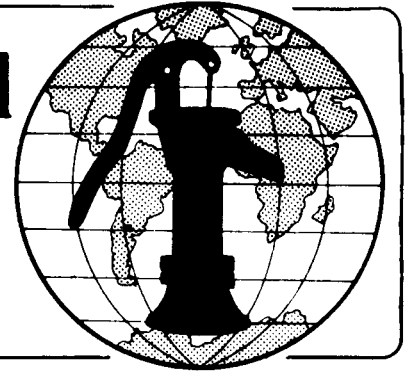


Water for the World



Disinfecting Wells

Technical Note No. RWS. 2.C.9

Disinfecting a well is necessary to eliminate the contamination that was introduced by equipment, materials, or surface drainage during construction or repairs. A chlorine compound is generally used for the disinfectant. Disinfecting a well involves calculating the required amount of chlorine compound, mixing a chlorine solution, and applying the solution to the well.

This technical note describes how to disinfect a well. Read the entire technical note before beginning the disinfection process.

Useful Definitions

AQUIFER - A water-saturated geologic zone that will yield water to springs and wells.

AVAILABLE CHLORINE - The amount of chlorine present in a chemical compound.

DISINFECTION - Destruction of harmful microorganisms present in water, through physical (such as boiling) or chemical (such as chlorination) means.

Materials Needed

To disinfect a well, you will need:

Chlorine compound such as calcium hypochlorite, bleaching powder, or liquid bleach,

Mixing container which should be rubber-lined or made from crockery or glass,

Stiff broom with a long handle, for hand dug wells,

Length of rope,

Length of perforated pipe, 0.5-1.0m long, 50-100mm in diameter, for deep-drilled wells with a high water table.

Caution!

Chlorine compounds or solutions may irritate skin and eyes upon contact. If possible, wear gloves, protective clothing, and glasses when handling chlorine. If you get chlorine on your skin or in your eyes, immediately wash it off with water.

General Information

The most easily obtainable and safest disinfectants are chlorine compounds. These compounds have various amounts of available chlorine, that is, chlorine that can be released to disinfect the water.

Calcium hypochlorite, also known as high-test hypochlorite or HTH, has 70 percent available chlorine. It is produced as powder, granules, or tablets. Bleaching powders have 25-35 percent available chlorine. Common household laundry bleach, such as Clorox and Purex, has about 5 percent available chlorine.

Chlorine compounds should be stored in their original containers in a cool, dark place.

Calculating the Amount of Compound Needed

To disinfect a well properly, make a mix of available chlorine and water from the well in a ratio of 100 parts per million, ppm. To illustrate: 1 ml per 1000 liters equals 1 ppm; 100ml per 1000 liters equals 100ppm.

Table 1 shows the amounts of HTH, bleaching powder, and chlorine bleach that must be added to various volumes of well water to produce 100ppm of available chlorine. Before you can use the table, you must calculate the volume of water in the well.

The volume of water in a well equals the radius of the well squared times the depth of the water in the well times 3.1416.

$$V = r^2 \times D \times 3.1416$$

The radius, r, equals the diameter, d, of the well divided by two.

$$r = \frac{d}{2}$$

The diameter, d, can be measured directly or read from design drawings or from the driller's log described in "Maintaining Well Logs," RWS.2.C.6.

The depth, d, of the water in the well can be measured directly by lowering a rock tied to a length of twine to the bottom of the well, retrieving the twine, and measuring the wet portion. Or, it can be read from the driller's log.

For example, suppose the diameter of the well is 100mm (0.10m) and the depth of the water in the well is 12m. First, calculate the radius.

$$r = \frac{d}{2} \quad r = \frac{0.10m}{2} \quad r = 0.05m$$

Then calculate the volume of water.

$$V = r^2 \times D \times 3.1416$$

$$V = 0.05m \times 0.05m \times 12m \times 3.1416$$

$$V = \text{about } 0.1m^3$$

See Worksheet A Lines 1-4.

From Table 1, you can see that in order to disinfect this well you would need to use 0.2 liters of chlorine bleach, 5 percent available chlorine, or 33 grams of bleaching powder, 30 percent available chlorine, or 14 grams of high-test hypochlorite, 70 percent available chlorine.

For another example, suppose the diameter of the well is 1.2m and the depth of the water in the well is 2.6m. The radius equals the diameter divided by two = $\frac{1.2m}{2} = 0.6m$ Now calculate

the volume.

$$V = r^2 \times D \times 3.1416$$

$$V = 0.6 \times 0.6 \times 2.6 \times 3.1416$$

$$V = 2.9m^3$$

See Worksheet A, Lines 5-8.

