For more information refer to the Water Wells That Last video series Part III — Shock Chlorination.

Well maintenance is essential to ensure that a well will last.

Wells can also be contaminated with harmful bacteria such as fecal coliforms or E. coli. Shock chlorination is the most effective method to eliminate them.

Shock Chlorination — Well Maintenance

Shock chlorination is a relatively inexpensive and straightforward procedure used to control bacteria in water wells. Many types of bacteria can contaminate wells, but the most common are iron and sulfate-reducing bacteria. Although not a cause of health problems in humans, bacteria growth will coat the inside of the well casing, water piping and pumping equipment, creating problems such as:

- Reduced well yield
- Restricted water flow in distribution lines
- Staining of plumbing fixtures and laundry
- Plugging of water treatment equipment
- “Rotten egg” odor.

Bacteria may be introduced during drilling of a well or when pumps are removed for repair and laid on the ground. However, iron and sulfate-reducing bacteria (as well as other bacteria) can exist naturally in groundwater.

A well creates a direct path for oxygen to travel into the ground where it would not normally exist. When a well is pumped, the water flowing in will also bring in nutrients that enhance bacterial growth.

> Note: All iron staining problems are not necessarily caused by iron bacteria. The iron naturally present in the water can be the cause (see Module 12 "Other Resources" for more information.)

Ideal Conditions for Iron Bacteria

Water wells provide ideal conditions for iron bacteria. To thrive, iron bacteria require 0.5-4 mg/L of dissolved oxygen, as little as 0.01 mg/L dissolved iron and a temperature range of 5 to 15°C. Some iron bacteria use dissolved iron in the water as a food source.

Signs of Iron and Sulfate-Reducing Bacteria

There are a number of signs that indicate the presence of iron and sulfate-reducing bacteria. They include:

- Slime growth
- Rotten egg odor
- Increased staining.

Slime Growth

The easiest way to check a well and water system for iron bacteria is to examine the inside surface of the toilet flush tank. If you see a greasy slime or growth, iron bacteria are probably present. Iron bacteria leave this slimy by-product on almost every surface the water is in contact with.

Rotten Egg Odor

Sulfate-reducing bacteria can cause a rotten egg odor in water. Iron bacteria aggravate the problem by creating an environment that encourages the growth of sulfate-reducing bacteria in the well. Sulfate-reducing bacteria prefer to live underneath the slime layer that the iron bacteria form. Some of these bacteria produce hydrogen sulfide gas as a by-product, resulting in a "rotten egg" or sulfur odor in the water. Others produce small amounts of sulfuric acid that can corrode the well casing and pumping equipment.

Increased Staining Problems

Iron bacteria can concentrate iron in water sources with low iron content. It can create a staining problem where one never existed before or make an iron staining problem worse as time goes by.

Use the following checklist to determine if you have an iron or sulfate-reducing bacteria problem. The first three are very specific problems related to these bacteria. The last two problems can be signs of other problems as well.

✔ Checklist to Determine an Iron or Sulfate-Reducing Bacteria Problem

- ❐ Greasy slime on inside surface of toilet flush tank
- ❐ Increased red staining of plumbing fixtures and laundry
- ❐ Sulfur odor
- ❐ Reduced well yield
- ❐ Restricted water flow

Shock Chlorination Method

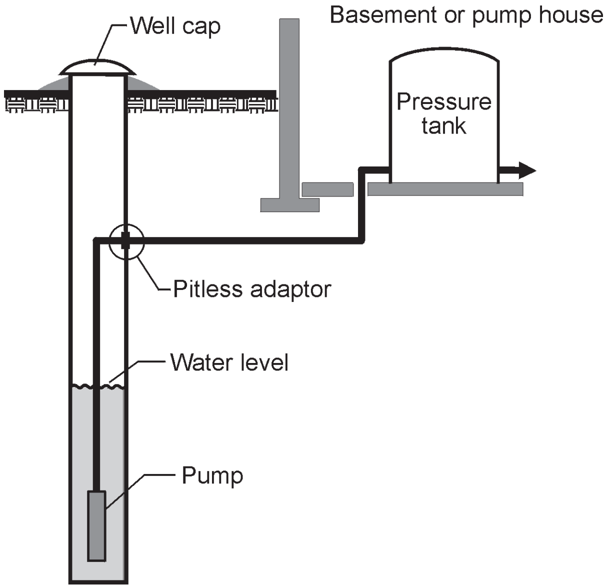
Before you shock chlorinate, consult your water treatment equipment supplier to ensure the appropriate steps are taken to protect your treatment equipment.

