

**ORIENT PAPER MILLS - CAUSTIC SODA UNIT, AMLAI, ANUPPUR (M.P.)****PRODUCT STEWARDSHIP SUMMARY****CHLORINE**

Synonyms	: Chlorine, dichlorine
Chemical Formula	: Cl <sub>2</sub>
Molecular Weight	: 70.9
Description	: Liquid chlorine has a clear amber color while chlorine gas is greenish yellow and has a characteristic penetrating, irritating odor.

**Product Overview**

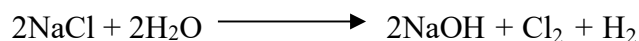
Chlorine is a naturally occurring chemical element that belongs to a group of chemicals called halogens and is an essential component in many industrial and commercial applications. It is an element that is found in nature bonded to other elements like sodium, potassium, and calcium and is an essential nutrient for plants and animals. Chlorine in its elemental form is a very powerful oxidant and chlorine containing compounds are used to keep swimming pools clean and sanitary, protect food and crops, design pharmaceuticals, and make plastics. Ordinary table salt, sodium chloride, is the best known chlorine containing compound. Liquid chlorine vaporizes quickly under normal atmospheric conditions. At ambient temperatures, elemental chlorine is a greenish-yellow gas that is 2½ times heavier than air.

**Production**

The process of manufacture of caustic soda and chlorine by Ion Exchange Membrane (IEM) process.

The aqueous solution of sodium chloride (ultra pure brine) goes to the cells which are having two chambers called cathode chamber and anode chamber separated by a membrane.

Feed brine enters the anode chamber whereas dilute caustic enters the cathode chamber. During electrolysis following reaction takes place.





After electrolysis depleted brine with chlorine which is called anolyte comes out from the anode chamber and is taken to chlorine gas separator for stripping of chlorine gas. The hot chlorine from cells contains solid impurities such as brine mists etc. which are removed in chlorine cooler and mist eliminator. The cooled chlorine is further cooled with chilled water in heat exchanger, dried in sulphuric acid driers and then sent to liquefier through a filter via chlorine compressor and mist eliminator.

The liquid chlorine from liquefier goes to the storage tank from where it is transferred to Cl<sub>2</sub> cylinder through dehumidified air padding.

**Uses**

**Chemical Production** - The chemical industry consumes a significant portion of the chlorine. Chlorine serves as a reactive intermediate to make a host of organic and inorganic chemicals.

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**Water Disinfection and Purification** - Chlorine is used in virtually all water treatment. It is an important chemical for water purification in disinfectants and in bleach. Chlorine is used to kill bacteria and other microbes in drinking water supplies, public swimming pools, and all potable stored water systems. It reduces the spread of water-borne diseases and maintains public water sanitation.

**Titanium Dioxide** - Chlorine is reacted with mined titanium ore to produce titanium dioxide. Titanium dioxide is used to make paint, paper, food, and pharmaceuticals white and bright, and protect us from ultra-violet light in sunscreen and cosmetics.

**Pharmaceutical Production** - Chlorine is used in 98% of pharmaceutical and drug design. The highly reactive, oxidative properties of chlorine make selective synthesis possible.

**Polyvinyl chloride (PVC)** - The single largest end use for chlorine is the manufacture of PVC precursors. Chlorine is used to make ethylene dichloride and vinyl chloride monomer, two important intermediates in the production of PVC plastic. This is used to make hundreds of products in a variety of applications including residential and commercial construction, electrical insulation, food packaging and protection, and computer parts.



**Isocyanates** - Chlorine is used in the production of MDI (Methylene diphenyl diisocyanate) and TDI (toluene diisocyanate), which are used in the production of polyurethanes for flexible and rigid urethane foams, coatings, and adhesives. Polyurethane foams are used in a host of products including residential and commercial insulation, gaskets, sealants, and automotive components.

**Epoxy Resins** - Chlorine is used to make epichlorohydrin, an intermediate in the manufacture of epoxy resins. This is a highly engineered material, used in the production of surface coatings, adhesives, composites, and laminates.

**Chlorinated solvents** - Chlorine is used to produce chlorinated methanes and ethanes, including perchloroethylene, trichloroethylene, ethyl chloride, and Tri-ethane® solvent. These are used in dry cleaning, metal cleaning, refrigerants, and plastic composites.

