DISINFECTION

Disinfection – Emergency Chemical Feed Pump Settings

Per Standard Operating Procedure No. 12 – Chlorination

Required Equipment

- *Chemical Feed Pump* – LMI pumps are stored on the top shelf in the Drafting Room. Two (2) pumps, manuals, and required parts for hookup to well pump piping are also stored there.
- *12.5% Sodium Hypochlorite (chlorine)*
- *Chlorine Injector* – A quill chlorine injector is present in the wellhead skid piping and is ready for hookup at all times.
- *Chlorine Residual Tester/Testers* – There are two (2) chlorine tester units available in the drafting room: (1) a Hach chlorine, free chlorine, total chlorine and pH color wheel and a (2) Hach D 300 DPD total chlorine, 10 ml, laboratory reagent indicator for total chlorine.

Pre-Procedure

- Pump *Chemical Feed Pump* from 55-gallon barrel of 12.5% chlorine into the quill chlorine injector. There are two (2) plastic 55-gallon barrels available in the reservoirs that can be filled from the WRF's chlorine tank if chlorinating the water system must take place quickly. There is a plastic hand pump with clear plastic 1-inch tubing that can be used to pump chlorine out of the plant chlorine tank and into the 55-gallon barrel. The LMI pumps are already set up with a round skid top that can be placed on top of the 55-gallon barrels. If there is time, the WRF operator can have 55-gallon drums of chlorine delivered the next day. The LMI pumps are currently set up to use 55-gallon drums. If necessary, the water operator can switch to the measurable "day tanks". The day tanks are permanently kept in the reservoir buildings, next to the well pump skids.

  The WRF's chlorine is 12.5%. Emergency chlorinating dosages are designed at this percentage (see dosage information below).

Procedure

1. ***Preparation***
   a. Set *Chemical Feed Pu*mp to desired initial flow rate.
      Set up the LMI Feed Pump. Connect to the wellhead injection quill. Set up the 55-gallon drum of chlorine and suction lines to the injector pump. Consult the LMI pump manual for proper priming and pump settings for initial startup. Also study the Injection Dosage Chart shown below. This chart is also present in the reservoir on the wall adjacent to the wellhead.
   b. Plug in *Chemical Feed Pump*.

2. ***Action***
   a. Turn on the well pump; the chemical feed pump should now be running.
   b. Using the Chlorine Residual Tester, measure the CL.2 free residual at nearby sample tap.
   c. Adjust the Chemical Feed Pump rate of injection until the CL.2 free residual is at least a 0.8 mg/l**.**
3. ***Finishing***
   Using the Chlorine Residual Tester, measure the CL.2 free residual at the most remote part of the water system. It has to measure 0.2 mg/l or better. If the residual is less than 0.2 mg/l, adjust the Chemical Feed Pump rate of injection higher.

Documentation

Document the Chemical Feed Pump settings, CL2 residuals, the amount of chlorine left in the barrel, and any changes that were made, etc.

Disinfection of Water Mains

Per the Environmental Protection Agency (EPA), the construction, rehabilitation, and repair of water mains are extremely common activities that occur on a regular basis in all water systems. The relative frequency and nature of these activities represent a potential contamination risk to water distribution systems if proper procedures and existing standards are not followed. Installation and

repair of water mains provides the potential for direct contamination of the distribution system.

Water Main Disinfection Procedure

ANSI/AWWA C651-14 (2014)

This standard presents essential procedures for disinfecting new and repaired water mains. Topics covered include forms of chlorine disinfection, a description of the disinfection procedure, preventative and corrective measures during construction, methods of chlorination, final flushing, bacteriological testing, re-disinfection, final connections to existing mains, disinfection procedures when cutting into or repairing existing mains, and special procedures for caulked tapping sleeves. Appendices cover chlorine residual testing, and disposal of heavily chlorinated water.

LOWER RESERVOIR DISINFECTION PROCEDURE

Equipment Required:

rubber gloves & goggles

250 ml graduated cylinder

55-gallon drum

12% sodium hypochlorite (bleach)

LMI chemical feed pump

Poly/piping connections to injection point/drum

2-gallon bucket filled with water

stopwatch

Procedure: Measure LMI pumping rate. Insert pump suction line into the bucket of water. Set the pump control knob to 5; have stopwatch ready. Turn on pump, establish prime, measure mls/per minute water flow into graduated cylinder. Adjust pump feed rate until desired feed mls/per minute is reached. Once desired feed rate is established, transfer pump to hypochlorite tank; hook up suction/discharge supply lines, test for leaks and start pump. Do not over-tighten plastic fittings. Sample chlorine residual at different reservoir effluent. Residual will be lower at effluent due to demand.