From Table 1, you can see that the nearest volume to this is 3.0m³, so to disinfect this well you would need to mix in 6.0 liters of chlorine bleach, or 1010 grams of bleaching powder, or 433 grams of HTH.

Table 1. Amounts of Chlorine Compounds for Well Disinfection

Water in Well (m ³)	Liquid Bleach 5% available chlorine (liters)	Bleaching Powder 30% available chlorine (grams)	Calcium Hypochlorite (HTH) 70% available chlorine (grams)
0.1	0.2	33	14
0.12	0.24	40	17
0.15	0.3	51	22
0.2	0.4	68	29
0.25	0.5	86	37
0.3	0.6	100	43
0.4	0.8	133	57
0.5	1.0	170	73
0.6	1.2	203	87
0.7	1.4	233	100
0.8	1.6	267	113
1.0	2.0	334	143
1.2	2.4	400	173
1.5	3.0	500	217
2.0	4.0	670	287
2.5	5.0	860	367
3.0	6.0	1010	433
4.0	8.0	1330	567
5	10	1700	730
6	12	2000	870
7	14	2300	1000
8	16	2600	1130
10	20	3300	1430
12	24	4000	1730
15	30	5000	2170
20	40	6700	2870

**Worksheet A. Calculating the Volume of Water
in a Well**

Drilled Wells

1. Diameter of well = $\left(\frac{100 \text{ mm}}{1000 \text{ mm/m}} \right) = \underline{0.10} \text{ m}$
2. Radius of well = $\frac{\text{Line 1}}{2} = \left(\frac{0.10 \text{ m}}{2} \right) = \underline{0.05} \text{ m}$
3. Depth of water in well = $\underline{12} \text{ m}$
4. Volume of water in well = Line 2 x Line 2 x Line 3 x 3.1416 =
 $\underline{0.05} \text{ m} \times \underline{0.05} \text{ m} \times \underline{12} \text{ m} \times 3.1416 = \underline{0.09} \text{ m}^3$

Hand Dug Wells

5. Diameter of well = $\underline{1.2} \text{ m}$
6. Radius of well = $\frac{\text{Line 5}}{2} = \left(\frac{1.2 \text{ m}}{2} \right) = \underline{0.6} \text{ m}$
7. Depth of water in well = $\underline{2.6} \text{ m}$
8. Volume of water in well = Line 6 x Line 7 x 3.1416 =
 $\underline{0.6} \text{ m} \times \underline{0.6} \text{ m} \times \underline{2.6} \text{ m} \times 3.1416 = \underline{2.9} \text{ m}^3$

Mixing the Solution

Do not pour the chlorine compound directly into the well. It will not mix properly. First make a chlorine solution.

To make a chlorine solution from chlorine bleach, mix one part of bleach with one part of water, then pour the entire solution into the well. In the second example, this would mean mixing 6.0 liters of chlorine bleach with 6.0 liters of water and pouring 12.0 liters of chlorine solution into the well.

To make a chlorine solution with HTH or bleaching powder, first mix the compound with enough water to form a smooth paste, then mix the paste with water in the ratio of one liter of water per 15 grams of compound. To calculate the amount of water needed to make a chlorine solution, divide the amount of chlorine compound by 15. In the second example,

$$\frac{1010 \text{ grams of bleaching powder}}{15 \text{ grams}} =$$

67 liters of water

$$\frac{433 \text{ grams of HTH}}{15 \text{ grams}} = 29 \text{ liters of water}$$

Mix the chlorine paste with the water for 10-15 minutes. Allow inert materials to settle and use only the clear chlorine solution. Discard the rest. Pour the clear chlorine solution, about 67 liters in the case of bleaching powder or about 29 liters in the case of HTH, into the well.

Do not mix chlorine solutions in metal containers. Mix them in clean containers that are rubber-lined or made from crockery or glass.

Disinfecting a Hand Dug Well

If the well has no cover, it should be disinfected every day, or as often as possible. If the well is covered it must be disinfected before the first use and every time it is opened for maintenance or repair.

For a dug well with pump and cover:

1. Prepare a chlorine solution to wash the inside of the well casing. Mix 10 liters of water with one of the following: 0.02 liters of chlorine bleach, or 3.3 grams of bleaching powder, or 1.4 grams of HTH.

2. Wash the exterior surface of the pump cylinder and drop pipe with the chlorine solution before they are lowered into the well.

