


Taiwan Chlorine Industries Ltd.
SAFETY DATA SHEET (SDS)

SDS-TCI-Rev. 4

I. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Chlorine
Synonyms : Chlorine; Cl ₂
Recommended use and restrictions on use : 1. Manufacture of chlorinated hydrocarbons, hydrogen chloride, polyvinyl chloride, hypochlorous acid, a metal chloride, water sterilization; 2. It has strong oxidation. If reacting with water, it will become corrosive. If contacting combustible materials, it could cause fire or lead to explosion.
Names, addresses, and phone numbers of the manufacturer or supplier : Taiwan Chlorine Industries Ltd. 25 Chung Chih Street, Hsiao Kang District, Kaohsiung, Taiwan Tel. (07) 8715171
Emergency contact phone numbers : Tel: 07-8716923 Fax: 07-8717289

II. HAZARD IDENTIFICATION

A. Chemical Hazard Classification : Pressurized gas, oxidizing gas Level 1, Level 1 acute toxic substances (inhalation), corrosion / irritation Skin Level 1 substances, severe damage / irritation of the eyes Level 1 substances, hazardous substances (acute toxicity) Water Environment Section 1.
B. Labeling Information : Hazard Symbols: 
Warnings : Danger Hazard Warning: The third class of toxic chemical substances; after exposure to chemicals, will immediately endanger human health or the biological lives. 1. Containing pressurized gas; may explode if heated 2. May cause or intensify fire; oxidizer 3. Fatal if inhaled 4. Cause severe skin burns and eye damage 5. Cause serious eye damage 6. Very toxic to aquatic organisms Hazard Precautions: 1. Poisoning first aid: Immediately remove the victims from contaminated area and give first aid. If breathing is difficult, give oxygen or artificial respiration and rush to hospital for further treatment. If contacting with eyes and skin, rinse with water at least 15 minutes and rush to hospital for further treatment. 2. Contamination control measures: Install exhaust system and neutralization system; prepare Kit A, Kit B, Kit C tools; introducing waste water into the plant wastewater treatment system. 3. Emergency treatment: When dealing with chlorine leak, should wear the appropriate PPE. Use emergency tools to stop the leak, but do not spray water to the leaking points at the pipelines, the container and the trailer.

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| 4. Regulations for the personnel who make emergency rescue: must wear proper PPE and evacuate the other persons to upwind places.
5. Keep fire and inflammables away from the storage area. |
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Other Hazards :

Major Symptoms : Irritation, cough, difficulty breathing, choking sensation, chest pain, vomiting, thirst, nausea.

Special Hazards : Can irritate the eyes, skin, respiratory system, lead to mucosal burns, skin frostbite and corrosive, or blindness if overexposed.

III. COMPOSITION, INFORMATION ON INGREDIENTS

Pure Substance :

Chinese and English Name : 氯 / Chlorine

Synonyms : Molecular Chlorine, Liquefied Chlorine Gas

Chemical Abstract Service No. (CAS NO.) : 7782-50-5

The Hazardous Ingredient (% of the content) : 99.7% (w/w) above

IV. FIRST-AID MEASURES

Before rescue, personnel should wear proper PPE before entering the disaster area.

The first aid measures for different exposure routes :

A. INHALATION :

1. Remove the victims immediately to the upwind place with fresh air. Keep away or remove the pollutant.
2. If the victim can breathe, then place them in a more comfortable position to maintain their body temperature and take a rest while waiting for physician treatment.
3. If breathing is difficult, oxygen should be administered by qualified personnel.
4. If breathing stopped, immediately give "mouth to mouth" artificial respiration and CPR.
5. While taking the above first aid measures, contact the doctors to take further medical treatment as soon as possible.
6. After exposure or inhalation of chlorine, suggest the victims get more rest.

B. EYE/SKIN CONTACT :

1. Immediately flush the affected area with plenty of water (skin can be added with soap) at least 15 minutes (must remove contact lenses first).
2. If irritating, when using the drug treatment please do not use the chemical neutralization method.
3. Without professional physician instructions, do not impose any medical treatment.

The most important symptoms and reactions: irritation, hard breathing, burning sensation, overexposure may cause pulmonary edema.

For protection of emergency personnel: should wear C level protective clothing and do the first aid in the safe area.

Physician's Tip: When dealing with the symptoms, please pay more attention to observe the early symptoms of pulmonary edema which are easily ignored. Consider giving oxygen to help breathing.

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V. FIRE FIGHTING MEASURES

Appropriate fire extinguishing media :

Small fires: dry chemicals, carbon dioxide.

Large fires: Flood with fine water spray, foam (due to chlorine itself is non-combustible, fire extinguishing agents are used to extinguish fires around).

Specific hazards may be encountered during fire-fighting :

1. Chlorine is heavier than air and it can fill in the low-lying areas.
2. It will generate toxic products when burned with the combustibles.
3. The container or cylinder may rupture or explode if exposed to heat.

