

Seasonal System Disinfection for Start-up

The information below is intended to assist noncommunity seasonal public water systems but is not a complete guide to industry standard practices. AWWA Standard C651 provides detailed guidance and procedures for disinfecting components of a water system. Chlorine bleach is a caustic chemical that must be handled properly. Check the label precautions. Also, be aware that use of a higher than necessary dose or concentration may result in damage to system components. More is not always better!

Disinfecting a storage tank and distribution system

If you believe it is necessary to disinfect both your wells and your storage tanks, disinfect the source first.

1. Start by calculating the volume of water in the distribution piping. This volume will be added to the volume of the storage tank to estimate the total volume of water in the system to be disinfected. Table 1 shows some common water distribution main sizes and volumes per foot of pipe. Estimate the total length of water pipes in your water system and multiply the total by the appropriate value from the table. You can use as-built drawings of the water system or a simple map to help estimate pipe diameters and lengths.

Table 1 Estimating Volume of Water in the Distribution System		
Pipe Diameter (inches)	Volume in each linear foot of pipe (gallons)	Volume in 100 linear feet of pipe (gallons)
1	0.04	4
2	0.16	16
4	0.65	65
6	1.47	147

2. Add the volume in the distribution piping estimated in Step 1 to the storage tank volume and use Table 2 to determine the amount of chlorine to be added to the storage tank to result in the desired dose throughout the system. (If your system does not have a storage tank, drop down to the next section, "Disinfecting a distribution system that does not have a storage tank".)
3. Draw down the level of water in the storage tank. Pour the chlorine into the tank as the tank is refilling, in order to get some mixing.

Table 2 Storage Tank Disinfection: Amount of Chlorine Bleach to Use			
Tank Volume PLUS Piping Volume (gallons)	Dosage		
	Non-scented Household Bleach (6%)		12% Bleach
	10 mg/L	20 mg/L	10 mg/L
5,000	13 ¹ / ₃ cups	1 ³ / ₄ gallons	6 ² / ₃ cups
10,000	1 ³ / ₄ gallons	3 ¹ / ₂ gallons	13 ¹ / ₃ cups
20,000	3 ¹ / ₂ gallons	8 ¹ / ₂ gallons	1 ³ / ₄ gallons
50,000	8 ¹ / ₂ gallons	16 ³ / ₄ gallons	4 ¹ / ₄ gallons

4. Use a blow-off, fire hydrant, or outside faucet in the distribution system to draw chlorinated water from the tank out into the distribution system. Then go to all of the faucets in the water system and flush water from them until you detect chlorinated water. Usually you can smell the chlorine, but to be more accurate, use a chlorine residual test kit to measure chlorine residual.
5. Allow the chlorine to remain in the water system overnight (6 hours minimum, 24 hours is preferable). Chlorine needs time to do an effective job of disinfecting.
6. Use one or more outside faucets, blow-offs, or hydrants to draw water out of the water system in order to replace the chlorinated water with chlorine-free water from your source. During this process, make sure you don't damage a pump by drawing water down below a pump intake. Never discharge chlorinated water into any water body, wetland, or drainage ditch because it is extremely toxic to fish.
7. Unless the system normally disinfects its water, the water must not have any detectable chlorine when total coliform samples are taken. Using a chlorine residual test kit to confirm there is no chlorine remaining in the water before collecting a coliform sample is recommended. Otherwise, waiting at least seven days after flushing will help ensure there is no chlorine remaining. The coliform sample result will indicate whether the disinfection was effective.

Example – A campground has 500 feet of 4 inch pipe and 2,000 feet of 2 inch pipe and a 5,000 gallon storage tank.

Volume in 4" pipe = $500 \times 0.65 \text{ gal/ft.} = 325 \text{ gal.}$

Volume in 2" pipe = $2,000 \times 0.0.16 \text{ gal/ft.} = 320 \text{ gal.}$

Volume in pipe plus tank = $325 \text{ gal} + 320 \text{ gal} + 5000 \text{ gal} = 5625 \text{ gal.}$

From Table 2- To achieve a concentration of 10 mg/L of chlorine in the tank and piping, 13 ⅓ cups of 6% bleach are required for the tank volume and 1 ⅓ cups ($625/5000 \times 13.33 \text{ cups}$) are required for the piping volume. A total of 15 cups of 6% bleach solution should be added to the tank.

