Water System Disinfection

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All Stations

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<u>Active Divisions/Departments</u>

FEMC

Raytheon Polar Services Company
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Purpose

This procedure outlines the necessary requirements at the stations for disinfecting a water system, whether it is newly installed or drained for repairs. This includes water mains, heaters, water storage tanks, snow melters, etc.

Responsibility

Personnel

Plumbing Work Center, FEMC, Water Plant personnel, Area Directorates (Operations) personnel, Project Engineer/Coordinator, and RPSC Environmental Staff

Discussion

According to the *American Water Works Association* (AWWA) standards for disinfecting water mains, this procedure is adapted from AWWAC651-86. According to AWWA standards, all new water mains must be disinfected before they can go into service. In addition, all water mains, water holding tanks, or snow melters removed from service for inspections, repairs, or other activities that could potentially cause water contamination must be disinfected before returning to service. This procedure is adapted from AWWA standard C651-86.

Requirements

Tools and Equipment

Liquid Chlorine, Sodium Hypochlorite, or Calcium Hypochlorite.

Warning: Strong sodium Hypochlorite solutions are powerful oxidizing agents that rapidly produce burns when in contact with the skin. Do not handle directly or allow the solution to splash or spill on any part of the body.

Avoid accidental mixing with acids, as this will liberate chlorine gas. With ammonia or ammonium compounds, explosive products may be formed.

Certain organic compounds like Acetone and Formaldehyde react vigorously with Sodium Hypochlorite solutions. Similarly organic contamination of any kind is liable to cause decomposition, which is especially dangerous with strong Hypochlorite solutions.

Keeping Pipe Clean and Dry

To keep pipes clean and dry before construction begins and minimize contamination, take the following precautions:

1. Deliver pipe for construction so that it is strung in a manner that minimizes the entrance of foreign material.
2. Keep all openings to pipe closed with watertight plugs during any work stoppage, including end of work day, breaks, work delays, etc.
3. Maintain only as much pipe at the work site as necessary, ensuring that pipe is quickly installed and not laying around the work site for long periods of time prior to installation.

Minimizing Risks of Contamination during Construction, Maintenance, or Repair Work

To minimize the risks of contamination that can occur during construction, use the following steps:

1. Complete the joints of all pipes before stopping work.
2. Use only approved packing materials, which include molded or tubular rubber rings, rope of treated paper, or other approved materials.
3. Handle sealing material or gaskets in a manner that avoids contamination.

   Do not use contaminated material or any material capable of supporting microorganism growth. Sealing material must be suitable for use in a potable water system. It must also be stored and delivered in closed containers and kept clean.
4. Clean pipe by mechanical means if dirt cannot be removed by flushing.

   After completing mechanical cleaning, swab the interior of the pipe with a one (1) percent hypochlorite disinfecting solution.

   Note The Project Engineer or Project Coordinator should determine if and how the interior of the pipe will be disinfected.
5. Ensure that when pipe or fittings cannot be kept dry during installation, then every effort will be made to ensure that the water entering the pipe contains an available chlorine concentration of approximately 25 mg/L.

   This can be accomplished by adding calcium hypochlorite granules or tablets to each length of pipe before it is lowered into any area holding water, such as a wet trench. It can also be accomplished by treating the standing water with hypochlorite tablets.

Results By following these steps, all precautions are exercised to ensure pipes remain as clean and dry as possible.

Disinfecting Water Mains

AWWA outlines several methods of disinfection for new mains, including the slug, continuous feed, and tablet methods. The Plumbing Work Center shall complete the disinfection process for new and repaired water mains. RPSC designates a water main as any section of pipe that is 20 feet or more in length: This procedure describes the continuous feed disinfection method. If the slug or tablet method is used instead, consult the AWWA standards for the proper steps. To disinfect a water main using the continuous feed disinfection method, complete the following steps:

1. Verify that the system is completely flushed and cleaned, using water of sufficient velocity to remove dirt and foreign materials.

