SHOCK CHLORINATION OF WELLS AND WATER STORAGE RESERVOIRS **FULL VERSION**

PLEASE READ CAREFULLY AND COMPLETELY BEFORE BEGINNING

Bio-films are layers of bacteria and their organic products that attach to the interior walls of water distribution pipes, appliances, water filters, purification devices, and to one another. This bacterial community traps nutrients, other microorganisms, and waterborne pathogens to eventually form an almost impenetrable material. Almost immediately after attaching itself to pipeline walls, the organism begins building upon itself, adding layer upon layer, forming a plaque-like coating similar to the plaque that forms on teeth. If you've had your teeth cleaned, you know how difficult that coating can be to remove. For shock chlorination to be most effective, as much of this biofouling layer should be removed as is practical. Small pipe interiors are sometimes impossible to access, but larger tanks and other areas that can be accessed should be mechanically scrubbed before proceeding. Because this biofilm protects microorganisms from the disinfectants that are used to kill them, "infected" systems that are positive for Iron Reducing Bacteria, Slime Bacteria, or Sulfur Reducing Bacteria, should be disinfected using the higher dosages and longer exposure times, and residual testing should be done to assure adequate disinfection.

If any of the following occur, you should have bacterial testing done to determine the cause, and then treat the system accordingly.

1. Reduced well yield
2. Restricted water flow in distribution lines
3. Staining of plumbing fixtures and laundry
4. Clogging of water treatment equipment
5. Rotten egg odor
6. Slime growth – especially apparent on inside of toilet tanks and other water reservoirs

Proper and effective shock-chlorination procedure requires:

1. A dose of 50 to 200 ppm of free chlorine evenly distributed through out the piping and fixtures

2. Testing of the residual to verify that the levels are present at the fixtures and hose bib or valve sections.

3. Contact time with the piping, undisturbed for 12 to 48 hours. The longer contact time the better the result.

4. Retesting of the chlorine residual after 12 hours

If the chlorine residual is less than 10 ppm after 12 hours, repeat the entire procedure above. If the beginning dose is 50 to 100 ppm and the remaining residual after 12 hours is less than 10 ppm, this indicates severe bio-fouling or large amounts of dirt or slime present.

Well maintenance.

Shock chlorination is a relatively inexpensive way to control bacterial growth in a well and its distribution system. However, it will not eliminate the source of the problem, so it is very important to identify the source and correct any problems that can lead to recontamination of the well and distribution system before shock chlorinating.

Proper shock chlorination will disinfect:

1. The entire well depth

2. The porous water-yielding geological formation around the bottom of the well shaft

3. The pressure system

4. Some of the water treatment equipment (CAUTION – some water treatment equipment will be permanently damaged by chlorine, or will be rendered ineffective, so be sure to check that each element in your water purification system can tolerate chlorination. If not, remove it, divert chlorination around it, or plan to replace it after shock chlorination is completed. This includes all filters in the system.)

5. The distribution system

What shock chlorination will NOT do.

1. It will not eliminate a contamination source leaking into your system

2. It will not kill cryptosporidium or giardia cysts, and some other hardy parasites

3. It will not remove problems that arise out of the presence of chemicals in the water. It will not detoxify most chemical contaminants.

If Iron or Sulfur or Slime bacteria have been found in the system:

They may not be eliminated in a single shock chlorination. You may need to repeat the procedure several times. In some cases after a second or third shocking, the problem is solved, and no further symptoms are encountered. However, if this is not the case with your system, there are several options available.

1. Make chlorine-shocking part of your annual well maintenance program. Usually shocking once in spring and once in Fall is enough. In some cases, once a year is enough

2. Install a continuous chlorination system to chlorinate the well at levels just high enough to prevent further microbial growth

In very severe cases the pump may have to be removed and chemical solutions added to the well with vigorous agitation carried out with special equipment. This is to dislodge and remove bacterial slime and biofilm. A drilling contractor should do this. Thankfully, in White County, this is almost never the case.

