University of Nevada Cooperative Extension

CSREES Southwest States & Pacific Islands Regional Water Quality Program
Applying knowledge to improve water quality

Fact Sheet-06-69

Shock Chlorination:
Estimating the Amount of Bleach Needed

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This fact sheet explains how to estimate the amount of household bleach needed to disinfect a well and home water system. It provides examples of how to estimate the volume of water that must be treated, and the amount of bleach that must be added to have the proper dose of chlorine. For background about shock chlorination of wells and home water systems, including information about testing water to determine if shock chlorination is needed, see the fact sheet "Shock Chlorination: Background and Principles," FS-06-68. For a step-by-step illustrated guide to shock chlorination, see the fact sheet "A Step-by-Step Guide to Shock Chlorinating Wells and Home Water Supply Systems," FS-06-70.

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INTRODUCTION

The key to successfully disinfecting a well and home water system is adequate contact between bacteria and the disinfecting solution. Two aspects of contact are important. The first is the concentration of the disinfectant in water and the second is the amount of time that bacteria are exposed to disinfectant. Household bleach, which is usually about 5.25% sodium hypochlorite, is most often used for disinfection.

IMPORTANT CONSIDERATIONS

Disinfection takes time and is likely to involve the entire water supply in a home, including the well and household plumbing. This means that water supplies will not be available from faucets, because water will contain too much bleach to be used for cooking, irrigation, or bathing. Accordingly, before disinfecting the well, store drinking water for pets and people, complete any cleaning that requires water, irrigate, and run evaporative coolers. Toilets may be used sparingly while shock chlorination is taking place, but if you have a septic tank avoid flushing too much chlorinated water into it. The septic tank relies on beneficial bacteria to function properly and excess chlorine may kill them.

Most wells produce small amounts of mud and sand, which may accumulate in hot water heaters. These sediments can shield bacteria from the disinfecting solution, allowing them to survive and repopulate after the system is disinfected. Water heaters have a faucet that can be used to drain the hot water tank. This may involve turning off the heater and restarting it after the system is disinfected and refilled. Be sure to follow the manufacturer's instructions for shutting down and starting the heater, or ask someone with experience with this type of appliance, such as a plumber, for assistance. To flush sediment from the tank, connect a garden hose to the faucet and run the hose outside or to a drain. This often must be done by shutting off the cold water supply to the heater and opening either a hot water faucet or a pressure relief valve to allow water to flow from the tank.

Some parts of home water supply systems can be damaged by bleach. For example, filtration systems that contain activated carbon should have the cartridges removed before adding bleach to the system. If cartridges are left in the system they will need to be replaced after disinfection has been completed. Reverse osmosis membranes are also vulnerable to chlorine damage. The membranes are constructed of a thin plastic attached to fiberglass. Bleach makes the membranes brittle, and they may crack and let water pass through without being treated.

Water softeners can be adversely affected by high concentrations of bleach. These rely on resin beads to exchange sodium for calcium, magnesium and other positive ions dissolved in water. The beads can be protected from the hypochlorite solution by simply running a regeneration cycle prior to shock chlorination.

Most domestic water systems have a storage tank that contains an air bladder, often made of butyl rubber, to regulate water pressure and to provide a reservoir to prevent the well pump from cycling on and off whenever water is used. Bleach can attack adhesives used on the butyl rubber, which may cause the bladder to leak. Check with the manufacturer of your pressure tank to determine if bleach will harm the bladder before adding bleach to the well.

Not all components of a household plumbing system are compatible with bleach.

Finally, chlorine may react with metal and non-metal components of the plumbing system as well as soil, rock, and organic matter in the aquifer to release chemicals, such as lead, arsenic, copper and zinc. The concentrations of these chemicals can be very high immediately after adding bleach, but generally decrease as chlorinated water is pumped from the system after treatment. It is extremely important to carefully follow guidelines about purging the home water system after treatment has been completed (see FS-XXX-XXX, A Step-by-step Guide to Shock Chlorinating Wells and Home Water Supply Systems).

DETERMINING THE AMOUNT OF BLEACH TO ADD

Step 1: How much water must be treated

Successful shock chlorination depends on maintaining an adequate dose of sodium hypochlorite long enough to kill microorganisms. For the calculations that follow, we assume that the concentration needed is 250 ppm and that the amount of time needed to complete disinfection is at least 12 hours.

The amount of bleach needed to make a solution of 250 ppm sodium hypochlorite depends, in part, on the volume of water in a well. The volume of water can be estimated from two measurements – the interior diameter of the well casing and the number of feet of standing water (Table 1).

To estimate the number of feet of water standing in a well, subtract the depth to groundwater from the top of the well casing from the total depth of the well (also measured from the top of the casing (Figure 1)). The measurements should be made after the pump in the well has been idle for some time, so that the water level is approximately static.

To determine the depth to water, remove the well cap and measure the distance to the water surface using a clean tape measure or string. It is sometimes helpful to mark the tape measure with chalk. The chalk will show a distinct wet line that indicates where the tape or string entered the water.

If the total depth of the well is unknown, it may be available from a state or local well permitting agency, or the contractor who constructed the well. In Nevada, many well records are available tharough the Nevada Division of Water Resources, at: www.water.nv.gov, under the tab labelled "Well Log Database."