Disinfecting a distribution system that does not have a storage tank

Disinfecting a distribution system that does not have a storage tank begins with adding disinfectant solution to the well water so it may be pumped into the pressure tank and distribution lines. Simply pouring a bottle of chlorine bleach or dropping tablets into the well will not produce good disinfection results because the chlorine does not get evenly distributed in the casing and borehole.

1. Calculate volumes of water in the well and distribution system or plumbing. Table 3 can be used to estimate well water volume once you determine the height of the water column in the well and the casing diameter. Estimate the volume of water in your distribution system using the Table 1 above. Add the volumes to estimate the total water volume in the system.
2. Use the total system volume and Table 4 to determine the amount of liquid chlorine bleach solution to needed to achieve the desired chlorine dosage.
3. **Optional method** – Prepare diluted solution at surface before adding to well. On the surface, in a water container or tank large enough to hold the total water volume, fill the container with water and add white distilled vinegar to lower the pH to approximately 3.5. This is important for proper mixing and to optimize the disinfecting ability of the solution. Test strips, kits or probes can be used to measure the pH of the disinfecting solution.

Then, add the chlorine, at a slow rate, to the water/acid solution until the pH raises to approximately 6.0. The solution must be stirred with either a plastic or wood rod to ensure proper mixture. **CAUTION: Improper handling, mixing, or use of these chemicals can introduce the unwarranted risk of accidental exposure to potentially hazardous materials from spillage or inhalation. Extreme care must be used while working with any chemical. Work in a well-ventilated area. If you are uncomfortable performing a well disinfection, contact a licensed well driller or water system installer for assistance.** Do not use bleach with fragrance additives. Solid chlorine pellets, which are 65% to 70% calcium hypochlorite, should be dissolved in five gallons of water. Use only chlorine pellet products intended for water well disinfection. Do not use solid chlorine products used for swimming pools because they may contain additional

Table 3 Estimating Well Volume	
Well Casing Diameter (inches)	Volume (gallons per vertical foot of water)
6	1.5
8	2.6
10	4.1
12	5.9
14	8.0
16	10
36	53

Table 4 Well Disinfection: Amount of Chlorine Bleach to Use			
Well Volume (gallons)	Dosage		
	Non-scented Household Bleach (6%)		12% Bleach
	10 mg/L	20 mg/L	10 mg/L
50	2 ¼ Tbsps.	4 ½ Tbsps.	1 Tbsp.
100	4 ½ Tbsps.	9 Tbsps.	2 Tbsps.
200	10 Tbsps.	1 ¼ cups	4 Tbsps.
500	1 ½ cup	2 ¾ cups	10 Tbsps.
1000	3 cups	5 ½ cups	1 ½ cup

Alternative Method of Adding Chlorine to Well

Carefully pour the solution mixed at the surface directly into the well and then recirculate the chlorinated water by connecting a new garden hose (or one reserved for this purpose) to the nearest outside faucet and circulate the water through the hose and back into the well. This will mix the chlorine with the water and the pump will draw the chlorine to the bottom of the well. After you start smelling the chlorine in the water coming out of the hose, use the hose to rinse the upper portion of the well casing with the disinfectant. Recirculate for at least 30 minutes to about 2 hours from the time you smell chlorine from the garden hose.

chemicals, such as algaecides. If your water has a lot of dissolved calcium, do not use calcium hypochlorite because it may cause clogging of the well borehole.

4. Add the solution to the well. Thorough mixing to the bottom of the well can be achieved by injecting the solution into the well through a tremie pipe. The tremie pipe must be placed near the bottom of the well; this will ensure that the water is evenly distributed from the bottom and stirred enough for the chlorine to reach all the bacteria in the well. Gravity feeding, through a tremie pipe, should be sufficient for the disinfection process.

Then follow Steps 4 through 7 above under “Disinfecting a storage tank and distribution system”.

NOTE: Do not to consume the water during the disinfection process. Arrange for an alternative source of drinking water. Please follow all directions and warnings for the chemical products used. Always use rubber gloves, eye protection, and protective clothing when handling mild acids and chlorine products (such as bleach). Avoid contact with the mild acids and chlorine products. If you should splash chlorine or acid solutions on your person or clothing, immediately rinse thoroughly with water.