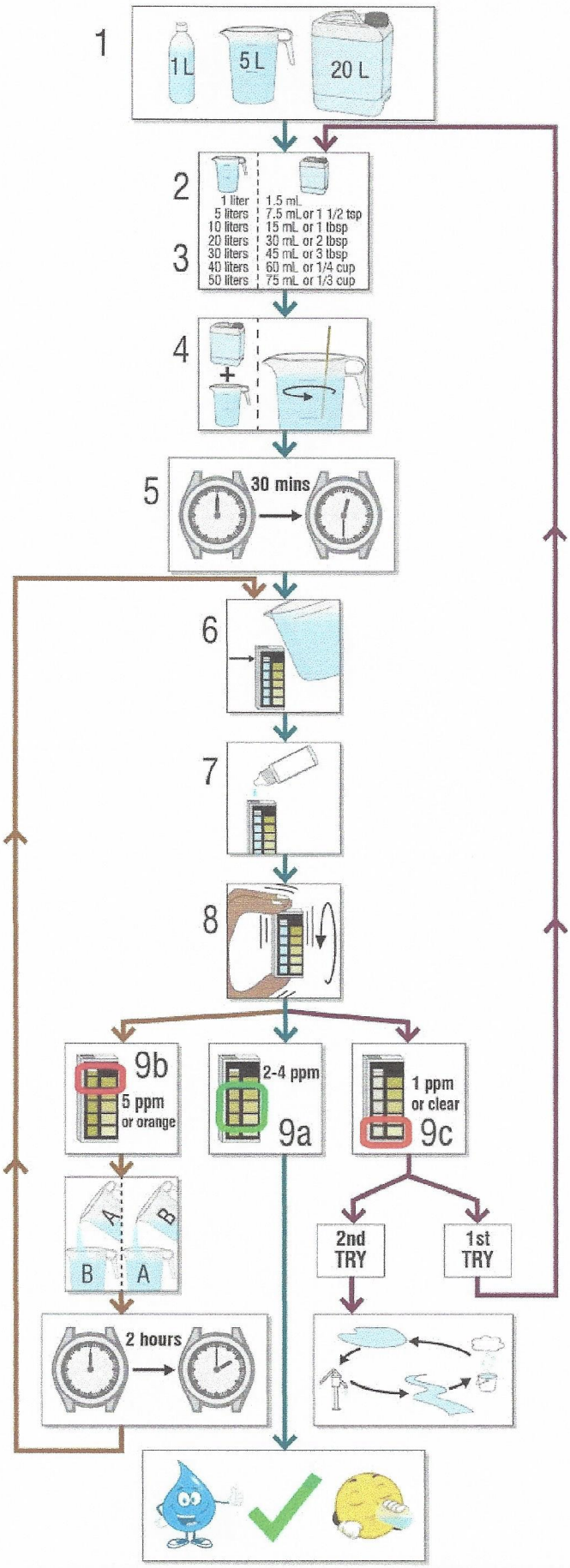
- Medical waste.
- Spills of bodily fluids and feces.



DISINFECTING WATER - How to use the bleach to disinfect water:

1. Determine the amount of water to be disinfected.
2. If the water is cloudy or colored, filter it through a clean cloth, paper towel or coffee filter. If it cannot be filtered or if the water is very cold, add twice the amount recommended below.
3. Add 1 1/2 milliliter of bleach solution for each liter of water to be disinfected.
   a. 5 liters add 1 ½ teaspoon or 7.5 milliliter
   b. 10 liters add 1 tablespoon or 15 milliliters
   c. 20 liters add 2 tablespoons or 30 milliliters
   d. 30 liters add 3 tablespoons or 45 milliliters
   e. 40 liters add ¼ cup or 60 milliliters
   f. 50 liters add ⅓ cup or 75 milliliters
4. Mix the water and the bleach solution. If the container cannot be shaken, use a clean disinfected stick to stir.
5. Wait 30 minutes.
6. Fill tester's water column from the mixture.
7. Add 1 drop of reagent from the test kit bottle, to the tester's water column.
8. Place your finger over the top of the tester's water column and gently rotate three times.
9. Compare the color of the water column to the color scale on the tester.
   a. If the water column's yellow color matches the 2, 3 or 4 ppm on the tester, the water is ready to drink.
   b. If the water tests 5 ppm or is orange, pour the water from one clean container to another 5 times. Wait for an additional 2 hours and retest, go back to step 6.
   c. If the water tests for 1 ppm or is clear go back to step 3 and add more bleach. If the water tests 1 ppm or is clear a second time, do not use this water source. Find another water source and start over.

