WATER SUPPLY DISINFECTION

Rationale

All newly constructed water supplies and all existing water supplies which have been repaired, reconstructed, flooded, or reactivated after a period of shutdown, must be disinfected and have a "safe" water sample prior to use.

Bacterial contamination from drilling operations, greasy equipment, etc., is usually eliminated during development, test pumping, or simple disinfection by the well drilling contractor. Occasionally, however, the contamination may be very persistent and the well continues to produce water showing coliform bacterial contamination. Simple low-cost procedures may eliminate bacterial contamination in most wells, but some problem wells will require costly, time consuming methods. Therefore, well disinfection should be approached in a systematic fashion, beginning with the simplest, least costly method.

Construction Considerations

It is essential that the well construction details be known prior to attempting disinfection. Existing wells which are inaccessible for maintenance may be impossible to properly disinfect.

Most clamp-on and weld-on pitless adapters will allow disinfectant solution to pass below the adapter into the well without having to pull up the drop pipe and submersible pump. Thread-on, spool-type pitless units generally have an opening through the spool for the electrical wire or a vent, which will accept the chlorine solution. Sometimes the spool must be pulled up enough to unseat it in order for disinfectant to pass into the well. Well installations without pitless adapters may be disinfected by adding chlorine through the top of the casing after removing the well seal or through the well vent.

Drop pipes, ejectors, packer-jets, foot valves, bremer checks, drawdown seals, and other appurtenances may interfere with the disinfection of the screen and lower portion of the casing. It may be necessary to remove such devices from the well.

Generally, a well can be effectively disinfected without removing the submersible pump. Because of the cost of removing and reinstalling the pump and the increased chance of recontamination, the submersible pump should not be removed unless absolutely necessary.

Shallow well jet installations present special problems in well disinfection. In shallow well jet pump installations, a check valve may be located near the pump or at the end of the drop pipe in the well. If the check valve is near the pump, the disinfectant may be placed into the well via the suction line. In this case, the suction line must be disconnected upstream (toward the well) from the check valve and disinfectant added at that point. The pump must be reprimed prior to operation. Placing a chlorine solution into the suction line when a foot valve is on the end of a drop line will disinfect only a drop pipe. In this situation, it is necessary to disinfect by placing the chlorine solution directly into the well.

Deep well jet installations present problems similar to those of shallow well jet pumps. In a double-pipe deep well jet installation with ejector (3" minimum well diameter), the well may be disinfected only by placing the chlorine solution into the well itself. In a single-pipe deep well jet installation with a packer jet (2" well diameter), it is not possible to disinfect the entire length of the well unless the drop pipe and packer jet are removed. The piping and the ejector or packer jet may be disinfected by injecting the chlorine solution through a small diameter pipe into the suction side of the deep well pump. This must be done only when the pump is made to continue operating, as the suction is converted to pressure when the pump stops. This method should only be attempted by qualified individuals.

In 2" wells, a bremer check is often used just above the screen. It must be removed if the screen area is to be disinfected.

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Each water supply must be treated as a special case, since no single disinfection method will be effective in all types of wells. The approaches outlined below are for wells with submersible pumps. Procedures must be modified for wells with other types of pumps.

First Approach to Disinfection

1. The well should be pumped to waste until the water is as clear and free from turbidity as possible, as suspended matter in the well will reduce the amount of free chlorine available for disinfection purposes.

2. Using Table 1 below, determine the amount of chlorine (liquid, tablet, or granular) required for disinfection. Add the chlorine to five (5) gallons of water.

3. Slowly pour the chlorine solution into the top of the well. Allow a contact time of at least 2 hours.

4. After this contact period, start the pump and discharge the chlorine solution throughout the household piping system. Starting with the tap closest to the well and working to the point furthest away from it, turn on each tap one at a time until the odor of chlorine can be detected, then turn off the tap. When all taps have been completed, the entire distribution system will contain chlorinated water. Leave the solution in the distribution system overnight if possible but for at least 2 hours.

5. Connect a hose to a tap and pump water back into the well casing. Wash the interior of the casing down thoroughly for approximately 1 hour. This circulates chlorinated water from the well to the pump, drop pipe, well discharge line, and distribution system, and back.

6. After Step 5 is complete, pump to waste until the water is free of chlorine odor. A sample should then be collected from a tap near the well for bacteriological analysis.

Table 1

Casing Diameter Inches	Depth of Water in Well	5 ¼ % Bleach-Cups	65% Hypochlorite Tablets*	65% Hypochlorite Granular
1 ¼	50	¼	1	1/5 oz
2	50	¾	3	½ oz
3	50	1 ½	6	1 oz
4	50	2 ½	10	1 2/3 oz
5	50	3 ½	14	2 1/3 oz
6	50	5	20	3 1/3 oz

*Based on 100 tablets per pound of hypochlorite compound.