3. Remove all equipment and materials that will not be a permanent part of the well.

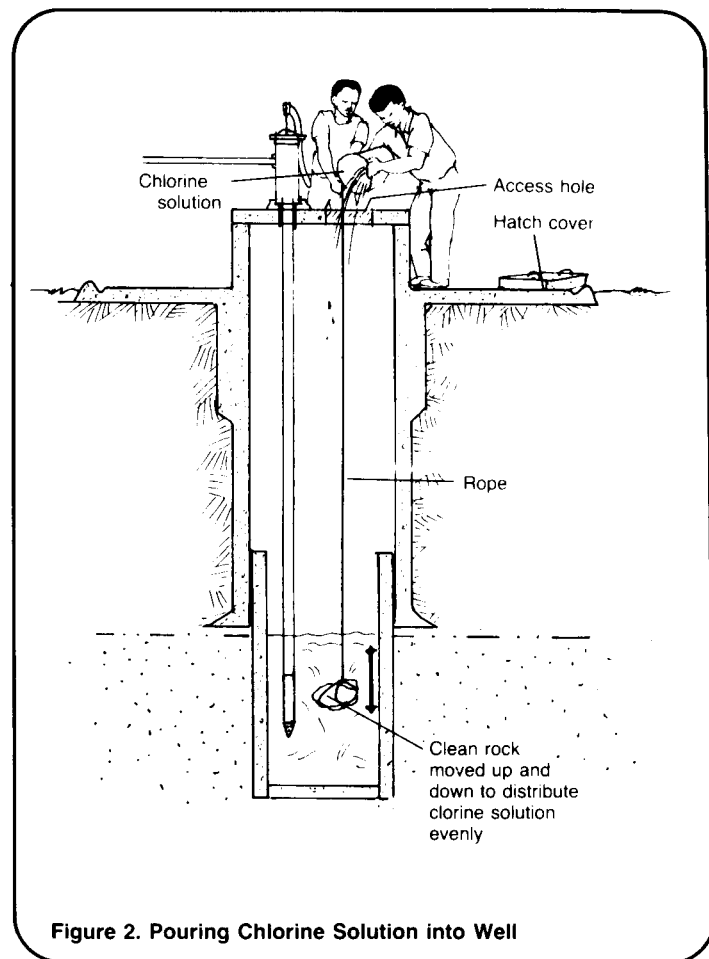
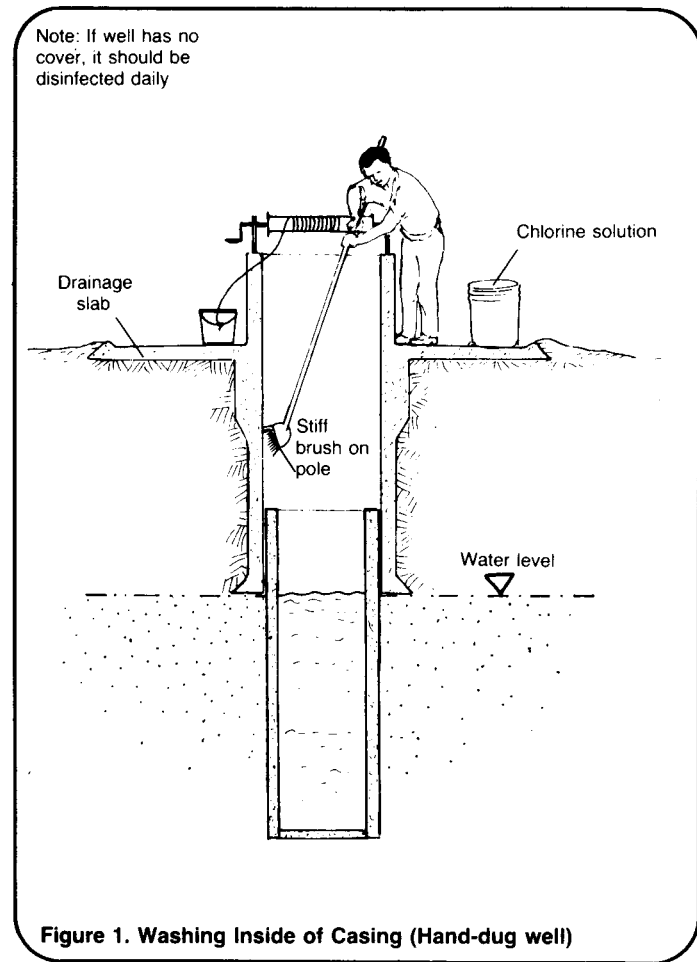
4. Wash the inside surface of the well casing with a clean, stiff broom and the 10 liters of chlorine solution. See Figure 1.

