



Product Stewardship Summary

Chlorine

Summary

Chlorine is a greenish-yellow gas with a pungent and irritating odor. It is a very active element that is found in nature only in combination with other elements. Ordinary table salt, sodium chloride, is the chief source of chlorine.

Important uses of chlorine include water disinfection and bleaching textiles. Much of the chlorine that is manufactured is used as a raw material in the production of polyvinyl chloride, a plastic used in flooring, pipe, wallpaper, clothing, furniture and a wide range of other products. Chlorine also is used to manufacture other compounds ranging from pharmaceuticals to insecticides.

1. Chemical Identity

Name: Chlorine

Chemical Abstracts Service (CAS) number: 7782-50-5

Chemical Formula: Cl₂

Molecular Weight: 35.453

2. Production

OxyChem manufactures chlorine gas in the United States by the electrolysis of sodium chloride brine in either a membrane or diaphragm electrolytic cell. The co-products are sodium hydroxide and hydrogen gas. The reaction is:



The chlorine gas is cooled and dried. Then, compressors and refrigeration machines are used to liquefy the gas. Chlorine is most easily handled as a liquid in specially designed pressure containers.

3. Uses

Some of the earliest uses of chlorine are still very familiar to us. Bleaching textiles with chlorine is just one of its major early uses. Its disinfecting properties remain vital to public health as chlorine is used extensively in water purification systems.

Today, much of the chlorine that is manufactured is used as a raw material in the production of polyvinyl chloride, a plastic used in fabricating flooring, pipe, wallpaper, clothing, furniture, and a wide range of household products. We commonly treat illnesses with complex drugs and spray crops with insecticides, herbicides, and fungicides that contain chlorine as part of their basic structure. Chlorinated chemicals also

enable us to refrigerate and freeze food, cool homes, offices and cars, and even insulate buildings from the heat and cold.

Some of the most important uses of chlorine are helping produce chemicals that contain no chlorine at all. Chlorine and chlorine chemicals help promote reactions that produce chemicals for antifreeze, textile lubricants, fabric softeners, book-binding pastes, solvents for lacquers, brake fluids, polyester fibers, and a host of other products.

4. Physical and Chemical Properties

Chlorine, at ordinary conditions of temperature and pressure, is a greenish-yellow gas with a pungent and irritating odor. Since chlorine is very active chemically, it is found in nature only in combination with other elements. Sodium chloride (salt), for example, is widely and abundantly distributed in nature and constitutes the chief source of chlorine.

Because gaseous chlorine is approximately 2.5 times as heavy as air, it is slow to diffuse into the air. It tends to accumulate in low places.

Gaseous chlorine can be liquefied by the application of pressure at reduced temperatures to form a clear, amber-colored liquid. Liquid chlorine is approximately 1.5 times as heavy as water.

In the presence of moisture, both gaseous and liquid chlorine are extremely corrosive to common metals of construction. At low pressures, wet chlorine can be handled in equipment made of glass, chemical stoneware, titanium, and certain plastics.

Dry chlorine, both gaseous and liquid, can be handled safely in equipment fabricated from iron, steel, certain stainless steels, Monel metal, nickel, copper, brass, bronze, and lead. These metals are not aggressively attacked by dry chlorine, but the slightest trace of moisture will cause severe corrosion. Titanium and dry chlorine react violently and cause fire. Dry chlorine attacks other metals, including carbon steel, at elevated temperatures. Operations above 250°F should be avoided.

Chlorine boils at about -30°F. Under certain conditions, it can embrittle ordinary carbon steels. If temperatures below -20°F are expected to occur, special carbon steels, or other materials of construction should be considered.

Chlorine is not explosive or flammable, but it will act as an oxidizer and support combustion, even in the absence of oxygen.

Chlorine reacts chemically with many substances, especially at elevated temperatures.

5. Health Effects

Chlorine gas irritates the mucous membranes, respiratory tract and eyes. Chlorine has a distinct odor that is detectable at levels ranging from 0.3 to 3.0 parts per million, depending on the individual. The odor usually provides a warning of its presence at concentrations far below levels that create hazards to humans, and at high concentrations, it is visible as a greenish-yellow gas. Exposure to the gas causes coughing and gagging. In extreme cases, massive exposure can result in pulmonary edema and death.

In the presence of moisture, chlorine gas forms hydrochloric acid, which irritates the eyes and skin. Liquid chlorine removes body heat, freezing exposed skin.

Chlorine is not classified as a carcinogen by the National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC), or the Occupational Safety and Health Administration (OSHA).

In animals, effects have been reported on the following organs: kidney, liver and lungs. Chlorine does not interfere with reproduction in animals. Animal studies indicate that chlorine does not cause birth defects, but it may be embryo-toxic when administered at high doses in drinking water to pregnant rats.

6. Environmental Effects

Chlorine is highly toxic to fish and other aquatic organisms. Because it is highly reactive, chlorine will likely react with materials in the soil that contain calcium, sodium and potassium. Degradation of chlorine is expected in the soil environment, although the biodegradation rates of other substances may be reduced or stopped by excessively high concentrations of chlorine.

7. Exposure

The most likely ways exposures can occur are:

- Worker exposure – Exposure could occur in the manufacturing facility or in industrial facilities that use chlorine. Chlorine is handled in closed systems, so special precautions are typically required for employees involved in maintenance activities, sample collection, or similar activities. Good industrial hygiene practices and the use of personal protective equipment minimize the risk of exposure.
- Consumer exposure – OxyChem does not sell chlorine gas in retail stores, although chlorine may be an ingredient in some consumer products, such as disinfectants used in pools and spas, or hypochlorite cleaning products, such as bleach. Safety precautions are provided by the manufacturers of these products.
- Releases – If a release occurs, the area should be evacuated. Emergency personnel should wear protective equipment to minimize exposures during response operations. Chlorine gas is about 2.5 times as heavy as air. It settles in low areas in buildings or valleys.