Sources of chlorine:

1. Household bleach from local retail stores. Do NOT use bleaches with special additives, fragrances, or enzymes etc.

2. 12% Industrial sodium hypochlorite and 70% high test hypochlorite are available from:

    a. water treatment suppliers

    b. swimming pool maintenance suppliers

    c. dairy equipment suppliers

d. some hardware stores

Safety Practices:

Before you begin the shock chlorination process, run some fresh water into a five gallon container. If concentrated chlorine accidentally comes in contact with your eyes or skin, use this fresh water to flush the affected area for 10-15 minutes. If you get some of the chlorine solution in your eyes, see your doctor after thoroughly flushing the affected eye.

A second safety practice is to wear appropriate safety clothing and equipment. Wear goggles to avoid contact with the strong chlorine material and your eyes. Wear a pair of rubber gloves to protect your hands and rubber boots on your feet. To prevent discoloration of your clothing, wear a waterproof suit, coveralls or a full-length apron.

Never mix acids with chlorine – it produces toxic gases.

Do not mix chlorine while standing in a depression or enclosure. The chlorine gas will build up around you and can quickly kill an unsuspecting individual.

Well Chlorination:

Shock chlorination of the well consists of mixing sufficient chlorine-based chemical with the well water to create a solution containing 200 milligrams per liter (mg/l), or parts per million (ppm) of chlorine throughout the entire system (well, distribution pipeline, water heater, pressure tank and other equipment).

Remember that chlorine is very volatile so it is dangerous to work with in confined areas. Make sure the work area is well ventilated. Prepare a mixture of one-half gallon of household bleach per 5 gallons of fresh water. Disinfect the well pit, spring house or other portions of the distribution equipment that may contribute bacteria to the water supply (pump, motor, pressure tank and exposed wiring conduits).

Drain as much water from the system as possible. For systems with pressure tanks containing a bladder, the rubber air-water separator inside the tank could be damaged by the chlorine solution. Check manufacturers' recommendations to determine if the pressure tank should be bypassed. For pressure tanks without bladders, release the air so that the tank can be filled with chlorinated water. Drain water from the water heater so that chlorinated water can be circulated through the hot water pipelines.

Backwash and clean water softeners, sand filters and iron removal filters with a strong chlorine solution. **Do not** chlorinate activated carbon filters since these filters will remove the chlorine until they become overloaded. Activated carbon filters should be

removed from the distribution system until after chlorine has been flushed from the system.

To Determine the amount of chlorine product required for a 200 ppm solution. Table I lists the product amounts needed to create a 200 ppm chlorine solution using typically available sources. If you decide to purchase laundry bleach, you will need 3 pints of bleach per 100 gallons of water in the well and distribution system.

Table I: Amount of Chlorine Product required to create a chlorine concentration of about 200 ppm

Chlorine Product	Amount per 100 gallons of water
Household Chlorine Bleach (5.25% NaOCl)	3 pints
Commercial Strength Bleach (12-17% NaOCl)	1 pint
Chlorinated Lime (25% $CaOCl_2$)	11 ounces
Calcium Hypochlorite (65-75% $Ca(OCl)_2$)	4 ounces

Note:

Well water containing iron, hydrogen sulfide, or organic substances may require more chemical to create a 200-ppm solution. Chlorine combines readily with these materials, making some of the chlorine ineffective as a disinfectant.

HOW TO CALCULATE WHAT YOU NEED:

Volume of Water	Example	Your System

1. Depth of Well	100 feet	
2. Depth to Water	90 feet	
3. Total depth of Water (#1- #2)	10 feet	
4. Diameter of Well (Measure inside diameter of well in inches)	30 inches	
5. Calculate Volume of Water per Foot using (23.5 X #4/24 X #4/24) Ex 23.5 X (30□24) X (30□24) = 23.5 X 1.5 X 1.5 = 52.88	52.88 gal	
6. Total Volume of Water in Well #3 X #5; Ex. 10ft X 52.88gal/ft =	528.8 gal	
7. Volume in Storage Tank, cistern or Reservoir (in gallons)	1000 gal	
8. Volume in Distribution System Pipelines (estimate in gallons)	50 gal	
9. Water Heater (in gallons)	30 gal	
10. Pressure Tank (in gallons)	30 gal	
11. Entire System Volume = (#6 + #7 + #8 + #9)	1638.8 gallons	

