

FACT SHEET #4

**GUIDELINES FOR SANITIZING A
WATER WELL**

PRODUCED BY:

CANADIAN GROUND WATER ASSOCIATION

In collaboration with the

RED DEER COLLEGE

NOTICE TO READERS: ASSUMPTION OF RISK AND EXCLUSION OF LIABILITY

The procedures and products described herein are **EXTREMELY DANGEROUS** and should only be undertaken with the utmost caution. Improper sanitization of a well can cause serious illness or death.

The Canadian Ground Water Association and Red Deer College hereby disclaim any liability or responsibility for any injury or damage resulting from the use, directly or indirectly, of the information contained herein.

Preface:

For almost 30% of Canadians who use ground water as their sole source of water, a real value cannot be established. The mission statement of the Canadian Ground Water Association is to encourage the management and protection of the resource.

The recommendations and procedures in these guidelines are minimum guidelines, however it must be emphasized that they will meet the criteria set out in most existing regulations and legislation.

The terms disinfecting and sanitizing for all intents and purposes mean the same and are both used in the text of this Fact Sheet.

1.0 GENERAL GUIDELINES:

1.1 Every well shall be located:

1.1.1. At the highest point on the site consistent with the general layout and surroundings, but also protected against surface wash or flooding and surrounded by an area which can be kept in a sanitary condition.

1.1.2. As far removed from any known or probable source of contamination as the general layout of the premises and surroundings permit and in accordance with all provincial, health, sanitation, and sewage disposal regulations.

1.2.1 Use of pitless adapters or pitless units are recommended by the Canadian Ground Water Association.

1.2.2 All well caps or covers should be water tight, insect proof, and vented.

(From Guidelines for Water Well Construction - Canadian Ground Water Association 1995)

1.3 The bacteria and viruses picked up on drilling tools, pipes and pumps during construction or servicing of a well are commonly those living in the soil at or near the well site and are usually non pathogenic. However, the bacteria used as an indicator of possible disease - producing bacteria may be among them.

This indicator bacteria is known as coliform bacteria, and if present, is taken as evidence that the water may contain disease producing organisms that live in the intestinal tracts of man and other warm blooded animals.

Since identification of disease producing micro-organisms is difficult, tests are generally done for the number of coliform bacteria and not for the absence of pathogenic bacteria. Water from a well is considered safe to drink when tests show that it contains 0 coliform bacteria per 100 mL.

1.4 Fecal coliform bacteria, which include E.coli, are normal organisms found in the intestinal tract of all mammals. Most coliform bacteria, including E.coli, are important in digestive processes of humans and animals.

E.coli 0157:H7 is one particular type which can cause disease in humans and the symptoms range from mild diarrhea to kidney failure and death.

Their presence at any level indicates the water is contaminated with human sewage and/or animal manure and the water is unsafe to drink. Maximum acceptable concentration is 0 per 100 mg/L.

Bacteria contaminations, both non-pathogenic and pathogenic can occur or be introduced during drilling, pump servicing, or any time the well is open for repair or maintenance. An example of this has occurred because vermin proof well caps were not used and earwigs entered the well creating a bacteria invasion. Coliform bacteria may also enter wells from surface sources of contamination via faulty well seals or faulty casing seals (eg: poor well caps, unsealed or ungrouted annular space outside the casing etc.)

1.5 Other bacteria, (eg: sulphate reducing bacteria and iron bacteria), may not necessarily be a health problem but may cause reduced well production, staining, and plugging of distribution systems.

1.5.1 IRON BACTERIA are often found in wells completed in aquifers which have a high iron content. Iron bacteria oxidize dissolved (ferrous) iron, forcing it to come out of solution. The oxidized (ferric) iron is deposited on the well casing/screen. As iron bacteria multiply, they produce a stringy jelly-like slime. A combination of the iron deposit and bacteria build-up on casing perforations, screen slot openings and in the pore spaces of the water bearing formation, can reduce the yield of a well.

1.5.2 SULPHATE-REDUCING BACTERIA can be a problem in wells completed in aquifers which have a high content of naturally occurring sulphate. Sulphate-reducing bacteria generate sulphides from sulphate and produce hydrogen sulphide gas (H₂S), which is characterized by a “rotten egg” odour. H₂S gas corrodes iron and steel casing/screens and produces a scale called ferric sulphide (FeS₂). As this scale deposits and the sulphate-reducing bacteria accumulate, the slot openings on the casing/screen become plugged, and the well yield is reduced.

2.0 **DISINFECTION/SANITIZING:**

2.1 Disinfection of any well will kill only the bacteria present in the well or on the pumping equipment. However, if there is some external source of contamination, the problem will be solved only temporarily by a single application of chlorine solution.

2.2 In order to protect water wells from contamination by iron bacteria, a minimum chlorine residual of 250 mg/l (ppm) should be maintained in the drilling fluid continuously.

This will serve to disinfect any drill tools used during the drilling operation.

