MATERIAL SAFETY DATASHEET

JK PAPER LIMITED, (UNIT - JKPM)
At/PO: Jaykaypur, Dist: Rayagada, Odisha-765017

MATERIAL SAFETY DATA SHEET OF CHLORINE

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name : **CHLORINE**
Chemical Formula : Cl_2
CAS no. : 7782-50-5
UN No. : 1017
Synonymous : Molecular chlorine, Di chlorine
HAZCH : 2XE
Label /Class : Chlorine is a toxic gas (Class 2.3) that is also corrosive (Class 8) and an oxidizing agent (Class 5.1)
General Use : Used in water purification, paper manufacturing, and the synthesis of chlorinated hydrocarbons. Chlorine is a commonly used household cleaner and disinfectant. It is widely used as an oxidizing agent in water treatment and chemical processes. It is also used in the bleaching process of wood pulp in pulp mills.

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :

Signal Word : Danger

GHS Hazard Statements :
H270 (72.4%): May cause or intensify fire; oxidizer [Danger Oxidizing gases]
H280 (73.6%): Contains gas under pressure; may explode if heated [Warning Gases under pressure]
H315 (100%): Causes skin irritation [Warning Skin corrosion/irritation]
H319 (100%): Causes serious eye irritation [Warning Serious eye damage/eye irritation]
H330 (56.6%): Fatal if inhaled [Danger Acute toxicity, inhalation]
H331 (43.4%): Toxic if inhaled [Danger Acute toxicity, inhalation]
H335 (100%): May cause respiratory irritation [Warning Specific target organ toxicity, single exposure; Respiratory tract irritation]
H400 (100%): Very toxic to aquatic life [Warning Hazardous to the aquatic environment, acute hazard]
H410 (14.4%): Very toxic to aquatic life with long lasting effects [Warning Hazardous to the aquatic environment, long-term hazard]

Precautionary Statement Codes: P220, P244, P260, P261, P264, P264+P265, P271, P273, P280, P284, P302+P352, P304+P340, P305+P351+P338, P316, P319, P320, P321, P332+P317, P337+P317, P362+P364, P370+P376, P391, P403, P403+P233, P405, P410+P403, and P501
(The corresponding statement to each P-code can be found at the GHS Classification page.)

Skin corrosion : category 1A
NFPA Hazard Classification

NFPA 704 Diamond :

Diamond	Hazard	Value	Description
	🟦 Health	4	Can be lethal.
	🟥 Flammability	0	Will not burn under typical fire conditions.
	🟨 Instability	0	Normally stable, even under fire conditions.
	◇ Special	OX	Possesses oxidizing properties.

Health Hazards : Poisonous; may be fatal if inhaled. Contact may cause burns to skin and eyes. Bronchitis or chronic lung conditions.

Fire Hazards : May ignite other combustible materials (wood, paper, oil, etc.). Mixture with fuels may cause explosion. Container may explode in heat of fire. Vapor explosion and poison hazard indoors, outdoors or in sewers. Hydrogen and chlorine mixtures (5-95%) are exploded by almost any form of energy (heat, sunlight, sparks, etc.). May combine with water or steam to produce toxic and corrosive fumes of hydrochloric acid. Emits highly toxic fumes when heated. Avoid plastics and rubber. Avoid heat and contact with hydrogen gas or powdered metals.

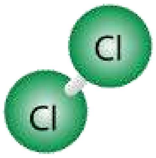
Explosion Hazards : Chlorine reacts explosively or forms explosive compounds with many common substances including, acetylene, ether, turpentine, ammonia, fuel gas, hydrogen, fluorine, and finely divided metals. Chlorine is not combustible. Containers may explode when heated. Ruptured cylinders may rocket.

Hazards Summary : Chlorine is a potent irritant to the eyes, the upper respiratory tract, and lungs. Chronic (long-term) exposure to chlorine gas in workers has resulted in respiratory effects, including eye and throat irritation and airflow obstruction.

Skin, Eye, and Respiratory Irritations: Potential symptoms of overexposure are burning of eyes, nose and mouth; lacrimation, rhinorrhea; coughing, choking and substernal pain; nausea, vomiting; headache, dizziness; syncope; pulmonary edema; pneumonia; hypoxemia; dermatitis; direct contact with liquid may cause frostbite.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Structural Formula :



Chemical Family : Halogen Family. [A nonmetal in group 17 of the periodic table.]

Molecular weight : 70.90 g/mol

CAS No : 7782-50-5

Molecular Formula : Cl_2

Name : Chlorine

Identification and Use : Chlorine is a greenish yellow gas, and becomes a clear to amber liquid under pressure and has a pungent suffocating odor. The major uses of chlorine are in the manufacture of chlorinated organic chemicals and inorganic chemicals. It is used as a bleaching agent in the manufacture of pulp and paper; in bleaching textiles, in the manufacture of pesticides, herbicides, refrigerants, propellants, household and commercial bleaches, detergents for automatic dish washers, antifreeze, antiknock compounds, plastics, synthetic rubbers, adhesives, pharmaceuticals, drinking and swimming water purification, sanitation of industrial and sewage wastes and in the degassing of aluminum metal.

SECTION 4: FIRST-AID MEASURES

Inhalation : Fresh air, rest. Half-upright position. Refer immediately for medical attention. Artificial respiration may be needed.

Skin Contact : First rinse with plenty of water for at least 15 minutes, then remove contaminated clothes and rinse again. Refer immediately for medical attention.

Eye Contact : Rinse with plenty of water for several minutes (remove contact lenses if easily possible). Refer immediately for medical attention.

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : 143.85°C (290.9°F)

Auto ignition Temperature	:	Not flammable
LEL	:	Not Applicable
UEL	:	Not Applicable
Flammability Classification	:	Not flammable
Extinguishing Media	:	Use water spray, alcohol-resistant foam, dry chemical, or carbon dioxide.
Unusual Fire or Explosion Hazards	:	May combine with water or steam to produce toxic and corrosive fumes of hydrochloric acid.
Fire-Fighting Instructions	:	Evacuate area endangered by gas. Stay upwind; keep out of low areas. Wear positive pressure breathing apparatus and full protective clothing. Move container from fire area if you can do so without risk. Spray cooling water on containers that are exposed to flames until well after fire is out. If it is necessary to stop the flow of gas, use water spray to direct escaping gas away from those effecting shut-off. Will not burn, but most combustible materials will burn in chlorine as they do in oxygen; flammable gases will form explosive mixtures with chlorine. Dry chemical, carbon dioxide, water spray, fog or foam. (EPA, 1998)
Advice for firefighters	:	Wear self-contained breathing apparatus for firefighting if necessary.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Spill or Leak:

- Do not touch or walk through spilled material.
- Keep combustibles (wood, paper, oil, etc.) away from spilled material.
- Stop leak if you can do it without risk.
- Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material.
- Do not direct water at spill or source of leak.
- If possible, turn leaking containers so that gas escapes rather than liquid.
- Prevent entry into waterways, sewers, basements or confined areas.
- Isolate area until gas has dispersed.
- Ventilate the area.

Isolation and Evacuation:

Immediate Precautionary Measure: Isolate spill or leak area for at least 100 meters (330 feet) in all directions.

Spillage Disposal: Evacuate danger area! Consult an expert! Personal protection: gas-tight chemical protection suit including self-contained breathing apparatus. Ventilation. Shut off cylinder if possible. Isolate the area until the gas has dispersed. NEVER direct water jet on liquid. Remove gas with fine water spray. Do NOT let this chemical enter the environment.

Cleanup Methods: Personal precautions, protective equipment and emergency procedures: Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Environmental precautions: Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided. Methods and materials for containment and cleaning up: Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations.

Disposal Methods: See Section 13 for more details.

Preventive Measures:

Personal precautions, protective equipment and emergency procedures: Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Environmental precautions: Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Antidote and Emergency Treatment:

As with most types of electrolyte imbalance, the treatment of high blood chloride levels is based on correcting the underlying cause. If the patient is dehydrated, therapy consists of establishing and maintaining adequate hydration. If the condition is caused or exacerbated by medications or treatments, these may be altered or discontinued, if deemed prudent. If there is underlying kidney disease (which is likely if there are other electrolyte disturbances), then the patient will be referred to a nephrologist for further care. If there is an underlying dysfunction of the endocrine or hormone system, the patient will likely be referred to an endocrinologist for further assessment.

SECTION 7: HANDLING AND STORAGE

Non-fire Spill Response:

Excerpt from ERG Guide 124 [Gases - Toxic and/or Corrosive - Oxidizing]:

Do not touch or walk through spilled material. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Stop leak if you can do it without risk. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Do not direct water at spill or source of leak. If possible, turn leaking containers so that gas escapes rather than liquid. Prevent entry into waterways, sewers, basements or confined areas. Isolate area until gas has dispersed. Ventilate the area. (ERG, 2024)

Safe Storage: Fireproof if in building. Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs. See Chemical Dangers. Cool. Dry. Keep in a well-ventilated room. Store in an area without drain or sewer access.

Storage Conditions: Keep container tightly closed in a dry and well-ventilated place. Contents under pressure. Storage class (TRGS 510): Gases. Store in a cool, dry, well-ventilated location. Separate from combustible, organic, or easily oxidizable materials. Isolate from acetylene, ammonia, hydrogen, hydrocarbons, ether, turpentine, and finely divided metals. Outside or detached storage is preferred.

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Protective Clothing:

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer when there is NO RISK OF FIRE.
- Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.

Control parameters:

Short-Term Exposure Limit (TLV-STEL):	0.4 ppm, 8-hr TWA
IDLH- Immediately Dangerous to Life and Health:	10 ppm or 15 mg/m^3
OSHA PEL-Permissible Exposure Limit:	1 ppm (3 mg/cu m), 8-hr TWA

Effects of Short-Term Exposure:

Lachrymation. The substance is corrosive to the eyes, skin and respiratory tract. Rapid evaporation of the liquid may cause frostbite. Inhalation may cause asthma-like reactions. Inhalation may cause pneumonitis. Inhalation may cause lung oedema, but only after initial corrosive effects on eyes and/or airways have become manifest. Exposure could cause death.

Effects of Long-Term Exposure:

The substance may have effects on the respiratory tract and lungs. This may result in chronic inflammation and impaired functions. The substance may have effects on the teeth. This may result in erosion.

Personal Protective Equipment (PPE):

Excerpt from NIOSH Pocket Guide for Chlorine:

Skin: FROSTBITE - Compressed gases may create low temperatures when they expand rapidly. Leaks and uses that allow rapid expansion may cause a frostbite hazard. Wear appropriate personal protective clothing to prevent the skin from becoming frozen.

Eyes: FROSTBITE - Wear appropriate eye protection to prevent eye contact with the liquid that could result in burns or tissue damage from frostbite.

Wash skin: No recommendation is made specifying the need for washing the substance from the skin (either immediately or at the end of the work shift).

Remove: No recommendation is made specifying the need for removing clothing that becomes wet or contaminated.

Change: No recommendation is made specifying the need for the worker to change clothing after the work shift.

Provide: FROSTBITE WASH - Quick drench facilities and/or eyewash fountains should be provided within the immediate work area for emergency use where there is any possibility of exposure to liquids that are extremely cold or rapidly evaporating.

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Molecular Weight	:	70.90 g/mol
Physical State	:	Gas at normal condition, liquefied compressed gas (as shipped)
Appearance	:	Yellowish-green gas at room temperature, amber-colored liquid under increased pressure or at temperatures below -34°C.
Odor	:	Pungent Suffocating Odor
Boiling Point/ Range, ^{0}C	:	-30.3°F or -34.6°C at 760 mmHg
Melting/Freezing Point, ^{0}C	:	-150 °F or -101.1 ^{0}C
Vapor Pressure at	:	7600 mm Hg Vapor Pressure @ 86 °F or 30 ^{0}C
Vapor Density (Air=1)	:	2.49 - Heavier than air; will sink
Density	:	1.424 at 59 °F or 15^{O}C - Denser than water; will sink
Solubility in Water	:	Moderately Soluble, with its solubility decreasing as temperature increases, and it reacts with water forming hydrochloric acid (HCl) and hypochlorous acid (HOCl).
Specific Gravity, (Water-1)	:	1.56 g/cu cm at -33.6 ^{O}C
Viscosity	:	0.134 mPa.sec at 20 °C (gas); 0.346 mPa.sec at 20 °C (liquid)
Corrosivity	:	Highly corrosive to all metals in the presence of any humidity factor
Heat of Vaporization	:	20.41 kJ/mol at -34.03 °C; 17.76 kJ/mol at 25 °C
Surface Tension	:	18.4 dynes/cm at 20 °C in contact with vapor
Critical Temperature:		144 °C
Critical Pressure	:	76.1 atm
Odor Threshold	:	0.2 to 0.4 ppm

SECTION 10: STABILITY & REACTIVITY

Air and Water Reactions : Water dissolves about twice its volume of chlorine gas, forming a mixture of hydrochloric acid and hypochlorous acids. Will be corrosive due to acidity and oxidizing potential.

Stability : Stable under recommended storage conditions.

Reactivity : Strong Oxidizing Agent, Water-Reactive, Halogenating Agents

Hazardous Incompatible materials : Reactive with Alcohols.

SECTION 11: TOXICOLOGICAL INFORMATION

HUMAN EXPOSURE AND TOXICITY: Chlorine has a suffocating pungent odor and the gas irritates the eyes and causes tears. Exposure to chlorine gas can be from oral, inhalation and dermal and eye routes. Chlorine gas can lead to ocular irritation and burns. Skin exposure can cause irritation, pain, erythema, blister and burns. Liquid chlorine on contact can burn the skin and eyes. Initially the irritation of the eyes, nose and throat, followed by coughing and wheezing, dyspnea, sputum production and chest pain. Larger exposures may lead to hyperchloremic acidosis, anoxia and may lead to cardiac or respiratory arrest. Chemical pneumonitis may follow. The effects of chronic exposure to chlorine among workers at a pulp mill have shown persistent respiratory symptoms. Bronchial obstruction and bronchial hyper-responsiveness were noted. There have also been occasional reports of asthma precipitated by exposure to chlorinated water.

Carcinogen Classification: No indication of carcinogenicity (not listed by IARC). (L135)

Exposure Routes: inhalation, skin and/or eye contact

Symptoms:

Inhalation Exposure: Cough. Sore throat. Shortness of breath. Wheezing. Laboured breathing. Symptoms may be delayed. Inhalation is the main route of chlorine gas exposure. Contact with the escaping gas may cause frost bite. Compressed liquid can cause frostbite and/or chemical burns to the eyes and skin. Significant skin absorption or ingestion is unlikely. Chlorine is a gas at room temperature, making ingestion an unlikely route of exposure.

Skin Exposure: On contact with liquid: frostbite. Redness. Burning sensation. Pain. Skin burns.

Eye Exposure: Watering of the eyes. Redness. Pain. Burns. Burning of eyes, nose, mouth; lacrimation (discharge of tears), rhinorrhea (discharge of thin nasal mucus); cough, choking, substernal (occurring beneath the sternum) pain; nausea, vomiting; headache, dizziness; syncope; pulmonary edema; pneumonitis; hypoxemia (reduced O2 in the blood); dermatitis; liquid: frostbite

Ingestion Exposure: Chlorine is present as a gas at room temperature, so ingestion is unlikely.

Target Organs: Dermal (Skin), Gastrointestinal (Stomach and Intestines, part of the digestive system), Respiratory (From the Nose to the Lungs)

Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR if necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention.

Non-Human Toxicity Excerpts: Chlorine (Cl_2) is a highly reactive oxidant gas that, when inhaled, may cause acute lung injury culminating in death from respiratory failure.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity Studies:

/AQUATIC SPECIES/ Chlorine (Cl) is a highly toxic, widely used halogen disinfectant that is present in point-source pollution discharges from wastewater treatment plants and industrial facilities. The presence of carcinogenic and mutagenic chemicals in the effluent of a wastewater treatment plant was indicated by papilloma development in caged bullhead catfish (Ictalurus melas), hepatic enzyme induction in exposed fish, and Ames test mutagenicity of organic extracts of wastewater. ... Mutagenic and carcinogenic chemicals were not identified in the wastewater, but chlorination was implicated as a factor contributing to the induction of papillomas. The prevalence of papillomas on wild black bullheads exposed to the effluent decreased from 73 to 23% after the amount of residual chlorine in the effluent leaving the chlorine contact chamber was reduced from 1.3-3.1 mg/L to 0.25-1.2 mg/L.

Environmental Fate / Exposure Summary:

Chlorine's production and use in the manufacture of chemicals, as an oxidizing and bleaching agent, and as a water disinfectant may result in its release to the environment through various waste streams. Scientists have proposed that minute quantities of chlorine are generated naturally during the photolysis of seawater aerosols. Volcanic gases can contain free chlorine gas. If released to air, a vapor pressure of 5850 mm Hg at 25 °C indicates chlorine will exist solely as a gas in the atmosphere. Gas-phase chlorine is removed from air primarily by direct photolysis with an estimated half-life of 1-4 hours, depending on the time of the day. Chlorine is also expected to react with cloud particulates and rain drops that it comes into contact with in the atmosphere, forming hydrochloric and hypochlorous acids. These acids can then be washed out of the atmosphere by precipitation. If released to soil in a spill situation as a liquid, chlorine will react with both organic and inorganic matter in the soil and much of the chlorine is expected to volatilize immediately. Chlorine is expected to dissolve and disproportionate in the water of moist soils to form chloride and hypochlorite. Chlorine is toxic to microbial communities; therefore, biodegradation is not considered to be a relevant fate process in soil and water.

The general population may be exposed to chlorine via inhalation and dermal contact as a result of an accident involving chlorine that occurs nearby, such as a liquid chlorine spill, a leak from a chlorine tank, or a leak from a facility that produces or uses chlorine. Individuals may be exposed to chlorine upon mixing a cleaning product that contains an acid with a solution containing sodium hypochlorite (bleach). The misuse of swimming pool chemicals may also potentially expose the general population to chlorine. The general public is not exposed to molecular chlorine in drinking water as a result of water sanitation practices, even though chlorine gas may be used in these processes. Because chlorine is so reactive in water and air, it is not normally detected in the environment except for very low levels in the air above seawater.

