K·STATE Research and Extension

Shock Chlorination of Private Water Well Systems

A safe, adequate water supply is important for everyone's health and livelihood. The owner or user of a well should understand that proper location and construction are essential requirements for a safe water supply. Routine maintenance, repair, and protection are important elements for maintaining a safe water supply. Shock chlorination involves disinfecting a well and household plumbing system. Annual shock chlorination ensures a safe water supply. Chlorine is the recommended disinfectant. Chlorine is available as both dry and liquid products and should be certified to meet NSF/ANSI Standard 60, which is a U.S. guideline setting minimum health-effect requirements for the chemicals. Shock chlorination can be done by the well owner, user, driller, or other service provider. Other options for your well may be available; contact your well technician for other well disinfection products and options.

Shock chlorination should be done:

- following construction of a well,
- following repair of the water system,
- following a flood or other event when nonpotable water may have entered the well,
- anytime water has a bad taste or smell,
- when a water test is positive for bacteria, and
- as a part of annual well maintenance.

Preparation Before Treatment

Shock chlorination of a water source that does not meet construction standards only gives limited benefits. Bacteria can enter the well within 50 feet, so area protection near the well is essential for safe water. Hand-dug wells are difficult to protect because they may not have a casing system to prevent entry of exterior water, insects, animals, and soil. K-State Research and Extension publication, *Private Wells – Safe Location*, MF3667, has information on construction standards for wells.

Well construction standards include:

- Well casing is sealed to the surrounding soil.
- Soil surface slopes away from the well in all directions for 20 feet, and no surface water collects within 50 feet.
- The well casing extends at least a foot above the ground surface or the highest flood level.
- The casing is watertight and has an approved sanitary well seal.
- A watertight pitless adapter connects the well outflow waterline to the casing below the frost level.

Inspect the well to confirm current construction standards are followed. Make all needed repairs before proceeding with shock chlorination. Verify the water source is properly managed, and adequately maintained. Remove any direct contamination routes such as abandoned wells and cross connections.

Chlorine Safety

Chlorine is harmful to eyes and skin. Safety glasses, gloves, and arm protection are recommended. Having a bucket of clean water nearby to quickly wash contaminated eyes and skin is a good safety plan. Users of these products must follow all label instructions.

Shock Chlorination Procedure

Remove, bypass, or disconnect all water treatment equipment, such as water softeners, reverse osmosis, and filter units to prevent damage. Most pressure tanks are captive-air type with a rubber bladder to contain the water. High chlorine concentrations may damage the bladder. Check with the manufacturer about possible damage to any equipment. After the chlorine is flushed from the system, there is usually enough residual chlorine to disinfect water treatment equipment, such as a water softener, when it is returned to service. Turning off the electric circuit breaker when not using the pump and the water heater and other water treatment equipment are safety and equipment recommendations.

Before chlorine treatment, inform all water users that the water is being treated and should not be used. Provide temporary alternative drinking water and put a reminder on each faucet. Take special precautions for children and elderly people in the household. Livestock may refuse to drink strongly chlorinated water, so provide them with an alternative water supply.

Step 1. Preparation. Equipment for chlorination includes clean water hoses, a clean 5-gallon mixing bucket, a clean container for the sanitary seal of the well, the chlorine dose, and tools to remove the sanitary seal. A large clean

Table 1. *Volume of Water in Wells*

Inside Diameter of Casing (Inches)	Volume of Well Per Foot of Casing	
	gal/ft	ft^3/ft
2	0.16	0.02
3	0.37	0.05
4	0.65	0.09
5	1.02	0.14
6	1.47	0.20
8	2.61	0.35
10	4.08	0.55
12	5.88	0.79
14	8.00	1.07
16	10.44	1.40
18 (1.5 feet)	13.22	1.77
24 (2.0 feet)	23.50	3.14
30 (2.5 feet)	36.72	4.91
36 (3.0 feet)	52.88	7.07

tank may be used for chlorinated water to flow into the well or spring.

The amount of chlorine used in the treatment depends on the amount of water involved in the treatment. Calculate the well water volume by multiplying the volume per foot of the casing diameter (Table 1) by the depth of water (well depth minus the depth to water). If the well was drilled after 1975, a well log may be available from the county or state water office that will have the well depth and depth to water level at the time the well was drilled. Kansas Geological Survey has construction information on wells in Kansas. If the depth information is not available, the depths should be measured. K-State Research and Extension publication, *Measuring Depth to Water in Wells* (MF2669), has instructions on obtaining the measurements. Add the volume of water contained in the pressure tank, water heater, other containments, and plumbing pipes using the volumes in Table 2. Sum all containments to determine the total water volume to be treated. Find the chlorine dose calculated to produce a chlorine concentration of 500 mg/L or ppm from Table 3.

