UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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Construction Grants
Program Requirements Memorandum
PRM No. 79-1

Subject: Safety Requirements for the Design and Operation of Chlorination Facilities Using Gaseous Chlorine

From: John T. Rhett, Deputy Assistant Administrator for Water Program Operations (WH-546)

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To: Regional Administrators (I-X)
Attn: Water Division Directors

Purpose:

This memorandum establishes the policy pertaining to safety requirements for the design and operation of chlorination facilities utilizing gaseous chlorine.

While many engineering considerations and operational practices with regard to chlorine handling are site specific, a number of significant design specifications and operational procedures should be required as minimum acceptable practice. There are numerous publications that provide detailed information pertaining to this subject, including those listed in Attachment B. This memorandum provides guidelines and general principles to be used in the design and operation of chlorination facilities using gaseous chlorine.

Discussion:

Gaseous chlorine refers to chlorine purchased in its elemental form, occurring in the gaseous or liquid state. It is supplied commercially in pressurized containers sized to contain either 100 pounds, 150 pounds or 2,000 pounds of chlorine. In addition, chlorine can be purchased in single unit and multi-unit railroad tank cars, as well as tank trucks.

Chlorine is a respiratory irritant, and under conditions of sufficient concentration and exposure, can cause death by suffocation. Chlorine, especially when combined with even small amounts of water, is highly corrosive, and can cause severe burns when brought into contact with skin and eyes. Unfortunately, the toxic and corrosive effects of chlorine were recently demonstrated by the two publicized railroad tank car derailments and their subsequent after effects.

The on-going construction grants program will continue to generate significant construction of wastewater treatment facilities throughout the country. Chlorination continues to represent the most commonly used method of disinfection for sewage, and consequently many new treatment facilities will include provisions for chlorinating treated effluent prior to discharge. As a result, a major part of EPA's overall responsibility is ensuring that safe chlorination practices are implemented.

EPA policy is designed to ensure that:

1. Chlorination systems are designed to prevent chlorine leaks and to minimize operator and local resident exposure should leaks occur.

2. Chlorine leaks that do occur are handled safely, quickly, and with minimal environmental exposure.

Policy:

Attachment A is guidance for the design and operation of safe chlorination facilities. It is intended that in reviewing plans and specifications and operation and maintenance manuals for those projects incorporating chlorination processes, Sections I and II of Attachment A be used as a technical guide and basis for minimum adequacy in safety considerations. The information contained in the guidance was developed to serve as part of the overall criteria applicable to the design and operation of such facilities. While it is believed that complying with the guidance will substantially reduce chlorine hazards which can be potentially dangerous to plant personnel and nearby residents, it is recommended that the guidance in this PRM be used to supplement other applicable information on chlorination facilities.

Implementation:

The measures specified in this memorandum are required for all projects that have not yet received Step 3 grants by the date of this memorandum. In addition, projects that have already received Step 3 grants should incorporate the sections under operation and maintenance in the O&M manual. Where practical, current Step 3 projects should be encouraged to make revisions to their designs to comply with the measures specified herein.

Attachments

ATTACHMENT A

Procedure for the Safety in the Design and Operation of Chlorine Facilities

This guidance contains a detailed procedure which represents good engineering practices for the safety in the design and operation of chlorination facilities. Because it is not the intent of the guidance to modify or replace any appropriate safety requirements and regulations published by the Occupational Safety and Health Administration (OSHA), it is recommended that the guidance be used to supplement the OSHA and any other appropriate safety requirements.

I. Design of Gaseous Chlorine Facilities

A. If gas chlorination equipment and chlorine cylinders are to be installed or stored in a building used for other purposes, a gas-tight partition should separate the chlorination room from any other portion of the building. Doors to this room should open only to the outside of the building, and should be equipped with panic hardware. Such rooms should be at ground level, and should permit easy access to all equipment; the chlorine storage area(s) should be separated from the chlorine feed area(s).

B. A clear glass, gas-tight window should be installed in an exterior door or interior wall of the chlorination room to permit the chlorinator(s) to be viewed without entering the room.