2. If possible, ensure the water used to dilute the disinfecting agent has a pH between 7.4 and 7.6.

   Note The disinfecting power is strongest at this pH. The pH may be adjusted by using alkali (caustic soda or soda ash) or hydrochloric acid.

3. Before determining which method to use for disinfection, consult AWWA Standard C651-92, *AWWA Standard for Disinfecting Water Mains*, to determine which is the most effective and safest method to use, paying particular attention to any warnings.

   For example, AWWA warns against using the tablet method with calcium hypochlorite granules on solvent-welded plastic or screwed-joint steel pipe. It poses a danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

4. If disinfection involves a repaired main and water service must be quickly put back on line, minimum disinfection involves swabbing or spraying the affected pipe sections and fittings with a 1% to 5% hypochlorite solution and flushing the main from both directions, if possible, before returning the system to service.

   If conditions permit, the affected section should be isolated, service connections should be shut off, and the section disinfected as described in Steps 5-13.

5. For new mains, inject disinfectant (free chlorine in liquid, powder, tablet, or gas form) following one of the methods (continuous, slug, or tablet method) outlined in AWWA Manual M20, *Water Chlorination Principles and Practices*, pp35-36 and AWWA Standard C651-92.

   The continuous feed method outlined in AWWA manual M20 calls for a disinfection residual of at least 50 mg/L to remain in contact with affected portion of the water distribution system for 24 hours. Refer to the AWWA Standard C651-92, p. 7, for the amount of chlorine required for each 100 feet of pipe of various diameters.

6. Bleed water from outlets to ensure distribution throughout the system.

7. Test for the required disinfectant residual at a minimum of 15% of the outlets.

8. Maintain disinfectant in system for 24 hours, during which time all valves and hydrants in the treated section should be operated to ensure disinfection of the appurtenances.

9. Repeat Steps 4-7 if final disinfectant residual tests at less than 10 mg/L.

10. Once the final disinfectant residual is tested at 10 mg/L or greater, flush the disinfectant from the system until residual is equal to that of incoming water, which is approximately 1.0 mg/L.

11. After the system is flushed, Water Plant personnel should take samples from 10% of outlets and water entry within 24 hours after flushing and analyze the samples in accordance with AWWA C651-92.

12. Place the water system back in service.

    Note If it is necessary to place the water system in service as soon as possible, it may be done prior to the sample analysis.

13. If the sample analysis shows that the system is still not disinfected, repeat the disinfection process.

After completing these steps, the disinfection process is complete.

Cleaning All Other Water Pipe

The necessity for disinfection may not always be necessary for small water system components and piping sections less than 20 feet in length. Both the need for disinfection and the disinfection method chosen from AWWA regulations are up to the discretion of the Project Manager. Consultation with the RPSC Environmental Staff can be helpful in determining whether the disinfection is necessary and which method is the most thorough.

To ensure that a water system is clean before placing in service, complete the following steps:

1. Swab or spray interiors of the affected pipe sections and fittings with a 1% to 5% hypochlorite solution.
2. Flush the section – from both directions, if possible – before returning the system to service.
3. If the contamination level requires a greater degree of disinfection, use the slug method of disinfection by isolating and flushing the section and then chlorinating with a dose that may be increased to as much as 300mg/L. With this concentration of chlorine, the exposure time can be reduced to as little as 15 minutes.
4. Flush the system until discolored water is eliminated and the water is free of noticeable chlorine odor.
5. For a more detailed description of the slug method, refer to the AWWA Standard C651-92.
6. Take a bacteriological sample to provide a record of the procedure's effectiveness.

Results After completing these steps, the disinfection process should be complete.

References

American Water Works Association (AWWA) *AWWA Standard for Disinfecting Water Mains*

AWWA Manual M20, *Water Chlorination Principles and Practices*

Records

Water sample records are maintained by the Water Plant Operations and EH&S departments.