SECTION 13: DISPOSAL CONSIDERATION

Disposal Methods:

Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in air, soil or water; effects on animal, aquatic and plant life; and conformance with environmental and public health regulations. If it is possible or reasonable use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination.

SECTION 14: TRANSPORTATION INFORMATION

DOT ID and Guide: 1017 124

DOT Label: Poison Gas Oxidizer Corrosive

DOT Emergency Guidelines:

If THERE IS NO FIRE, go directly to the Table of Initial Isolation and Protective Action Distances to obtain initial isolation and protective action distances. IF THERE IS A FIRE, or IF A FIRE IS INVOLVED, go directly to the appropriate and use the evacuation information shown under PUBLIC SAFETY.

Standard Transportation Number: 49 041 20; Chlorine

Shipment Methods and Regulations:

No person may /transport/ offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177)/

Packaging and Labelling:
Special insulated cylinder. Marine pollutant.

UN Classification: 2.3; UN Subsidiary Risks: 5.1 and 8

SECTION 15: REGULATORY INFORMATION

Atmospheric Standards: Listed as a hazardous air pollutant (HAP) generally known or suspected to cause serious health problems. The Clean Air Act, as amended in 1990, directs EPA to set standards requiring major sources to sharply reduce routine emissions of toxic pollutants. EPA is required to establish and phase in specific performance-based standards for all air emission sources that emit one or more of the listed pollutants. Chlorine is included on this list.

Clean Water Act Requirements: Chlorine is designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. This designation includes any isomers and hydrates, as well as any solutions and mixtures containing this substance.

CERCLA Reportable Quantities: Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 10 lb or 4.54 kg. The toll-free number of the NRC is (800) 424-8802. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV. D.3.b).

RCRA Requirements: D002; A solid waste containing chlorine may become characterized as a hazardous waste when subjected to testing for corrosivity as stipulated in 40 CFR 261.22, and if so characterized, must be managed as a hazardous waste.

FIFRA Requirements: Chlorine gas is exempted from the requirement of a tolerance when used preharvest or postharvest in solution on all raw agricultural commodities.

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:

A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, PubChem, Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS), Safe Work Australia

MATERIAL SAFETY DATA SHEET OF SULPHUR DIOXIDE

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name	:	**SULPHUR DIOXIDE**
Chemical Formula	:	SO_2
CAS no.	:	7446-09-5
UN No.	:	1079
Synonymous	:	Sulfurous Anhydride, Sulfurous Oxide, Sulfur Superoxide, Feminicide Powder (powder form of sulfur dioxide)
HAZCHEM code	:	2RE
Class/ Label	:	Class 2.3 (Toxic Gas)
General Use	:	Formed as a byproduct of burning sulfur-containing materials; used for bleaching, disinfecting, and fumigating; [ACGIH] Used to preserve fruits and other foods; manufacture molasses, wine, and beer; bleach textile fibers; tan leather; pulp wood; manufacture lithium batteries and glass; treat water; and refine oil and metal.

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :

Compressed Gas

Corrosive

Acute Toxic

Signal Word : Danger

GHS Hazard Statements :

H280 (19.3%): Contains gas under pressure; may explode if heated [Warning Gases under pressure]
H314 (83.7%): Causes severe skin burns and eye damage [Danger Skin corrosion/irritation]
H331 (82.2%): Toxic if inhaled [Danger Acute toxicity, inhalation]

Precautionary Statement Codes:
P260, P261, P264, P271, P280, P301+P330+P331, P302+P361+P354, P304+P340, P305+P354+P338, P316, P321, P363, P403+P233, P405, P410+P403, and P501
(The corresponding statement to each P-code can be found at the GHS Classification page.)

NFPA Hazard Classification
NFPA 704 Diamond :

Diamond	Hazard	Value	Description
0 3 0	Health	3	Can cause serious or permanent injury.
	Flammability	0	Will not burn under typical fire conditions.
	Instability	0	Normally stable, even under fire conditions.
	Special		

Hazard Classes and Categories: Acute toxicity - category 3
Skin corrosion - category 1B
Gases under pressure

Health Hazards: It may cause death or permanent injury after very short exposure to small quantities. 1,000 ppm causes death in from 10 minutes to several hours by respiratory depression. It is an eye and respiratory tract irritant. Persons with asthma, subnormal pulmonary functions or cardiovascular disease are at a greater risk. (EPA, 1998)

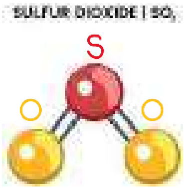
Fire Hazards: Containers may explode in heat of fire or they may rupture and release irritating toxic sulfur dioxide. Sulfur dioxide has explosive properties when it comes in contact with sodium hydride; potassium chlorate at elevated temperatures; ethanol; ether; zinc ethylsulfurinate at very cool temperatures (-15C); fluorine; chlorine trifluoride and chlorates. It will react with water or steam to produce toxic and corrosive fumes. When the liquid is heated it may release irritating, toxic sulfur dioxide gas. Avoid ammonia, monocesium or monopotassium acetylide; dicesium monoxide; iron (II) oxide; tin oxide; lead (IV) oxide; chromium; manganese; molten sodium, powder aluminum and rubidium. Sulfur dioxide has explosive properties when it comes in contact with sodium hydride; potassium chlorate at elevated temperatures; ethanol; ether; zinc ethylsulfurinate at very cool temperatures (-15C); fluorine; chlorine trifluoride and chlorates. It will react with water or steam to produce toxic and corrosive fumes. Hazardous polymerization may not occur. (EPA, 1998)

Hazards Summary: Sulfur dioxide is a colorless gas with a pungent odor. It is a liquid when under pressure, and it dissolves in water very easily. Sulfur dioxide in the air comes mainly from activities such as the burning of coal and oil at power plants or from copper smelting. In nature, sulfur dioxide can be released to the air from volcanic eruptions.

Skin, Eye, and Respiratory Irritations: Because of the high solubility of sulfur dioxide, it is extremely irritating to the eyes and upper respiratory tract, warning the exposed individual to escape before serious damage occurs.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Structural Formula :



Name : Sulfur Dioxide
Molecular Formula : SO_2
Molecular Weight : 64.07 g/mol
Chemical Family : Sulfur Oxide family
CAS No : 7446-09-5

SECTION 4: FIRST-AID MEASURES

Note: Persons with asthma, subnormal pulmonary function, or cardiovascular disease are at greater risk.

Signs and Symptoms of Acute Sulfur Dioxide Exposure:
Sulfur dioxide may irritate the eyes and respiratory tract. Signs and symptoms of acute exposure to sulfur dioxide may be severe and include coughing, choking, dyspnea (shortness of breath), sneezing, wheezing, and chest discomfort. Upper airway edema (swelling) or obstruction, bronchoconstriction, pneumonia, pulmonary edema, and respiratory paralysis may occur. Fatigue may be noted. Gastrointestinal effects may include nausea, vomiting, and abdominal pain. Cyanosis (blue tint to skin and mucous membranes) may be noted following exposure to sulfur dioxide.

Emergency Life-Support Procedures: Acute exposure to sulfur dioxide may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination.

Inhalation Exposure:

1. Move victims to fresh air. Emergency personnel should avoid self-exposure to sulfur dioxide.
2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support.

3. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures.
4. Transport to a health care facility.

Dermal/Eye Exposure:

1. Remove victims from exposure. Emergency personnel should avoid self- exposure to sulfur dioxide.
2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support.
3. Remove contaminated clothing as soon as possible.
4. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes.
5. Wash exposed skin areas with soap and water.
6. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures.
7. Transport to a health care facility.

Ingestion Exposure: No information is available. (EPA, 1998)

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : Non-Flammable
Auto ignition Temperature : Not flammable
LEL : Not Applicable
UEL : Not Applicable
Flammability Classification : Non-Flammable

Fire Fighting: Wear self-contained breathing apparatus and full protective clothing. Move container from fire area. Stay away from ends of tanks. Cool containers that are exposed to flames with water from the side until well after the fire is out. Isolate area until gas has dispersed. Keep unnecessary people away. Not flammable. Extinguish fires with dry chemical, carbon dioxide, water spray, fog or foam. (EPA, 1998)

Fire Fighting Procedures: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Wear self-contained breathing apparatus for firefighting if necessary.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Public Safety: ERG 2024, Guide 125 (Sulfur dioxide)

- CALL 911. Then call emergency response telephone number on shipping paper. If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.
- Keep unauthorized personnel away.
- Stay upwind, uphill and/or upstream.
- Many gases are heavier than air and will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.).
- Ventilate closed spaces before entering, but only if properly trained and equipped.

Isolation and Evacuation:

Excerpt from ERG Guide 125 [Gases - Toxic and/or Corrosive]:
IMMEDIATE PRECAUTIONARY MEASURE: Isolate spill or leak area for at least 100 meters (330 feet) in all directions.
SPILL: See ERG Tables 1 and 3 - Initial Isolation and Protective Action Distances on the UN/NA 1079 datasheet.
FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions. (ERG, 2024)

Spillage Disposal: Evacuate danger area! Consult an expert! Personal protection: complete protective clothing including self-contained breathing apparatus. Ventilation. NEVER direct water jet on liquid.

Disposal Methods: See section – 13.

Cleanup Methods:
1. Ventilate area of spill or leak to disperse gas.
2. If in gaseous form, stop flow of gas. If source of leak is cylinder and leak cannot be stopped in place, remove leaking cylinder to safe place in open air, and repair the leak or allow ... to empty.
3. If in liquid form, allow to vaporize.

Preventive Measures:

ACCIDENTAL RELEASE MEASURES; Personal precautions, protective equipment and emergency procedures: Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Environmental precautions: Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

SECTION 7: HANDLING AND STORAGE

Non-Fire Response:

Excerpt from ERG Guide 125 [Gases - Toxic and/or Corrosive]:
Do not touch or walk through spilled material. Stop leak if you can do it without risk. If possible, turn leaking containers so that gas escapes rather than liquid. Prevent entry into waterways, sewers, basements or confined areas. Do not direct water at spill or source of leak. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Isolate area until gas has dispersed. (ERG, 2024)

Safe Storage: Keep container tightly closed in a dry and well-ventilated place.

Storage Conditions: Storage temp: less than 130 °F. Store in a cool, dry, well-ventilated location. Outside or detached storage is preferred. Isolate from oxidizing materials and alkalis. /Sulfur dioxide, liquefied/

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Protective Clothing: ERG 2024, Guide 125 (Sulfur dioxide)
- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer when there is NO RISK OF FIRE.
- Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.

Control parameters:

Occupational Exposure Limits (EU-OEL)	1.3 mg/m
REL-TWA (Time Weighted Average)	2 ppm (5 mg/m^3)
REL-STEL (Short Term Exposure Limit)	5 ppm (13 mg/m^3)
Threshold Limit Values (TLV -STEL)	0.25 [ppm]
IDLH- Immediately Dangerous to Life and Health	100 ppm
PEL-TWA (8-Hour Time Weighted Average)	5 ppm (13 mg/m^3)

Inhalation Risk: A harmful concentration of this gas in the air will be reached very quickly on loss of containment.

Effects of Short-Term Exposure: Rapid evaporation of the liquid may cause frostbite. The substance is irritating to the eyes and respiratory tract. Inhalation may cause asthma-like reactions. The substance may cause effects on the respiratory tract. This may result in asthma-like reactions, reflex spasm of the larynx and respiratory arrest. The effects may be delayed. Medical observation is indicated.

Effects of Long-Term Exposure: Repeated or prolonged inhalation may cause asthma.

Allowable Tolerances: A tolerance is established as follows for sulfite residues of the fungicide sulfur dioxide (determined as (SO2)) in or on the following raw agricultural commodity(ies): grapes, postharvest: 10.0 ppm.

Personal Protective Equipment (PPE):

Excerpt from NIOSH Pocket Guide for Sulfur dioxide:
Skin: FROSTBITE - Compressed gases may create low temperatures when they expand rapidly. Leaks and uses that allow rapid expansion may cause a frostbite hazard. Wear appropriate personal protective clothing to prevent the skin from becoming frozen.
Eyes: FROSTBITE - Wear appropriate eye protection to prevent eye contact with the liquid that could result in burns or tissue damage from frostbite.
Wash skin: No recommendation is made specifying the need for washing the substance from the skin (either immediately or at the end of the work shift).
Remove: WHEN WET OR CONTAMINATED (LIQUID) - If this chemical is in liquid form, work clothing that becomes wet or significantly contaminated should be removed and replaced.
Change: No recommendation is made specifying the need for the worker to change clothing after the work shift.
Provide: FROSTBITE WASH - Quick drench facilities and/or eyewash fountains should be provided within the immediate work area for emergency use where there is any possibility of exposure to liquids that are extremely cold or rapidly evaporating. (NIOSH, 2024)

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Molecular Weight	:	64.07 g/mol
Physical Description	:	Sulfur Dioxide appears as a Colorless, non-flammable gas with acid taste.
Appearance	:	Colorless Gas
Odor	:	Choking or Strong Suffocating odor
Boiling Point/ Range, ^{0}C	:	14 °F or -10 ^{0}C at 760 mmHg
Melting/Freezing Point, ^{0}C	:	-98.9 °F or -72.7 ^{0}C
Vapor Pressure, ^{0}C	:	2432 mmHg at 68 °F 20 °C
Vapor Density (Air=1)	:	2.26 at 0 °C- Heavier than air; will sink
Density	:	1.434 - Denser than water; will sink
Solubility in Water	:	10%
Viscosity	:	Gas: 0.0124 mPa.s at 18 °C. Liquid: 0.368 mPa.s at 0 °C.
Critical Temperature	:	157.49 °C
Critical Pressure	:	7.884 Mpa
Heat of Vaporization	:	22.92 kJ/mol
Odor Threshold	:	Low: 0.33 [ppm] High: 5.0 [ppm]

SECTION 10: STABILITY & REACTIVITY

Reactivity Alerts	:	Water-Reactive
Reactive Group	:	Acids, Strong Non-oxidizing Reducing Agents, Weak
Stability	:	Stable under recommended storage conditions.
Hazardous Incompatible materials	:	Will react with water or steam to produce toxic and corrosive fumes.

Air and Water Reactions: Dissolves in water to form sulfurous acid, a corrosive liquid. Moist sulfur dioxide is very corrosive due to the slow formation of sulfuric acid.

Reactivity Profile SULFUR DIOXIDE is acidic. Reacts exothermically with bases such as amines, amides, metal oxides, and hydroxides. Frequently used as a reducing agent although it is not a powerful one. Acts as a reducing bleach to decolorize many materials. Can act as an oxidizing agent. Readily liquefied by compression. Contact between the liquid and water may result in vigorous or violent boiling and extremely rapid vaporization. If the water is hot an explosion may occur. Pressures may build to dangerous levels if the liquid contacts water in a closed container

SECTION 11: TOXICOLOGICAL INFORMATION

IDENTIFICATION AND USE: Sulfur dioxide (SO_2) is a colorless gas or liquid with a strong suffocating odor. SO_2 is used as a fungicide and preservative for grapes. It is also used for the manufacture of corn syrups and molasses, in the manufacture of wine to destroy bacteria, mold, and unwanted yeasts, and for sterilization, and prevents the formation of nitrosamines in beer. SO_2 is used to manufacture hydrosulfites, to bleach wood pulp and paper, to process, disinfect, and bleach food, for waste and water treatment, in metal and ore refining, and in oil refining.

Evidence for Carcinogenicity: Sulfur dioxide, sulfites, bisulfites and metabisulfites are not classifiable as to their carcinogenicity to humans (Group 3).

Exposure Routes: The substance can be absorbed into the body by inhalation.
Symptoms:

INHALATION EXPOSURE: Cough. Shortness of breath. Sore throat. Laboured breathing.
SKIN EXPOSURE: on contact with liquid: Frostbite.
EYE EXPOSURE: irritation eyes, nose, throat; rhinorrhea (discharge of thin nasal mucus); choking, cough; reflex bronchoconstriction; liquid: frostbite

Target Organs: Respiratory (From the Nose to the Lungs)

Adverse Effects:
Chronic Bronchitis - Chronic bronchitis is persistent coughing and production of phlegm for at least 3 months out of the year for at least two successive years. (American Thoracic Society).
Toxic Pneumonitis - Inflammation of the lungs induced by inhalation of metal fumes or toxic gases and vapors.
Fibro genic - Inducing tissue injury and fibrosis (scarring).
ACGIH Carcinogen - Not Classifiable.

Antidote and Emergency Treatment:

Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR as necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Sulfur and related compounds/

Human Toxicity Excerpts: /HUMAN EXPOSURE STUDIES/ Twenty-five healthy adults were tested and found to have increased airway resistance (determined in a body plethysmograph) at 5 ppm (13 mg/cu m) of sulfur dioxide and at higher levels when breathing normally for 10 min, but not at lower levels. After 25 deep breaths, as might occur in laborers doing hard physical work, the subjects had a statistically significant increase in airway resistance at 1 ppm and after 8 deep breaths at 3 ppm.

Non-Human Toxicity Excerpts: /LABORATORY ANIMALS: Acute Exposure/ When rabbits inhaled 300 ppm of sulfur dioxide, ciliary action in the upper airways was inhibited, and at 400 ppm, mucosal irritation, mucous gland hypertrophy, and proliferation of pulmonary goblet cells occurred. Acute Exposure/ Exposure-effect curves have been developed for guinea pigs ... and dogs ... In /the guinea pig/ study, a linear relationship was obtained between exposure for 1 hr to sulfur dioxide concn ranging from 0.46 to 2380 mg/cu m (0.16-835 ppm) and corresponding increases in pulmonary flow resistance. The /dog/ study showed that nasal flow resistance increased roughly in proportion to exposure to sulfur dioxide concentrations ranging from 20 to 660 mg/cu m (7-230 ppm) for a 15-20 min period.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity Excerpts:

/BIRDS and MAMMALS/ In the oil sands of Alberta, Canada, toxicology research has largely neglected the effects of air contaminants on biota. Captive Japanese quail (Coturnix c. japonica) and American kestrels (Falco sparverius) were exposed to mixtures of volatile organic compounds and oxidizing agents (benzene, toluene, NO2 and SO2) in a whole-body inhalation chamber, to test for toxicological responses. Hepatic biotransformation measured through 7-ethoxyresorufin-O-dealkylase (EROD) tended to be increased in exposed kestrels (p=0.06) but not in quail (p=0.15). Plasma corticosterone was increased in the low dose group for quail on the final day of exposure (p=0.0001), and midway through the exposure period in exposed kestrels (p=0.04). For both species, there was no alteration of T and B-cell responses, immune organ mass, or histology of immune organs (p>0.05).

