

# Article 500-Well Disinfection

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## BACKGROUND

Well disinfection is the sanitization of wells to eliminate introduced pathogenic organisms or naturally occurring subsurface organisms, such as iron bacteria, that can grow and cause clogging of well screens and pumping equipment. Disinfection is generally done at the time a new well is constructed or following repair of an old well or its pumping equipment. Also, disinfection is often done when it has been demonstrated that a well may be bacterially contaminated.

Many contractors disinfect wells as a matter of standard procedure whenever the well is opened for repair or maintenance, and sanitization is required by DWR Bulletin 74-81 as well as many local regulatory agencies. The extent of sanitization requirements vary from one jurisdiction to another, and specific measures and procedures employed by individual contractors generally depend on particular conditions. It is not the purpose of this position paper to define procedures that would be used in all situations. Rather it is to suggest basic operational guidelines and to offer minimum safety precautions both during and after disinfection procedures.

Disinfection chemicals, generally chlorine compounds, are known to be potentially harmful. All contractors have a responsibility to provide well disinfection services in a manner which is both effective and safe for people and the environment. However, it should be recognized that there are limits to a contractor's liabilities. Therefore, it is also the purpose of this paper to describe those situations and areas that are outside a contractor's scope of work or beyond his control.

## DISCUSSION

There are three broad categories where disinfection is necessary.

- A. Following construction of a new well or repair of an old well.
- B. Following installation or replacement of pumping equipment.
- C. When there is known or suspected contamination with harmful bacteria.

Although each category may entail somewhat different procedures, there are safe handling considerations common to all. It is the contractor's responsibility to insure that only properly trained personnel are allowed to disinfect. Personnel should also be completely capable of explaining all procedures and of satisfactorily providing warnings to property owners and any others who may have access to the well throughout the disinfection process.

## PUBLIC SAFETY PRECAUTIONS

Water disinfection involves the introduction of potentially hazardous chlorine compounds into the potable water supply. The possibility exists that persons with no understanding of these hazards may attempt to utilize the water system before the contractor can complete its disinfection efforts and render the water safe for use. Therefore adequate measures should be taken to minimize the risk of harm to persons and property.

No one set of recommended safety precautions is appropriate for all situations, and a contractor must carefully assess the degree of risk in choosing its warning/public safety procedures. At a minimum, hazardous chemicals should be properly labeled, stored in a secure place, and used only in a controlled environment. Other possible public safety measures include:

1. Warning labels properly affixed to all control devices used to isolate or turn off the water system.
2. Meetings with the customer and/or other water users to discuss the hazards. Written warnings, either in conjunction with a meeting or as an alternative, may be appropriate. Written warnings should be posted at the service disconnect. As a general rule, any notice should clearly convey that the water is to be considered hazardous to health and property until further notice from the contractor.
3. Where access cannot be restricted, and continual presence by the contractor or other responsible persons cannot be achieved, physically disabling the system may be prudent. Such actions may include "lock out" of electrical controls and/or service valves, or temporary disconnection of water lines or the electrical service to the well.
4. Depending on the situation, the contractor may need to return to the site and verify that the water is safe for use before the system is placed back in operation. Warning labels should be left in place until the absence of high concentrations of chlorine is determined. This is generally accomplished by testing for available chlorine residual.

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### GENERAL SAFE HANDLING PROCEDURES

The following minimum safety precautions should be practiced by anyone handling or around chlorine compounds:

- Store only in approved, air tight containers.
- Maintain adequate ventilation.
- Keep away from eyes and mouth
- Use rubber gloves
- Never add water to dry chlorine
- Dispose of residue and containers properly.
- Keep current Material Safety Data Sheet.
- *Caution! Never mix sodium based and calcium based disinfection compounds.*

The following minimum precautions should be practiced when discharging heavily chlorinated water:

- Do not discharge water onto living plant life such as trees, shrubs, lawns, flowers, etc.
- Keep discharge away from fish and other aquatic life.
- Do not discharge water where livestock may drink it.
- Do not discharge directly into septic systems.
- Do not discharge into an enclosed space lacking adequate ventilation.
- Keep discharge away from eyes and mouth.

### PERFORMANCE LIMITATIONS

Even though a groundwater contractor has carefully followed established protocol and adhered to industry standards in the disinfection work, this does not guarantee that the end result will be the elimination of all harmful bacteria. Testing is performed solely to establish the presence of coliform bacteria. And these disinfection procedures are never intended to eliminate other drinking water contaminants.

In common with many other groundwater operations, such as exploration, development, and sampling, disinfection activities are subject to many factors which are beyond the contractor's reasonable ability to control or mitigate. Any of these can frustrate satisfactory disinfection by even an experienced contractor using the most exacting methods. As a result, a certain percentage of wells will fail one or more tests for coliform bacteria, in spite of using the procedures described in these guidelines.

Frequently the failure of the water sample to pass after disinfection can be due to factors unconnected with the water itself, such as contamination of the tap point or sample container, improper handling of the sample, or erroneous lab results. In other instances the contamination in the well may have been too extensive to completely eliminate in one treatment. This is particularly true where the contamination has worked its way out of the well into the surrounding formation, as can happen in new well development.

In a few instances the groundwater aquifer itself may be contaminated. This is generally caused by pollutants from nearby sources leaking past defective surface sanitary seals around the well casing, although pathogens can be more broadly disbursed.

In each of these situations, the cause of the failure to achieve complete disinfection must be determined. The owner, in consultation with the contractor, may have to consider a second sample taking, repeated or stronger treatment methods, or in a few situations the well may require repair or replacement.

