

## Disinfecting Well Water By Chlorination

**C**hlorination is the oldest method of disinfection for water supplies. Chlorination has been studied extensively and is the standard by which other disinfection procedures are judged.

Chlorine is a strong oxidizing agent. It is cheap, reliable, easy to use and to monitor, and it is safe. A dose of chlorine large enough to be harmful smells too bad to drink and will cause the eyes to burn or water. Chlorine is also easy to remove. Exposure to the atmosphere, heating, or filtering through activated carbon will remove chlorine from water.

Chlorine does have some drawbacks. It requires time to react, and organisms vary in their resistance to chlorine. Most bacteria are relatively easy to kill. Viruses as a rule are more difficult to kill, and many cysts and worms are relatively unaffected. Chlorine also attacks reduced forms of iron and manganese and organic matter which is common in many water supplies. If the chlorine is consumed in reacting with these elements, it is not available to attack the pathogens for which it was intended. In addition, the reaction of chlorine with organic matter may produce trihalomethanes (THMs), which are known carcinogens. Finally, many people do not like the taste or smell of chlorine, and a few react to even very low levels of chlorine in the water.

Many forms of chlorine are available. Ordinary laundry bleach normally contains 5.25-percent available chlorine, but the label should be checked for the percentage of chlorine and to determine if cleaning agents have been added. Bleach with cleaning agents should not be used for disinfecting water supplies. Stronger solutions that contain 12- to 17-percent chlorine are also available. Normally used for swimming pool disinfection, they are also suitable for water treatment. Finally, there are powders and tablets. Dry chlorine sources range from 25- to 75-percent available chlorine. Dry chlorine sources are usually put into solution prior to use, but tablets may be used directly for some applications.

### Methods Of Chlorination

Two basic methods are used to apply chlorine. Chlorine may either be added to a known volume of water as shock treatment procedure or injected into the water supply stream for continuous disinfection.

The amount of chlorine consumed in oxidation reactions is known as the "chlorine demand" of a water supply. The amount of chlorine remaining in the water after the chlorine demand is satisfied is known as the "free chlorine residual." Only if a chlorine residual is found in the water after adequate contact time can you be sure that disinfection has been completed.

**Shock Chlorination.** Shock chlorination is recommended when a new system is put into operation or when an existing system has been exposed to contamination. Shock chlorination requires a strong chlorine solution, 200 to 400 parts per million (ppm). This is equivalent to 200 to 400 milligrams of chlorine per liter of water (mg/L).

Adequate shock chlorination involves the following steps.

1. Pump and clean the water supply or well thoroughly. Remove any debris or other foreign matter. If the water is stored in a cistern or other reservoir be sure to scrub the interior surfaces to remove sediments or deposits.

2. Calculate the depth of water in the well or the amount in the storage reservoir. Determine the amount of chlorine required from Table 1. Any common household liquid bleach that contains approximately 5-percent "active" ingredient, usually sodium hypochlorite, is the most convenient chemical to use.

3. Add and thoroughly mix the required amount of chlorine into the water supply.

The best way to add chlorine to a drilled well is to pump well water into a tank or other container that holds more water than the amount stored inside the well diameter. Mix the chlorine with the water in the

**Table 1. Volume of 5.25-Percent Bleach Solution Required To Disinfect Wells.<sup>a</sup>**

Well Diameter (inches)	Water Depth Of Well (feet)					
	20	30	40	50	100	200
4 to 6	4 oz <sup>b</sup>	6 oz	8 oz	10 oz	20 oz	40 oz
6 to 12	16 oz	24 oz	32 oz	40 oz	2.5 qt	4 qt
12 to 24	2 qt	3 qt	4 qt			
24 to 48	2 gal	3 gal	4 gal			

<sup>a</sup>Disinfection strength should be approximately 50 parts per million.

<sup>b</sup>Liquid ounces. Note: 32 ounces = 1 quart. A standard measuring cup = 8 ounces.

Source: Faust 1975.

tank and allow the chlorinated water to flow back into the well. Attach a hose to a nearby faucet or hydrant; then start the pump to recirculate that chlorinated water out of the well and back into it. Wash down the well casing and delivery pipe with the hose as the water is returned to the well. The returning water must have a strong chlorine odor. If it does not, add more chlorine to the well. In the case of shallow dug wells, the chlorine solution can be added directly to the water by simply raising the cover.

Wells that are more than 75 feet deep may require special methods to get chlorine to the bottom.

One method uses a short pipe filled with high-test hypochlorite powder. Cap both ends of the pipe and drill small holes through each cap or through the sides of the pipe. Fasten an eye to one of the caps and attach a line. The disinfecting agent will be distributed throughout the well as you raise and lower the pipe.

Another method is to use extra chlorine in tablet form to reach the bottom of a deep well. When the tablets settle to the bottom, they will dissolve slowly.

After adding the solution, make sure that the well seal or cover is properly replaced.

4. Fill the distribution system with chlorinated water. Before disinfecting the distribution system, temporarily remove or bypass any carbon filter used in the system.

Open each faucet and hydrant in the distribution system one at a time and run the water until a strong chlorine odor is present. When you smell chlorine, turn the faucet off and open the next one. Add more chlorine to the water in the well if the chlorine odor becomes weak at any faucet.

Drain and refill the water heater and other water system accessories with chlorinated water. Release the air from the pressure tank (except for those tanks with a permanent air cushion) so the tank can fill completely with chlorinated water. Backwash the

water softener and all filters (except carbon filters) with chlorinated water.