C. Chlorination rooms should be equipped with heating and ventilating equipment designed to maintain the room(s) containing the chlorine containers at approximately 18-21°C (65-70°F) and the room(s) containing the chlorinator feed equipment at a temperature of 5-10°F higher.

D. Containers (except insulated rail or cargo tanks) should be shielded from direct sunlight or from overheating above 60°C (140°F) any source, either while in storage or in use. Pairs of level rails or properly designed cradles should be provided for storing one ton cylinders.

E. Forced mechanical ventilation should be included that will provide a complete air change at least every 1-4 minutes. Because chlorine gas is heavier than air, location of air inlets and outlets should be carefully considered to ensure that the entire room will be thoroughly ventilated. For example, in the exhaust ventilation system, the exhaust outlet should be located near the floor, with the discharge being positioned outside of the building at a point where it will not contaminate the air inlet to any buildings or inhabited areas. The fresh air inlet should be located at the opposite end of the room from the exhaust outlet, to facilitate complete air replacement.

F. Exhaust equipment should be automatically activated by external light switches. That is, an operator should be able to turn the lights on outside of the chlorination room and thereby activate the ventilation system prior to entering the enclosed area. Other automatic systems, including door-activated mechanisms, should also be considered.

G. Emergency showers and eye baths should be located near, but external to, the chlorination facilities.

H. For facilities having a design hydraulic capacity of five million gallons per day or more, an automatic chlorine detection system should be included as part of the chlorination facility. The detection system should sound alarms and activate flashing lights that are audible and visible within the POTW. Connection of the alarm system to the local police station, POTW operator's area, or both, is also recommended where practical. Consideration of such detection and alarm systems should also be given in the case of smaller facilities, where the potential benefits are sufficient to warrant the additional cost and associated increase in operational complexity.

II. Operation and Maintenance

The following procedures should be included in operation and maintenance manuals for treatment facilities which incorporate chlorination processes. While the following criteria are related primarily to the operation and maintenance of chlorination systems, they should also be read in the context of their applicability to the design of treatment plants.

A. Loading and Unloading of Chlorine

1. DOT regulations (174.560) provide that single-unit railroad tank cars must be unloaded on a private track. This requirement applies to all EPA supported projects.

2. Whenever practicable, single and multi-unit tank cars should be delivered at a deadend siding(s) used only for chlorine delivery, with insurance that the tracks are level. The car(s) should be protected by a locked derail, a closed and locked switch, or preferably both.

3. Railway flat cars delivering one ton containers should also be delivered on a special siding assigned to chlorine unloading only.

4. Chains, rope slings, or magnetic hoists should never be used. When cylinders are to be lifted, forklift trucks or hoisting equipment with special cradles or carriers designed for chlorine equipment should be utilized.

5. Tank barge unloading facilities should be in compliance with the Army Corps of Engineers and Coast Guard Regulations.

B. Handling of Chlorine Containers

1. One ton cylinders should be stored on properly designed cradles or pairs of level rails. Chocks should be placed to prevent the containers from rolling when unattended.

2. 100 and 150 pound cylinders should be secured with safety chains in storage and during transport.

3. Containers should never be piled on top of one another.

4. Containers should be stored in a manner that will prevent them from being hit by vehicles or other heavy objects.

5. Chlorine should not be stored with other compressed gases.

6. Empty containers should be so tagged, and should be stored separately from full containers.

7. Cylinders should be used in the order in which they are received, to prevent valve packing from becoming dry and developing leaks.

8. Only approved tools designed for use with chlorine container should be used. For example, hand trucks specifically designed for 100 and 150 pound cylinders should be used instead of rolling them on the rim.

9. Chlorine cylinder emergency repair kits should be readily available.

C. Leak Detection and Emergency Procedures

1. Each POTW should have a formal written set of emergency procedures that includes the items discussed below, prior to startup of the chlorination facilities. In addition, operator's manual must include pre-planned procedures in the event of a catastrophic leak or container rupture.