In some regions of the state procedures often need to be modified to accommodate local well dynamics and conditions. Many low yielding wells, such as those found in areas of hard rock, produce such limited quantities of water to make it impractical to purge high concentrations of chlorine in a reasonable length of time. In such cases it can usually be demonstrated that alternative methods, dosages, contact periods, and/or duration of pumping (i.e. purging spread out over longer periods) can be employed.

Once disinfected, all wells should be properly sealed to prevent the re-introduction of bacteria and other contaminants. A watertight well-head seal must be installed. Some method must also be used to prevent surface water from entering the well. The owner's failure to have such work performed may contribute to repeated contamination of the well.

### RECOMMENDED PROCEDURES

#### DISINFECTION

Always consult local governing body rules and regulations. The following procedures are recommended unless contrary to those rules and regulations: All operations should conform to the Public Safety Precautions and General Safe Handling Procedures for the use of chlorine as set forth in the discussion section of this standard. Chlorine and other disinfectants work only by contact with the bacteria. Therefore, regardless of the particular procedure utilized below, care should be taken to ensure thorough agitation of the solution, and adequate flushing and contact time with all components to be disinfected.

##### A. New Wells or Modification of Old Wells

Disinfection chemicals are introduced into the well immediately following construction or after completion of development. Whenever the contract calls only for new well construction or modification, disinfection chemicals can be introduced and left. Actual dosage may be established by the agency having jurisdiction.

##### B. New Pump Installation, Replacement, or Repair; Repair of Old Wells

It is often sufficient during or following installation or repair of water pumping equipment to simply introduce the minimum amount of chlorine solution to meet the applicable government standard and put the well back in service. Unless there is a known or potential contamination source, the minimum required concentrations will generally sanitize the well and equipment following normal installation procedures. In these cases, the homeowner should be notified of the presence of chlorine and warned not to use the water source for a designated period of time. Once the time has elapsed, the owner should be directed to purge the entire water system until no chlorine residual is detected.

##### C. Treatment of Contaminated Wells

When more effective sanitization is necessary, including existing wells known or suspected to be contaminated, higher doses of chlorine solution need to be introduced into the well and more stringent disinfection procedures need to be followed. The minimum concentration of chlorine recommended by most agencies is 50 mg/l (parts per million), although many recommend higher. An effective procedure is as follows:

- (1). Calculate water volume in well and service plumbing to be disinfected.
- (2). Determine quantity of liquid Sodium Hypochlorite (household bleach) or dry Calcium Hypochlorite needed to bring this volume of water to the necessary concentration (see chart in appendix). High PH-water requires greater chlorine dosages to achieve disinfection.
- (3). Pour the calculated amount of chlorine down the well. Dry or powder chlorine compounds may be pre-mixed into solution for easier pouring.  
**CAUTION!!! Never add water to dry chlorine!**
- (4). Pumps that do not incorporate check valves should be turned on and off several times to surge the solution, thereby mixing the chlorine in the well.
- (5). For all other pumps, circulate the chlorinated water directly back into the well with an uncontaminated hose until chlorine is detected at the hose. This will mix the chlorine solution better.
- (6). When chlorine is detected in all affected piping in the system, or when the presence of chlorine is verified by a test kit, shut the well pump off and let water stand in the well and piping for 12 hours minimum.
- (7). Follow any necessary public safety precautions and communicate warnings as needed after assessing the degree of risk, if any (see section on "Public Safety Precautions").
- (8). After a minimum of 12 hours has passed, purge the water from the well until the absence of residual chlorine has been verified by testing. Smell should never be recommended as a method for testing for the presence of chlorine, as the vapors are damaging to the olfactory nerves.
- (9). Arrange for sampling to verify the absence of coliform bacteria. Repeated disinfection and sampling is often necessary in very contaminated wells. In extremely contaminated wells and distribution systems, where it becomes necessary to disinfect with chlorine gas, special handling and licensing is required. Use of such volatile compounds is beyond the scope of normal well disinfection contracts.

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### SAMPLING

In the course of disinfection procedures, contractors are often expected to draw samples to be tested. Samples are also generally requested when property is refinanced or there is a transfer of ownership. Care must be taken not to introduce bacteria while drawing water or false positives may result. The testing laboratory will usually provide sterile sampling containers, along with Chain of Custody forms and sampling protocol. In the absence of a specific laboratory protocol, the following procedure is recommended:

1. Use a tap as close to the well as possible. If a tap is not available, temporary plumbing must be installed. If temporary plumbing is necessary, all parts should be thoroughly decontaminated with a chlorine solution prior to use.
2. Allow water to run through the tap for five minutes and then verify there is not residual chlorine.
3. Shut off tap and heat opening with a torch. If this is not possible, decontaminate tap opening with liquid bleach.
4. Let water flow through tap once again. Reduce flow, and fill sample container, leaving a small air space. Care must be taken not to splash water around lip of container or to touch inside of container or cap. Leave the cap on the container until the sample is drawn.
5. Complete Chain of Custody form and deliver to an approved laboratory within their designated holding time. In the course of well sanitization procedures, water samples are generally drawn immediately after flushing the well and piping system of chlorinated water. However, there are situations where it is necessary to determine if there is slow intrusion of contaminants, for example when disinfecting a well that has already been verified to be contaminated. Furthermore, Contractors are sometimes requested to provide assurances that the bacterial test is valid. In those cases, it may be necessary to discharge two or more complete well volumes of water before drawing samples and/or to draw a second sample after the first sample. The owner should be notified that a second test should be performed after two weeks of normal usage, and periodically thereafter, to insure the well and surrounding aquifer are and continue to be free of bacteria.

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For more information, please contact the CGA at [wellguy@groundh2o.org](mailto:wellguy@groundh2o.org) or call 707-578-4408.