/AQUATIC SPECIES/ ... 16 to 19 ppm of sulfur dioxide killed sunfish in 1 hr. ... Concentrations of 10 ppm of sulfur dioxide in tap water caused trout to float within 10 min and also reports that 5 ppm of sulfur dioxide killed trout in 1 hr.

/PLANTS/ Nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) generated by excessive coal combustion and motor vehicle emissions are major air pollutants in the large cities of China. Pollen grains were exposed to 0.5 ppm to 5.0 ppm NO_2 or SO_2 for 4 hours and assessed for morphological damage by field emission scanning electron microscopy and for viability using the trypan blue stain. Exposure to NO_2 or SO_2 significantly decreased the viability of pollen grains, compared with exposure to air; with SO_2 being slightly more detrimental than NO_2. Exposure to acid solutions also induced pollen damage, which appeared to be pH-dependent (from 24.6% at pH 6.0 to 55.8% at pH 4.0; compared to 3.8% at pH 7.0). Short-term exposure of oak pollen to high concentrations of SO_2 or NO_2 significantly increases their fragility and disruption, leading to subsequent release of pollen cytoplasmic granules into the atmosphere. These results suggest that heightened air pollution during the oak pollen season may possibly increase the incidence of allergic airway disease in sensitized individuals by facilitating the bioavailability of airborne pollen allergens.

Environmental Fate / Exposure Summary: Sulfur dioxide's production from fuel combustion will result in its direct release to the environment. On a global basis, fossil fuel combustion accounts for 75 to 85% of man-made sulfur dioxide emissions, and industrial processes such as refining and smelting account for the remainder. The global sulfur cycle involves an atmospheric flux of about (140-350) X10+6 tons/annum, with (40-60) X10+6 tons as anthropogenic sulfur, in the form of sulfur dioxide, sulfuric acid, and sulfate. Sulfur dioxide can react with other compounds in the atmosphere and form fine particles that result in haze that reduces visibility. Gas-phase sulfur dioxide is oxidized rapidly by homogeneous and heterogeneous reactions. The oxidation of sulfur dioxide to sulfuric acid and sulfates in the atmosphere is an important contributor to air pollution, specifically producing acid rain. Sulfur dioxide dissolves in water, forming a weak acid solution of sulfurous acid. This acid rain effects sensitive forest, soil and aquatic ecosystems. The atmospheric lifetime of sulfur dioxide is about 10 days. Sulfur dioxide may be photochemically or catalytically oxidized to SO3 and sulfate in air. If released to soil, sulfur dioxide is expected to absorb to soil. Volatilization from moist soil surfaces is expected to be an important fate process based upon a Henry's Law constant of 8.10X10-4 atm-cu m/mole.

Soil Adsorption / Mobility: Sulfur dioxide can be absorbed by soil. In the form of acid rain, it is the leading cause of an increase in heavy metal mobility in soil.

Environmental Water Concentrations: RAIN/SNOW/FOG: It has been estimated that 70% of the sulfate that is present in rainwater comes from the washout of sulfur dioxide from the atmosphere.

SECTION 13: DISPOSAL CONSIDERATION

Disposal Methods:

Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in air, soil or water; effects on animal, aquatic and plant life; and conformance with environmental and public health regulations. If it is possible or reasonable use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination.

Wastewater from contaminant suppression, cleaning of protective clothing/equipment, or contaminated sites should be contained and evaluated for subject chemical or decomposition product concentrations. Concentrations shall be lower than applicable environmental discharge or disposal criteria. Alternatively, pretreatment and/or discharge to a permitted wastewater treatment facility is acceptable only after review by the governing authority and assurance that "pass through" violations will not occur. Due consideration shall be given to remediation worker exposure (inhalation, dermal and ingestion) as well as fate during treatment, transfer and disposal. If it is not practicable to manage the chemical in this fashion, it must be evaluated in accordance with EPA 40 CFR Part 261, specifically Subpart B, in order to determine the appropriate local, state and federal requirements for disposal.

SECTION 14: TRANSPORTATION INFORMATION

DOT Emergency Guidelines:

If ... THERE IS NO FIRE, go directly to the Table of Initial Isolation and Protective Action Distances /(see table below)/ ... to obtain initial isolation and protective action distances. IF THERE IS A FIRE, or IF A FIRE IS INVOLVED, go directly to the appropriate guide /(see guide(s) below)/ and use the evacuation information shown under PUBLIC SAFETY.

DOT ID and Guide: 1079 125
Shipping Name: UN 1079; Sulfur dioxide
DOT Label: Poison Gas, Corrosive
Standard Transportation Number: 49 042 90; Sulfur dioxide

Shipment Methods and Regulations:

No person may /transport, / offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177). /

UN Classification: UN Hazard Class: 2.3; UN Subsidiary Risks: 8

SECTION 15: REGULATORY INFORMATION

CERCLA Reportable Quantities: Releases of CERCLA hazardous substances are subject to the release reporting requirement of CERCLA section 103, codified at 40 CFR part 302, in addition to the requirements of 40 CFR part 355. Sulfur dioxide is an extremely hazardous substance (EHS) subject to reporting requirements when stored in amounts in excess of its threshold planning quantity (TPQ) of 500 lbs.

FIFRA Requirements: A tolerance is established as follows for sulfite residues of the fungicide sulfur dioxide (determined as (SO_2)) in or on the following raw agricultural commodity(ies): grapes, postharvest: 10.0 ppm.

FDA Requirements: Sulfur dioxide ... is generally recognized as safe when used in accordance with good manufacturing practice, except that it is not used in meats; in food recognized as a source of vitamin B1; on fruits or vegetables intended to be served raw to consumers or sold raw to consumers, or to be presented to consumers as fresh.

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

MATERIAL SAFETY DATA SHEET OF SULPHUR DIOXIDE

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

Sources Used:
A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, Public Chemical Information (PubChem) - National Institutes of Health (NIH) -National Library of Medicine (NLM), Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS).

MATERIAL SAFETY DATA SHEET OF HYDROGEN PEROXIDE

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name	:	**HYDROGEN PEROXIDE**
Chemical Formula	:	H_2O_2 (Aqueous Solution, With Not Less Than 20% But Not More Than 60% Hydrogen Peroxide (Stabilized as Necessary))
CAS no.	:	7722-84-1
UN No.	:	2015
Synonymous	:	Interox, Inhibine, Albone, Kastone, Superoxol, Oxydol
HAZCHEM code	:	2PE
Class/ Label	:	Hazard Class 5.1 (Oxidizers) & Subsidiary Hazard Class 8 (Corrosive)
General Use	:	Used in purifying coke and iron ores, pickling sheet iron, Regeneration of water treatment resigns, photography, pharmaceutical Industries. Hydrogen peroxide is a versatile chemical used as a disinfectant to kill bacteria, viruses, and fungi. It serves as a mild antiseptic for minor wounds, a stain remover for fabrics and surfaces, and a bleaching agent in the textile and paper industries. Additionally, it's used in producing foam rubber, other organic chemicals, and in wastewater treatment to eliminate organic impurities.

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram	:	 Oxidizer  Corrosive  Irritant
Signal Word	:	Danger
GHS Hazard Statements	:	

H271 (90.4%): May cause fire or explosion; strong Oxidizer [Danger Oxidizing liquids; Oxidizing solids]
H302 (97.8%): Harmful if swallowed [Warning Acute toxicity, oral]
H314 (99.6%): Causes severe skin burns and eye damage [Danger Skin corrosion/irritation]
H318 (36.9%): Causes serious eye damage [Danger Serious eye damage/eye irritation]
H332 (93.9%): Harmful if inhaled [Warning Acute toxicity, inhalation]
H335 (27.2%): May cause respiratory irritation [Warning Specific target organ toxicity, single exposure; Respiratory tract irritation]
H412 (18.5%): Harmful to aquatic life with long lasting effects [Hazardous to the aquatic environment, long-term hazard]

Precautionary Statement Codes:
P210, P220, P260, P261, P264, P264+P265, P270, P271, P273, P280, P283, P301 + P317, P301 + P330 + P331, P302 + P361 + P354, P304 + P340, P305 + P354 + P338, P306 + P360, P316, P317, P319, P321, P330, P363, P370 + P378, P371 + P380 + P375, P403 + P233, P405, P420, and P501
(The corresponding statement to each P-code can be found at the GHS Classification page.)

MATERIAL SAFETY DATA SHEET OF HYDROGEN PEROXIDE

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

NFPA Hazard Classification
NFPA 704 Diamond :

Diamond	Hazard	Value	Description
	◆ Health	3	Can cause serious or permanent injury.
	◆ Flammability	0	Will not burn under typical fire conditions.
	◆ Instability	1	Normally stable but can become unstable at elevated temperatures and pressures.
	◇ Special	OX	Possesses oxidizing properties.

Hazard Classes and Categories:
Oxidizing liquid: Category 1
Specific Target Organ Toxicity (STOT) – Single Exposure: Category 3
Skin corrosion: Category 1A
Acute toxicity: category 4

Health Hazards: Excerpt from ERG Guide 143 [Oxidizers (Unstable)]:
TOXIC; inhalation, ingestion or contact (skin, eyes) with vapors, dusts or substance may cause severe injury, burns or death. Fire may produce irritating and/or toxic gases. Toxic fumes or dust may accumulate in confined areas (basement, tanks, hopper/tank cars, etc.). Runoff from fire control or dilution water may cause environmental contamination. (ERG, 2024)

Fire Hazards: Excerpt from ERG Guide 140 [Oxidizers]:
CAUTION: Ammonium nitrate products may explode if involved in fire or contaminated with hydrocarbons (fuels), organic matter, other contaminants or when hot molten and contained. Treat as an explosive (ERG Guide 112). These substances will accelerate burning when involved in a fire. Some may decompose explosively when heated or involved in a fire. May explode from heat or contamination. Some will react explosively with hydrocarbons (fuels). May ignite combustibles (wood, paper, oil, clothing, etc.). Containers may explode when heated. Runoff may create fire or explosion hazard. (ERG, 2024)

Hazards Summary: Hydrogen peroxide is a colorless liquid at room temperature with a bitter taste. Small amounts of gaseous hydrogen peroxide occur naturally in the air. Hydrogen peroxide is unstable, decomposing readily to oxygen and water with release of heat. Although nonflammable, it is a powerful oxidizing agent that can cause spontaneous combustion when it comes in contact with organic material.

Skin, Eye, and Respiratory Irritations: Pure hydrogen peroxide, its solutions, vapors, and mists are very irritating to body tissue. This irritation can vary from mild to severe depending upon the concentration of hydrogen peroxide.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Structural Formula :

Name : Hydrogen Peroxide
Molecular Formula : H_2O_2
Molecular Weight : 34.015 g/mol
Chemical Family : Peroxides
CAS No : 7722-84-1

SECTION 4: FIRST-AID MEASURES

EYES: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

SKIN: IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. IMMEDIATELY call a hospital or poison control center even if no symptoms (such as redness or irritation) develop. IMMEDIATELY transport the victim to a hospital for treatment after washing the affected areas.

INHALATION: IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing.

INGESTION: DO NOT INDUCE VOMITING. Corrosive chemicals will destroy the membranes of the mouth, throat, and esophagus and, in addition, have a high risk of being aspirated into the victim's lungs during vomiting which increases the medical problems. If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center. IMMEDIATELY transport the victim to a hospital. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. DO NOT INDUCE VOMITING. Transport the victim IMMEDIATELY to a hospital. (NTP, 1992)

Signs and Symptoms of Acute Hydrogen Peroxide Exposure: Signs and symptoms of acute exposure to hydrogen peroxide may be severe and include irritation or burns to the skin, eyes, respiratory tract, mouth, esophagus, stomach, and intestines. Distension or rupture of the stomach and other hollow viscera may occur; vomiting is common. Corneal ulceration may develop.

Emergency Life-Support Procedures: Acute exposure to hydrogen peroxide may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination.

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : Non-Flammable
Auto ignition Temperature : Not flammable.
LEL : Not Applicable
UEL : Not Applicable
Flammability Classification : Noncombustible Liquid, but a powerful oxidizer.
Decomposition : Decomposed by many organic solvents.

Fire Fighting: Excerpt from ERG Guide 143 [Oxidizers (Unstable)]:
SMALL FIRE: Use water. Do not use dry chemicals or foams. CO2 or HalonÂ® may provide limited control.
LARGE FIRE: Flood fire area with water from a distance. Do not move cargo or vehicle if cargo has been exposed to heat. If it can be done safely, move undamaged containers away from the area around the fire. Do not get water inside containers: a violent reaction may occur.
FIRE INVOLVING TANKS, RAIL TANK CARS OR HIGHWAY TANKS: Cool containers with flooding quantities of water until well after fire is out. Dike runoff from fire control for later disposal. ALWAYS

stay away from tanks in direct contact with flames. For massive fire, use unmanned master stream devices or monitor nozzles; if this is impossible, withdraw from area and let fire burn. (ERG, 2024)

Fire Fighting Procedures: Suitable extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. /Hydrogen peroxide solution (>/= 30% to <50%)/. If material involved in fire: Use water in flooding quantities as fog. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible. /Hydrogen peroxide, aqueous solutions/

Advice for firefighters: Wear self-contained breathing apparatus for firefighting if necessary. /Hydrogen peroxide solution (>/= 30% to <50%)/

SECTION 6: ACCIDENTAL RELEASE MEASURES

Public Safety: ERG 2024, Guide 140 (Hydrogen peroxide, aqueous solution, with not less than 8% but less than 20% hydrogen peroxide; Hydrogen peroxide, aqueous solution, with not less than 20% but not more than 60% hydrogen peroxide (stabilized as necessary))

- CALL 911. Then call emergency response telephone number on shipping paper. If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.
- Keep unauthorized personnel away.
- Stay upwind, uphill and/or upstream.
- Ventilate closed spaces before entering, but only if properly trained and equipped.

Spill or Leak: ERG 2024, Guide 140 (Hydrogen peroxide, aqueous solution, with not less than 8% but less than 20% hydrogen peroxide; Hydrogen peroxide, aqueous solution, with not less than 20% but not more than 60% hydrogen peroxide (stabilized as necessary))

- Keep combustibles (wood, paper, oil, etc.) away from spilled material.
- Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
- Stop leak if you can do it without risk.
- Do not get water inside containers.

Small Dry Spill: With clean shovel, place material into clean, dry container and cover loosely; move containers from spill area.
Small Liquid Spill: Use a non-combustible material like vermiculite or sand to soak up the product and place into a container for later disposal.
Large Spill: Dike far ahead of liquid spill for later disposal.

Isolation and Evacuation: Excerpt from ERG Guide 143 [Oxidizers (Unstable)]:
IMMEDIATE PRECAUTIONARY MEASURE: Isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids.
SPILL: Increase the immediate precautionary measure distance, in the downwind direction, as necessary.

FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024).

Disposal Methods: See section – 13.

Spillage Disposal: Consult an expert! Personal protection: chemical protection suit including self-contained breathing apparatus. Ventilation. Do NOT let this chemical enter the environment. Absorb liquid in sand or inert absorbent. Do NOT absorb in saw-dust or other combustible absorbents. Carefully collect remainder. Store and dispose of according to local regulations.

Cleanup Methods: ACCIDENTAL RELEASE MEASURES: Personal precautions, protective equipment and emergency procedures: Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Environmental precautions: Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided. Methods and materials for containment and cleaning up: Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal. /Hydrogen peroxide solution (>/= 30% to <50%)/

Preventive Measures: ACCIDENTAL RELEASE MEASURES: Personal precautions, protective equipment and emergency procedures: Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Environmental precautions: Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided. /Hydrogen peroxide solution (>/= 30% to <50%)/.

SECTION 7: HANDLING AND STORAGE

Non-Fire Spill Response: Excerpt from ERG Guide 143 [Oxidizers (Unstable)]:

Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Use water spray to reduce vapors or divert vapor cloud drift. Prevent entry into waterways, sewers, basements or confined areas.
SMALL SPILL: Flush area with large amounts of water.
LARGE SPILL: DO NOT CLEAN-UP OR DISPOSE OF, EXCEPT UNDER SUPERVISION OF A SPECIALIST. (ERG, 2024)

Safe Storage: Store in an area without drain or sewer access. Separated from food and feedstuffs. See Chemical Dangers. Cool. Keep in the dark. Store in vented containers. Store only if stabilized.

Storage Conditions: Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Recommended storage temperature 2 - 8 °C. /Hydrogen peroxide solution (>/= 30% to <50%)/

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Protective Clothing: Protective Clothing: ERG 2024, Guide 140 (Hydrogen peroxide, aqueous solution, with not less than 8% but less than 20% hydrogen peroxide; Hydrogen peroxide, aqueous solution, with not less than 20% but not more than 60% hydrogen peroxide (stabilized as necessary))

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer when there is NO RISK OF FIRE.
- Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.

Control parameters:

Occupational Exposure Limits (EU-OEL)	0.71 mg/m
REL-TWA (Time Weighted Average)	1 ppm (1.4 mg/m^3)
Threshold Limit Values (TLV -STEL)	1 ppm
IDLH- Immediately Dangerous to Life and Health	75 ppm
PEL-TWA (8-Hour Time Weighted Average)	1 ppm (1.4 mg/m^3)

Inhalation Risk: A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20 °C.

Effects of Short-Term Exposure: The substance is corrosive to the eyes, skin and respiratory tract. Corrosive on ingestion. The vapor is severely irritating to the respiratory tract. Ingestion may cause strong foam formation with risk of asphyxiation and aspiration. Exposure to this substance may produce oxygen bubbles (embolism) in the blood, resulting in shock.

Effects of Long-Term Exposure: Repeated or chronic inhalation of the vapor may cause chronic inflammation of the upper respiratory tract. Lungs may be affected by repeated or prolongated exposure. The substance may have effects on the hair. This may result in bleaching.