Specific fire-fighting methods :

1. Firefighters should wear positive pressure self-contained breathing apparatus (SCBA) and the required protective clothing if they may be exposed to the harmful gases.
2. The chlorine containers should be promptly removed away from the fire. If it cannot be removed, notify the firefighters to cool them with water spray.
3. If the containers are leaking, do not spray water directly on leak.
4. The chlorine has combustion-supporting. If reacting with hydrogen, alcohol, ether, or metal may cause an explosion.
5. Chlorine may violently react with steel containers at temperature above 450 F(232°C) and burn.

Protective equipment and precautions for firefighters :

Fire-fighters must wear self-contained breathing apparatus and full fire-fighting turnout gear.

VI. ACCIDENTAL RELEASE MEASURES

Personal Precautions :

1. No one is allowed to access to the danger area until it is cleaned.
2. Only the trained personnel are responsible for cleaning up.
3. Only the personnel who wear positive pressure self-contained breathing apparatus (SCBA) and protective clothing and equipment are allowed to enter the danger area from the upwind place and take care of the victims and stop the release.

Environmental Precautions :

1. Remove all ignition sources.
2. Keep good ventilation in leakage area.
3. Notify the government health and safety and environmental protection units.

Steps to be taken if material is released or spilled :

1. Do not touch spilled material; use a cloth dipped with ammonia to find out the leaking points.
2. When liquid chlorine cylinder or steel cylinder container leak, should turn the leaking points up and stanch the leak.
3. Avoid chlorine flowing into sewer, ditch and other confined space.
4. Use caustic sodium, soda ash or lime liquid to neutralize the chlorine and then collect in a steel container.

Remark: Emergency brochure and tools, such as cylinders, ton containers and trailers, should be ready during chlorine transportation. TCI can provide the related data and trainings.

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VII. HANDLING AND STORAGE

Handling :

1. The Chlorine staff should be well-aware of the risk of chlorine and the usage of PPE.
2. Follow the SOP when dealing with chlorine: use wrench correctly, the lid of the ton container should be closed and fastened during transportation and do not put the ton container into water or spray water on leak.
3. Make sure piping is dry and free of contamination of any type before admitting chlorine.
4. Never tamper with fusible plugs or safety devices on containers; never manifold containers from liquid valves. Check storage place and operation area and use ammonia to test leaks every day.

Storage :

1. The storage area should remain dry, ventilated and fire-proof, away from direct sunlight and flammable materials because heat will melt the safety fuse plug of cylinder / steel container or actuate the tank's safety valves.
2. Storage areas should be clearly marked, both empty and heavy containers should be placed separately, and there is no obstacle around. It has to have warning signs stated only specific personnel be allowed to enter. Storage areas shall be equipped with tools for stopping leaks and install a detecting alarm system. Hold safety trainings periodically.

VIII. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls :

1. Operate in a fully enclosed or isolated condition.
2. Supply sufficient fresh air to supplement the extracted mixed air from exhaust system.
3. Keep system dry to prevent metal corrosion.

Control Parameters :

1. 8-hour Time-Weighted Average (TWA) : --
2. Short-Term Exposure Limit (STEL) : --
3. Maximum exposure limits (CEILING) : 0.5ppm
4. Biological indicators BEIs : --

Personal Protective Equipment :

Respiratory Protection :

1. Chemical cartridge respirator: When operating the work of chlorine, the respirator should be carried at all times.
2. Below 5 ppm: Use a regulatory compliant full face piece air purifying respirator with appropriate chemical cartridges or positive-pressure, air-supplied respirator.
3. Above 5 ppm : Use SCBA
4. For unknown concentration : Use SCBA

Hand Protection : Butyl rubber, Neoprene, Tychem 10000, Teflon, Viton

Eye/Face Protection : Splash-proof goggles

Skin and Body Protection: Boots, aprons, or chemical suits should be used when necessary to prevent skin contact.

Hygiene Measures: After finished leak of chlorine, this area should be decontaminated; smoking and eating are prohibited in the workplace.

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IX. PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Greenish-yellow gas or amber liquid	Odor : Pungent, irritating.
Odor threshold : 0.08ppm(detected)	Melting point : -101°C
PH value : acidic	Boiling point/Boiling point range : -34°C
Flammability (solid / gas) : --	Flash point : Noncombustible
Decomposition temperature : --	Test method : <input type="checkbox"/> open cup <input type="checkbox"/> closed Cup
Auto-ignition temperature : /	Explosive limits : -
Vapor pressure : 6.64 atm@ 20°C	Vapor density (air=1) : 2.48
Specific Gravity (Water=1): 1.468 @ 0°C	Solubility : 0.73g/100g@20°C (water)
Partition coefficient : n-Octanol / water : (log/Kow)--	Evaporation rate : NA