### Health Effects

Chlorine gas is toxic if inhaled; breathing air containing high concentrations of chlorine can cause death. Read and follow all instructions on the product label and review the Material Safety Data Sheet (MSDS) to understand and avoid the hazards associated with chlorine. Chlorine has a distinct odor that is detectable by most individuals at low concentrations (approximately 0.3 parts per million (ppm) in water and 0.002 ppm in air). The odor usually provides a warning of its presence at concentrations far below the concentration level that creates a health hazard to humans. The OSHA Permissible Exposure Limit (PEL) is a Ceiling Limit of 1 ppm (parts per million). A Ceiling Limit should not be exceeded during any part of the working exposure. Liquid chlorine can cause skin and eye burns upon contact. When open to the air, liquid chlorine vaporizes to chlorine gas. In sufficient concentration, the gas irritates the mucous membranes, the respiratory system, and the skin. In extreme cases difficulty breathing may increase to the point where death can occur from suffocation.

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Before handling, it is important that engineering controls are operating and protective equipment requirements and personal hygiene measures are being followed. People working with this chemical should be properly trained regarding its hazards and its safe use. Persons in a chlorine work area should, at a minimum and at all times, carry a NIOSH-approved cartridge type escape respirator, be trained in its use, and have ready access in the work area to and full-face, supplied air respirators.

**Environmental Effects**

Although chlorine is an effective antimicrobial agent for water treatment, it is highly toxic to fish and other aquatic organisms above concentrations of 0.1 ppm and should be kept out of lakes, streams, ponds, or other water sources to preserve aquatic life. 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.

**Exposure Potential**

Chlorine is used in the production of industrial and consumer products. Since chlorine is corrosive, precautions should be taken to minimize potential harm to people, animals, and the environment. Potential for exposure may vary depending upon site-specific conditions. When handling chlorine, refer to the Material Safety Data Sheet and Product Warning Label and follow all instructions and warnings. Based on the expected uses for chlorine, exposure could be through:

**Workplace exposure** - Exposure could occur in the manufacturing facility or in the industrial facility that uses chlorine. Chlorine is handled in closed systems, so special precautions are typically required for employees involved in maintenance activities, sample collection, or similar activities. As chlorine is highly irritating and can be corrosive, good industrial hygiene practices and the use of personal protective equipment will minimize the risk of exposure. These should include respiratory, eye and skin protection. The facility’s guidelines and training programs for working with chlorine should be followed.



**Environmental releases** - If a release occurs, the area should be evacuated. Emergency personnel should wear protective equipment to minimize exposures during response operations. The high vapor pressure makes chlorine vaporize into the air, which creates an inhalation risk. Many aspects of a spill control program are mandated by national, state and local requirements. In addition, if a spill occurs, national reporting may be required. Refer to the Material Safety Data Sheet for instructions to contain and clean up a spill to minimize exposure.

**Consumer exposure** - Consumer exposure to chlorine can occur at large public pools and spas where chlorine based disinfectants are used to treat water. Consumers can also be exposed through hypochlorite compounds in cleaning products, such as bleach. Refer to instructions provided with products and follow MSDS to protect against unnecessary exposure.

**Safe Handling and Storage**

Since chlorine gas is approximately 2½ times as heavy as air, it settles toward the ground and collects in low spots. This property is an important consideration for persons planning the location and ventilation of chlorine storage areas.

Dry chlorine containing less than 50 ppm moisture, as manufactured by OPM\_CSU, does not appreciably corrode common metals at temperatures below 110°C (230°F). However, chlorine reacts

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with moisture to form hydrochloric and hypochlorous acids, which are highly corrosive. Therefore, the following precautions should be taken :

- Make sure that piping is dry and free of contamination of any type before admitting chlorine.
- Use only dry (-40°F dew point or below) oil-free air or nitrogen for purging, testing for leaks or padding tank cars.
- Never use water to detect or absorb leaking gas, and never put a leaking container into water.

For additional information, refer to the Material Safety Data Sheet.

### Packaging and Transportation

Road Trucks- OPM-CSU moves chlorine through trucks in 900 / 1000kg tonners

**Pipeline** – OPM bring chlorine safely onto their site via chemical pipelines.

Chlorine liquid and gas by themselves are nonflammable and nonexplosive. However, chlorine can support the combustion of certain substances. For example, carbon steel ignites at 251°C (483°F) in the presence of chlorine gas, and finely divided metal ignites even more readily. Many organic chemicals react readily with chlorine; some can result in a violent explosion.