Second Approach to Disinfection

If bacteria contamination persists, it may be desirable to repeat the first approach before continuing with the second approach. The second approach is as follows:

1. Same as Step 1, First Approach.

2. Using Table 2 below, determine the amount of chlorine required for disinfection. Add the chlorine to the volume of water indicted in the last column. This volume represents a volume equal to the amount of water in the well casing.

3. Slowly pour the chlorine solution into the top of the well. Allow a contact time of at least 12 hours.

4. Same as Steps 4, 5, and 6, First Approach.

Table 2

Casing Diameter Inches	Depth of Water in Well	5 ¼ % Bleach-Cups	65% Hypochlorite Tablets*	65% Hypochlorite Granules	Gallons of Water Required**
1 ¼	50	½	2	½ oz	3
2	50	1 ½	6	1 oz	9
3	50	3	12	2 oz	18
4	50	5	20	3 1/3 oz	32
5	50	7	28	4 2/3 oz	50
6	50	10	40	6 2/3 oz	75

*Based on 100 tablets per pound of hypochlorite compound.
**Gallons of water required for chlorine-water solution per 50’ of water depth.

Third Approach to Disinfection

If bacteria contamination persists, it may be desirable to repeat the second procedure before continuing with the third approach. It may be necessary to contact a well driller with a large volume truck-mounted water tank. The third approach is as follows:

1. Same as Step 1, First Approach.

2. Using Table 3 below, determine the amount of chlorine required for disinfection. Add the chlorine to the volume of water indicated in the last column. This volume represents a volume equal to twice the amount of water in the well casing. Placing this amount of water into the well should displace the water from the well so that chlorinated water enters the formation.

3. Same as Steps 3, 4, 5, and 6, Second Approach.

Table 3

Casing Diameter Inches	Depth of Water in Well	5 ¼ % Bleach-Cups	65% Hypochlorite Tablets*	65% Hypochlorite Granules	Gallons of Water Required**
1 ¼	50	2	8	2 oz	6
2	50	6	24	4 oz	18
3	50	12	48	8 oz	32
4	50	20	80	13 1/3 oz	64
5	50	28	112	18 2/3 oz	100
6	50	40	160	26 2/3 oz	150

*Based on 100 tablets per pound of hypochlorite compound.
**Gallons of water required for chlorine-water solution per 50’ of water depth.

Alternative Approaches to Disinfection

In persistent cases of bacterial contamination, repetition and combinations of the above methods and alternative approaches may be necessary.

A liquid chlorine solution poured into the top of the well may stratify in the upper well water. Granular calcium hypochlorite settles slowly and dissolves too quickly to achieve uniform distribution. Calcium hypochlorite tables settle rapidly and dissolve slowly. In cases of deep wells with high static water levels, it may be necessary to utilize special methods to introduce chlorine into the well, assuring adequate distribution of the disinfectant through the well. The following methods are suggested:

1. A garden hose or tremie pipe may be used for introducing disinfectant into the well. When using this method, the pipe should be lowered to the bottom of the well, then slowly raised as the disinfectant is added. A well driller will often use his drill rods for this purpose. Remember, any type of pipe or hose placed into the well should be clean.

2. Another procedure is to place granulated calcium hypochlorite in a short section of pipe with caps at both ends. The pipe should have a number of small diameter holes drilled into it and a cable attached to one end of the pipe. Raising and lowering the pipe distributes the chlorine throughout the well bore. This device may also be used for disinfecting flowing wells.

3. Surging the well with a bailer, sand pump, surge block, compressed air, etc., may help force the chlorinated water out through the screen or into the rock formation. Another technique used is to lower a pipe into the well with a cap on the end and holes drilled into the cap. Chlorinated water is pumped under pressure and jetted out through the pipe. This jet action will assist in disinfection of the screen, gravel pack, rock formation, etc.

4. Continuous pumping to waste for long periods of time may assist in clearing contamination from the well. Arrangements should be made for proper discharge of the water. This method should be used in conjunction with one of the disinfection approaches.

5. It should be remembered that only clean surfaces can be disinfected with chlorine. Well casings may contain grease, cutting oils, joint dope, iron oxide, soil, slime, and other foreign materials. Since these substances may harbor bacteria and protect bacteria from the disinfectant, it is necessary to remove them from the well. Using phosphate or other chemical well cleaners and swabbing the casing with a burlap swab or clean chimney flue brush may be required in unusually persistent cases.

Prevention of Contamination

It is much simpler and more effective to prevent contamination during construction of a new well than to attempt to remove it after the well is completed. Emphasis should be placed on the use of clean, chlorinated water in the drilling process and the prevention of surface contaminants from entering the well during or after construction. Well drilling equipment and tools should be kept clean. A conscientious effort should also be made to prevent the transporting of contaminants from one drilling site to another.