2.3 Every well, after construction or repair, should be disinfected.

3.0 **TIME OF DISINFECTION:**

3.1 Normally, the time that a well should be disinfected is when construction is considered complete and the well has been tested for yield. It should, however, be disinfected preceding the collection of any samples for determination of bacteriological quality.

- 3.2 If a well is intended for the production of water for human consumption, the driller shall:
- 3.2.1 where he installs the pump fittings, disinfect the well after the installation of the pump fittings, and
 - 3.2.2 where he does not install the pump fittings, disinfect the well when he completes his work on the well.

4.0 CHLORINATION:

- 4.1 The quantity of chlorine compounds used for disinfecting a well shall be sufficient to produce two hundred and fifty (250) mg/l (ppm) of chlorine solution when mixed with the total volume of water retained within the well. Refer to Tables 1 and 2.
- 4.2 Well without pump - liquid chlorine: measure the diameter of the well and calculate the volume of chlorine bleach (5.25% active chlorine) required using Table 1. Take the volume of chlorine bleach determined from the Table and mix this in at least forty-five (45) liters (ten (10) gallons) of water. Pour this solution into the well and let it stay in the well for at least twelve (12) hours. Pump the well for at least one (1) hour to remove the chlorine solution.
- 4.3 Well with pump - liquid chlorine: measure the diameter of the well and calculate the volume of chlorine bleach (5.25% active chlorine) required using Table 1. Take the volume of chlorine bleach determined from the Table and mix this in at least forty-five (45) liters (ten (10) gallons) of water. Pour the solution into the well between the drop pipes and the outer casing. This may be done by pouring or siphoning through the air vent or by removing the well seal. Where the casing has a well cap, remove the well cap and pour the solution directly into the well. Open all faucets in the system and let the water run until the chlorine odor is detected. Turn the water off and add a second volume of chlorine bleach (the same amount as initially added). Seal the top of the well. Let the system sit idle for twelve (12) hours. Discharge the water from all outlets until chlorine odor has disappeared. Faucets on fixtures discharging to septic tank systems should be temporarily diverted to an outside discharge point, to avoid impacting the disposal system.
- 4.4 Disinfection with chlorine tablets or powder: chlorine tablets normally contain about 65 to 70% available chlorine present in calcium hypochlorite. **Users should be aware that these tablets may cause chemical burns, fire, or explosion if adequate safety precautions are not taken.** Always follow the directions on the label prior to usage. Measure the diameter of the well and calculate the weight of the tablets required per thirty (30) meters (one hundred (100) feet) of water using Table 2 (250 mg/l (ppm) solution). Dissolve the required weight of tablets in warm water, remove the well cap, and pour the solution into the well. When the plumbing system is also being disinfected, pump the chlorine solution until a chlorine odor is detected at each faucet or tap. Leave the solution in the well and plumbing system for at least twelve (12) hours. Discharge water from all outlets until the chlorine odor has disappeared.
- 4.5 The time of contact with the chlorine solution referred to in this subsection shall be at least twelve (12) hours.

TABLE 1

WELL WITHOUT PUMP - LIQUID CHLORINE

Well Diameter		Litres of 5% Bleach per 30 Meters (100 Feet) of Water in Well (for 250 mg/l (ppm) Solution)
<u>mm</u>	<u>Inches</u>	
100	4	1.5
130	5	2.25
150	6	3.0
200	8	5.0
250	10	8.5
300	12	12.0
610	24	43.5

TABLE 2

DISINFECTION WITH CHLORINE TABLETS OR POWDER

Well Diameter		Grams of 65-70% Chlorine Tablets (for 250 mg/l (ppm) Solution Dry Weight)	
<u>mm</u>	<u>Inches</u>	<u>g</u>	<u>Oz</u>
100	4	100	3.5
150	6	282.5	10.0
200	8	425	15.0
250	10	565	20.0
300	12	850	30.0
610	24	3400	120.0

Variable size tablets are the most effective for well chlorination

5.0 **SHOCK CHLORINATION:**

A procedure known as “Shock Chlorination” is a relatively easy method used to treat water wells that have an iron bacteria or sulphate reducing bacteria problem.

Shock chlorination may not completely solve the problem but through periodic applications, it will reduce iron and sulphate reducing bacteria to a minimum and hold it in check.

5.1 With the shock chlorination procedure, 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 sulphate-reducing bacteria. To be effective, enough chlorine solution must be used to disinfect the entire cased section of the well and the adjacent water-bearing formation. Bacteria collect in the pore spaces of the formation as well as on the casing or screened surface of the well.

Highly chlorinated water can be prepared by dissolving the chemical calcium hypochlorite in water. This chemical is marketed today in granular and tablet form, and contains from 60-65 percent available chlorine. The granular form is recommended because it dissolves quickest. It may be purchased at most chemical supply distributors.

Calcium hypochlorite is recommended rather than household bleaches and other commercial solutions containing weaker concentration of sodium hypochlorite.