Allowable Tolerances: When used as ingredients in an antimicrobial pesticide formulation may be applied to: Food-contact surfaces in public eating places, dairy-processing equipment, and food-processing equipment and utensils. Hydrogen peroxide is included on this list. Limit: When ready for use, the end-use concentration is not to exceed 91 ppm.

Personal Protective Equipment (PPE): Excerpt from NIOSH Pocket Guide for Hydrogen peroxide:

Skin: PREVENT SKIN CONTACT - Wear appropriate personal protective clothing to prevent skin contact.
Eyes: PREVENT EYE CONTACT - Wear appropriate eye protection to prevent eye contact.
Wash skin: WHEN CONTAMINATED - The worker should immediately wash the skin when it becomes contaminated.
Remove: WHEN WET OR CONTAMINATED - Work clothing that becomes wet or significantly contaminated should be removed and replaced.
Change: No recommendation is made specifying the need for the worker to change clothing after the work shift.
Provide:
EYEWASH - Eyewash fountains should be provided in areas where there is any possibility that workers could be exposed to the substances; this is irrespective of the recommendation involving the wearing of eye protection.
QUICK DRENCH - Facilities for quickly drenching the body should be provided within the immediate work area for emergency use where there is a possibility of exposure. [Note: It is intended that these facilities provide a sufficient quantity or flow of water to quickly remove the substance from anybody areas likely to be exposed. The actual determination of what constitutes an adequate quick drench facility depends on the specific circumstances. In certain instances, a deluge shower should be readily available, whereas in others, the availability of water from a sink or hose could be considered adequate.] (NIOSH, 2024)

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Molecular Weight	:	34.015 g/mol
Physical Description	:	Hydrogen peroxide, aqueous solution, with not less than 20% but not more than 60% hydrogen peroxide (stabilized as necessary) appears as colorless aqueous solution.
Appearance	:	Colorless Liquid
Odor	:	Slightly Pungent, Irritating Odor.
Boiling Point/ Range, ^{0}C	:	302.4 °F or 150.2 ^{0}C at 760 mmHg
Melting/Freezing Point, ^{0}C	:	31.3 °F or -0.38 ^{0}C
Vapor Pressure, ^{0}C	:	1 mmHg at 59.5 °F 15.27 °C
Vapor Density (Air=1)	:	1.02 - Heavier than air; will sink
Density	:	1.11 at 68 °F or 20 ^{0}C- Denser than water; will sink
Solubility in Water	:	infinite @30 ^{0}C
Viscosity	:	1.819 cP at 0 °C; 1.249 cP at 20 °C
Corrosivity	:	Corrosive
Critical Temperature	:	457 °C
Critical Pressure	:	20.99 Mpa
Heat of Vaporization	:	1519 J-g/K at 25 °C
pH	:	Weak acid; H_2O_2 concentration wt% = 35, 50, 70, 90; corresponding true pH: 4.6, 4.3, 4.4, 5.1

SECTION 10: STABILITY & REACTIVITY

Reactivity Alerts	:	Explosive Strong Oxidizing Agent
Reactive Group	:	Oxidizing Agents, Strong Water and Aqueous Solutions
Stability	:	Stable under recommended storage conditions.
Hazardous Incompatible materials	:	Zinc, powdered metals, iron, copper, nickel, brass, iron and iron salts. /Hydrogen peroxide solution (>/= 30% to <50%)/

Air and Water Reactions: An aqueous solution that is readily diluted.

Reactivity Profile: Hydrogen peroxide solutions with over 60% concentration are highly reactive and powerful oxidizers. They can decompose violently when in contact with metals, alkaline substances, dust, or organic materials, even with stabilizers present. Contact with combustible materials may cause spontaneous ignition. Mixtures with organic solvents or acids can lead to explosive reactions, especially at high concentrations.

SECTION 11: TOXICOLOGICAL INFORMATION

IDENTIFICATION AND USE: It is an oxidizing agent which, in the presence of organic matter or if permitted to become alkaline, vigorously decomposes to oxygen and water. Hydrogen peroxide is used as a 6% solution for bleaching hair, and some disinfectant solutions for contact lenses contain a 3% hydrogen peroxide. Chlorine-free bleaches contain 6% hydrogen peroxide. Some newer fabric stain removers and bleaches contain 5% to 15% hydrogen peroxide. Industrial strengths of hydrogen peroxide are manufactured up to 90%. They are used mainly as bleaching and oxidizing agents. Solutions of 90% are used as rocket fuel.

Evidence for Carcinogenicity: Group 3: Not classifiable as to its carcinogenicity to humans

Exposure Routes: The substance can be absorbed into the body by inhalation of its vapour, by ingestion and through the skin.

Symptoms:

Inhalation Exposure: Sore Throat. Cough. Dizziness. Headache. Nausea. Shortness Of Breath.
Skin Exposure: MAY BE ABSORBED! Skin Discoloration. Swelling. Redness. Pain. Skin Burns.
Eye Exposure: Redness. Pain. Blurred vision. Corneal damage. Burns.
Ingestion Exposure: Aspiration hazard! Sore throat. Abdominal pain. Abdominal distension. Shock or collapse.

Target Organs: Eyes, Skin, Respiratory system (From the Nose to the Lungs)

Adverse Effects:
Dermatotoxin - Skin burns.
Toxic Pneumonitis - Inflammation of the lungs induced by inhalation of metal fumes or toxic gases and vapors.
ACGIH Carcinogen - Confirmed Animal.

Antidote and Emergency Treatment:

Immediate first aid: Ensure adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR if necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Oxidizers/

Basic treatment: Establish a patent airway (oropharyngeal or nasopharyngeal airway, if needed). Suction if necessary. Watch for signs of respiratory insufficiency and assist ventilations if necessary.

Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious, has severe pulmonary edema, or is in severe respiratory distress. Early intubation, at the first sign of upper airway obstruction, may be necessary. Positive-pressure ventilation techniques with a bag-valve-mask device may be beneficial. Consider drug therapy for pulmonary edema .... Monitor cardiac rhythm and treat arrhythmias as necessary

Human Toxicity Excerpts: /SIGNS AND SYMPTOMS/ Pure hydrogen peroxide, its solutions, vapors, and mists are very irritating to body tissue. This irritation can vary from mild to severe depending upon the concentration of hydrogen peroxide. For instance, solutions of hydrogen peroxide of 35 wt% and over can easily cause blistering of the skin. ... The eyes are particularly sensitive to this material.

Non-Human Toxicity Excerpts: /LABORATORY ANIMALS: Acute Exposure-This study developed a new mouse model for chronic cystitis using a single intravesical injection of 1.5% hydrogen peroxide (H_2O_2). The injection caused rapid and sustained bladder inflammation, increased voiding frequency, bladder weight, and urothelial damage, with effects lasting up to 7 days. Despite recovery of urothelial function, inflammation markers and vascular changes persisted. Anti-inflammatory and pain-relief drugs reduced the symptoms. The study concludes that H_2O_2-induced cystitis is a simple, effective model for studying chronic bladder inflammation and testing potential therapies.

SECTION 12: ECOLOGICAL INFORMATION

Natural Pollution Sources: Gaseous hydrogen peroxide is a key component and product of the earth's lower atmospheric photochemical reactions, in both clean and polluted atmospheres. Atmospheric hydrogen peroxide is believed to be generated exclusively by gas-phase photochemical reactions. It has been found in rain and surface water, in human and plant tissues, in foods and beverages and in bacteria (1). Hydrogen peroxide occurs in cloud water with higher values generally occurring in the vicinity of lightning activity (2).

Environmental Fate / Exposure Summary: TERRESTRIAL FATE: Hydrogen peroxide is unstable and breaks down rapidly to oxygen and water (1). Therefore, adsorption to soil, volatilization and biodegradation are not important environmental fate processes in soil (SRC). AQUATIC FATE: Hydrogen peroxide is unstable and breaks down rapidly to oxygen and water (1). Therefore, adsorption to suspended solids and sediment, volatilization, biodegradation and bioconcentration are not important environmental fate processes in water (SRC). ATMOSPHERIC FATE: Hydrogen peroxide is unstable and breaks down rapidly to oxygen and water. It is expected to be broken down by sunlight (1).

SECTION 13: DISPOSAL CONSIDERATION

Disposal Methods:

SRP: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in air, soil or water; effects on animal, aquatic and plant life; and conformance with environmental and public health regulations. If it is possible or reasonable use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination.

Wastewater from contaminant suppression, cleaning of protective clothing/equipment, or contaminated sites should be contained and evaluated for subject chemical or decomposition product concentrations. Concentrations shall be lower than applicable environmental discharge or disposal criteria. Alternatively, pretreatment and/or discharge to a permitted wastewater treatment facility is acceptable only after review by the governing authority and assurance that "pass through" violations will not occur. Due consideration shall be given to remediation worker exposure (inhalation, dermal and ingestion) as well as fate during treatment, transfer and disposal. If it is not practicable to manage the chemical in this fashion, it must be evaluated in accordance with EPA 40 CFR Part 261, specifically Subpart B, in order to determine the appropriate local, state and federal requirements for disposal.

SECTION 14: TRANSPORTATION INFORMATION

DOT Emergency Guidelines: /GUIDE 140 OXIDIZERS/ Fire or Explosion: These substances will accelerate burning when involved in a fire. Some may decompose explosively when heated or involved in a fire. May explode from heat or contamination. Some will react explosively with hydrocarbons (fuels). May ignite combustibles (wood, paper, oil, clothing, etc.). Containers may explode when heated. Runoff may create fire or explosion hazard. /Hydrogen peroxide, aqueous solution, with not less than 20% but not more than 60% Hydrogen peroxide (stabilized as necessary); Hydrogen peroxide, aqueous solution, with not less than 8% but less than 20% Hydrogen peroxide/

DOT ID and Guide: 2984 140 (8-20% solution)
2014 140 (20-60% solution)
2015 143 (>60% solution)

Shipping Name: UN 2014; Hydrogen, peroxide, aqueous solutions with more than 40 percent but not more than 60 percent hydrogen peroxide (stabilized as necessary); Hydrogen peroxide, aqueous solutions with not less than 20 percent but not more than 40 percent hydrogen peroxide (stabilized as necessary)

DOT Label: Oxidizer, Corrosive
Packaging and Labelling: Special material.

Shipment Methods and Regulations: No person may /transport, / offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177). /

UN Classification: UN Hazard Class: 5.1; UN Subsidiary Risks: 8; UN Pack Group: I

SECTION 15: REGULATORY INFORMATION

CERCLA Reportable Quantities: Releases of CERCLA hazardous substances are subject to the release reporting requirement of CERCLA section 103, codified at 40 CFR part 302, in addition to the requirements of 40 CFR part 355. Hydrogen peroxide (Conc >52%) is an extremely hazardous substance (EHS) subject to reporting requirements when stored in amounts in excess of its threshold planning quantity (TPQ) of 1,000 lbs.

FIFRA Requirements: when used as ingredients in an antimicrobial pesticide formulation may be applied to: Food-contact surfaces in public eating places, dairy-processing equipment, and food-processing equipment and utensils. Hydrogen peroxide is included on this list. Limit: When ready for use, the end-use concentration is not to exceed 91 ppm.

FDA Requirements: The Generic Animal Drug and Patent Restoration act requires that each sponsor of an approved animal drug must submit to the FDA certain information regarding patents held for the animal drug or its method of use. The Act requires that this information, as well as a list of all animal drug products approved for safety and effectiveness, be made available to the public. Hydrogen peroxide is included on this list.

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:
A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, Public Chemical Information (PubChem) - National Institutes of Health (NIH) -National Library of Medicine (NLM), Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS).

MATERIAL SAFETY DATA SHEET OF CAUSTIC SODA

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name : **Caustic Soda**
Chemical Formula : Sodium Hydroxide (NaOH)
CAS no. : 1310-73-2
UN No. : 1824
Synonymous : Caustic Soda, Soda Lye, Lye
General Use : In rayon, In pulp, textile, rubber, Aluminum and food industry, petroleum industry, In manufacturing of soaps and detergents, and in water treatment.
HAZCH : 2R
Label /Class : Class 8, corrosive

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :

GHS05

Irritant

Signal Word : Danger

GHS Hazard Statements : H402 - Harmful to aquatic life.
H314 (> 99.9%): Causes severe skin burns and eye damage [Danger Skin corrosion/irritation]
H290 (47.3%): May be corrosive to metals [Warning Corrosive to Metals]
H318 (43.8%): Causes serious eye damage [Danger Serious eye damage/eye irritation]
H319 (36.7%): Causes serious eye irritation [Warning Serious eye damage/eye irritation]
H315 (36.5%): Causes skin irritation [Warning Skin corrosion/ irritation]

NFPA Hazard Classification
NFPA 704 Diamond :

Diamond	Hazard	Value	Description
	◆ Health	3	Can cause serious or permanent injury.
	◆ Flammability	0	Will not burn under typical fire conditions.
	◆ Instability	1	Normally stable but can become unstable at elevated temperatures and pressures.
	◇ Special		

Precautionary Statement Codes: P234, P260, P264, P264 + P265, P280, P301 + P330 + P331, P302 + P352, P302 + P361 + P354, P304 + P340, P305 + P351 + P338, P305 + P354 + P338, P316, P317, P321, P332 + P317, P337 + P317, P362 + P364, P363, P390, P405, P406, and P501 (The corresponding statement to each P-code can be found at the GHS Classification page.)

Health Hazards : Strong corrosive action on contacted tissues. Inhalation: dust may cause damage to upper respiratory tract and lung itself, producing from mild nose irritation to pneumonitis. Ingestion: severe damage to mucous membranes; severe scar formation or perforation may occur. Eye Contact: produces severe damage.

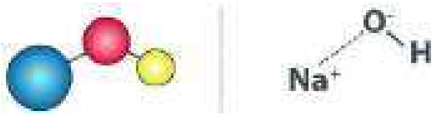
Fire Hazards : Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes. Some are oxidizers and may ignite combustibles (wood, paper, oil, clothing, etc.). Corrosives in contact with metals may evolve flammable hydrogen gas. Containers may explode when heated. For electric vehicles or equipment, ERG Guide 147 (lithium ion or sodium ion batteries) or ERG Guide 138 (sodium batteries) should also be consulted. (ERG, 2024)

Hazards Summary : When dissolved in water or neutralized with acid it liberates substantial heat, which may be sufficient to ignite combustible materials. Sodium hydroxide is very corrosive. It is generally used as a solid or a 50% solution. Other common names include caustic soda and lye.

Skin, Eye, and Respiratory Irritations: Liquid or solid sodium hydroxide is a severe skin irritant. It causes second and third degree burns on short contact and is very injurious to the eyes.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Structural Formula



Name : Sodium Hydroxide
Molecular Formula : $NaOH$
Molecular Weight : 40.0 g/mol
Chemical Family : Alkali Family – It is a base that can neutralize acids.
CAS No : 1310-73-2
Classification : Skin Corr. 1A, H314
Eye Dam. 1, H318
Aquatic Acute 3, H402

SECTION 4: FIRST-AID MEASURES

Eyes : Immediately flush eyes with lukewarm water for at least 20 minutes, hold eyelids open during flushing. If irritation persists, repeat flushing. Obtain medical attention IMMEDIATELY. Do not transport victim until the recommended flushing period is completed unless flushing can be continued during transport.

Skin : Immediately flush skin with water for at least 20 minutes, Remove contaminated clothing, jewelry, and shoes. If irritation persists, repeat flushing. Obtain medical attention immediately. Discard contaminated clothing and shoes in a manner which limits further exposure.

Inhalation : Prompt Medical Attention Is Mandatory in All Cases of Overexposure. Rescue Personnel Should Be Equipped with Self-Contained Breathing Apparatus. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given mouth-to-mouth resuscitation and supplemental oxygen. Keep the person warm and quiet. Assure that mucus or vomited material does not obstruct the airway by positional drainage.

Keep the patient under medical observation for at least 24 hours

Ingestion : Do not give anything by mouth to an unconscious person. Do not induce vomiting unless told to do so by doctor.

Most important symptoms/ effects, acute and or delayed : Eye Contact-Causes serious eye damage. Contact with rapidly expanding gas may cause burns or frostbite.
Inhalation- Fatal if inhaled. May cause respiratory irritation.
Skin contact- Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.
Frostbite- Try to warm up the frozen tissues and seek medical attention.

SECTION 5: FIRE -FIGHTING MEASURES

Excerpt from ERG Guide 154 [Substances - Toxic and/or Corrosive (Non-Combustible)]:

Small Fire : Dry chemical, CO_2 or water spray.

Large Fire : Dry chemical, CO_2, alcohol-resistant foam or water spray. If it can be done safely, move undamaged containers away from the area around the fire. Dike runoff from fire control for later disposal.

FIRE INVOLVING TANKS, RAIL TANK CARS OR HIGHWAY TANKS: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks in direct contact with flames. (ERG, 2024)

Fire Extinguishing Media : Use extinguishing media suitable for the surrounding fire.
If water is used, care should be taken, since it can generate heat and cause spattering if applied directly to sodium hydroxide.

Hazardous Decomposition Products: Sodium hydroxide will not burn or support combustion. The reaction of sodium hydroxide with water can generate sufficient heat to ignite nearby combustible materials. Sodium hydroxide can react with metals, such as aluminum, tin and zinc, to form flammable hydrogen gas.

Advice for firefighters :

Protective actions during Firefighting :

Avoid breathing fire gases or vapors. Evacuate area. Keep upwind to avoid inhalation of gases, vapors, fumes and smoke. Cool containers exposed to heat with water spray and remove them from the fire area if it can be done without risk. Cool containers exposed to flames with water until well after the fire is out. If a leak or spill has not ignited, use water spray to disperse vapors and protect men stopping the leak. Avoid discharge to the aquatic environment. Control run-off water by containing and keeping it out of sewers and watercourses. If risk of water pollution occurs, notify appropriate authorities.

Special protective equipment for firefighters : Regular protection may not be safe. Wear chemical protective suit. Wear positive-pressure self-contained breathing apparatus (SCBA) and appropriate protective clothing. Firefighter's clothing conforming to European standard EN469 (including helmets, protective boots and gloves) will provide a basic level of protection for chemical incidents.