Shock chlorination is used to control iron and sulfate-reducing bacteria and to eliminate faecal coliform or *E. coli* bacteria in a water system. To be effective, shock chlorination should be done on a regular basis at least once or twice per year as part of a routine well maintenance program. Start the treatments early in the life of your well. Shock chlorination will disinfect the following:

- The entire well depth
- The pressure system
- The distribution system.
- The formation around the bottom of the well
- Some water treatment equipment

To accomplish this, a large volume of chlorinated water is siphoned down the well to displace all the water in the well and some of the water in the formation surrounding the well.

Figure 1 Water System



Effectiveness of Shock Chlorination

With shock chlorination, the entire system (from the water-bearing formation, through the well-bore and the distribution system) is exposed to water which has a concentration of chlorine strong enough to kill iron and sulfate reducing bacteria (see Figure 1, Water System). Bacteria collect in the pore spaces of the formation and on the casing or screened surface of the well. To be effective, you must use enough chlorine and water mixture to reach and disinfect the entire cased section of the well and adjacent water-bearing formation.

The procedure described on the following pages does not completely eliminate iron bacteria from the water system, but it will hold it in check. To control the iron bacteria, you will have to repeat the treatment on a regular basis, likely each spring and fall as a regular maintenance procedure.

Shock chlorination will not be effective on wells that have been seldom or never been treated. These poorly maintained wells likely require the services of an experienced water well driller who has the necessary equipment and products to effectively and safely clean and restore the well water quality and production. Sometimes these wells can be restored to near their original water quality and production capacity after the well driller uses scrubbing equipment and applies an acid treatment to remove the heavy layers of bacterial slime on the well casing prior to disinfecting with a chlorine mixture. After a thorough cleaning it may be possible to return to regular shock chlorination treatments to control bacteria buildup and its related problems.

Shock Chlorination Procedure for Drilled Wells

A modified procedure is also provided for large diameter wells.

> Caution: If your well is low yielding or tends to pump any silt or sand, you must be very careful using the following procedure because overpumping may damage the well. When pumping out the chlorinated solution, monitor the water discharge for sediment.

To calculate the volume of a box-shaped container use the following formula:

Imperial: (feet)
length x width x depth x 6.24 = gallons

Metric: (centimetres)
length x width x depth ÷ 1000 = litres

Follow these steps to shock chlorinate your well.

Step 1 Store sufficient water to meet farm and family needs for 8 to 48 hours.

Step 2 Pump the recommended amount of water (see Table 1, Amount of Chlorine Required to Obtain a Chlorine Concentration of 200 PPM) into clean storage. A clean galvanized stock tank or pickup truck box lined with a 4 mil thick plastic sheet is suitable. The recommended amount of water to use is twice the volume of water present in the well casing. To measure how much water is in the casing, subtract the non-pumping water level from the total depth of the well. See the example below.

Imperial Example

The drilling record indicates the casing is 200 ft. in length and the non-pumping ("static") water level is 100 ft. The length of casing that is holding water in it is 100 ft. (200-100). If your casing is 6 in. in diameter you need to pump 2.4 gal. of water for every foot of water in the casing, into your storage container. Since you have 100 ft. of water in the casing, you will pump 2.4 gal./ft. x 100 ft. = 240 gal. of water into storage.

Using Table 1, calculate how much water you need to pump into clean storage.

Casing diameter_________ needs_________gal./ft. x __________ ft. = __________ gal.

12% industrial sodium hypochlorite and 70% high test hypochlorite are available from:

- *Water treatment suppliers*
- *Drilling contractor*
- *Swimming pool maintenance suppliers*
- *Dairy equipment suppliers*
- *Some hardware stores.*

Caution: Chlorine is corrosive and can even be deadly.

