shock-chlorinating small water systems

Sanitary water system components (well, pump, pipes, tanks and treatment equipment) are as essential to a hygienic drinking water supply as clean cooking and serving utensils are to wholesome food.

A properly designed well and water distribution system incorporates sanitary features that keep contamination from entering under normal operating conditions, but there are occasions when contaminants will get in. During well construction, or when pumps and other water system components are being installed, soil, grease, joint sealing compound, and other foreign materials that carry bacteria adhere to interior surfaces of the equipment. Furthermore, most water system repairs must usually be accomplished in trenches, well pits, or other locations where opportunities for contamination are numerous.

To combat disease-causing bacteria and viruses that remain in a water system following construction, repair, or maintenance, some means of disinfecting the interior surfaces is necessary. Shock chlorination is a convenient method for doing this through the use of a concentrated chlorine solution.

Shock chlorination is occasionally confused with the type of chlorination provided in public water systems, but the two processes differ substantially. Public water supply disinfection is accomplished with a *continuous* application of small amounts of chlorine. The major purpose is to disinfect the water itself, and water from community water supplies commonly contains less than 1 part per million (ppm) of chlorine. Shock chlorination, however, uses chlorine concentrations ranging from 50 to 200 ppm, and the primary purpose is to sanitize wells, piping, and other equipment that the water passes through.

Shock chlorination is *not* a continuous process and it cannot protect a defective well or plumbing system from continuous entry of contaminants. Only water systems that are protected against further contamination will benefit from shock chlorination. Poorly designed or deteriorated water system components that allow contamination to enter should be repaired or replaced, *then* shock chlorinated. For further information on the sanitary construction features that should be incorporated in a well, see *Good Wells for Safe Water,* ISU Extension publication Pm-840.

Control of nuisance organisms that can live in a water system is another use for shock chlorination. Iron bacteria, for example, are commonly found in water supply equipment. This type of bacteria is not known to cause disease, but it thrives in some iron-bearing waters and

Table 1. Pounds of HTH* needed to shock chlorinate wells of various depths and diameters.

Well water depth (feet)	Well diameter (inches) 4	6	8	12	18	24	30	36
25	0.04	0.09	0.16	0.35	0.8	1.4	2.2	3.2
50	0.08	0.18	0.31	0.7	1.6	2.8	4.4	6.4
75	0.12	0.26	0.47	1.1	2.4	4.2	6.6	9.5
100	0.16	0.35	0.6	1.4	3.2	5.6	8.8	12.7
125	0.20	0.44	0.8	1.8	4.0	7.1	11.0	15.9
150	0.24	0.5	0.9	2.1	4.8	8.5	13.2	19.1
175	0.27	0.6	1.1	2.5	5.6	9.9	15.4	22.2
200	0.31	0.7	1.3	2.8	6.4	11.3	17.6	25.4
250	0.39	0.9	1.6	3.5	7.9	14.1	22.1	31.8
300	0.47	1.1	1.9	4.2	9.5	16.9	26.5	38.1
350	0.5	1.2	2.2	4.9	11.1	19.8	30.9	44.5
400	0.6	1.4	2.5	5.6	12.7	22.6	35.3	50.8
450	0.7	1.6	2.8	6.4	14.3	25.4	39.7	57.2
500	0.8	1.8	3.1	7.1	15.9	28.2	44.1	63.5

*For products containing 65 to 75 percent $Ca(OCl)_2$.

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forms large amounts of rust-colored slime that clogs wells, pipelines, and water filters. Though extremely difficult to eliminate from a water system, iron bacteria growth can be controlled with periodic shock chlorination.

How to Shock Chlorinate

Sources and Amounts of Chlorine
Liquid and powdered forms of chlorine are readily available at grocery or hardware stores and swimming pool supply outlets. Liquid household bleach, which commonly contains 5.25 percent sodium hypochlorite (NaOCl), is a convenient product to use if your well is not extremely large or deep. High-test hypochlorite powder, commonly referred to as HTH, is a highly concentrated source of chlorine suitable for large or deep wells. It generally contains 65 to 75 percent calcium hypochlorite ($Ca(OCl)_2$).

Tables 1 and 2 indicate approximately how much HTH or bleach is needed to yield a chlorine concentration of 200 parts per million (ppm) in wells of various depth and diameter. Water containing substantial amounts of iron, hydrogen sulfide, or organic material will require more chemical because chlorine is depleted by these substances.

Example 1: A weighted string lowered into a 6-inch diameter well indicates water in the well is about 100 feet deep. Approximately **how much HTH** would be used to shock chlorinate this well?
From Table 1—enter the column for a 6-inch well and read down to the row for 100 foot depth. Approximately 0.35 pounds of HTH is needed.

Example 2: How much **household bleach,** containing 5.25 percent NaOCl, would be needed to shock chlorinate the well in Example 1?
From Table 2—again, read down the column for a 6-inch well until the row for 100 feet of water depth is reached. In this case 4.7 pints of bleach is recommended.

It is not necessary that chlorine levels in the well be exactly 200 ppm; 100 to 200 ppm is adequate. A strong chlorine odor, however, should be present in water pumped from the well to other parts of the plumbing system. If a strong odor is not noticeable, you will need to add more chlorine.

Disinfecting the Water System
Only the surfaces that are contacted by the chlorine solution will be disinfected. The following recommendations will help to accomplish a thorough job.

To avoid adding more contaminants to the well during the disinfection procedure, clean up the work area around the top of the well. Remove grease, mineral deposits, and other encrustation from accessible parts of the well interior and scrub these surfaces with a solution of ½ cup of laundry bleach in 5 gallons of water. Be sure to wash pumping equipment and piping with the chlorine solution as it is lowered into the well.