Fire Fighting Procedures : Cool tanks/drums with water spray/remove them into safety. When cooling/extinguishing: no water in the substance. Take account of toxic firefighting water. Use water moderately and if possible, collect or contain it.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Immediate Precautionary Measure: Isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids.

Small Spills : Increase the immediate precautionary measure distance, in the downwind direction, as necessary.

Fire : If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024)

Cleanup Methods : Clear up spills immediately and dispose of waste safely. This product is corrosive. Small Spillages: Collect spillage. Large Spillages: Absorb spillage with non-combustible, absorbent material. The contaminated absorbent may pose the same hazard as the spilled material. Collect and place in suitable waste disposal containers and seal securely. Label the containers containing waste and contaminated materials and remove from the area as soon as possible. Flush contaminated area with plenty of water. Wash thoroughly after dealing with a spillage.

Preventive Measures : SRP: The scientific literature for the use of contact lenses by industrial workers is inconsistent. The benefits or detrimental effects of wearing contact lenses depend not only upon the substance, but also on factors including the form of the substance, characteristics and duration of the exposure, the uses of other eye protection equipment, and the hygiene of the lenses. However, there may be individual substances whose irritating or corrosive properties are such that the wearing of contact lenses would be harmful to the eye. In those specific cases, contact lenses should not be worn. In any event, the usual eye protection equipment should be worn even when contact lenses are in place.

SECTION 7: HANDLING AND STORAGE

Excerpt from ERG Guide 154 [Substances - Toxic and/or Corrosive (Non-Combustible)]:

Non-fire Spill Response : ELIMINATE all ignition sources (no smoking, flares, sparks or flames) from immediate area. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. DO NOT GET WATER INSIDE CONTAINERS. (ERG, 2024)

Protective Clothing : Wide-brimmed hat; safety goggles with rubber side shields; tight-fitting cotton clothing; rubber gloves under shirt cuffs; rubber boots and apron. (USCG, 1999)

Handling Precautions : Handle all packages and containers carefully to minimize spills. Keep container tightly sealed when not in use. Avoid the formation of mists. This product is corrosive. Immediate first aid is imperative. Do not handle until all safety precautions have been read and understood. Do not handle broken packages without protective equipment. Do not reuse empty containers

Storage Requirements : Storage temperatures: Stores must be heated by steam under 18 C. Temperature range must be between 29 – 38 C. It creates corrosion and iron rust occurs above this temperature. The substance is hygroscopic and carbonate is formed together with moisture and carbon dioxide in contact with air. Surroundings must be well ventilated when it is stored in closed area. Store away from incompatible materials. Store locked up. Keep only in the original container. Keep container tightly closed, in a cool, well-ventilated place. Keep containers upright. Protect containers from damage. Bund storage facilities to prevent soil and water pollution in the event of spillage. The storage area floor should be leak-tight, jointless and not absorbent

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Engineering Controls : Provide adequate ventilation. Personal, workplace environment or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Use process enclosures, local exhaust ventilation or other engineering controls as the primary means to minimize worker exposure. Personal protective equipment should only be used if worker exposure cannot be controlled adequately by the engineering control measures. Ensure control measures are regularly inspected and maintained. Ensure operatives are trained to minimize exposure.

Respiratory Protection : Respiratory protection complying with an approved standard should be worn if a risk.

Protective Clothing / Equipment: Wear tight-fitting, chemical splash goggles or face shield. If inhalation hazards exist, a full-face respirator may be required instead.

Environmental exposure Controls : Keep container tightly sealed when not in use. Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Exposure limits : Permissible Exposure Limit (PEL): 2.0 mg/m^3
Immediately Dangerous to Life or Health (IDLH): 10 mg/m^3
Threshold Limit Values (TLV)-TWA: 2.0 mg/m^3

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Physical state : Liquid
Boiling Point/ Range : >266 °F at 760 mmHg
Vapor Pressure : < 0.1 hPa at 20 ^{O}C
Vapor Density (Air = 1) : 2.5
Appearance : Colorless
Melting/Freezing point : 323 °C
Odor : Odourless
Density : 1.5 at 68 °F
Solubility in water : Very soluble in water.
Viscosity : 4.0 cP at 350 °C
Heat of vaporization : 175 kJ/mol at 1388 °C

SECTION 10: STABILITY & REACTIVITY

Stability : Hygroscopic. Unstable on exposure to air.
Hazardous poly Incompatibility : Water, Strong oxidizers, strong acids, metals, combustible materials
Hazardous Combustion/ Decomposition products : Does not decompose

SECTION 11: TOXICOLOGICAL INFORMATION

Route of exposure : Ingestion, Eyes, Inhalation, Skin Absorption

Symptoms related to physical, chemical & toxicological characteristics : Causes severe skin burns. Causes serious eye damage. Corrosion of the eye tissue. Permanent eye damage.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity : Not regarded as dangerous for the environment. However, large or frequent spills may have hazardous effects on the environment.

Environmental Biodegradation : BOD-None.

Soil Adsorption / Mobility : N/A

SECTION 13: DISPOSAL CONSIDERATION

Disposal Methods : SRP: The most favorable course of action is to use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier.

Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal and plant life; and conformance with environmental and public health regulations.

SECTION 14: TRANSPORTATION INFORMATION

Shipping Name: SODIUM HYDROXIDE
UN No.: 1824
Labels required: Corrosive, Class - 8

SECTION 15: REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture:

National regulations:
Health and Safety at Work etc. Act 1974 (as amended).
The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (SI 2009 No. 1348) (as amended) ["CDG 2009"].
EH40/2005 Workplace exposure limits.

EU legislation:
Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) (as amended).
Commission Regulation (EU) No 2015/830 of 28 May 2015.

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:

A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, PubChem, Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS), Safe Work Australia

MATERIAL SAFETY DATA SHEET OF HYDROCHLORIC ACID

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name : **HYDROCHLORIC ACID**
Chemical Formula : HCl (In Aqueous Solution)
CAS no. : 7732-18-5 – Water (62-68%)
7647-01-0 - Hydrogen Chloride (32-38%)
UN No. : 1789
Molecular Weight : 36.46 g/mol
Synonymous : Muriatic Acid; Chlorohydric Acid; Hydrogen Chloride in Aqueous Solution.
HAZCH : 2R
Label /Class : Corrosive
General Use : It is used in Textiles, Steel and Galvanizing Industry, Metal Pickling, Gelatin, Dyestuffs, Pharmaceuticals, Synthetic Rubber, Metal Chlorides Manufacturing, PVC and Sugar Industry.

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :


Compressed Gas


Corrosive


Acute Toxic


Irritant

Signal Word : Danger!

GHS Hazard Statements : H314 (> 99.9%): Causes severe skin burns and eye damage [Danger Skin corrosion/irritation]
H318 (19.8%): Causes serious eye damage [Danger Serious eye damage/eye irritation]
H331 (47.1%): Toxic if inhaled [Danger Acute toxicity, inhalation]
H335 (61.7%): May cause respiratory irritation [Warning Specific target organ toxicity, single exposure; Respiratory tract irritation]

Skin corrosion : category 1B
NFPA Hazard Classification
NFPA 704 Diamond :

Diamond	Hazard	Value	Description
	◆ Health	3	Can cause serious or permanent injury.
	◆ Flammability	0	Will not burn under typical fire conditions.
	◆ Instability	1	Normally stable but can become unstable at elevated temperatures and pressures.
	◇ Special		

Health Hazards : Inhalation of fumes results in coughing and choking sensation, and irritation of nose and lungs. Liquid causes burns. TOXIC and/or CORROSIVE; may be fatal if inhaled, ingested or absorbed through skin. Vapors are extremely irritating and corrosive. Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite. Fire will produce irritating, corrosive and/or toxic gases. Runoff from fire control or dilution water may cause environmental contamination.

Fire Hazards : Fire may produce irritating or poisonous gases. Containers may explode in heat of fire. At high temperatures, it decomposes into hydrogen and chlorine.

Hazards Summary : At room temperature, hydrogen chloride is a colorless to slightly yellow, corrosive, nonflammable gas that is heavier than air and has a strong irritating odor. On exposure to air, hydrogen chloride forms dense white corrosive vapors. Hydrogen chloride can be released from volcanoes. Hydrogen chloride has many uses, including cleaning, pickling, electroplating metals, tanning leather, and refining and producing a wide variety of products. Hydrogen chloride can be formed during the burning of many plastics. Upon contact with water, it forms hydrochloric acid. Both hydrogen chloride and hydrochloric acid are corrosive.

Skin, Eye, and Respiratory Irritations : An aqueous solution (4%) of hydrogen chloride was slightly irritating, and a 10% solution was determined to be 'Irritating to skin

Potential Acute Health Effects:

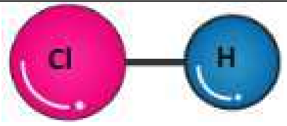
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:

Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target p. 2 organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Structural Formula :



Chemical Family : Acid

Molecular weight : 36.46 g/mol

CAS No : 7647-01-0 (HCl) 7732-18-5 (H2O)

Molecular Formula : HCl

Name : Hydrogen Chloride

Product identifier : 7647-01-0

% : 9-36% (HCl) 91 – 63% (H2O)

Classification : Causes severe skin burns and eye damage. Causes serious eye damage. Harmful if swallowed. Harmful if inhaled. Causes damage to organs through prolonged or repeated exposure (teeth)

SECTION 4: FIRST-AID MEASURES

INHALATION: remove person to fresh air; keep him warm and quiet and get medical attention immediately; start artificial respiration if breathing stops.

INGESTION: have person drink water or milk; do NOT induce vomiting.

EYES: immediately flush with plenty of water for at least 15 min. and get medical attention; continue flushing for another 15 min. if physician does not arrive promptly.

SKIN: immediately flush skin while removing contaminated clothing; get medical attention promptly; use soap and wash area for at least 15 min. (USCG, 1999)

Warning: Hydrogen chloride is extremely corrosive. Caution is advised.

Signs and Symptoms of Acute Hydrogen Chloride Exposure: Signs and symptoms of acute ingestion of hydrogen chloride may be severe and include salivation, intense thirst, difficulty in swallowing, chills, pain, and shock. Oral, esophageal, and stomach burns are common. Vomitus generally has a coffee-ground appearance. The potential for circulatory collapse is high following ingestion of hydrogen chloride. Acute inhalation exposure of hydrogen chloride may result in sneezing, hoarseness, choking, laryngitis, and respiratory tract irritation. Bleeding of nose and gums, ulceration of the nasal and oral mucosa, bronchitis, pneumonia, dyspnea (shortness of breath), chest pain, and pulmonary edema may also occur. If the eyes have come in contact with hydrogen chloride, irritation, pain, swelling, corneal erosion, and blindness may result. Dermal exposure may result in dermatitis (red, inflamed skin), severe burns, and pain.

Emergency Life-Support Procedures: Acute exposure to hydrogen chloride may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination.

Inhalation Exposure:

1. Move victims to fresh air. Emergency personnel should avoid self-exposure to hydrogen chloride.
2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support.
3. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures.
4. RUSH to a health care facility.

Dermal/Eye Exposure:

1. Remove victims from exposure. Emergency personnel should avoid self- exposure to hydrogen chloride.
2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support.
3. Remove contaminated clothing as soon as possible.
4. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes.
5. Wash exposed skin areas THOROUGHLY with soap and water.
6. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures.
7. RUSH to a health care facility.

Ingestion Exposure:

1. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support.
2. DO NOT induce vomiting or attempt to neutralize!
3. Rinse mouth with large amounts of water. Victims should not attempt to swallow this water.
4. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures.
5. Activated charcoal is of no value.
6. Give the victims water or milk: children up to 1 year old, 125 mL (4 oz or 1/2 cup); children 1 to 12 years old, 200 mL (6 oz or 3/4 cup); adults, 250 mL (8 oz or 1 cup). Water or milk should be given only if victims are conscious and alert.
7. RUSH to a health care facility. (EPA, 1998)

Excerpt from NIOSH Pocket Guide for Hydrogen chloride:

Eye:

- IRRIGATE IMMEDIATELY (SOLUTION) - If this chemical in solution contacts the eyes, immediately wash (irrigate) the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately.

- FROSTBITE - If eye tissue is frozen, seek medical attention immediately; if tissue is not frozen, immediately and thoroughly flush the eyes with large amounts of water for at least 15 minutes, occasionally lifting the lower and upper eyelids. If irritation, pain, swelling, lacrimation, or photophobia persist, get medical attention as soon as possible.

Skin:

- WATER FLUSH IMMEDIATELY (SOLUTION) - If this chemical in solution contacts the skin, immediately flush the contaminated skin with water. If this chemical penetrates the clothing, immediately remove the clothing and flush the skin with water. Get medical attention promptly.

- FROSTBITE - If frostbite has occurred, seek medical attention immediately; do NOT rub the affected areas or flush them with water. In order to prevent further tissue damage, do NOT attempt to remove frozen clothing from frostbitten areas. If frostbite has NOT occurred, immediately and thoroughly wash contaminated skin with soap and water.

Breathing: RESPIRATORY SUPPORT - If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

Swallow: MEDICAL ATTENTION IMMEDIATELY (SOLUTION) - If this chemical in solution has been swallowed, get medical attention immediately. (NIOSH, 2024)

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : Non-Combustible.
Flammability Range : Non-Flammable
Lower Explosive Limit (LEL) : Not combustible.
Upper Explosive Limit (UEL) : Not combustible.
Auto Ignition Temperature : Non-Combustible.
Flammability Classification : Non-Flammable.
Extinguishing Media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unusual Fire/Explosion Hazards: Non-explosive in presence of open flames and sparks, of shocks.

Advice for firefighters : Do not stay in dangerous zone without self-contained breathing apparatus. In order to avoid contact with skin, keep a safety distance and wear suitable protective clothing.

Small Fire : CO_2 (except for Cyanides), dry chemical, dry sand, alcohol-resistant foam.

Large Fire : Water spray, fog or alcohol-resistant foam. If it can be done safely, move undamaged containers away from the area around the fire. Avoid aiming straight or solid streams directly onto the product. Dike runoff from fire control for later disposal.

Fire involving Tanks, Rail Tank Cars or Highway Tanks:
Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks in direct contact with flames. (ERG, 2024)

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures:

Evacuate personnel to safe areas. Do not breathe vapors or spray mist. Wear a positive-pressure supplied-air respirator, flame retardant antistatic protective clothing. Shut off leaks if without risk. Keep people away from and upwind of spill/leak.

For non-emergency personnel: Emergency procedures: Avoid contact with skin, eyes and clothing.

For emergency responders: Protective equipment: Use personal protective equipment as required.

Environmental precautions: Contain or absorb leaking liquid with sand or earth, consults an expert. Prevent liquid entering sewers, basements and work pits. If substance has entered a water course or sewer or contaminated soil, advise policy.
Keep away from drains, surface and ground water. Retain contaminated washing water and dispose of it. The product is an acid. Before discharge into sewage plants the product normally needs to be neutralized.

Methods and material for containment and cleaning up :

Methods for cleaning up : Clean contaminated surfaces with an excess of water.

Small Spill : Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary, Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill : Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

SECTION 7: HANDLING AND STORAGE

Precautions:

Keep locked up. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:

Keep container tightly closed. Keep container in a cool, well-ventilated area

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

NFPA Rating	Health	3	Flammability	0
	Stability	0	Reactivity	1

ACGIH Time-Weighted Average (TLV-TWA):	2 ppm ,8-hr TWA
Short-Term Exposure Limit (TLV-STEL):	NA
IDLH- Immediately Dangerous to Life and Health:	50 ppm
OSHA PEL-Permissible Exposure Limit:	5 ppm , 8-hr TWA

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Physical State : Liquid
Boiling Point/ Range, ^{0}C : 83 Deg C @ 760 mmHg
Vapor Pressure at : 84 mm Hg @ 20 Deg C
Appearance : Clear, Colorless To Pale Yellow
Melting/Freezing Point, ^{0}C : -66 ^{0}C
Odor : Pungent. Irritating (Strong.)
Vapor Density (Air=1) : 1.27
Solubility in Water : Soluble
Specific Gravity, (Water-1) : 1.19 (38%)
Evaporation Rate at : > 1.00 (N-Butyl Acetate)
Critical Temperature : 51.4 °C
Critical Pressure : 81.6 atm

SECTION 10: STABILITY & REACTIVITY

Stability : The Product Is Stable.
Reactivity Profile:
HYDROCHLORIC ACID is an aqueous solution of hydrogen chloride, an acidic gas. Reacts exothermically with organic bases (amines, amides) and inorganic bases (oxides and hydroxides of metals). Reacts exothermically with carbonates (including limestone and building materials containing limestone) and hydrogen carbonates to generate carbon dioxide. Reacts with sulfides, carbides, borides, and phosphides to generate toxic or flammable gases. Reacts with many metals

Hazardous Reactivities and Incompatibilities :
The aqueous solution is a strong acid. Corrosive fumes emitted on contact with air. Reacts violently with bases, oxidizers forming toxic chlorine gas. Reacts, often violently, with acetic anhydride, active metals, aliphatic amines

SECTION 11: TOXICOLOGICAL INFORMATION

Human Exposure and Toxicity:	Hydrogen chloride will rapidly dissociate and its effects are thought to be a result of pH change (local deposition of H+) rather than effects of hydrogen chloride/hydrochloric acid. Hydrogen chloride is corrosive to the skin and severe effects can be expected from exposure to the eyes. No skin sensitization has been reported. The irritation of hydrogen chloride to mucous is so severe that workers evacuate from the work place shortly after detecting its odor.

SECTION 12: ECOLOGICAL INFORMATION

N/A

SECTION 13: DISPOSAL CONSIDERATION

Waste treatment methods:

Waste treatment-relevant information:
Recycling/reclamation of other inorganic materials. Regeneration of acids.

Sewage disposal-relevant information:
Do not empty into drains. Avoid release to the environment. Refer to special instructions/safety data sheets.

Waste treatment of containers/packaging:
It is a dangerous waste; only packaging which are approved (e.g. acc. to ADR) may be used. Completely emptied packages can be recycled. Handle contaminated packages in the same way as the substance itself.