5. Install the cover over the well.

6. Calculate the amount of chlorine solution needed to disinfect the well. Prepare the solution and pour it through the access hole in the cover, making sure that the solution covers as much of the surface of the water in the well as possible. See Figure 2.

7. Mix the chlorine solution with the water in the well by using a rope tied to a large, clean rock. Lower the rock into the well and move it up and down in the water.

8. Cover the access hole. Pump water from the well until you can smell chlorine.



9. Allow the chlorine solution to remain in the well for 24 hours.

10. Pump water from the well until chlorine can no longer be smelled or tasted. Dispose of this water in a soakaway.

Disinfecting a Driven, Jetted, Bored, or Cable Tool Well

After the well has been tested for yield as described in "Testing the Yield of Wells," RWS.2.C.7, it must be disinfected before its first use and every time it is opened for maintenance or repair.

1. Remove the test pump from the well.

2. Calculate the amount of chlorine solution needed to disinfect the well. Prepare the solution and pour it into the well.

3. Mix the chlorine solution with the water in the well by using a rope tied to a clean rock. Lower the rock into the well and move it up and down in the water.

4. Add 40 liters of clean, chlorinated water to the well to wash the aquifer. This solution can be made by mixing 40 liters of water with either one-half teaspoon of HTH or 20ml of chlorine bleach.

5. Prepare a chlorine solution to wash the pump cylinder and drop pipe. Mix 10 liters of water with one of the following: 0.02 liters of chlorine bleach, or 3.3 grams of bleaching powder, or 1.4 grams of HTH.

6. Wash the exterior surface of the pump cylinder and drop pipe as they are lowered into the well.

7. Pump water from the well until you can smell chlorine.

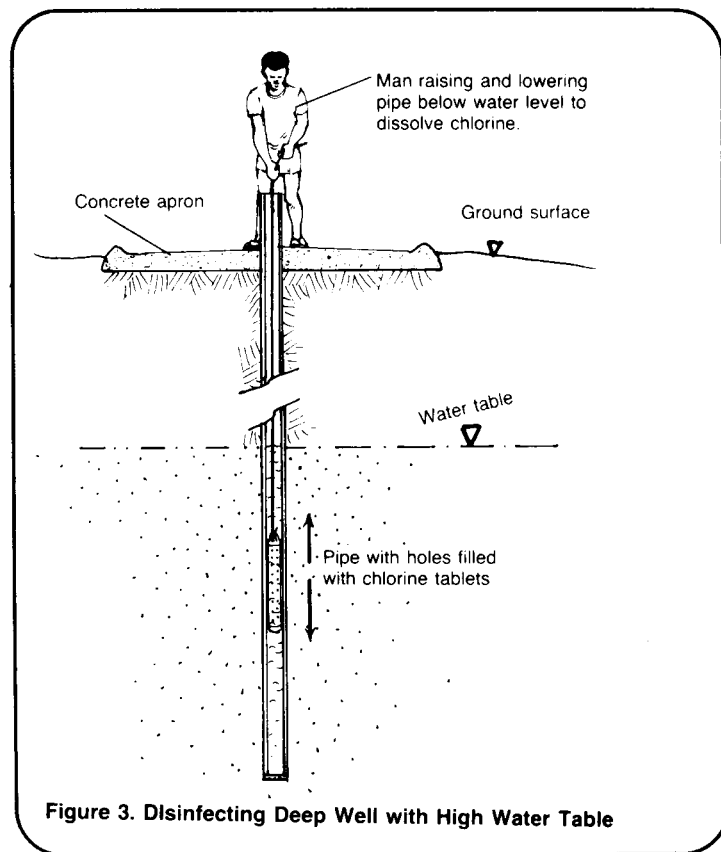
8. Allow the chlorine solution to remain in the well for 24 hours.

9. Pump water from the well until chlorine can no longer be smelled or tasted. Dispose of this water in a soakaway.

Deep Well with High Water Table

In the case of a deep well with a high water table, you need to take special steps to ensure that the chlorine and well water are properly mixed.

1. Drill a number of small holes through the sides of the pipe that is 0.5-1.0m long and 50-100mm in diameter. Cap one end of the pipe.



2. Pour the calculated amount of HTH granules or tablets into the pipe. Only HTH can be used in this method.

3. Fit the other end of the pipe with a threaded cap equipped with an eye loop.

4. Tie a rope to the eye loop, lower the pipe into the well, and alternately raise and lower the pipe in the water. Continue until the HTH has dissolved and the chlorine is distributed in the water. See Figure 3.