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GPS SAFETY SUMMARY CHLORINE

1. General Statement

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.

Chlorine gas is a greenish-yellow gas at room temperature, generated from sodium chloride (table salt) by electrolysis. It is hazardous to human health, and is made and used in closed systems and by trained professionals with safety equipment. It is highly recommended that only workers with specific training be allowed to handle this substance.

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.

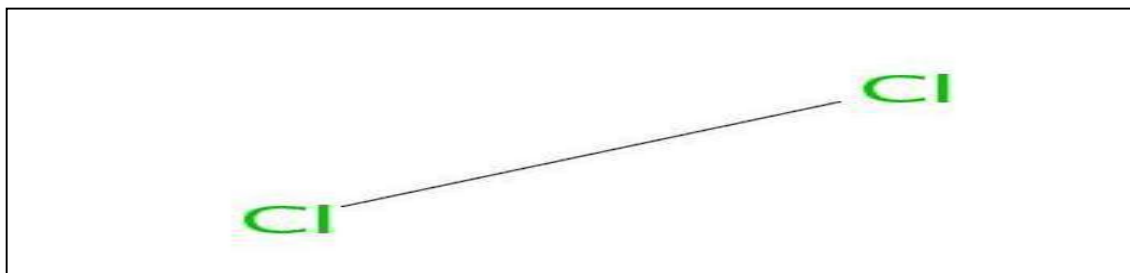
2. Chemical Identity

Synonyms : Chlorine,
 Chemical Formula : Cl₂
 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.

CAS number(s) : 7782-50-5

ES number : 231-959-5

Structure :



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3. Use and applications

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.

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.

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.

4. Physical / Chemical properties

At standard pressure and temperature, two chlorine atoms bond to form the diatomic molecule, dichlorine (Cl_2 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, at ordinary conditions of temperature and pressure, is a greenish-yellow gas with an irritating odor. Chlorine gas is $2\frac{1}{2}$ 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 $1\frac{1}{2}$ times as heavy as water. At atmospheric pressure, it boils at about -30°F .

Property	Value
Form	Compressed liquefied gas
Physical state (Liquid/solid/gaseous)	Gaseous at 20°C at 1013 hPa
Color	Yellow to green
Odor	Suffocating
Density	1.41 kg/m ³ at 20°C
Melting / boiling point	Melting point: -101°C at 1013 hPa Boiling point: -34°C at 1013 hPa

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Flammability (optional)	Not flammable
Explosive properties	Not explosive
Self-ignition temperature	No relative self-ignition temperature
Oxidizing properties	Oxidizing gas
Vapor pressure	6.78 hPa at 20°C 7.79 hPa at 25°C
Mol weight	40.0 g/mol
Water solubility	7.41 g/l at 20°C
Flash point	Not applicable
Octanol-water partition coefficient (LogKow)	Not applicable

5. Health Effects

The chlorine reacts with water to give hypochlorous acid (known as chlorine bleach). Exposure to the gas is possible if household chlorine bleach is mixed with acid, and therefore chlorine bleach (also sodium hypochlorite) should never be mixed with acids.

Effect Assessment	Result
Acute Toxicity Oral / inhalation / dermal	Fatal if inhaled. At high vapor/fog concentration: risk of mortality, pulmonary oedema, cough, and suffocation.
Irritation / corrosion Skin / eye/ respiratory tract	Chlorine (as chlorine bleach) may be considered as comparable to hypochlorous acid and/or hypochlorite for which experimental results are: <ul style="list-style-type: none"> – Irritating to skin. – Risk of serious damage to eyes. (In case of direct contact with liquid or exposure to vapours, serious lesions with possible after-effects if not washed immediately) – Irritating to respiratory system
Sensitisation	Based on the available test data, not expected to cause allergic skin reaction.
Toxicity after repeated exposure Oral / inhalation / dermal	Based on the available test data, not expected to cause toxicity after repeated exposure. Due to mechanism of toxicity, chlorine exposure leads only to local effects, the seriousness of which is related primarily to concentration of the gas in the air and not the duration of exposure.

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6. Environmental Effects

Chlorine reacts rapidly with water to form hypochlorous acid. This species is very toxic to aquatic organisms. However, due to the pattern of use, chlorine is not released into the natural aquatic environment, indicating that the risk to the environment is very low. In some applications, chlorine is added deliberately to drinking water supplies for disinfection and destruction of almost all harmful microorganisms. It can be used also in wastewater treatment plants to control sludge bulking. The substance is not bioaccumulative, is rapidly degraded and will not persist in the environment.

