

Chlorine is an effective and economical germ killer that is used to destroy and deactivate a wide range of dangerous germs in homes, hospitals, swimming pools, hotels, restaurants and other public places.

Chlorine is supplied in three basic forms:

- Sodium hypochlorite—a liquid commonly known as bleach
- Calcium hypochlorite—a powder or tablet
- Chlorine gas—container sizes range from 150 lb cylinders to rail cars

Due to its inherent hazards, water treatment operators should be trained in the safe use, handling and storage of chlorine. This training should include the dangers of bulk chlorine use, transportation labeling requirements and equipment safeguards that prevent chlorine overexposure.

Drinking Water Treatment

Before cities began routinely treating drinking water with chlorine, thousands of U.S. residents died each year due to cholera, typhoid fever, hepatitis A and dysentery. Drinking water chlorination and filtration have helped to virtually eliminate these diseases in the U.S. and other developed countries. During the treatment process, chlorine is added to drinking water as elemental chlorine (chlorine gas), sodium hypochlorite solution or dry calcium hypochlorite. Almost all U.S. systems that disinfect their water use some type of chlorine-based process, either alone or in combination with other disinfectants.

Potential Dangers to Bulk Chlorine Users

Chlorine presents several hazards to users. Elemental chlorine (chlorine gas) is a respiratory irritant. It can irritate mucous membranes such as the eyes, nose and throat and in extreme cases, breathing chlorine gas can cause respiratory collapse or lung failure, possibly resulting in death. Skin or eye contact with liquid chlorine will cause chemical burns or frostbite. Though chlorine is not normally considered explosive or flammable, it will support combustion in certain

situations. Chlorine can sometimes react explosively in contact with oil and grease or organic materials, such as wood and rags.

People can be seriously injured when chlorine

is improperly mixed with other chemicals, especially acids or acidic materials. In a water treatment plant, this mixing usually occurs by accident – for example, when a tank truck of acidic chemicals is unloaded into the sodium hypochlorite solution (bleach) storage tank. Some common acidic chemicals found at water and wastewater plants include ferric chloride, ferric sulfate, ferrous sulfate, ferrous chloride (pickle liquor), aluminum sulfate (alum), aluminum chloride, hydrochloric acid, sulfuric acid and phosphoric acid. Under the right circumstances, these chemicals can react with sodium hypochlorite to release hazardous chlorine gas.

Several steps can be taken to prevent chlorine-related accidents.

- **Extensive operator training**—Government regulations require that only specified operators highly trained in the unloading process should be assigned the duty of accepting tank truck or tank car deliveries.
- **Secured tank loading lines**—Prevent truckers from unloading without supervision by installing blind flanges or caps equipped with a padlock.



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- **Visually define which line is which**—Use color coding and labeling to differentiate different process lines and fittings. You can also change the fittings on the loading lines to different sizes or types for each line.
- **Checklist**—Create a checklist that your authorized operator must complete before accepting a chemical delivery. Items to include:
 - ▶ Confirm the name of the chemical
 - ▶ Review the shipping papers and the placards of the truck or tank car
 - ▶ Confirm that proper PPE is being used
 - ▶ Confirm that the volume being delivered does not exceed the storage capacity

You can help truck drivers avoid mistakes by placing signs on sodium hypochlorite unloading lines. Keep signs brief and to the point. Signs should be large enough to be visible from at least 10 feet away. Storage sites should consider placing stickers with the same wording on the actual sodium hypochlorite piping.

Sodium Hypochlorite Only (Bleach)

Additional Safety Devices and Information for Packaged Chlorine Users

Emergency valve closure systems—Equip systems with valves and/or actuators that will close automatically, stopping the flow of chlorine. These units should only be used to close valves in an emergency—not as a routine part of your operation.

Line pressure warning system—Chlorine release can occur when a container is disconnected while the line is still under pressure and/or the container valve did not close properly. Consider installing a pressure sensing device in the line to make sure that the chlorine line is depressurized before disconnecting.

Direct mounted vacuum chlorinators—These devices attach directly to the cylinder or the vapor (upper) valve on a container. They require a vacuum in the system to operate. If the vacuum is lost due to either a break in the system or the loss of water flow through the venturi injector, then the vacuum chlorinator will stop the flow of gas.

Atmospheric monitoring equipment for chlorine—This equipment can be used to detect leaks and monitor chlorine levels. Fixed area detectors are not intended to monitor personnel exposure or to quantify leaks in the absence of other input. Many states and local municipalities have established rules that require the use of these monitors for specific situations.

Acid detecting paint—This paint changes color from yellow to bright red when it is exposed to acidic gases like chlorine. The paint returns to its normal color after the leak is stopped and the leak site is neutralized.

Chlorine and Water System Security

The Department of Homeland Security has issued Chemical Facility Anti-Terrorism Standards for any facility that manufactures, uses, stores or distributes certain chemicals at or above a specified quantity—this includes chlorine. Visit the Department of Homeland Security’s website to learn more about how your facility is affected by these standards.

For Additional Information

Chlorine Chemical Council: www.c3.org

The Chlorine Institute: www.chlorineinstitute.org

Centers for Disease Control: www.cdc.gov

- Emergency Preparedness and Response – Facts About Chlorine

Department of Homeland Security: www.dhs.gov

- Critical Infrastructure – Chemical Security

AWC II, Inc.: www.awc-2.com

- Acid/base Detecting Products