SECTION 14: TRANSPORTATION INFORMATION

Shipping Name: Hydrogen chloride
UN Number: UN 1050
UN Hazard Class: 2.3
DOT Label: Corrosive
DOT Emergency Guidelines:
THERE IS NO FIRE, go directly to the Table of Initial Isolation and Protective Action Distances to obtain initial isolation and protective action distances. IF THERE IS A FIRE, or IF A FIRE IS INVOLVED, go directly to the appropriate guide.

SECTION 15: REGULATORY INFORMATION

Clean Water Act Requirements: Hydrochloric acid is designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. This designation includes any isomers and hydrates, as well as any solutions and mixtures containing this substance.

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:

A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, PubChem, Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS), Safe Work Australia.

MATERIAL SAFETY DATA SHEET OF CHLORINE DIOXIDE

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name	: **CHLORINE DIOXIDE**
Chemical Formula	: ClO_2
CAS no.	: 10049-04-4
UN No.	: 9191
Synonyms	: chlorine peroxide, Chlorine (IV) oxide, Alcide, Anthium Dioxide.
HAZCHEM Code	: 2XC
Label /Class	: Oxidizer Poison
General Use	: Used in bleaching wood pulp (95% of use); Also used in bleaching textiles; disinfecting hospital equipment; disinfecting fruits, vegetables, and meats; and treating municipal water.

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :

Oxidizer

Compressed Gas

Corrosive

Acute Toxic

Irritant

Environmental Hazard

Signal Word : Danger

GHS Hazard Statements:
H270 (29.9%): May cause or intensify fire; oxidizer [Danger Oxidizing gases]
H280 (29.2%): Contains gas under pressure; may explode if heated [Warning Gases under pressure]
H301 (72.1%): Toxic if swallowed [Danger Acute toxicity, oral]
H314 (76.2%): Causes severe skin burns and eye damage [Danger Skin corrosion/irritation]
H318 (46.3%): Causes serious eye damage [Danger Serious eye damage/eye irritation]
H319 (24.0%): Causes serious eye irritation [Warning Serious eye damage/eye irritation]
H330 (29.9%): Fatal if inhaled [Danger Acute toxicity, inhalation]
H332 (15.9%): Harmful if inhaled [Warning Acute toxicity, inhalation]
H400 (76.2%): Very toxic to aquatic life [Warning Hazardous to the aquatic environment, acute hazard]

Precautionary Statement Codes:
P220, P244, P260, P261, P264, P264+ P265, P270, P271, P273, P280, P284, P301+ P316, P301+ P330+ P331, P302+ P361+ P354, P304 + P340, P305 + P351 + P338, P305 + P354 + P338, P316, P317, P320, P321, P330, P337 + P317, P363, P370 + P376, P391, P403, P403 + P233, P405, P410 + P403, and P501

(The corresponding statement to each P-code can be found at the GHS Classification page.)

Hazard Classes and Categories:	Gases under pressure Oxidizing gas - category 1 Acute toxicity - category 2 Skin corrosion - category 1B Hazardous to the aquatic environment (acute) - category 1

NFPA Hazard Classification

NFPA 704 Diamond: Data Unavailable

Health Hazards: Excerpt from ERG Guide 143 [Oxidizers (Unstable)]; TOXIC; inhalation, ingestion or contact (skin, eyes) with vapors, dusts or substance may cause severe injury, burns or death. Fire may produce irritating and/or toxic gases. Toxic fumes or dust may accumulate in confined areas (basement, tanks, hopper/tank cars, etc.). Runoff from fire control or dilution water may cause environmental contamination. (ERG, 2024)

MATERIAL SAFETY DATA SHEET OF CHLORINE DIOXIDE

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

Fire Hazards: Excerpt from ERG Guide 143 [Oxidizers (Unstable)]; May explode from friction, heat or contamination. These substances will accelerate burning when involved in a fire. May ignite combustibles (wood, paper, oil, clothing, etc.). Some will react explosively with hydrocarbons (fuels). Containers may explode when heated. Runoff may create fire or explosion hazard. (ERG, 2024)

Hazards Summary: Chlorine dioxide is a yellow to reddish-yellow manufactured gas. It does not occur naturally in the environment. When added to water, chlorine dioxide forms chlorite ion, which is also a very reactive chemical. Chlorine dioxide is used as a bleaching agent at paper manufacturing plants, and in public water treatment facilities to make water safe to drink. In 2001, chlorine dioxide and chlorite were used to decontaminate a number of public buildings following the release of anthrax spores in the United States.

Skin, Eye, and Respiratory Irritations: Potential symptoms of overexposure are irritation of eyes, nose, and throat; coughing, wheezing, bronchitis, pulmonary edema; chronic bronchitis.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Structural Formula	:	
Chemical Family	:	Inorganic Compounds.
Molecular weight	:	67.45 g/mol
CAS No	:	10049-04-4
Molecular Formula	:	ClO_2
Name	:	Chlorine Dioxide
Identification and Use	:	General Use: Bleaching cellulose, paper-pulp, flour, leather, fats and oils, textiles, beeswax; purification of water; taste and odor control of water; cleaning and detaining leather; manufacture of chloride salts; oxidizing agent; bactericide, antiseptic and deodorizer. Used in Industrial Processes with risk of exposure - Pulp and Paper Processing [Category: Industry] Textiles (Fiber & Fabric Manufacturing) [Category: Industry] Using Disinfectants or Biocides [Category: Clean] Sewer and Wastewater Treatment [Category: Industry] Toxic Gas from Spilling Chemical in Water [Category: Other].

SECTION 4: FIRST-AID MEASURES

Excerpt from NIOSH Pocket Guide for Chlorine dioxide:

Eye: IRRIGATE IMMEDIATELY (LIQUID) - If this chemical in liquid form contacts the eyes, immediately wash (irrigate) the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately.

Skin: SOAP WASH IMMEDIATELY (LIQUID) - If this chemical in liquid form contacts the skin, immediately wash the contaminated skin with soap and water. If this chemical penetrates the clothing, immediately remove the clothing, wash the skin with soap and water, and get medical attention promptly.

Breathing: RESPIRATORY SUPPORT - If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

Swallow: MEDICAL ATTENTION IMMEDIATELY (LIQUID) - If this chemical in liquid form has been swallowed, get medical attention immediately. (NIOSH, 2024)

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : Data Unavailable

Auto ignition Temperature : Data Unavailable

LEL : Data Unavailable

UEL : Data Unavailable

Flammability Classification : Flammable Gas/Combustible Liquid

Conditions of Flammability : Chlorine dioxide gas may decompose autocatalytically with a pink/violet flame which may ignite combustible materials. This flame can be extinguished by diluting/ cooling with air. Chlorine dioxide does not require air for it to burn.

Extinguishing Media : When combustibles are burning in the presence of chlorine dioxide (or other strong oxidizers) water is the only effective extinguishing medium.

Fire Fighting:
Excerpt from ERG Guide 143 [Oxidizers (Unstable)]:

SMALL FIRE: Use water. Do not use dry chemicals or foams. CO_2 may provide limited control.

LARGE FIRE: Flood fire area with water from a distance. Do not move cargo or vehicle if cargo has been exposed to heat. If it can be done safely, move undamaged containers away from the area around the fire. Do not get water inside containers: a violent reaction may occur.

FIRE INVOLVING TANKS, RAIL TANK CARS OR HIGHWAY TANKS: Cool containers with flooding quantities of water until well after fire is out. Dike runoff from fire control for later disposal. ALWAYS stay away from tanks in direct contact with flames. For massive fire, use unmanned master stream devices or monitor nozzles; if this is impossible, withdraw from area and let fire burn. (ERG, 2024)
Fire Fighting Procedures: If material on fire or involved in fire: Use water in flooding quantities as fog. Cool all affected containers with flooding quantities of water. Extinguish fire using agent suitable for type of surrounding fire.

Firefighting Hazards: A powerful oxidizer, this chemical will increase the intensity of a fire, and can cause fire upon contact with combustibles. ... Vapors are heavier than air and will collect in low areas. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions.

Antidote and Emergency Treatment

Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR if necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Chlorine and related compounds/.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Spill or Leak:

- Do not touch or walk through spilled material.
- Keep combustibles (wood, paper, oil, etc.) away from spilled material.
- Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
- Use water spray to reduce vapors or divert vapor cloud drift.
- Prevent entry into waterways, sewers, basements or confined areas.
- Small Spill: Flush area with large amounts of water.
- Large Spill: Do Not Clean-Up or Dispose of, Except Under Supervision of a Specialist.

Isolation and Evacuation:

Excerpt from ERG Guide 143 [Oxidizers (Unstable)]:

Immediate Precautionary Measure: Isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids.

SPILL: See ERG Table 1 - Initial Isolation and Protective Action Distances on the UN/NA 9191 datasheet.

FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024).

Spillage Disposal: Evacuate danger area! Consult an expert! Personal protection: complete protective clothing including self-contained breathing apparatus. Ventilation. Remove gas with fine water spray.

Cleanup Methods: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until cleanup is complete. Remove all ignition sources. Ventilate area of leak or spill. If the gas is leaked, stop the flow of gas if it can be done safely. If the source of the leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air and repair the leak or allow the cylinder to empty. If the leak can be stopped in place, bubble chlorine dioxide through a solution made up of reducing agent sodium bisulfide and sodium bicarbonate with a trap in the line. For liquid spills, allow chlorine dioxide to evaporate with all available ventilation. Keep chlorine dioxide out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the buildup of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters.

Disposal Methods: See Section 13 for more details.

Preventive Measures:

Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

The scientific literature for the use of contact lenses by industrial workers is inconsistent. The benefits or detrimental effects of wearing contact lenses depend not only upon the substance, but also on factors including the form of the substance, characteristics and duration of the exposure, the uses of other eye protection equipment, and the hygiene of the lenses. However, there may be individual substances whose irritating or corrosive properties are such that the wearing of contact lenses would be harmful to the eye. In those specific cases, contact lenses should not be worn. In any event, the usual eye protection equipment should be worn even when contact lenses are in place.

SECTION 7: HANDLING AND STORAGE

Non-fire Spill Response:

Excerpt from ERG Guide 143 [Oxidizers (Unstable)]:

Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Use water spray to reduce vapors or divert vapor cloud drift. Prevent entry into waterways, sewers, basements or confined areas.

SMALL SPILL: Flush area with large amounts of water.

LARGE SPILL: DO NOT CLEAN-UP OR DISPOSE OF, EXCEPT UNDER SUPERVISION OF A SPECIALIST. (ERG, 2024)

Safe Storage: Fireproof if in building. Separated from combustible substances and reducing agents. Cool. Keep in the dark. Ventilation along the floor.

Storage Conditions: Store separately from all other flammable materials. Prior to working with chlorine dioxide, you should be trained on its proper handling and storage. This chemical is a powerful oxidizer, and is shock-, light- and heat sensitive. It is violently explosive in air at concentrations over 10%. Keep frozen when not in use. Store in tightly closed containers in a cool, dark, well-ventilated area at temperatures well below 130 °C. Gas explosions may occur above 130 °C. Use only no sparking tools and equipment, especially when opening and closing containers of this chemical. Sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Use explosion-proof electrical equipment and fittings in storage area.

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Protective Clothing:

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer when there is NO RISK OF FIRE.
- Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.

Control parameters:

Threshold Limit Values (TLV)	0.1 ppm, 8-hr TWA
IDLH- Immediately Dangerous to Life and Health:	5 ppm
REL-STEL (Short Term Exposure Limit)	0.3 ppm (0.9 mg/m^3)
Recommended Exposure Limit (REL)	0.1 ppm (0.3 mg/cu m). 10-hr TWA
OSHA PEL-Permissible Exposure Limit:	0.1 ppm (0.3 mg/cu m), 8-hr TWA

Effects of Short-Term Exposure:

The substance is severely irritating to the eyes, skin and respiratory tract. Inhalation of this gas may cause lung oedema. Exposure far above the OEL could cause death. The effects may be delayed. Medical observation is indicated.

Effects of Long-Term Exposure:

The substance may have effects on the lungs. This may result in chronic bronchitis.

Personal Protective Equipment (PPE):

Excerpt from NIOSH Pocket Guide for Chlorine dioxide external link:

Skin: PREVENT SKIN CONTACT (LIQUID) - If this chemical is in liquid form, wear appropriate personal protective clothing to prevent skin contact.

Eyes: PREVENT EYE CONTACT (LIQUID) - If this chemical is in liquid form, wear appropriate eye protection to prevent eye contact.

Wash skin: WHEN CONTAMINATED (LIQUID) - If this chemical is in liquid form, the worker should immediately wash the skin when it becomes contaminated.

Remove: WHEN WET (FLAMMABLE) - Work clothing that becomes wet should be immediately removed due to its flammability hazard (i.e., for liquids with a flash point <100°F).

Change: No recommendation is made specifying the need for the worker to change clothing after the work shift.

Provide:

- EYEWASH (LIQUID) - Eyewash fountains should be provided (when this chemical is in liquid form) in areas where there is any possibility that workers could be exposed to the substances; this is irrespective of the recommendation involving the wearing of eye protection.

- QUICK DRENCH (LIQUID) - Facilities for quickly drenching the body should be provided (when this chemical is in liquid form) within the immediate work area for emergency use where there is a possibility of exposure. [Note: It is intended that these facilities provide a sufficient quantity or flow of water to quickly remove the substance from anybody areas likely to be exposed. The actual determination of what constitutes an adequate quick drench facility depends on the specific circumstances. In certain instances, a deluge shower should be readily available, whereas in others, the availability of water from a sink or hose could be considered adequate.] (NIOSH, 2024).

Preventions:

Fire Prevention: NO contact with combustible substances. Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT expose to friction or shock.
Exposure Prevention: AVOID ALL CONTACT! IN ALL CASES CONSULT A DOCTOR!
Inhalation Prevention: Use closed system or ventilation.
Skin Prevention: Protective gloves. Protective clothing.
Eye Prevention: Wear safety goggles or eye protection in combination with breathing protection.

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Molecular Weight	:	67.45 g/mol
Physical Description	:	Chlorine dioxide hydrate, frozen is an orange colored solid, appearing as a block of ice, with a faint odor of chlorine. It may only be shipped in the frozen state and then only by private or contract motor carrier.
Appearance	:	Yellow to red gas or a red-brown liquid
Odor	:	Unpleasant odor similar to chlorine and nitric acid.
Boiling Point/ Range, ^{0}C	:	52 °F or 11.1^{o}C at 760 mmHg
Melting/Freezing Point, ^{0}C	:	-74 °F or -58.9 ^{0}C
Vapor Pressure at	:	> 1 atm or 101 kPa at 20 °C /758 mm Hg at 20 °C
Vapor Density (Air=1)	:	2.33 - Heavier than air; will sink
Density	:	1.6 (Liquid at 32 °F or 0 ^{O}C) - Denser than water; will sink
Solubility in Water	:	0.3 % at 77 °F or 25 ^{O}C
Heat of Combustion	:	Standard net heat of combustion (gas): -102.5 kJ/mol
Heat of Vaporization	:	30 kJ/mol at 11 °C
Critical Temperature	:	465K
Critical Pressure	:	8621.6 kPa
Odor Threshold	:	Low: 0.1 [ppm] High: 15.0 [ppm]

SECTION 10: STABILITY & REACTIVITY

Air and Water Reactions: Decomposes in water, products likely to include gaseous Cl2 (Lewis 2000). Reacts with water to produce toxic and corrosive fumes of chlorine. Based on a scenario where the chemical is spilled into an excess of water (at least 5-fold excess of water), half of the maximum theoretical yield of Chlorine gas will be created in 0.14 minutes.

Stability: Unstable in light; stable in dark if pure, but chlorides catalyze its decomposition even in the dark.

Reactivity: Reactive Group - Strong Oxidizing Agent, Halogenating Agents

Reactivity Alerts: Explosive, Strong Oxidizing Agent, Water-Reactive

Reactivity Profile: Chlorine Dioxide is a powerful oxidizer of low stability. Explodes violently on the slightest provocation as gas or liquid even below -100 °C by impact. Concentrations of greater than 10% in air are explosive. Severe explosion hazard when heated to 100 °C. Sensitive to shock and sunlight. Very sensitive to the presence of any easily oxidized material. These may, even in minute quantities, trigger a decomposition. Emits highly toxic fumes of chlorine gas upon decomposition.

Hazardous Incompatible materials: Mixtures with carbon monoxide, methane, ethane, propane, ethylene or butadiene always explode spontaneously. Materials such as rubber, hydrocarbons, carbon, iron, rust, reactive metals, and organics such as sawdust have all caused problems. Can react violently with fluorine, reducing reagents or finally dispersed organic matter.

SECTION 11: TOXICOLOGICAL INFORMATION

Toxicity Summary:

Identification and Use: Chlorine dioxide is a yellowish-brown gas with unpleasant odor similar to chlorine and nitric acid. Its uses include bleaching cellulose, paper-pulp, flour, leather, fats and oils, textiles, and beeswax. It is also used for purification of water, taste and odor control of water, cleaning and detaining leather, in the manufacture of chloride salts, and as an oxidizing agent, bactericide, antiseptic and deodorizer. Chlorine dioxide was found to be highly effective against various microorganisms tested at very low concentrations in a minimum contact time of 30 to 60 seconds.

Human Exposure and Toxicity: An assessment of the safety of chronically administered chlorine water disinfectants in man was conducted in 3 phases. Phase I, a rising dose tolerance investigation, examined the effects of single dose incr concn admin of disinfectants to normal healthy adult male volunteers. Phase II considered the impact on normal subjects of 12 wk daily ingestion of the disinfectants at a concn of 5 mg/L. In phase III, chlorite, at a concn of 5 mg/L, was administered daily to glucose 6-phosphate dehydrogenase (G-6-PD)-deficient subjects. The study affirmed the relative safety and tolerance of normal healthy adult males and normal healthy adult male G-6-PD-deficient individuals to daily 12 wk ingestion of 500 mL of chlorine disinfectants at a concentration of 5 mg/L. /Disinfection byproducts/.

Exposure Routes: inhalation, ingestion (liquid), skin and/or eye contact

Symptoms:
Potential symptoms of overexposure are irritation of eyes, nose, and throat; coughing, wheezing, bronchitis, pulmonary edema; chronic bronchitis.