Effect Assessment	Result
Aquatic Toxicity	The substance is very toxic to the aquatic environment.

Fate and behavior	Result
Biodegradation	Chlorine degrades rapidly in the environment due to its high reactivity as an oxidizing agent.
Bioaccumulation potential	Chlorine does not bioaccumulate.

7. Exposure

7.1 Human health

Consumers:

Consumer exposure to the substance in itself is unlikely as the substance is manufactured and handled in industrial and professional settings in closed systems. However, chlorine is sometimes used in the treatment of swimming pools or in other water disinfection. The chlorine reacts with water to give hypochlorous acid (known as chlorine bleach). Exposure to the gas is possible if household chlorine bleach is mixed with acid, and therefore chlorine bleach (also sodium hypochlorite) should never be mixed with acids.

Workers:

Sodium hydroxide is manufactured in a closed process, which minimizes the employee exposure potential. Workers who might accidentally come into contact with the undiluted substance should follow the safety measures recommended in the extended safety data sheet. The substance has been assessed as safe for professional and industrial use, when the provisions laid down in the extended safety data sheet are followed carefully

7.2 Environment

The manufacture of chlorine takes place in closed systems, as are the uses identified (apart from biocidal uses). No aqueous or gaseous effluents are emitted directly into the environment without passing through a treatment step, typically site water treatment for aqueous effluents and scrubbing gas effluents with sodium hydroxide to remove any unreacted chlorine. Any

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substance released is rapidly destroyed upon contact with organic material. It should be noted that there is also low levels of chlorine gas released from natural processes, such as chlorine reduction on coastlines.

Based on the risk assessment, the use of chlorine is safe under conditions recommended in the extended safety data sheet.

8. Risk Management recommendations

Human health measures		
Organizational	A basic standard of occupational hygiene is recommended. Ensure operatives are well informed of the hazards and trained to minimise exposures. Ensure regular inspection and maintenance of equipments and machines. Handle and store according to the indications of the Safety Data Sheet.	
Protection	Eye/Face protection:	Safety glasses. In case of spattering: safety glasses, fae-shield.
	Skin protection:	At the workplace: safety shoes, combination with delayed penetration Intervention at incident: complete chemical protection suit.
	Hand protection:	Neoprene gloves.
	Respiratory protection:	High concentration or prolonged activity: self contained breathing apparatus. In the case of vapor formation: use a respirator with an approved filter (recommended cartridge: B2 type).
Engineering controls	Use product only in closed system. Provide appropriate local exhaust ventilation at machinery. Provide sufficient air exchange and/or exhaust in work rooms. Frequently monitor and control the working atmosphere. Ensure that eyewash stations and safety showers are close to workstation locations. Ensure that self-contained breathing apparatus are located nearby.	
Environment protective measures		
Product must not be released into water without pre-treatment. Neutralize wastewater before release.		

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9. Regulatory Information / Classification and Labelling

The chlorine Material Safety Data Sheet contains regulatory information.

9.1 Regulatory Information

This substance is currently assessed or has been registered under:

EU Regulation EC 1907/2006 (REACH),

EU Regulation EC 793/93 (European Priority Lists and Risk Assessment),

EU Regulation 1272/2008 (CLP), Annex VI (Harmonised classification and labelling),





EU Regulation EC 1451/2007 (Biocidal Products Regulation).

9.2 Classification and labeling

Under GHS substances are classified according to their physical, health, and environmental hazards. The hazards are communicated via specific labels and the eSDS. GHS attempts to standardize hazard communication so that the intended audience (workers, consumers, transport workers, and emergency responders) can better understand the hazards of the chemicals in use. Substances registered for REACH are classified according CLP (EC) 1272/2008, implementation of the GHS in the European Union.

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Classification	
According to REGULATION (EC) no 1272/2008: — Oxidizing gases; Category 1; May cause or intensify fire; oxidizer — Gases under pressure; LG; Contains gas under pressure; may explode if heated — Acute toxicity, Category 2; Fatal if inhaled — Skin irritation; Category 2; Causes skin irritation — Eye irritation; Category 2; Causes serious eye irritation — Specific target organ toxicity – single exposure; Category 3; May cause respiratory irritation — Acute aquatic toxicity; Category 1; Very toxic to aquatic life — Aquatic chronic toxicity; Category 1; Very toxic to aquatic life with long lasting effects M-factor (acute) = 100 M-factor (chronic) = 10	
Signal Word	
Danger	
Pictogram	
— GHS03: Flame over circle	
— GHS04: Gas cylinder	
— GHS06: Skull and crossbones	
— GHS09: Environment	

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