During a fire, restrict access to necessary personnel in the area, and use water to cool the fire zone. No action shall be taken without suitable training. Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. For incidents involving large quantities, thermally insulated undergarments and thick textile or leather gloves should be worn. Water will reduce the reaction rate, but should not be applied directly to a chlorine leak. Contain fire water run-off to minimize the potential for adverse environmental impacts.

### Physical and Chemical Properties

At standard pressure and temperature, two chlorine atoms bond to form the diatomic molecule, dichlorine (Cl<sub>2</sub> or “chlorine”). This bond is very weak, which drives the high reactivity of chlorine gas. Chlorine reacts with almost all elements to give chloride compounds, especially at elevated temperatures. Chlorine is not explosive or flammable, but it will act as an oxidizer and support combustion, even in the absence of oxygen.



Chlorine gas is highly reactive and oxidative. As such, chlorine rarely exists in its elemental state in nature, and is typically found bonded to other elements in compounds. The most common form of chlorine is sodium chloride, or table salt. Chlorine reacts with most elements and many organic and inorganic compounds, usually with the evolution of heat. Unless controlled, these reactions can give off significant energy.

Chlorine, at ordinary conditions of temperature and pressure, is a greenish-yellow gas with an irritating odor. Chlorine gas is 2½ times as heavy as air and can be liquefied by the application of pressure at reduced temperature to form a liquid that is amber in color and about 1½ times as heavy as water. At atmospheric pressure, it boils at about -30 °F.

#### Properties of Chlorine

**Boiling Point**

-29°F (-34°C)

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<b>Specific Gravity of Gas @ 0 C, 1 atm (air = 1)</b>	2.49
<b>Specific Gravity of Liquid @ 0 C</b>	1.47
<b>Vapor Pressure, psig @ 25 C (77 F)</b>	98.3

### Regulatory Information

The chlorine Material Safety Data Sheet contains regulatory information

### Additional Product Information

**Source** - Chlorine is derived from a mineral source and has not been derived from plant, animal, synthetic, petroleum or fermentation sources.

**Allergenic Materials** - Chlorine is not manufactured using any of the following allergenic materials: carmine/cochineal extracts, celery, colors/color additives, dyes/food dyes, eggs/egg products, seafood/fish/shellfish/crustaceans, flavors, glutens, legumes, milk, monosodium glutamate (MSG), mollusks, mustards, plant nuts/seeds/oils (sesame, sunflower, safflower, canola, etc.), peanuts/peanut products, protein hydrolysates, soy/soybeans/soybean products, spices, sulfites, sulfates, tree nuts/tree nut oils and wheat.

**Bovine Spongiform Encephalopathy** - Chlorine is not of animal origin, and, to **OPM-CSU's** knowledge, does not contribute to Transmissible Spongiform Encephalopathy (TSE)/Bovine Spongiform Encephalopathy (BSE).

**Genetically Modified Organisms (GMOs)** - Chlorine is not manufactured with and does not contain genetically modified organisms.

**Natural Latex Rubber** - Chlorine is not manufactured with and does not contain natural latex rubber.



**Nutritional Value** - Chlorine does not have nutritional value.

### Product Stewardship

OPM-CSU is committed to managing chlorine so that it can be safely used by its employees and customers. OPM-CSU's relationships with its customers encourage communication about safety and environmental stewardship.

### Additional Information

For more information regarding OPM-CSU's Chlorine, contact our customer service department by calling 18-00-111735 Or, in Orient Paper Mills – Caustic Soda Unit, Distt. Anuppur, Madhya Pradesh – 484 117 India.

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**Notice**

Prior to its use, the user is responsible for determining the suitability of the product or products covered by this Product Stewardship Summary and for complying with state, local laws and regulations in connection with its use. Neither OPM-CSU nor any of its affiliates shall be responsible for any damages of any kind whatsoever resulting from the use of or reliance on this Product Stewardship Summary or product or products to which it refers.

This Product Stewardship Summary is intended only to provide a general summary of the potential hazards associated with the product or products described herein. It is not intended to provide detailed information about potential health effects and safe use and handling information and, although OPM-CSU believes this information is correct, OPM-CSU makes no warranties as to its completeness or accuracy. Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling the OPM-CSU product(s) mentioned in this document. Before working with any of these products, users must read and become familiar with the available information on product hazards, proper use, and handling. Information is available in several forms, such as Material safety data sheets (MSDS) and product labels. A copy of OPM-CSU's MSDS for Chlorine can be obtained by the company.

This information is subject to change without notice.

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