Remember to bypass, disconnect, or remove water treatment components that can be damaged by chlorine. The exchange media, typically polystyrene beads, of ion exchange units (water softeners and anion exchange) may be damaged. Set the control valve of water treatment equipment to the bypass position. Reverse osmosis systems could be seriously damaged and should be disconnected. Remove the sediment, carbon, and combination cartridge filters to avoid any damage and replace the empty filter case during shock chlorination.

Step 2. Remove and clean the sanitary well seal (or cap) and place it in a clean container. Clean visible mold, fungus, and debris from the inside of the casing and the exterior of pipe, wires, and other components inside the casing. Dirt on components greatly reduces the effectiveness of shock chlorine treatments.

Table 2. *Volume of Water in Small Diameter Pipes*

Diameter (Inches)	Volume (Gallons/100 ft)	ft^3/100 ft of Casing
0.75	2.29	0.31
1.00	4.08	0.55
1.25	6.38	0.85
1.50	9.18	1.23

Note: For 2-inch and larger diameters, see Table 1

Step 3. Add chlorine. Use a chlorine product with **5% sodium hypochlorite** that is certified for drinking water use. Most store-bought laundry bleach products are not certified for water treatment. Chlorine products of other percentages can be used if the product is labeled for human consumption and mixing instructions are included on the container. Mix the correct chlorine dose with 5 gallons of water. If dry chlorine is used, thoroughly mix it with warm water until the chlorine is completely dissolved. Pour the chlorine solution into the well so that the solution runs down the inside of the casing and the surface of wires and pump plumbing.

Step 4. Attach a water hose to the nearest water hydrant supplied by the well and place the other end of the hose into the top of the well casing. Turn on the water pump and hydrant to circulate water from the well through the plumbing and hose, and then back to the well. After a strong chlorine smell is detected, place enough chlorine solution in the container to cover the sanitary well seal. Thoroughly disinfect the inside of the well by slowly rotating the hose around the inside of the casing and continue flushing for 15 minutes. The flushing allows the chlorine solution to wash down the interior wall of the well casing, the exterior of the pump column, and the wiring. Keep the recirculation hose flowing to the casing while completing step 5.

Step 5. Distribute disinfectant. Open the next closest tap to the well, and let the water run until a strong odor of chlorine is detected. Close that tap and proceed to the next closest tap and open it until a strong chlorine smell is detected. Continue, tap by tap, throughout the entire distribution system (inside and outside the house) including faucets, tubs, showers, toilets, and hydrants. Open all cold-water outlets first and follow with the hot-water faucets until the chlorinated water is distributed throughout the entire water system. If the strong chlorine odor is not present, return to Step 3, add half the amount of chlorine used for the initial treatment to the well, and then resume this step.

When chlorinated water is distributed throughout the entire water system, turn off the pump, shut off all taps, remove the hose to the well, and cap the well with the sanitary seal. Allow the chlorine to remain in the system for 24 to 72 hours. Longer contact times improve treatment outcomes. Do not use any water during the disinfection time.

Step 6. Flush the water system with well water after the chlorinated water has been in the system for the desired disinfection time. Do not allow a large dose of chlorine to enter the home wastewater system or contact desirable plants. Direct the discharge hose to a gravel drive or road. Open outside taps and flush the system until no chlorine odor is detected. Flush the system tap by tap, leaving inside faucets until last to reduce the amount of chlorine that enters the wastewater system.

Step 7. After 2 weeks of water use, test the water to determine if chlorine is present. If chlorine test is positive, use well water for an additional 2 weeks and retest for chlorine. After the water tests are negative for chlorine, verify bacteria safety from the well and plumbing by an additional water test. Samples may be collected by the local health department or homeowner and should be sent to the laboratory on the same day. Samples for bacteria tests must be collected in sterile containers from the laboratory. For water test procedures, see K-State Research and Extension publication, *Taking a Water Sample* (MF963). Tests for total and fecal coliform bacteria should begin within 24 hours of sample collection.