8. Recommended Risk Management Measures

Chlorine is non-flammable and non-explosive. It is, however, a respiratory irritant and poses hazards to the skin and eyes. Massive exposure can result in death. Chlorine can react with certain materials of construction. Prior to using chlorine, carefully read and comprehend the Material Safety Data Sheet. The following are some risk management measures that are effective against these hazards:

- Work areas where chlorine is used should be well ventilated to maintain concentrations below exposure limits and to prevent the gas from accumulating in low areas. If exposures exceed accepted limits or if respiratory discomfort is experienced, a NIOSH approved air purifying respirator with acid gas cartridges may be acceptable.
- Provide eyewash fountains and safety showers in strategic areas where chlorine is used or handled.
- To prevent eye contact, protective eyewear such as goggles must be worn.
- Wear chemical resistant clothing to prevent contact with the skin. Rubber gloves and shoes are recommended.

- Equipment used for chlorine storage or handling must be constructed of the proper materials. In general, pipelines for handling chlorine should be fabricated from extra-heavy, black-iron pipe. Joints must be welded or flanged. Fittings must be eliminated wherever possible. Valves for chlorine service should be constructed of forged steel. Packing for these valves should be either PTFE or flexible graphite. For more detailed information regarding materials of construction, refer to the OxyChem Handbook.
- Personnel involved with chlorine handling operations should be properly trained.

9. Product Stewardship Programs

A product handbook prepared by OxyChem is available for chlorine. The handbook includes extensive physical property and technical data regarding the product. In addition, specific information for storing, unloading, preparing and using chlorine safely is provided, including data on materials of construction and equipment recommendations.

OxyChem is a member of The Chlorine Institute, Inc. The Chlorine Institute, Inc. was formed over 50 years ago by chlorine producers to promote the safe use of chlorine and to standardize chlorine handling equipment. The Institute also sponsors a mutual assistance program in which trained teams respond to chlorine emergencies on a 24-hour-a-day, 7-day-a-week basis. In the United States, this response program is known as CHLOREP (Chlorine Emergency Plan). The United States is divided into 16 sectors with CHLOREP teams available from 53 plant sites (one to three plant sites in each sector).

CHLOREP is affiliated with CHEMTREC, the Chemical Transportation Emergency Center maintained by the American Chemistry Council (ACC) in Washington, DC. Assistance can be summoned by calling either CHEMTREC (Toll free 1-800-4249300) or the appropriate CHLOREP team.

Canada is divided into five CHLOREP sectors with teams available from 5 plant sites. CHLOREP in Canada may be activated by calling CANUTEC, the Canadian Transport Emergency Centre operated by Transport Canada to assist emergency response personnel in handling dangerous goods emergencies. The CANUTEC emergency number is (613) 996-6666. In Canada, assistance is available by calling either CANUTEC or the appropriate response team.

In both the United States and Canada, these teams provide assistance in any chlorine emergency whether a transportation incident or a problem at the point of usage. Chlorine users must have the telephone number of their response team(s) readily available for use in chlorine emergency situations.

10. Regulatory Compliance Information

The following is a summary of regulations and guidelines that may pertain to chlorine (additional regulations and guidelines may apply):

- Chlorine is designated as a hazardous substance under Section 311(b) (2) of the Clean Water Act. See 40 CFR 116.4.
- A release of chlorine in an amount greater than the Reportable Quantity (RQ) is subject to reporting under Comprehensive Environmental Response, Compensation and Liability Act, Section 103. The RQ for chlorine is 10 pounds. See 40 CFR 302.4.
- Some uses of chlorine are considered pesticide uses and are regulated by the U.S. EPA under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

- Chlorine shipments are regulated by the U.S. Department of Transportation (DOT). The DOT identification number is UN 1017.
- The Occupational Safety and Health Administration has established a Permissible Exposure Limit for chlorine. The limit is 1 ppm as a ceiling limit.
- The American Conference of Governmental Industrial Hygienists has established Threshold Limit Values for chlorine. The guidelines are 0.5 ppm averaged over an 8 hour day and 1 ppm as short term exposure limit (averaged over 15 minutes).
- The National Institute for Occupational Safety and Health has established an Immediately Dangerous to Life and Health concentration for chlorine. The concentration is 10 ppm.

11. Sources for Additional Information

American Chemistry Council website: <http://www.americanchemistry.com/chlorine/>

Hazardous Substances Data Bank (HSDB), HSDB Number 206, Last revision date: April 22, 2008.

OxyChem Product Handbook web site:

http://www.oxy.com/OurBusinesses/Chemicals/Products/Pages/ChlorineandDerivatives.aspx#chem_chlorine

OxyChem Material Safety Data Sheet web site: <http://msds.oxy.com/>

Registry of Toxic Effects of Chemical Substances (RTECS), RTECS Number FO2100000, Review Date: May 2008.

SIDS Initial Assessment Profile, Chlorine (CAS No. 7782-50-5), May 2003

The Chlorine Institute website: <http://www.chlorineinstitute.org/AboutChlorine/ArticleList.cfm>

12. Contact Information: For additional information, call 1-800-752-5151 or 1-972-404-3700.

13. Preparation Date: 12/12/2008 **Revised:** 02/19/2013

This Product Stewardship Summary is intended to give general information about the product discussed above. It is not intended to provide an in-depth discussion of all health and safety information about the product or to replace any required regulatory communications.

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