X. STABILITY AND REACTIVITY

Stability: Stable at normal temperature and pressure
Possible Hazard Reaction May Occur in the Following Conditions: <ol style="list-style-type: none"> 1. With gaseous hydrocarbons (methane, ethane): explosive reaction 2. With liquid, solid hydrocarbons (natural or synthetic rubber, naphtha, gasoline, wax, oil): burning or explosion of violent reaction. 3. With metal (aluminum powder, brass, copper, manganese, tin): violent or explosive reactionn. 4. With nitrogen compounds (ammonia): generate highly explosive nitrogen trichloride. 5. With hydrogen: spark can ignite significant concentrations of chlorine and hydrogen mixture. 6. With non-metallic (phosphorus, boron, activated carbon, silicon): ignite at room temperature.
Conditions to avoid : 1. Temperature over 121 °C ° 2. Avoid contacting with moisture.
Materials to avoid : Hydrocarbons, metal, non-metal, hydrogen, nitrogen compound.
Hazardous decomposition products : --

XI. TOXICOLOGICAL INFORMATION

Routes of exposure : INHALATION, SKIN CONTACT, EYE CONTACT
Symptoms: tingling, cough, dyspnea, choking sensation, chest pain, vomiting, pleural effusion, redness and blistering, frostbite, blindness, burns, nausea.
Acute Toxicity : Skin : <ol style="list-style-type: none"> 1. Severe irritation at high concentrations can cause tingling, burning, redness, blistering. 2. Direct contact with its liquid can cause severe irritation, burns, and even frostbite. Inhalation : <ol style="list-style-type: none"> 1. Severely irritate nose, throat and upper respiratory tract. If inhale too much, may cause lung water. 2. 0.2-2 ppm can cause nasal irritation, mild cough, dry mouth. 3. 1.0-2 ppm can cause significant irritation, cough and mild breathing difficulties and headaches. 4. 1-4 ppm intolerable. 5. 15-60 ppm severe respiratory damage, including bronchitis, pulmonary edema symptoms, it

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may appear immediately or delayed up to 48 hours after exposed.
Eye : 1. Severe irritation, resulting in burning pain and tears. 2. Direct contact with liquid chlorine may cause burns and permanent damage, even blindness. LD50 (Test animals, absorption means) : -- LC50 (Test animals, absorption means) : 293 ppm /1H (Rat, Inhaled).
Chronic or Long-term Toxicity : 1. Prolonged or frequent exposure to concentrations below 5ppm may affect breathing, cause inflammation of the nose, difficulty breathing, irregular heartbeat, chest pain, and erosion of tooth enamel. 2. ACGIH: A4 – It cannot be judged as resulting in human's cancer. 3. IARC: There is no IARC classification. 4. 565mg / Kg (2 weeks pregnant rats swallow) caused neonatal rats poisoned.

XII. ECOLOGICAL INFORMATION

Ecotoxicological : This product is toxic to fish and water, so when dealing with waste disposal, should keep away from lakes, rivers, ponds or other water sources. LC50: 0.44 mg/1/96-hour --High toxic to water fish EC50: 0.49mg/1/48-hour-- Extreme toxicity to aquatic invertebrate. BCF : --
Persistence and Degradability : Chlorine is a strong oxidant but not very stable in the water, so it can oxidize inorganic substances promptly in water. It also can oxidize organic substances. Half-life (air) : -- Half-life (water surface) : -- Half-life (groundwater) : -- Half-life (soil) : --
Bioaccumulation: Because it will react with the cells and water, it is unlikely to accumulate.
Mobility in soil :
Other adverse effects : --

XIII. DISPOSAL CONSIDERATIONS

Waste Disposal Methods: Refer to Toxic Chemical Substances Control Act, and all applicable regulations.

XIV. TRANSPORT INFORMATION

UN Number : 1017
Proper Shipping Name : Chlorine
Transport Hazard Class : 2.3 Minor hazard class 5.1 for oxidizing substances, Class 8 corrosive substances.
Packing Group : --
Marine Pollutant (Y/N) : Y
Special Shipping Information: Road Traffic Safety Rule 84, Emergency response guide principles.

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XV. REGULATORY INFORMATION

Applicable Regulations :	
1. Occupational Safety and Health Act	5. Rules of DG and Hazardous material labeling and identification
2. Specific chemical hazard prevention standards	6. Permissible Exposure standards in the workplace
3. Road safety rules	7. Storage and disposal regulations for industrial wastes
4. Toxic Chemical Substances Control Act	8. Labor safety rules for high-pressure gas

XVI. OTHER INFORMATION

References	1. EPA SDS data. 2. ITRI worker safety and health center number: 29 Chlorine Safety Data Sheet	
Organization that prepared the SDS	Company : Taiwan Chlorine Industries Ltd.	
	Address / Tel. : 25 Chung Chih Street, Hsiao Kang District Kaohsiung / (07) 8715171	
Person	Title : QA and Logistic Manager	Name : M.S. Liu
Date issued	Revised on Jan. 14, 2015	
Remarks	The above-mentioned symbol "--" means "The information is not available."	

The above SDS comes from Taiwan Chlorine Industries Ltd. and refers to the proper information and documents. It is for reference only.