If your well is located in a pit, you must make sure there is proper ventilation during the chlorination procedure. Well pits are no longer legal to construct. Use a drilling contractor who has the proper equipment and experience to do the job safely.

Table 1 Amount of Chlorine Required to Obtain a Chlorine Concentration of 200 PPM

Casing Diameter		Volume of Water Needed		5 1/4% [1]Domestic Chlorine Bleach	12% Industrial Sodium Hypochlorite	[2]70% High Test Hypochlorite
		Water needed per 1 ft. (30 cm) of water in the casing		L needed per 1 ft. (30 cm) of water	L needed per 1 ft. (30 cm) of water	Dry weight[2] per 1 ft. (30 cm) of water
(in)	(mm)	(gal.)	(L)	(L)	(L)	(g)
4	(100)	1.1	5.0	.019	.008	1.44
6	(150)	2.4	10.9	.042	.018	3.12
8	(200)	4.2	19.1	.072	.032	5.46
24	(600)[3]	extra 200 gal.	extra 1000 L	.340	.148	25.40
36	(900)[3]	extra 200 gal.	extra 1000 L	.76	.34	57.20

[1] **Domestic chlorine bleach should not have additives or perfumes.**

[2] **Since a dry chemical is being used, it should be mixed with water to form a chlorine solution before placing it in the well.**

[3] **See modified procedure for large diameter wells on page 53.**

[4] **To reduce the chlorine concentrations to 50 ppm, divide the above chlorine amounts by 4.**

Step 3 Calculate the amount of chlorine that is required, as shown in Table 1. Mix the chlorine with the previously measured water to obtain a 200 ppm chlorine solution.

Calculating Amount of Chlorine Example

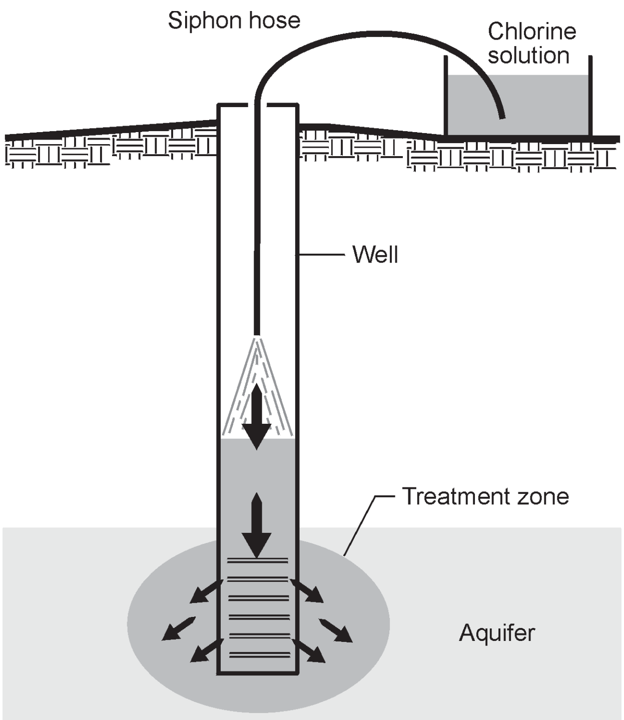
If your casing is 6 in. and you are using 12% industrial sodium hypochlorite, you will require 0.018 L per ft. of water in the casing. If you have 100 ft. of water in the casing, you will use 0.018 L x 100 ft. = 1.8 L of 12% chlorine.

Using Table 1, calculate the amount of chlorine you will need for your well.

Casing diameter_______ Chlorine strength_______

L needed per 1 ft. of water_______ x _______ ft. of water in casing = _______ L of chlorine.

Figure 2 Siphoning Chlorine Solution



Step 4 Siphon this solution into the well (see Figure 2, Siphoning Chlorine Solution).

Step 5 Open each hydrant and faucet in the distribution system (including all appliances that use water such as dishwasher, washing machine, furnace humidifier) until the water coming out has a chlorine odor. This will ensure all the plumbing fixtures are chlorinated. Allow the hot water tank to fill completely. Consult your water treatment equipment supplier to find out if any part of your water treatment system should be bypassed, to prevent damage.