To estimate the volume of water in gallons, multiply the number of feet of water in the well by the number in the right hand column of Table 1 that corresponds with the casing diameter in inches.

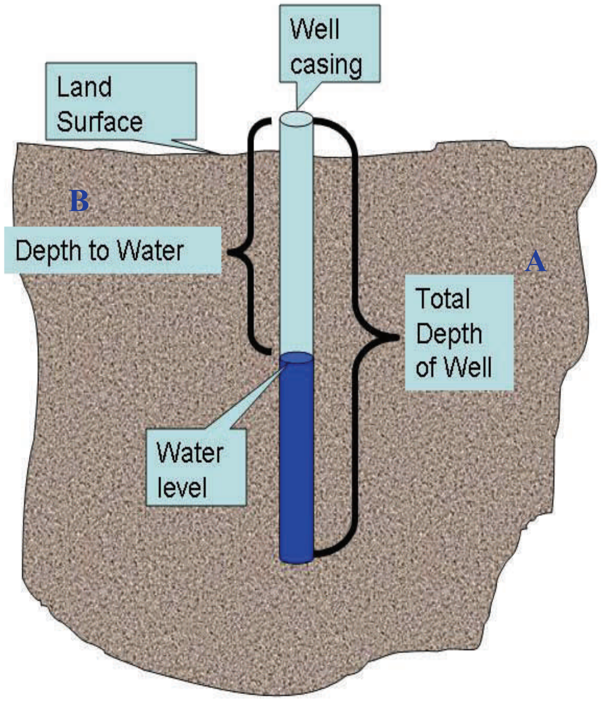

*Figure 1: Use a clean tape measure or a string to estimate the depth of standing water in a well. The depth of standing water is the difference between the total depth **(A)** and the depth to water **(B)**.*

Step 2: How much bleach must be added

Effective disinfection requires adding enough, but not too much, bleach. The amount needed corresponds with the volume of water in the entire home water system. To determine this volume, use the following formula*:

Total volume (gal.) = Water in well (gal.) + water in pressure tank (gal.) + # of toilets x 3 gal. + 10 gal. (plumbing contents) + water heater volume.

**Note: if any of the parts of the system represented in this equation are not going to be treated, do not add their volumes to determine the total volume of the system.*

With the total volume of the system calculated, use Table 2 to estimate the volume of household bleach that should be added to the well to achieve the proper dose for disinfection. It is important to take time to make accurate estimates of well volume. The example below illustrates how to use Tables 1 and 2 to estimate the appropriate amount of chlorine bleach needed for successful shock chlorination.

Table 1: Volume of Water Contained in Well, in Gallons per Foot

Well casing diameter	Gallons per foot of casing
4 in.	0.7
5 in.	1.0
6 in.	1.5
8 in.	2.6
10 in.	4.1
12 in.	5.9
18 in.	13.2
24 in.	23.5
36 in.	52.9

Table 2: Quantity of Household Bleach Needed to Shock Chlorinate at 250 ppm for Twelve Hours

Volume of water to be treated	Volume of bleach needed
10 gal.	3/4 cup
25 gal.	1 3/4 cups
50 gal.	3 1/2 cups
100 gal.	7 cups
150 gal.	10 1/2 cups
200 gal.	14 cups
300 gal.	21 cups

Example

A household well has a total depth of 75 feet below the land surface, from the top of the casing to the bottom of the well. The water level in the well after the pump has been idle for an hour is 52 feet below the land surface. The interior diameter of the well casing is 4 inches. The well owner wishes to disinfect the well, a pressure tank that contains 25 gallons and a 30 gallon water heater. The household has two toilets.

Step 1

Estimate the volume of water to be treated:

The well has 23 feet of standing water (75 ft. total depth – 52 ft. to the water surface) in a 4 inch casing. From Table 1, a 4 inch casing contains 0.7 gallons of water per foot of standing water. Therefore the casing contains 16 gallons of water. The total volume of water to be disinfected is: 16+25 (in the pressure tank)+30 (in the hot water heater)+6 (number of gallons of water in two toilets)+10(household plumbing)=87 gallons.

Step 2

Estimate the amount of liquid bleach that should be used:

Table 2 indicates that we would need between 3 and 7 cups of bleach (the amounts needed to treat 50 and 100 gallons of water, respectively) to have a final concentration of at least 250 ppm. In order to estimate the exact volume of bleach needed, use the proportion for the upper end of this range to determine the number of cups needed:

$$^{7\text{ cups}}/_{100\text{ gallons}} = {}^{?\text{ Cups}}/_{87\text{ gallons}}$$

To find the answer in cups, multiply 87 × 7 and divide the result by 100. The result is 6 cups, which is between the 3 and 7 recommended for 50 and 100 gallons, respectively .

For further information please contact:

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Additional Resources:

Section 15, Well Disinfection, Lifewater International, www.lifewater.ca/Section_15.htm
Shock Chlorination: Background and Principles (FS-06-68)
A Step-by-Step Guide to Shock Chlorinating Wells and Home Water Supplies," (FS-06-70)
Shock Chlorination: Disinfecting the Hot Water Portion of Household Pluming (FS-06-71)
Water Testing for Private Well Owners (SP-00-02: www.unce.unr.edu/publications/SP00/SP0020.pdf)
Drinking Water Quality in Nevada (FS-00-46: www.unce.unr.edu/publications/FS00/FS0046.pdf)

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