A 5ppm concentration of chlorine dioxide was definitely irritating and 19 ppm of the gas inside a bleach tank was more than sufficient to cause the death of one worker (time of exposure not specified) Based on these findings, /investigators/ suggested in 1950 a maximal acceptable concentration of 1 ppm.

Target Organs: Developmental (effects while organs are developing), Gastrointestinal (Stomach and Intestines, part of the digestive system), Respiratory (From the Nose to the Lungs)

Immediate first aid: Ensure that adequate decontamination has been carried out as needed. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR if necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Choking Agents (Pulmonary/Lung-Damaging Agents)/

Non-Human Toxicity Excerpts: Chlorine dioxide (ClO_2) is toxic gas that, when inhaled pulmonary edema and emphysema were seen in all groups of chlorine dioxide-exposed animals, with the incidence increasing in a dose-related manner. General clinical signs of toxicity were observed among all treated groups of animals; in addition, there were occasional observations of red nasal discharge.

Macroscopically, at 40 and 80 mg/kg body weight only, animals showed signs of corrosive activity in the stomach and gastrointestinal tract. There were no other treatment-related macroscopic abnormalities.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity Studies:

/AQUATIC SPECIES/ Environmental effect evaluation of disinfection of combined sewer overflow events with alternative chemical disinfectants requires that the environmental toxicity of the disinfectants and the main by-products of their use are known. Many disinfectants degrade quickly in water which should be included in the evaluation of both their toxicity as determined in standardized tests and their possible negative effect in the water environment.

Environmental Fate / Exposure Summary:

It is generally accepted that the predominant reaction product of chlorine dioxide in water treatment is chlorite and that chlorate and other ions are produced in minor amounts ... an approximately 50% conversion of chlorine dioxide to chlorite was reported ... /in/ water containing natural humic acids.

Hydrogen peroxide (H2O2), chlorite, chlorate, Cl2O3, oxygen (O2), and chlorine have all been reported as intermediates or products /of chlorine dioxide breakdown/. Presumably chlorine dioxide will not persist in open basins or reservoirs, although it can remain for days in clean distribution systems.

Environmental Abiotic Degradation

Since chlorite is formed at a rate of 50% of the chlorine dioxide demand, serious consideration must be given to limiting chlorite formation before chlorine dioxide is adopted as disinfectant to replace chlorine.

SECTION 13: DISPOSAL CONSIDERATION

Disposal Methods:

Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in air, soil or water; effects on animal, aquatic and plant life; and conformance with environmental and public health regulations. If it is possible or reasonable use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination.

Wastewater from contaminant suppression, cleaning of protective clothing/equipment, or contaminated sites should be contained and evaluated for subject chemical or decomposition product concentrations. Concentrations shall be lower than applicable environmental discharge or disposal criteria. Alternatively, pretreatment and/or discharge to a permitted wastewater treatment facility is acceptable only after review by the governing authority and assurance that "pass through" violations will not occur. Due consideration shall be given to remediation worker exposure (inhalation, dermal and ingestion) as well as fate during treatment, transfer and disposal. If it is not practicable to manage the chemical in this fashion, it must be evaluated in accordance with EPA 40 CFR Part 261, specifically Subpart B, in order to determine the appropriate local, state and federal requirements for disposal.

SECTION 14: TRANSPORTATION INFORMATION

DOT ID and Guide: 9191 143 (hydrate, frozen)

DOT Label: Oxidizer Poison

Standard Transportation Number: 49 181 10; Chlorine dioxide hydrate, frozen

Shipment Methods and Regulations:

No person may /transport/ offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177)/

SECTION 15: REGULATORY INFORMATION

FIFRA Requirements: Residues of the following chemical substances are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food.

FDA Requirements

Chlorine dioxide (CAS Reg. No. 10049-04-4) may be safely used in food in accordance with the following prescribed conditions: (a)(1) The additive is generated by one of the following methods: (i) Treating an aqueous solution of sodium chlorite with either chlorine gas or a mixture of sodium hypochlorite and hydrochloric acid. (ii) Treating an aqueous solution of sodium chlorate with hydrogen peroxide in the presence of sulfuric acid. (iii) Treating an aqueous solution of sodium chlorite by electrolysis. (2) The generator effluent contains at least 90 percent (by weight) of chlorine dioxide with respect to all chlorine species as determined by Method 4500-ClO2 E in the "Standard Methods for the Examination of Water and Wastewater,"

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:

A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, PubChem, Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS), Safe Work Australia

MATERIAL SAFETY DATA SHEET OF LIGHT DIESEL OIL

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name	:	**Light Diesel Oil (LDO)**
Chemical Formula	:	Complex Mixtures of Hydrocarbons
CAS no.	:	68334-30-5
UN No.	:	1202
Synonymous	:	LDO
General Use	:	Used as fuel for engines, lamps, heaters, furnaces, and stoves; Also used as solvents.
HAZCH	:	3Y'E

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :

Signal Word : Danger

GHS Hazard Statements : H304 (65.8%): May be fatal if swallowed and enters airways [Danger Aspiration hazard]

NFPA Hazard Classification
NFPA 704 Diamond :

Diamond	Hazard	Value	Description
2 1 0	Health	1	Can cause significant irritation.
	Flammability	2	Must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.
	Instability	0	Normally stable, even under fire conditions.
	Special		

Health Hazards : Inhalation causes headache and slight giddiness. Ingestion causes nausea, vomiting, and cramping; depression of central nervous system ranging from mild headache to anesthesia, coma, and death; pulmonary irritation secondary to exhalation of solvent; signs of kidney and liver damage may be delayed. Aspiration causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema; later, signs of bronchopneumonia and pneumonitis; acute onset of central nervous system excitement followed by depression.

Fire Hazards : Highly Flammable: Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.). Vapor explosion hazard indoors, outdoors or in sewers. Those substances designated with a (P) may polymerize explosively when heated or involved in a fire. Runoff to sewer may create fire or explosion hazard. Containers may explode when heated. Many liquids will float on water. Substance may be transported hot. For hybrid vehicles, Hazards Summary : Critical Effects: skin; irritation; Avoid prolonged and repeated skin contact to diesel fuels which can lead to dermal irritation and may be associated with and increased risk of skin cancer. Diesel fuel does not contain significant levels of polynuclear aromatics (PNAs) and contains <0.01% benzene and n-hexane.

Skin, Eye, and Respiratory Irritations : Slight smarting of eyes or respiratory system if present in high concentrations.

Hazard Classes and Categories

Carcinogenicity : category 2

Acute toxicity : category 4

Aspiration hazard : category 1

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Composition : Light diesel oil (LDO) is a fuel that's made up of medium-length chains of hydrogen and carbon, including alkanes, cycloalkanes, aromatics, and oils. It's a byproduct of petroleum distillation, and is typically characterized by its low sulfur content, high cetane number, and specific gravity.

LDO is mainly used as an industrial fuel to generate heat and electricity in production units. It has a lower flash point than heavier fuel oil, making it easier to ignite.

SECTION 4: FIRST-AID MEASURES

Eyes : Wash with copious quantity of water.

Skin : Remove solvent by wiping and wash with soap and water.

Aspiration : Enforce bed rest; administer oxygen; seek medical attention.

Ingestion : Do not induce vomiting.

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : > 66°C

Flash Point Method : Pensky Marten

Auto ignition Temperature : 257 °C (494 °F)

LEL : 0.5 %

UEL : 5.0 %

Flammability Classification : Flammable

Extinguishing Media : Foam, Dry Chemical Powder, CO_2

Unusual Fire or Explosion Hazards: Heat produces vapors and can cause violent rupture of containers.

Hazardous Combustion Products: Carbon di oxide, carbon mono oxide, benzene

Fire-Fighting Instructions : Small fires can be extinguished by hand held extinguishers.

Advice for firefighters : Major fires may require withdrawal and allowing the tank to burn. Fire fighters should wear self-breathing apparatus while fighting fire.

Fire Fighting Procedures : If material on fire or involved in fire: Do not extinguish fire unless flow can be stopped. Use water in flooding quantities as fog. Solid streams of water may spread fire. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible. Use foam, dry chemical, or carbon dioxide.

MATERIAL SAFETY DATA SHEET OF LIGHT DIESEL OIL

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 6: ACCIDENTAL RELEASE MEASURES

Immediate Precautionary Measure:		Isolate spill or leak area for at least 50 meters (150 feet) in all directions.
Small Spills	:	Shut off leaks without risk. Absorb on sand or earth.
Large Spill	:	Consider initial downwind evacuation for at least 300 meters (1000 feet).
Containment	:	Prevent spillage from entering drains or water sources
Fire	:	If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024)
Cleanup Methods	:	Environmental considerations: Land spill: Dig a pit, pond, lagoon, holding area to contain liquid or solid material. /SRP: If time permits, pits, ponds, lagoons, soak holes, or holding areas should be sealed with an impermeable flexible membrane liner. Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete. Absorb bulk liquid with fly ash, cement powder, or commercial sorbents.
Preventive Measures	:	If material not on fire and not involved in fire: Keep sparks, flames, and other sources of ignition away. Keep material out of water sources and sewers. Build dikes to contain flow as necessary. Use water spray to knock-down vapors.
	:	Personnel protection: Avoid breathing vapors. Keep upwind. Do not handle broken packages unless wearing appropriate personal protective equipment. Wash away any material which may have contacted the body with copious amounts of water or soap and water

SECTION 7: HANDLING AND STORAGE

Non-fire Spill Response	:	ELIMINATE all ignition sources (no smoking, flares, sparks or flames) from immediate area. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor-suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Use clean, non-sparking tools to collect absorbed material.
Handling Precautions	:	Do not use/store near heat/open flame. Use gumboots, gloves while handling the product. Do not inhale. Stay upwind while handling the product. Product should never be used to remove oil or grease from skin. It should not be siphoned by mouth. It should be stored in closed containers away from heat & source of ignition. Avoid contact with skin and eyes. Wash thoroughly after handling
Storage Requirements	:	Do not use/store near heat/open flame/water/acids.

MATERIAL SAFETY DATA SHEET OF LIGHT DIESEL OIL

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Engineering Controls : Provide proper ventilation for environment to be below TWA
Respiratory Protection : Use respiratory protection if ventilation is Improper
Protective Clothing / Equipment: Use face shield, PVC gloves, safety boots while handling. Contaminated clothing to be immediately removed.

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Physical state : Liquid
Boiling Point/ Range : 282 - 338 °C (540 to 640 °F) at 760 mmHg
Vapor Pressure at : 2.1 mmHg 20 °C
Appearance : Brown, slightly viscous liquid
Melting/Freezing point : -29 °C
Odor : Diesel Fuel
Vapor Density (Air=1) : 3 to 5
Solubility in water : Insoluble
Specific gravity, 15.5 deg C : 0.9 to 1.05
Evaporation rate at : 30 °C
Calorific value (Kcal/Kg) : 10400
Viscosity : 4.04 cP at 15 °C
Heat of vaporization, Kcal/kg : 2.9
Sp. Heat liq. J/KG : 1.9

SECTION 10: STABILITY & REACTIVITY

Stability : Stable, Conditions to avoid, Keep away from heat & open flame.
Hazardous poly Incompatibility : Oxidizing agents. Conditions to avoid.
Hazardous Combustion/ Decomposition products : Toxic gases/ vapours (CO).

SECTION 11: TOXICOLOGICAL INFORMATION

Human exposure and toxicity : A spill of about 21 gal or more of fuel oil would present a human health risk for central nervous and reproductive systems for 8 days or longer. Its carcinogenicity to humans is unknown.

Ecotoxicity Studies : Several studies have shown pronounced effects of fuel oil on the reproductive capacity of birds after application on the shell surface (decreased hatchability, deformed bills, dead embryos). Fuel oil was also toxic in several aquatic species.

Antidote and Emergency Treatment: The primary threat from petroleum distillate ingestion is respiratory failure. Patients should be quickly evaluated for respiratory signs (e.g., cyanosis, tachypnea, intercoastal retractions) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases should be intubated. A chest radiograph should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.

SECTION 12: ECOLOGICAL INFORMATION

Exposure Summary:

It usually contains hydrocarbons in the C11-C20 range with paraffins (normal, branched, cyclo) accounting for 69-79% and aromatic hydrocarbons (alkylbenzenes, naphthalenes, other) accounting for 19-25%. If released to air, a vapor pressure range of 3.4X10-4 to >2.0 mm Hg at 25 °C indicates the components of Fuel Oil No. 2 will exist primarily as a vapor in the atmosphere. Vapor-phase Fuel Oil No. 2 will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to range from 4 to 40 hours. If released to soil, Fuel Oil No. 2 is expected to have low to no mobility based upon a Koc range of 1,000 to 501,000.

An estimated BCF range of 70 to 2700 suggests the potential for bioconcentration in aquatic organisms is moderate to very high provided the compounds are not metabolized by the organism.

Environmental Biodegradation:

Biodegradation of fuel oils (in general) is dependent on the degradation of the various hydrocarbon fractions present in the oils. The relative order for biodegradation of the hydrocarbon fractions from the most readily degraded to the least is as follows: n-alkanes, iso-alkanes, olefins, low molecular weight aromatics (at low, non-toxic concentrations), PAHs, and cycloalkanes. Biodegradation of fuel oils in sediments is inhibited under anaerobic conditions.

Soil Adsorption / Mobility:

The log Koc of Fuel Oil No. 2 is reported to range from 3.0 to 5.7 (Koc range of 1,000 to 501,000) (1,2). According to a suggested classification scheme (3), this Koc range suggests that Fuel Oil No. 2 is expected to have low to no mobility in soil (SRC).

SECTION 13: DISPOSAL CONSIDERATION

Disposal Methods : SRP - The most favorable course of action is to use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal and plant life; and conformance with environmental and public health regulations.

SECTION 14: TRANSPORTATION INFORMATION

Shipping Name: Light Diesel Oil

DOT Emergency Guidelines :

/GUIDE 128: FLAMMABLE LIQUIDS (NON-POLAR/WATER-IMMISCIBLE)/ Fire or Explosion: HIGHLY FLAMMABLE: Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks). Vapor explosion hazard indoors, outdoors or in sewers. Those substances designated with a "P" may polymerize explosively when heated or involved in a fire. Runoff to sewer may create fire or explosion hazard. Containers may explode when heated. Many liquids are lighter than water. Substances may be transported hot.

Standard Transportation Number: 49 151 12; Fuel Oil No. 1, 2, 4, or 5

Shipment Methods and Regulations:

No person may /transport, / offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177). /

SECTION 15: REGULATORY INFORMATION

Non - Toxic/Flammable Substance

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:

A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, PubChem, Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS), Safe Work Australia

MATERIAL SAFETY DATA SHEET OF FURNACE OIL

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name : **FURNACE OIL**
Chemical Formula : Complex mixture of Hydrocarbons
CAS no. : 68476-33-5
UN No. : 1223
Synonymous : Fuel Oil, Residual Oil
HAZCH : 2PE
Label /Class : Category 1, Class C Flammable Liquid
General Use : Synthetic/Analytical chemistry.

SECTION 2: HAZARDS IDENTIFICATION

Primary Entry Routes : Inhalation, Skin, Mucous Membranes, Eye Contact and Ingestion
Acute Effects : Prolonged exposure makes skin dry, erythema, oil acne, and oil folliculitis. Warty growth may occur which may become skin cancer, skin cracking & contact dermatitis. As these are handled at elevated temperatures, skin contact could produce bums. Eye Contact: Light to moderate irritation.
Carcinogenic Effects : Not listed as carcinogenic
Chronic Effects : No data available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Composition : Complex mixture of heavy hydrocarbons
Hazardous Components : All components nontoxic/inflammable
ACGIH TLV : 5 mg/m^3 as mineral oil mist.

SECTION 4: FIRST-AID MEASURES

Eyes : Flush with water for 15 min. get medical attention.
Skin : Wash with warm water & soap.

Inhalation : Remove to fresh air. Consult a physician if irritation persists.
Ingestion : Get medical help at once. Do not induce vomiting. It may lead to chemical pneumonitis.

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : >66°C
Flammability Range : 1% - 5%
Auto Ignition Temperature : 220°C- 250°C
LEL : 1%
UEL : 5%
Flammability Classification : Flammability-2
Extinguishing Media : Alcohol Resistant foam, carbon dioxide, dry chemical powder, Water Spray, Inert gas, Sand.
Unusual Fire/Explosion Hazards : Heat produces vapors and can cause rupture of containers. Tanks head space can have light hydrocarbons. Flashback may occur along vapor trail.

Hazardous Combustion Products : Carbon Mono Oxide (CO), Carbon Dioxide (CO_2), Sulphur Dioxide (SO_2)

SECTION 6: ACCIDENTAL RELEASE MEASURES

Small spill : Steps to be taken: Recover Spillage Using Absorbent Material Like Sawdust, Sand, Do Not Push in to Drainage.

Containment : Prevent spillage from entering drains or water sources

Cleanup : After spills wash area with soap and water preventing runoff from entering drains.

SECTION 7: HANDLING AND STORAGE

Handling Precautions : Do not use/store near heat/open flame. Use PPEs. avoid contact with skin and eyes. Wash thoroughly after handling.

Storage Requirements : Do not use/store near heat/open flame/water/acids.

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Engineering Controls : Provide proper ventilation for environment.

Respiratory Protection : Use respiratory protection if ventilation is Improper

Protective Clothing/Equipment : Use face shield, PVC gloves, safety boots while Handling. Contaminated clothing to be immediately removed.

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Physical State : Liquid
Boiling Point/ Range, Deg.C : 185°C-500^{O}C
Melting/Freezing Point, Deg.C : -1^{O}C – 13^{O}C
Vapor Pressure at : > 5 hPa (at 20^{O}C)
Appearance : Brownish to Black
Odor : Characteristic odor
Vapor Density (Air=1) : 3.00 -5.00 (Heavier than Air)
Density : 0.84 g/cm^3 (at 15^{O}C)
Solubility in Water at 30^{O}C : Insoluble
Specific Gravity, (Water-1) : 0.95-0.98 gm /cc at 15^{O}C (Lighter than Water)

SECTION 10: STABILITY & REACTIVITY

Stability : Chemically stable under storage at normal ambient temperature.

Hazardous poly Incompatibility : Incompatible with Oxidizing agents & Chlorine. It reacts vigorously with oxidizing materials.