Step 6 Leave the chlorine solution in the well and distribution system for 8 to 48 hours. The longer the contact time, the better the results.

Step 7 Open an outside tap and allow the water to run until the chlorine odor is greatly reduced. Make sure to direct the water away from sensitive plants or landscaping.

Step 8 Flush the chlorine solution from the hot water heater and household distribution system. The small amount of chlorine in the distribution system will not harm the septic tank.

Step 9 Backwash and regenerate any water treatment equipment.

If you have an old well that has not been routinely chlorinated, consider hiring a drilling contractor to thoroughly clean the well prior to chlorinating. Any floating debris should be removed from the well and the casing should be scrubbed or hosed to disturb the sludge buildup.

Modified Procedure for Large Diameter Wells

Due to the large volume of water in many bored wells the above procedure can be impractical. A more practical way to shock chlorinate a bored well is to mix the recommended amount of chlorine right in the well. The chlorinated water is used to force some of the chlorine solution into the formation around the well. Follow these steps to shock chlorinate a large diameter bored well.

Worksheet

Use the "Calculating Water and Chlorine Requirements for Shock Chlorination" worksheet to determine how much water and chlorine you need to shock chlorinate your well. A sample worksheet is included at the back of this module. Working copies are included in the pocket on the back cover. Store the completed worksheet in the back pocket.

Step 1 Pump 200 gal. (1000 L) of water into a clean storage tank at the well head.

Step 2 Mix 20 L of 5 1/4% domestic chlorine bleach that does not have additives or perfumes (or 8 L of 12% bleach or 1.4 kg of 70% calcium hypochlorite) into the 200 gal. of stored water. This mixture will be used later in Step 5.

Step 3 Using Table 1 calculate the amount of chlorine you require per foot of water in the casing and add directly into the well. (Note that the 70% hypochlorite powder should be dissolved in water to form a solution before placing in the well.)

Step 4 Circulate chlorine added to the water in the well by hooking a garden hose up to an outside faucet and placing the other end back down the well. This circulates the chlorinated water through the pressure system and back down the well. Continue for at least 15 minutes.

Don't mix acids with chlorine. This is dangerous.

Step 5 Siphon the 200 gal. bleach and water solution prepared in Steps 1 and 2 into the well.

Step 6 Complete the procedure as described in Steps 5 to 9 for drilled wells.

Worksheet

Calculating Water and Chlorine Requirements (200 PPM) for Shock Chlorination

Complete the following table using your own figures to determine how much water and chlorine you need to shock chlorinate your well.

Casing Diameter		Volume of Water Needed	5 1/4% [1]Domestic Chlorine Bleach	12% Industrial Sodium Hypochlorite	[2]70% High Test Calcium Hypochlorite
(in)	(mm)	Imperial gal. needed per 1 ft. of water in the casing	L per 1 ft. (30 cm) of water	L per 1 ft. (30 cm) of water	Dry weight[2] per 1 ft. (30 cm) of water
4	(100)	______ft. x 1.1 gal. =______	______ft. x 0.019 L =______	______ft. x 0.008 L =______	______ft. x 1.44 g =______
6	(150)	______ft. x 2.4 gal. =______	______ft. x 0.042 L =______	______ft. x 0.018 L =______	______ft. x 3.12 g =______
8	(200)	______ft. x 4.2 gal. =______	______ft. x 0.072 L =______	______ft. x 0.032 L =______	______ft. x 5.46 g =______
24	(600)[3]	extra 200 gal.	______ft. x 0.340 L =______	______ft. x 0.148 L =______	______ft. x 25.40 g =______
36	(900)[3]	extra 200 gal.	______ft. x 0.760 L =______	______ft. x 0.34 L =______	______ft. x 57.20 g =______

[1] Domestic chlorine bleach should not have additives or perfumes.

[2] Since a dry chemical is being used, it should be mixed with water to form a chlorine solution prior to placing it in the well.

[3] See modified procedure for large diameter wells on page 53.

*** Working copies are included in the pocket on the back cover.**