If your first try resulted in too much or not enough bleach, adjust the amount of bleach added so the test result is positive, 2, 3 or 4 ppm. After making several successful tests, it will not be necessary to repeat testing, provided the



water comes from the same source and the container is the same size. It is important to let the mixture sit for 30 minutes and then confirm that the mixture has a faint smell of chlorine.

Start over, repeating the testing procedure, when a new batch of bleach is produced.

****

MAINTENANCE AND TROUBLESHOOTING

Maintenance:

- After use, rinse the bleach generator electrode package, jerrycan, measuring cups, funnel and tester with clean water.
- Keep the battery fully charged.
- After repeated usage, a white lime scale may build up on the electrodes. Soaking the electrodes in vinegar will remove this scale.

TroubleShooting:

No bubbles, bubbling sound or chlorine smell:

- Check to see if battery is hooked up correctly.
- Make sure salt was added.

Low test reading:

- Battery is weak.
- Insufficient time.
- Check to see if battery clamps are fastened securely to the battery terminals.
- Insufficient salt.
- Water is too cold.

References:

EPA - Emergency Disinfection of Drinking Water
CDC - Personal Preparation and Storage of Safe Water
CDC - Make Water Safe

Beckmar
ENVIRONMENTAL LABORATORY

Jeffersontown Business Park
3251 Ruckriegel Parkway
Jeffersontown, KY 40299
502.266.6533
Fax: 502.266.6446
www.beckmarlab.com

Frank Diebold
1724 Spring St.
Louisville, KY, 40205-1325

Beckmar Certificate Of Analysis 160720001

160720001.01 **Collection Date:** 07/19/2016 11:00 AM **Sampled By:** Frank Diebold

Project: Bleach Maker Test **Sample Description:** Bleach Maker Test ` **Matrix:** Wastewater

Test Name	Parameter	Result	Unit	MDL	Type	Method	Analyzed Date/Time	Analyst
Chlorine-Free	Chlorine, Free	7880	mg/L	0.01	Grab	HACH 8021	07/19/2016 04:00 PM	MDC

Thank You,

Kimberly Fallon
Quality Control Officer

RP16072018

Beckmar Environmental Laboratory
3251 Ruckriegel Parkway
Louisville, KY 40299
Phone: (502) 266-6533
Fax: (502) 266-6446

Beckmar

CHAIN OF CUSTODY
AND ANALYTICAL REQUEST

Month: July Year: 2016

*Job ID:160720001

Frank Diebold

Special Instructions:

Calibration ID: _____

Facility Information	Send Results To: (same as client info ☐ yes ☐ no)	Billing Information (same as client info ☐ yes ☐ no)	PWS ID (if applicable)
Client Name	Client Name ~~Frank~~	Client Name WaterStep	Compliance (Y/N) State
Address	Address	Address 625 Myrtle Street	Samples chlorinated (Y/N)
Cty, St, ZIP	City, State, ZIP	City, State, ZIP Louisville, Ky 40208	
Phone	Phone / Fax	Contact Name: 1502 568-6342	
	E-mail		
Collected by (please print): *Frank Diebold	(signature):	P.O. Number	

Bottle ID (Lab Use Only)	Collection Day Start / Stop	Collection Time (24Hr) Start / Stop	Sample Point / Description	Analysis Requested	Field Data pH (S.U.)	DO (Mg/L)	Cl_2 (mg/L) Free	Cl_2 (mg/L) Total	Temp. (°C)	Collection Type (See Bottom Right)	Number of Containers	Type of Container (See Bottom Center)	Matrix Code (See Bottom Right)	Preservative Code (See Bottom Right)	Initial Laboratory Location	Preservative Added In-house
01	7/8	1105	Bleach Maker Test #1	Free Chlorine											RL	