The chlorine content in these solutions ranges from 3 to 15 percent, and due to the unstable nature of these compounds, the strength of the chlorine weakens so that at the time of use, they may not contain the labeled amount of available chlorine.

Table 3 illustrates the quantities of calcium hypochlorite to be used based on the characteristics of an individual well.

(From "How to Shock chlorinate Your Well" - pamphlet distributed Alberta Water Well Drilling Association and reprinted with their permission)

5.2 Procedure:

- 5.2.1 Store enough water to meet household and farm water needs for a **minimum** of 12 hours.
- 5.2.2 Before disinfecting the water system, remove or bypass any carbon filter in the system. Be sure that the hot water heater's heat source is turned off.
- 5.2.3 Measure the column of water in the well. Calculate, from Table 3, the volume of water that requires chlorination (for example, a 245 ft. well, 8" diameter, with a non-pumping water level of 45 ft. has a column of water of 200 ft; the volume of water in the well would be 2 x 435 or 870 gallons of water).
- 5.2.4 Calculate the amount of chlorine that is required and mix it with the water previously measured (in the example, 870 gallons of water should be mixed with 2 x 22 oz. or 44 oz. of chlorine).
- 5.2.5 Prior to adding the chlorine solution into the well it is much more effective if the well bore, casings and screens can be thoroughly cleaned. In the case of large diameter wells such as bored or dug wells all floating debris should be removed and the casing/cribbing washed or scrubbed. It is extremely important to remove all sludge that has accumulated at the very bottom of any diameter well because bacteria will likely be present. In drilled wells (eg: 5"-6") the pumping equipment would have to be removed before cleaning. After the cleaning the pump could be reinstalled and the well pumped until the water is clear.
- 5.2.6 Pour the chlorine solution into the well.
- 5.2.7 Open each hydrant, faucet, etc. in the distribution system, (all appliances that use water such as dishwasher, washing machine, furnace humidifier) until the water at each outlet has a chlorine odour. This will chlorinate the plumbing fixtures. Allow the hot water tank to fill completely.
- 5.2.8 Leave chlorine mixture in the entire distribution system for a **MINIMUM** of 8 hours (usually overnight).
- 5.2.9 Chlorinated water should **NEVER** be allowed to drain into the septic tank.
- 5.2.10 After the **MINIMUM** 8 hours, re-open each hydrant, faucet, etc. in the distribution system, and let it run until the smell of chlorine disappears (generally takes between 2 to 3 hours).
- 5.2.11 Backwash all filters and softeners and flush the hot water tank.

This procedure for shock chlorination will work for most wells with a bacteria problem. If the water still has a foul odour after chlorination, particularly in the case of sulphate-reducing bacteria, the entire procedure should be repeated as such odor is a sign that not enough chlorine was used.

Note that this procedure will not completely eliminate bacteria from the water system but will hold it in check. Shock chlorination may have to be repeated from time to time, in order to control the problem.

CAUTION: If a well is slow yielding or tends to pump any sediment, go about the shock chlorination procedure very cautiously. Slowly siphon the solution down the well and pump it out very slowly. Over pumping the well may worsen the sediment problem.

TABLE 3

**Amount of Chlorine Required to
Obtain a Chlorine Concentration
of 200 PPM* in a 100 ft.
Column of Water**

CASING DIAMETER (INCHES)	VOLUME OF WATER NEEDED (Per 100 Ft. of Casing)		CALCIUM HYPOCHLORITE 65% AVAILABLE CHLORINE (Dry Weight**)	
	IMPERIAL (Gallons)	METRIC (Litres)	IMPERIAL (Ounces)	METRIC (Grams)
2	25	125	1.5	40
4	110	500	6	150
6	245	1100	12	350
8	435	2000	22	600
10	680	3000	34	950
12	1000	4500	50	1400 (1.4 kg)
16	1750	7900	85	2500 (2.5 kg)
18	2200	10000	110 (7 lbs)	3000 (3.0 kg)
20	2700	12500	135 (8 lbs)	3800 (3.8 kg)
24	3900	18000	195 (12 lbs)	5500 (5.5 kg)

* This is the recommended minimum chlorine concentration. Depending on the severity of the problem, a stronger concentration may be used.

** 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.

Note that quantities are calculated to provide twice as much chlorinated solution as is needed to clean inside the well; the extra amount is to ensure cleaning of the contaminated formation surrounding the well.

(From "How to Shock chlorinate Your Well" - pamphlet distributed Alberta Water Well Drilling Association and reprinted with their permission)

CANADIAN GROUND WATER ASSOCIATION

MISSION STATEMENT

To encourage the management and protection of ground water by creating partnerships for public awareness and utilization.

GOALS & OBJECTIVES

To continually serve as recognized stewards of the ground water resource in Canada.

To promote education of its members and the public.

To promote the development of ground water guidelines and strategies.

Acknowledgment to Alberta Water Well Drilling Association

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