Table 2. Pints of bleach* needed to shock chlorinate wells of various depths and diameters.

Well water depth (feet)	Well diameter (inches)								
	4	6	8	12	18	24	30	36	48
25	0.5	1.2	2.1	4.7	10.6	18.8	29.3	42.2	75.1
50	1.0	2.3	4.2	9.4	21.1	37.5	58.7		
75	1.6	3.5	6.3	14.1	31.7	56.3			
100	2.1	4.7	8.3	18.8	42.2	75.1			
125	2.6	5.9	10.4	23.5	52.8				
150	3.1	7.0	12.5	28.2	63.4				
175	3.7	8.2	14.6	32.9	73.9				
200	4.2	9.4	16.7	37.5					
250	5.2	11.7	20.9	46.9					
300	6.3	14.1	25.0	56.3					
350	7.3	16.4	29.2	65.7					
400	8.3	18.8	33.4	75.1					
450	9.4	21.1	37.5						
500	10.4	23.5	41.7						

*For bleach containing 5.25 percent NaOCl.

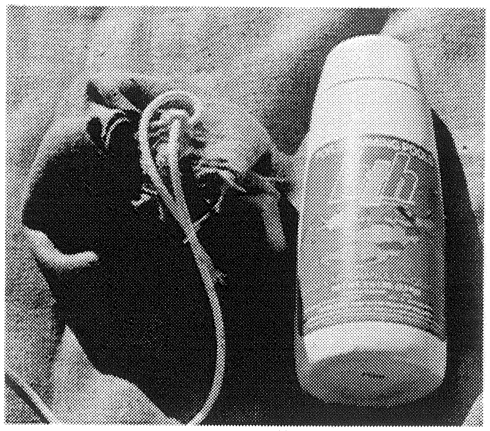

Fig. 1. Cloth sack filled with powdered chlorine compound is ready to be lowered into the well.

Fig. 2. Weighted sack filled with chlorine powder is lowered into the well.

Fig. 3. Strong chlorine solution is recirculated back to the well.

Newly constructed wells, or those that have been submerged by flood waters, may contain substantial amounts of sediment that cloud the water and interfere with disinfection. Pump the well until the water clears before proceeding with shock chlorination.

Liquid sources of chlorine can be poured directly into the well. Powdered chlorine compounds can be introduced in two ways:

1. Mix the required amount of dry compound with a small amount of water and stir thoroughly to dissolve. Let the undissolved calcium carbonate particles settle. Pour off the clear chlorine solution and use this to disinfect the well.

OR

2. Place the required amount of chemical in a weighted cloth sack (fig. 1) or in a section of perforated pipe that has been capped on both ends. Attach a rope and alternately raise and lower the chemical throughout the water-bearing portion of the well to dissolve the compound and distribute the disinfectant (fig. 2).

Pumping will help to mix the disinfectant with the water standing in the well. Use a garden hose to recirculate the strong chlorine solution directly back into the well (fig. 3). Direct the return flow onto the pump piping and interior portions of the well casing that are above the water level.

Open the faucets and hydrants on each water line, one by one, and allow water to flow until a strong chlorine odor is detected. If a strong chlorine odor is not detectable, add more chlorine at the well. This will be necessary if the water contains substantial amounts of iron, hydrogen sulfide, or organic materials that deplete the chlorine in solution.

Drain water heaters and bleed the air from pressure tanks so that chlorinated water can completely fill and sanitize them. Water softeners, sand filters, and iron removal filters should be backwashed with the strongly chlorinated water. *Do not* chlorinate carbon or charcoal filters because this will deplete their capacity.

It takes time for the chlorine to do a thorough job of disinfecting. Allow the chlorine to remain in the water system for *at least 2 hours*—longer, if possible.

Before using the water supply, thoroughly flush the remaining chlorine from the system. Minimize the amount of chlorinated water that enters a septic tank by flushing the well, pressure tank, and other large volumes of disinfecting solution through outside hydrants. Vegetation may be harmed by the strongly chlorinated water; dispose of it on ground where damage will be minimal. Pipes that serve indoor plumbing fixtures can be flushed after the well and pressure tank have been filled with fresh water.

Observe These Precautions

All concentrated chlorine solutions are corrosive, and care should be taken to avoid splashing them onto skin or into eyes. Rubber gloves, goggles, and protective aprons are recommended when handling chlorine solutions. Skin areas contacted by the disinfecting solution should be flushed immediately with clean water.

Never mix chlorine solutions with compounds containing acids or ammonia to improve their cleansing ability because toxic gases will form.

Both liquid and powdered chlorine sources lose strength with time. Exposure to heat, light, and moisture (if the compound is powdered) accelerates decomposition of the materials. Accordingly, buy fresh chemicals in small quantities to avoid storage losses. Always read and follow the manufacturer's recommendations for handling and storing powdered and liquid chlorine compounds.

Strongly chlorinated water may damage the elastic air-water separator or air bladder used in some pressure tanks. Check the manufacturer's recommendations if your pressure tank is equipped with this feature.

Retest Before Drinking

Follow-up testing for bacteria is an essential part of the shock chlorination procedure. Wait a few days after shock chlorinating before collecting the water sample. If bacteria are still entering the water system, it may take several days for detectable amounts to show up in a water sample.

Do not drink the water until results from the water test indicate the supply is safe. It's a good idea to retest a few weeks later to be sure that all points of entry for contamination have been blocked. Bacterial contamination is most likely to enter a well during wet weather when the water table is high and excess surface water seeps into the ground. A well that shows little or no signs of bacterial contamination during dry weather may be heavily contaminated during wet seasons.

If a water system continues to show bacterial contamination following shock chlorination, it may be necessary to hire a plumber or well driller to help locate and repair places where contamination enters.

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