5. Once the chlorine adequately reaches all points of the distribution system, allow the chlorinated water to stand in the well and the distribution system for at least 2 hours. If possible, allow the chlorine solution to stay in the system overnight.

6. Thoroughly pump the water supply source and flush the system until all of the residual chlorine has been diluted to an acceptable level for use. Pump the wastewater through a hose to a roadside ditch or some other bare area.

Do not irrigate a garden or lawn with this wastewater and do not let more than 100 gallons of the strongly chlorinated water flow into drains which ultimately discharge into a septic tank.

In addition to these steps, two additional steps are suggested if iron bacteria or other nuisance organisms are in the system.

First, dislodge and remove bacterial masses from the piping system by using compressed air or gas to create water surges or to induce a waterhammer effect. Take care not to create excessive pressures which may rupture pipelines. Second, shock chlorinate the water source and the water distribution system again within 24 to 48 hours.

7. To ensure the water is safe for drinking, test it for coliform bacteria. Allow at least 24 hours before taking the sample. This will ensure that all water in the well has been replaced with fresh water from underground sources.

If coliform organisms are still present, the groundwater is continuously contaminated. In this case, you should abandon the well or water source and develop a new one. If new construction is not possible or feasible, your water supply should be disinfected continuously by a chlorinator installed in the water system.

**Continuous Chlorination.** If tests show the presence of coliform bacteria even after the well has been disinfected and if wells and septic tanks are crowded together, then the groundwater is continuously contaminated. In these situations, the water may be permanently disinfected by a home chlorinator that feeds chlorine continuously into the water. Continuous chlorination should always be used on surface water supplies, such as ponds, springs, lakes, or cisterns.

Some chlorinators feed just enough bleach, approximately 1 to 2 parts per million (ppm), to adequately disinfect the water and leave a small residual, 0.2 to 0.5 ppm, of chlorine as a safety factor. This is called **simple chlorination**.

Other units feed the bleach at higher dosages in the range of 5 to 10 ppm and leave a high residual of

chlorine. This method of chlorination is called **super chlorination**. In this case, the high residual chlorine imparts a strong chlorine odor and taste to the water. This strong chlorine odor and taste can be removed with an activated carbon filter. Removing chlorine is called **dechlorination**.

There are many types of commercially available home chlorinators, but most of them work on the principle of feeding a chlorine solution into the water. These units are usually located on the discharge side of the well pump and before the pressure storage tank.

Some home chlorinators feed chlorine directly into the well. Feeding chlorine directly into the well has several potential benefits. If iron bacteria are present in the well, they can be treated at the source. If the water contains iron or manganese, the minerals may be precipitated from solution by chlorination. After precipitation by chlorination, they may be removed by filtration.

Two common methods of feeding chlorine are pumps and aspirators. A **chlorine pump** is a positive displacement or chemical-feed device which adds a small amount of chlorine to the water. The dose is either fixed or varies with water flow rates. The chlorine is drawn into the device and then pumped to the water delivery line. See Figure 1. Corrosion of the chlorination device can be a problem.

An **aspirator** is a simple, inexpensive mechanism in which a vacuum created by water flowing through a tube draws chlorine into a tank where it mixes with untreated water. The treated solution is then fed into the water system. The chlorine doses are not consistently accurate.

Although other methods of disinfection are available, chlorination is one of the least expensive and most reliable techniques used.

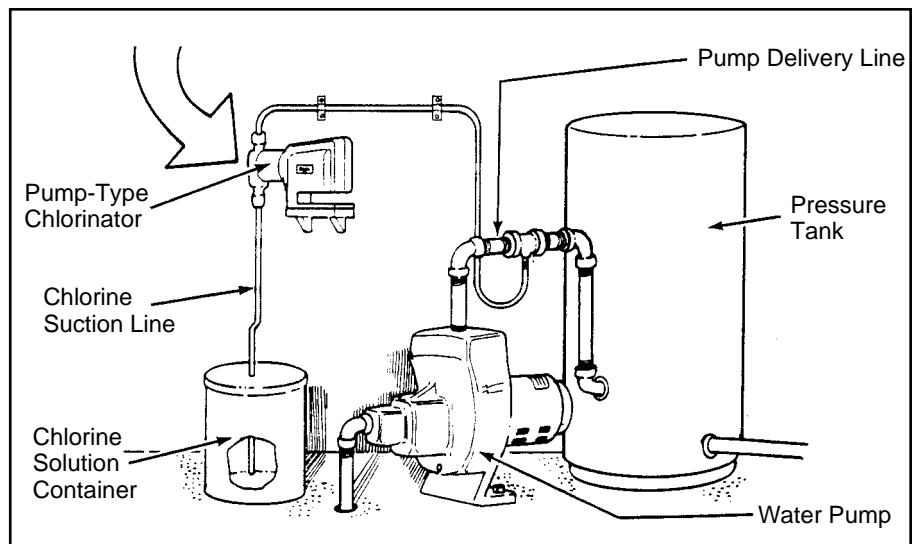
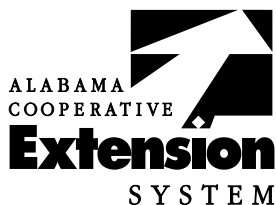


Figure 1. Pump-type diaphragm chlorinator.

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