Calculate the amount of Chlorine Product to achieve 200ppm for the particular Chlorine product used

Chlorine Product and Calculation	**Amt / 100 gallons**	**Your System**
12. Amount of chosen product needed per 100 gallons (ex 4 ounces Calcium Hypochlorite is needed per 100 gal)	4 ounces	
13. Entire System Volume □ 100	16.38	
Calculate total product needed: #12 X #13 = Ex 4 ounces X 16.38 =	65.52 ounces	

Introduce the chlorine material into the well and distribution system. The best way to introduce chlorine material into the well or storage tank is to dissolve the chlorine in a 5-gallon bucket of fresh water. Be sure the bucket is plastic and has been thoroughly washed. Then pour the chlorine solution into the well or storage tank. Try to splash the solution on the sidewalls of the well or storage tank casing as much as possible. Attach a hose to the water hydrant or faucet nearest the well or storage tank and run water through the hydrant and back into the well or storage tank. This will thoroughly mix the chlorine solution and well or storage tank water. A larger container can be used, and the chlorine solution siphoned into the well, but this is a bit more risky.

After the chlorine has been placed in the well or storage tank, and the casing has been washed down, move around the water distribution system and open each faucet (hot and cold), hydrant or other water outlet including dishwasher, washing machine, water heater, etc.. (Consult your water treatment equipment supplier to find out if any part of your system should be bypassed to prevent damage). Allow water to flow until a strong chlorine odor reaches that position in the system. Then close the valve at that location. Do this with all faucets, hydrants and other outlets in the system.

If a strong chlorine odor is not detected at each site, add more chlorine to the well or storage tank. This may be an indication that your well or water storage reservoir contains iron, hydrogen sulfide or organic materials (ex. Biofilm). This lack of odor is caused by the chemical removal of chlorine when it reacts with ionic or organic matter in the water or biofilm.

Let the chlorine disinfect the system. The most difficult step is to refrain from using water from the well or water storage reservoir so that the chlorine can disinfect the system. The system should remain idle for at least 8-48 hours, preferably overnight. Longer is better.

Flush the system to remove the chlorine. After the water system chlorination has been completed, the entire system must be emptied of chlorine and thoroughly flushed with fresh water. Open an outside tap and allow the water to run until the chlorine odor dissipates. Make sure to direct this water away from sensitive plants or landscaping. Distribute the wastewater on gravel roads or other areas without plants or aquatic life, which it might harm. **Do not allow the chlorinated water to enter the septic system.** If possible, attach a hose to outlets inside the house and distribute the water to a non-grassy area away from the house. The chlorine will eventually evaporate into the atmosphere. Flush the chlorine from the hot water heater and household distribution system. The small amount of chlorine remaining will not harm the septic tank.

Backwash and regenerate any water treatment equipment.

Retest the water supply for bacterial contamination: The final step is to retest the water to ensure that the water source is bacteria free. Take a water sample 1-2 weeks

after shock chlorinating the well or water storage reservoir, using the same procedures as before. Though most shock chlorination treatments are successful, do not drink the water until the laboratory results confirm that no bacteria are present. Retest the well or water storage reservoir every month for 2-3 months to be sure contamination is not reoccurring. If test results are negative, an annual water analysis program can be reinstated.

REMEMBER SAFETY FIRST:

Chlorine compounds are volatile so they will degrade with time. **Purchase only what you'll need and use it all.** Always read and follow manufacturers' recommendations. When using chlorine bleaches, do not purchase bleaches that have scents or other additives. **Do not add other cleaning materials to the chlorine solution.** Some combinations of chlorine and acids or ammonia could produce dangerous gases.

Make sure all work areas are well-ventilated.