Calculation for 12% Bleach: Ex:Dose x flow x 8.34 = lbs./day @ 650 gpm = .936 mgd 1 mg/L x flow .936 mgd x 8.34 lbs/gal = 7.8 lbs/day

Specific gravity of 12 % bleach is 1.2, which translates to 10.18 lb/gal 1 mg/L x flow .936 mgd x 10.08 lb/gal = 9.44 lbs/day

9.44 lbs./day / .12 or 12% bleach = 78.6 lbs/day

78.6 lbs. day / 10.08 lbs per gallon = 7.8 gallons per day

Calculated Feed Rates for Lower Reservoir - pumping rate of 650 gpm.

DOSE		FEED RATE		
0.5	mg/L dose	0.62 L per hour	or	10 mls/min
1.0	mg/L dose	1.23 L per hour	or	21 mls/min
1.5	mg/L dose	1.85 L per hour	or	31 mls/min
2.0	mg/L dose	2.46 L per hour	or	41 mls/min
2.5	mg/L dose	3.08 L per hour	or	51 mls/min
3.0	mg/L dose	3.69 L per hour	or	62 mls/min

Emergency CLS Disinfection Feed Rates for Repeat Failed Coliform Tests.

Approximately 11 miles of 6-inch distribution mains

11 miles of 6-inch distribution mains contain 85,378 gallons of water

Upper Reservoir Capacity = 135,000 gallons

Lower Reservoir Capacity = 135,000 gallons

Total water in distribution mains, and reservoirs combined = 355,378 gallons or 0.355 mg.

Dosages for a 1-time reservoir/distribution system dosing

1.5 mg/L with 12.5 % bleach = 2.0 gallons per reservoir

2.0 mg/L with 12.5 % bleach = 2.6 gallons per reservoir

2.5 mg/L with 12.5 % bleach = 3.2 gallons per reservoir

3.0 mg/L with 12.5 5 bleach = 3.9 gallons per reservoir

Dosages when feeding into wellhead with LMI Pumps - Lower Reservoir only @ 600 gpm, with a cL2 concentration of 12.5 %

1.5 mg/L = 9.4 gallons per day, or a pump setting of 25 mls/min

2.0 mg/L = 12.5 gallons per day, or a pump setting of 33 mls/min

2.5 mg/L = 15.7 gallons per day, or a pump setting of 42 mls/min

3.0 mg/L = 18.8 gallons per day, or a pump setting of 50 mls/min

UPPER RESERVOIR EMERGENCY DISINFECTION PROCEDURE

Equipment Required:

rubber gloves

goggles

250 MI graduated cylinder

55-gallon drum

12% sodium hypocholorite (bleach)

LMI chemical feed pump

poly piping/connections to injection point/drum

2-gallon bucket filled with water

stopwatch

Procedure:

Measure LMI pumping rate. Insert pump suction line into bucket of water. Set pump control knob to 5; have stopwatch ready. Turn on pump, establish prime, measure mls/per minute water flow into graduated cylinder. Adjust pump feed rate until desired feed, mls/minute is reached. Once desired feed rate is established, transfer pump to hypochlorite tank. Hook up suction/discharge supply lines, test for leaks and start pump. Do not over-tighten plastic fittings. Sample chlorine residual at reservoir effluent. Residual will be lower at effluent due to demand.

Calculation for 12% bleach:
Ex: Dose x Flow x 8.34 = lbs./day @ 450 gpm = 648 mgd

1 mg/L x flow .648 mgd x 8.34 lbs./gal = 5.4 lbs./day

Specific gravity of 12% Bleach is 1.2, which translates to 10.08 lbs./gal

1 mg/L x flow .648 mgd x 10.08 lbs./gal=6.53 lbs./day

6.53 lbs./day / .12 or 12% bleach = 54.5 lbs./day

54.5 lbs./day / 10.08 lbs. per gallon = 5.4 gallons per day.

Calculated feed rates for upper reservoir pumping rate of 450 gpm.

DOSE		**FEED RATE**		
0.5	mg/L dose	0.426 L per hour	or	7.0 mls/min.
1.0	mg/L dose	0.85 L per hour	or	14 mls/min.
1.5	mg/L dose	1.28 L per hour	or	21 mls/min
2.0	mg/L dose	1.7 L per hour	or	28 mls/min
2.5	mg/L dose	2.13 L per hour	or	36 mls/min
3.0	mg/L dose	2.55 L per hour	or	43 mls/min

After event is over, flush LMI pump with mineral water.