Well with iron bacteria. Iron bacteria are a common problem, especially in alluvial wells, and can be introduced as the well is drilled. If the well is not thoroughly disinfected after drilling, these bacteria can proliferate. Unchecked, the bacteria can clog the well screen and the gravel pack. The best defense is immediate and thorough disinfection after drilling and after any service of the well or pump. Acid treatment of wells may be an option and should be conducted by professional well service personnel.

In case of a severe bacteria problem, multiple treatments may be required. The first treatment may result in bacterial slime sloughing and it may be necessary to remove the pump and scrape bacterial slime off the pump column and the inside of the casing. An acid treatment may be required to remove severe build up. Minimize the transfer of debris from the water treatments into the home water system by opening the hydrant nearest the well. If a water tap is not near the well, it may be desirable to install one. If multiple treatments are unsuccessful, continuous chlorination equipment may be necessary, inspection or repair by a licensed water-well service technician may be required, or a new well location should be considered.

Wells with sediment. A well that received surface inflow from a flood, leaky casing, or accident should be checked for sediment in the well. If more than 6 inches of sediment exists, the sediment should be removed before doing the shock chlorination. Sediment interferes with effective shock chlorination and can harbor bacteria, insects, worms, and other contaminants. Sediment removal may involve pump removal and special equipment. Contacting a well driller may be the best option for sediment removal.

Emergency disinfection of water. Water that contains coliform bacteria, especially fecal coliform or *E. coli* should not be used for drinking without treatment. Boiling water for at least 3 minutes is the most reliable emergency procedure because it is effective for all water that has organic debris.

If the water is clear (no cloudiness or debris), chlorine products also can be used for emergency disinfection. It is important to follow directions on the chlorine source container.

Safe water comes from safe wells. Safe wells are:

- located away from pollution sources and out of pollutant pathways.
- constructed to meet current standards.
- maintained annually through a maintenance check of the well and water quality testing of the system.
- protected from contamination by an adhered-to water safety source plan.

Additional Information

K-State Research and Extension offices — *www.ksre.k-state.edu/about/statewide-locations/*

Local health departments — *www.kdhe.ks.gov/2085/Directories-Maps*

Local environmental offices or county sanitarian — *www.kdhe.ks.gov/BusinessDirectoryII.aspx?lngBusinessCategoryID=49*

Testing Private Water Systems (MF3655) — *bookstore.ksre.ksu.edu/download/MF3655*

Private Well Maintenance and Protection (MF3666) — *bookstore.ksre.ksu.edu/download/MF3666*

Private Wells — Safe Location — *bookstore.ksre.ksu.edu/download/MF3667*

Acknowledgments

Information in this publication was drawn from:

Powell, G. M., D. H. Rogers, & J. M. Willingham (2005). S*hock Chlorination for Private Water Systems* (MF911). Kansas State University.

Table 3. *Volume of 5% Chlorine Product Required for Shock Chlorination Based on Water Volumes in Various Diameter Wells.*

	Well Diameter					
	4-inch		6-inch		8-inch	
Feet of Water in Well*	Gallons of Water in Well	Quarts	Gallons of Water in Well	Quarts	Gallons of Water in Well	Quarts
10	7		15		26	0.5
20	13	0.25	29	0.5	52	1.0
30	20		44		78	
40	26		59	1.0	104	1.5
50	33	0.5	74		131	2.0
60	39		88		157	
70	46		103	1.5	183	2.5
80	52	0.75	118		209	3.0
90	59		132	2.0	235	
100	65	1.0	147		261	4.0
110	72		162	2.5	287	
120	78		176		313	
130	85		191		339	5.0
140	91		206	3.0	365	
150	98	1.5	221		392	6.0
160	104		235		418	
170	111		250		444	
180	117		265	4.0	470	7.0
190	124		279		496	
200	130	2.0	294		522	8.0
210	137		309	4.5	548	
220	143		323		574	
230	150		338	5.0	600	9.0
240	156		353		626	
250	163	2.5	368	5.5	653	10.0
260	169		382		679	
270	176		397	6.0	705	
280	182		412		731	11.0
290	189		426	6.5	757	
300	195		441		783	
310	202	3.0	456		809	12.0
320	208		470	7.0	835	
330	215		485		861	13.0
340	221		500	7.5	887	
350	228		515		914	14.0
360	234	3.5	529	8.0	940	
370	241		544		966	
380	247		559	8.5	992	15.0
390	254		573		1,018	
400	260	4.0	588	9.0	1,044	16.0

*** Feet of water in a well** is the total well depth minus the distance from the top of the well to the water level.

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