2. Self-contained positive pressure helmets, with their own compressed air supply and full facepiece, should be available for emergency use. The canister type gas mask is specifically not recommended. The helmets should be located at readily accessible points, away from the area(s) likely to be contaminated with chlorine gas. Spare air supply cylinders should also be on site for use during prolonged emergencies.

Helmets and breathing air supply tanks should be routinely inspected and maintained in good condition. They should be cleaned after each use, and also cleaned routinely at regular intervals. When needed, air supply tanks should be refilled at stations where proper air compressor equipment is used to filter out oil in a contaminated air environment.

Specifications for properly designed positive pressure helmets for chlorine service can be obtained from the U.S. Bureau of Mines, OSHA, or NIOSH. In addition, potential users of these helmets, as well as users of other emergency equipment, should have formal training in their use and should also be required to have regular practice sessions.

3. A strong solution of aqueous ammonia (18° Baume or higher) should be available for use in locating the source of leaks. Dense white clouds of ammonium chloride are formed by the reaction of the ammonia and chlorine, thus confirming the source of the chlorine leak.

4. Repair of any chlorine leaks should be performed by at least two people wearing self-contained air breathing equipment. If such repairs must be made below grade, persons entering the area must also wear safety harnesses which are connected to ropes extending to a higher level where additional people are stationed to assist in emergency rescue operations.

5. Piping and valves in chlorine rooms should be color coded and properly labeled for rapid identification.

6. If a container is leaking chlorine, it should be turned, if possible, so that gas instead of liquid escapes. The quantity of chlorine that escapes from a gas leak is about one-fifteenth the amount that escapes from a liquid leak through the same size hole.

7. If possible, a leaking container should be moved to an isolated spot where it will do the least harm.

8. Never immerse or throw a leaking chlorine container into a body of water. The leak will be aggravated and the container may float when still partially full of liquid chlorine, allowing gas evolution at the surface.

9. Emergency kits should be readily available for the quick repair of chlorine leaks. Information on emergency kits is available from the Chlorine Institute, New York, NY (see Reference 1).

10. In the event of an emergency, technical assistance can be obtained by calling CHEMTREC (Manufacturing Chemists Association, Chemical Transportation Emergency Center) at 800/424-9300. This is a 24-hour toll-free service.

ATTACHMENT B

REFERENCES

1. "Chlorine Manual," The Chlorine Institute, Inc. 342 Madison Avenue, New York, NY, December, 1972.

2. "WPCF Manual of Practice No. 1 - Safety in Wastewater Works," Water Pollution Control Federation, 1975.

3. "WPCF Manual of Practice No. 4 - Chlorination of Wastewater," Water Pollution Control Federation, 1976.

4. "WPCF Manual of Practice No. 8 - Wastewater Treatment Plant Design," Water Pollution Control Federation, 1977.

5. "Liquid Chlorine" Technical and Engineering Service Bulletin No. 7, Allied Chemical, Morristown, NJ.

6. "Chemical Safety Data Sheet SD-80, Properties and Essential Information for Safe Handling and use of Chlorine," Manufacturing Chemists Association, 1970.

7. "Standards for Waste Treatment Works, Municipal Sewerage Facilities," New York State Department of Environmental Conservation, 1970.

8. "Chlorine Handbook," Diamond Shamrock Chemical Company, 1976.

9. "Dow Chlorine Handbook," Dow Chemical U.S.A., 1975.

10. Sax, Irving N., Dangerous Properties of Industrial Materials, Van Nostrand Reinhold Company, 1975.

11. White, George C., Handbook Of Chlorination, Van Nostrand Reinhold Company, 1972.

12. "Hazardous Materials Regulations of the Department of Transportation, Including Specifications for Shipping Containers," R.M. Grazianos Tariff Publishing.

13. "Chlorine Detector Saves a Life," Public Works, March, 1978.

14. "Safe Handling of Compressed Gases and Containers," Compressed Gas Association, Inc., 1974.

15. "Supplement to Federal Guidelines: Design, Operation and Maintenance of Wastewater Treatment Facilities," Technical Bulletin No. D-71-1, U.S. Environmental Protection Agency, September, 1970.