Relinquished by:	Received by:	Date	Time
[signature]	[signature]	7/19/16	1505

Type of Container

G10 = 1000ml Glass
G5 = 500ml Glass
P10 = 1000ml Plastic
H40 - 40ml Headspace
SG = 16 Oz Glass - Soil
W1 = 120ml Plastic Sterile
D1 = 120ml Plastic Sterile
P25 = 250ml Plastic
P1 = 100ml Plastic
4LC - 4 Liter Cube
1LC - 1 Liter Cube

Sample rejection : Reason: _____
Temp. At Receipt _____ °C
Check Applicable Field Wet Ice _____ Blue Ice _____

Sample integrity

	Yes	No	N/A
Broken Containers	___	___	___
Custody Seals Intact	___	___	___
COC / Sample Label Agreement	___	___	___
Proper Containers	___	___	___
Samples Within Holding Times	___	___	___
All Samples on COC Received	___	___	___
W1 & D1 Filled to 100ml mark	___	___	___
Headspace acceptable	___	___	___

Preservative Added (Date/Time) _____

Matrix Codes

DW = Drinking Water S = Soil O = Other
WW = Wastewater SL = Sludge
GW = Groundwater P = Paint
SW = Surface Water V = Vegetation

Collection Types	Preservative Codes
G - Grab	NI = Nitric Acid (HNO_3)
C8 - 8Hr Composite	SA = Sulfuric Acid (H_2SO_4)
C12 - 12Hr Composite	HA = Hydrochloric Acid (HCl_3)
C24 - 24Hr Composite	SH = Sodium Hydroxide (NaOH)
C - Composi	ST = Sodium Thiosulfate
	ZN = Zinc Acetate
	SS = Sodium Sulfite
	AA = Ascorbic Acid
	R = Refrigerated (<4° C)

Initial

Comments:

Beckmar Laboratories, Inc.
3251 Ruckriegel Parkway
Louisville, KY 40299

Invoice Date 7/25/2016 **Invoice #** 00005299

INVOICE

RECEIVED BY:
RECEIPT DATE:
AMOUNT OF PMT:
METHOD:

PAID 07/25/2016

Logged

Phone # 502-266-6533 **Fax #** 502-266-64[illegible]

Bill To:
Frank Diebold
1724 Spring Dr
Louisville KY 40205-1325

PLEASE PAY THIS AMOUNT ▶▶▶▶ $0.00

Make checks payable to: **Beckmar Laboratories, Inc.**

☐ Please check box if address is incorrect or has changed, and indicate change(s) on reverse side.

Have E-Mail? _____

PLEASE DETACH AND RETURN TOP PORTION WITH PAYMENT

Beckmar Laboratories, Inc.
3251 Ruckriegel Parkway
Louisville, KY 40299

Invoice # 00005299

P.O. No.	Terms	Due Date	Rep	Project
		7/25/2016		

Item	Qty	Description	Rate	Amount
F-Cl	1.00	Chlorine Test	15.00	15.00

BECKMAR ENVIRONMENTAL
3251 RUCKRIEGAL PKWY
LOUISVILLE, KY 40299
07/25/2016 11:15:33
CREDIT CARD
VISA SALE
CARD # XXXXXXXXXXXX7253
INVOICE 0002
SEQ #: 0001
Batch #: 000402
Approval Code: 00421C
Entry Method: Manual
Mode: Online
Avs Code: YYY
SALE AMOUNT $15.00
CUSTOMER COPY

Please pay the amount on remit slip to avoid over payments. If there is a difference between Customer total balance and amount due on remit slip, you may have a prior invoice that is unpaid. If you have any question please give us a call.

Total	$15.00
Payments/Credits	-$15.00
Balance Due	$0.00
Customer Total Balance	$0.00

THERE WILL BE A $25 CHARGE FOR ALL RETURNED CHECKS
10% INTEREST WILL BE ASSESSED ON ALL UNPAID BALANCES
AFTER 90 DAYS, EFFECTIVE JANUARY, 1 2013

Billing Inqueries? Call **502-266-6533**