Conditions to avoid : Can undergo auto-oxidation in air and generate heat which can build in a confined space to cause spontaneous combustion.

Hazardous Combustion/ Decomposition products : Carbon Mono Oxide (CO), Carbon Dioxide (CO_2), Sulphur Dioxide (SO_2)

SECTION 11: TOXICOLOGICAL INFORMATION

TLV as per ACIGH : 5 mg/ m^3 as mineral oil mist

Acute Inhalation Effects : No data available

SECTION 12: ECOLOGICAL INFORMATION

Prevent spillage from entering drains or water sources. After spills wash area with soap and water preventing runoff from entering drains. Can burn with lot of heat producing CO_2 and CO.

SECTION 13: DISPOSAL CONSIDERATION

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

SECTION 14: TRANSPORTATION INFORMATION

Shipping Name : Fuel Oil or Furnace Oil

SECTION 15: REGULATORY INFORMATION

Non-Toxic/Flammable Substance

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:

A Textbook of Chemical Technology Volume–II, https://cameochemicals.noaa.gov/ , https://pubchem.ncbi.nlm.nih.gov/ , Hazardous Substances Data Bank (HSDB)

MATERIAL SAFETY DATA SHEET OF HIGH-SPEED DIESEL

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name : **HIGH-SPEED DIESEL**
Chemical Formula : Common diesel fuel- $C_{12}H_{23}$, ranging from approx. $C_{10}H_{20}$ to $C_{15}H_{28}$. Petrol consists of hydrocarbons with between 5 and 12 carbon atoms per molecule but then it is blended for various uses. Complex mixture of hydrocarbons (75% saturated hydrocarbons & 25% aromatic hydrocarbons)
CAS no. : 68476-30-2 / 68334-30-5
UN No. : 1202 / 1993 (domestic)
Synonymous : Automotive Diesel Oil, HSD High Flash HSD
HAZCH Label /Class : Class 3
General Use : Motor Fuel and in Defense aircrafts

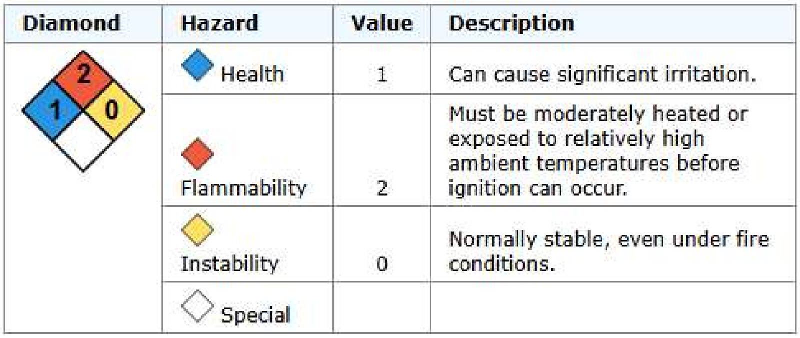
SECTION 2: HAZARDS IDENTIFICATION

Classification of the substance or mixture : Flammable Liquids - Category 4
Acute Toxicity (Inhalation) - Category 4
Skin Corrosion/Irritation - Category 2
Carcinogenicity - Category 2
Specific Target Organ Toxicity-Repeated Exposure-Category 2
Aspiration Hazard - Category 1

Hazard Pictogram :

Signal Word : Danger
Hazchem Code : 3Z
GHS Hazard Statements : H226 – Flammable liquid and vapor. H315 – Causes Skin irritation. H304 – May be fatal if swallowed and enters airways. H336 – May cause drowsiness or dizziness.

NFPA Hazard Classification
NFPA 704 Diamond :



Diamond	Hazard	Value	Description
2 1 0	🟦 Health	1	Can cause significant irritation.
	🟥 Flammability	2	Must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.
	🟨 Instability	0	Normally stable, even under fire conditions.
	◇ Special		

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Name	Product Identifier (CAS#)	% (w/w)	Classification
Diesel Fuel	68476-34-6	100	Flam. Liq. 3, H226; Skin Irrit. 2, H315; Aspiration 1, H304; STOT SE 3, H336; Carc. 2. H350; Aquatic Chronic 2, H411

Additional Formulation Information:

Diesel Fuel consists of C9+ hydrocarbons resulting from distillation of crude oil.
Low Sulfur Diesel Fuel typically contains less than 500 ppm of sulfur
Ultra Low Sulfur Diesel Fuel typically contains less than 15 ppm of sulfur

SECTION 4: FIRST-AID MEASURES

Inhalation	:	Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.
Ingestion	:	DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Ingestion may cause gastrointestinal disturbances including irritation, nausea, vomiting, and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory failure, and death.
Eye Contact	:	In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention. In case of contact lenses, remove immediately.
Skin Contact	:	Remove contaminated clothing and shoes. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops. Thermal burns require immediate medical attention depending on the severity and of the area of the body burned.
Most Important Symptoms	:	Contact with eyes and face may cause irritation. Long-term exposure may cause dermatitis (itching, irritation, pain and swelling). Inhalation may cause irritation and significant or long-term exposure could cause respiratory insufficiency and pulmonary edema. Ingestion may cause aspiration, gastrointestinal disturbance, and CNS effects.

Immediate Medical Attention and Special Treatment:

For contact with skin or eyes, immediately wash or flush contaminated eyes with gently flowing water. If possible, irrigate each eye continuously with 0.9% saline (NS). If ingested, rinse mouth. Do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). If inhaled, administer oxygen or establish a patent airway if breathing is labored. Suction if necessary. Monitor closely, anticipate seizures. Consider orotracheal or nostracheal intubation of airway control if patient is unconscious or is in severe respiratory distress. Discard any clothing or shoes contaminated as they may be flammable

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point	:	51.6^{O}C or 125 ^{O}F
Flammability Range	:	Flammable Class 3

Auto Ignition Temperature : 176.6°C to 329.4°C or 350 - 625°F
LEL : 0.5 %
UEL : 7.5 %
Flammability Classification : Flammable
Extinguishing Media : Foam, Dry Chemical Powder, CO_2
Unusual Fire/Explosion Hazards: It will spread along the ground and collect in sewers
Hazardous Combustion Products: Carbon mono oxide, benzene, Nitrogen oxide and other aromatic hydrocarbons
Fire-Fighting Instructions : Small fires can be extinguished by hand held extinguishers. Major fires may withdrawal and allowing the tank to burn. Fire fighters should wear self-breathing apparatus while fighting fire.

SECTION 6: ACCIDENTAL RELEASE MEASURES

For non-emergency personnel:

Immediately contact emergency personnel. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilt material. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Put on appropriate personal protective equipment. Floors may be slippery; use care to avoid falling. Eliminate all ignition sources.

For emergency responders:

Entry into a confined space or poorly ventilated area contaminated with vapor, mist or fume is extremely hazardous without the correct respiratory protective equipment and a safe system of work. Wear self-contained breathing apparatus. Wear a suitable chemical protective suit. Chemical resistant boots.

Environmental precautions:

Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. In case of small spillages in closed waters (i.e. ports), contain product with floating barriers or other equipment. Collect spilled product by absorbing with specific floating absorbents. If possible, large spillages in open waters should be contained with floating barriers or other mechanical means. If this is not possible, control the spreading of the spillage, and collect the product by skimming or other suitable mechanical means. The use of dispersants should be advised by an expert, and, if required, approved by local authorities. Collect recovered product and other contaminated materials in suitable tanks or containers for recycle, recovery or safe disposal.

Methods and material for containment and cleaning up:

Small spill:

Eliminate all ignition sources. Stop leak if without risk. Move containers from spill area. Absorb with an inert material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. The method and equipment used must be in conformance with appropriate regulations and industry practice on explosive atmospheres.

Large spill:

Eliminate all ignition sources. Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas.

Dike spill area and do not allow product to reach sewage system and surface or ground water. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Use spark-proof tools and explosion-proof equipment. Contaminated absorbent material may pose the same hazard as the spilt product. The method and equipment used must be in conformance with appropriate regulations and industry practice on explosive atmospheres. Dispose of via a licensed waste disposal contractor

Containment and Clean-Up Methods:

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of firefighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection. Take up with dry earth, sand or other non-combustible, inert oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container with clean, non-sparking tools for reclamation or disposal. Response and cleanup crews must be properly trained and must utilize proper protective equipment. Refer to Section 8 for appropriate protective equipment.

SECTION 7: HANDLING AND STORAGE

Handling Precautions:

Handle as a flammable liquid. Keep away from heat, sparks, and open flame. No smoking. Electrical equipment should be approved for classified area. Bond and ground containers during product transfer pursuant to NFPA 70 and API RP 2003 to reduce the possibility of static-initiated fire or explosion. Follow precautions to prevent static initiated fire. Use good personal hygiene practices. Use only with protective equipment specified in Section 8. Avoid repeated and/or prolonged skin exposure. Use only outdoors or in well-ventilated areas. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves. Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products.

Storage:

Large quantities of diesel fuel are stored in tanks or portable containers at an ambient storage temperature. Separate from incompatible chemicals (Refer to Section 10) by distance or secondary containment. Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers that are clearly labeled. Label all secondary containers that this material is transferred into with the chemical name and associated hazard(s). Empty product containers or vessels may contain flammable vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition. Storage tanks should have a venting system. If stored in small containers, the area should be well ventilated, away from ignition sources and protected from potential damage or vehicular traffic. Post “No Smoking” signs in product storage areas. This storage area should comply with NFPA 30 “Flammable and Combustible Liquid Code” or applicable building code. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 “Cleaning Mobile Tanks in Flammable and Combustible Liquid Service” and API RP 2015 “Safe Entry and Cleaning of Petroleum Storage Tanks”.

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Control Parameter:

Components	CAS Number	Type of exposure	Parameter of control	Standard
Diesel	68334-30-5	Respiration	100 mg/m^3	ACGIH

Appropriate engineering controls: All activities involving chemicals should be assessed for their risks to health, to ensure exposures are adequately controlled. Personal protective equipment should only be considered after other forms of control measures have been suitably evaluated. Personal protective equipment should conform to appropriate standards, be suitable for use, be kept in good condition and properly maintained

Exposure control: Ensure natural ventilation or use explosion-proof equipment to keep the storage zone, loading and unloading station well-ventilated. Install anti-lightning, anti-static equipment, explosion-proof electrical system at the storage, operation, transportation zone following the Government's requirements.

Personal protection for working: Eye protection: Specialized protection equipment is not required. Goggles are recommended in necessity case. Body protection: Use protective clothing.

Skin protection: Use protective gloves.

Hand protection: Wear chemical resistant gloves. Recommended: Nitrile gloves

Personal protection for responding incident: The oil spill response team, fire-fighting team must be equipped with specialized tool and equipment when approaching and handling the incident.

Sanitation measures: Wash hands with soap and clean up after getting into contact with the diesel oil.

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Physical State : Liquid
Color : Pure, clear, light yellow
Odor : Characteristic odor of Diesel
Boiling Point/ Range, ^{0}C : 282°C to 338 °C
Vapor Pressure at : 2.17mm – 26mm of Hg at 21°C
Appearance : Straw Yellow or Yellowish Brown
Melting/Freezing Point, ^{0}C : -29 to -18°C (-20.2 to -0.4°F) (Based on Fuels)
Vapor Density (Air=1) : 3 to 5 (Air = 1)
Solubility in Water : Insoluble
Specific Gravity, (Water-1) : 0.841 at 60.8°F
Critical Pressure : 20Bar
Critical Temperature : 446.85 ^{0}C (720 K)
Viscosity : Kinematic: 2 to 4.5 mm2 /s (2 to 4.5 cSt) at 40°C

SECTION 10: STABILITY & REACTIVITY

Stability : Chemically stable.
Hazardous poly Incompatibility: Incompatible with oxidizing agents such as Peroxides, Nitric Acid & Perchlorates. It reacts vigorously with oxidizing materials.
Hazardous Combustion/ Decomposition products : Carbon mono oxide, Sulphur dioxide Nitrogen oxide. and other aromatic hydrocarbons

Conditions to Avoid : Avoid high temperatures, open flames, sparks, static electricity, welding, smoking and other ignition sources.

SECTION 11: TOXICOLOGICAL INFORMATION

Acute poisoning via ingestion: LD50 (mice): 7,600 mg/kg.
Acute poisoning via inhalation: LC50 (mice) ≥ 4,1 mg/l.
Acute poisoning via skin: LD50 (rabbit) > 4,222 mg/kg.
Cancer's properties: Have a possibility to causes cancer to human.
Chronic poisoning: Stimulates and inhibits the nervous system. May causes damages to thymus, liver, bone marrow

SECTION 12: ECOLOGICAL INFORMATION

Toxicity to aquatic ecosystem: Prolonged influence to aquatic animal. Material is toxic to aquatic organisms based on an acute basis (LC50/EC50 >1 but < 10 mg/L in the most sensitive species tested). Material is a long-term aquatic hazard based on a chronic basis (LC50/EC50 >1 but < 10 mg/L in the most sensitive species tested).

Rottenness by bacteria: Natural biodegradable.

Mobility: Mobility Spillages may penetrate the soil causing ground water contamination. This material may accumulate in sediments.

SECTION 13: DISPOSAL CONSIDERATION

Disposal methods:

The generation of waste should be avoided or minimized wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: TRANSPORTATION INFORMATION

UN Identification Number: 1993
Proper Shipping Name: Diesel fuel
Hazard Class and Packing Group: 3, PGIII
Shipping Label: Flammable liquid
Placard / Bulk Package: Flammable liquid, 1993
Emergency Response Guidebook Guide Number: 128
This product may be re-classified as a "Combustible Liquid" meeting the definition in 49 CFR 173.120 unless transported by vessel or aircraft. Specific placard requirements must be met for shipments of this product as a Combustible Liquid by rail (See 49 CFR 172.332). Non-bulk packages (<= 119 gal) of Combustible Liquids in package sizes less than the product reportable quantity are not regulated as hazardous materials if the material does not meet any other hazard class.

SECTION 15: REGULATORY INFORMATION

OSHA Hazard Communication Standard This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Clean Water Act (Oil Spills):

Any spill or release of this product to "navigable waters" (Essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA Section 103 and SARA Section 304 (Release to the Environment):

The CERCLA definition of hazardous substances contains a "petroleum exclusion" clause which exempts this material. This product does not contain any chemicals subject to the reporting requirements of CERCLA Section 103 or SARA 304.

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:

A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, PubChem, Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS), Safe Work Australia

MATERIAL SAFETY DATA SHEET OF SULPHURIC ACID

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name : **SULPHURIC ACID**

Chemical Formula : H_2SO_4

CAS no. : 7664-93-9

UN No. : 1830

Synonymous : Hydrogen Sulphate, Oil of Vitriol, Battery

HAZCH : 2P

Label /Class : 8 / Corrosive

General Use : It is a key substance in the chemical industry. It is most commonly used in Fertilizer Manufacture. It is also important in Mineral Processing, Oil Refining, Wastewater Processing, and Chemical Synthesis.

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :

GHS05

Signal Word : Danger

GHS Hazard Statements : H314 (> 99.9%): Causes severe skin burns and eye damage [Danger Skin corrosion/irritation]

Skin corrosion : Category 1A

NFPA Hazard Classification

NFPA 704 Diamond :

Diamond	Hazard	Value	Description
	🟦 Health	3	Can cause serious or permanent injury.
	🟥 Flammability	0	Will not burn under typical fire conditions.
	🟨 Instability	2	Readily undergoes violent chemical changes at elevated temperatures and pressures.
	◇ Special	W	Reacts violently or explosively with water.

Health Hazards : Corrosive to all body tissues. Inhalation of vapor may cause serious lung damage. Contact with eyes may result in total loss of vision. Skin contact may produce severe necrosis. Chronic exposure may cause tracheobronchitis, stomatitis, conjunctivitis, and gastritis. Gastric perforation and peritonitis may occur and may be followed by circulatory collapse. Circulatory shock is often the immediate cause of death.

Fire Hazards : It is highly reactive and capable of igniting finely-divided combustible materials on contact. When heated, it emits highly toxic fumes. Avoid heat; water and organic materials. Can undergo violent chemical change at elevated temperatures and pressure. May react violently with water. Hazardous polymerization may not occur. Reaction with metals may produce hydrogen gas. Oxides of sulfur may be produced in fire.

Hazards Summary : 77%-98% acid causes second or third degree burns after short contact; Solutions <30% are corrosive; solutions >30% are highly corrosive; A corrosive substance that can cause pulmonary edema; May cause erosion of teeth enamel.

Skin, Eye, and Respiratory Irritations : Corrosive. Causes severe eye and skin burns.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Structural Formula :

Chemical Family	:	Acid
Molecular weight	:	98.07 g/mol
CAS No	:	7664-93-9
Molecular Formula	:	H_2SO_4
Name	:	Sulphuric Acid

Specific Concentration Limits:

Skin Corrosion 1A; H314: C ≥ 15 %
Skin Irritation 2; H315: 5 % ≤ C < 15 %
Eye Damage 1; H318: C ≥ 15 %
Eye Irritation 2; H319: 5 % ≤ C < 15 %

SECTION 4: FIRST-AID MEASURES

Inhalation	:	Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a poison center or doctor/physician.
Skin Contact	:	Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. Immediately call a poison center or doctor/physician.
Eye Contact	:	Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center or doctor/physician.
Ingestion	:	Rinse mouth. Do NOT induce vomiting. Immediately call a poison center or doctor/physician.

SECTION 5: FIRE -FIGHTING MEASURES

Fight fire from safe distance or from protected location. Use care as water applied directly to this acid results in evolution of heat and causes spattering. Cool containers that are exposed to flames with streams of water until fire is out. Wear positive pressure breathing apparatus and special protective clothing. Not flammable. For small fires use dry chemical or carbon dioxide. Use water on combustibles burning in vicinity of this material. For large fires flood fire area with water from a distance. Do not get solid streams of water on material. Move container from area if you can do so without risk.

Suitable extinguishing media: Use water spray, alcohol-resistant foam, dry chemical, or carbon dioxide. Use water spray only to keep fire-exposed containers cool.

Advice for firefighters: Wear self-contained breathing apparatus for firefighting if necessary.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Spill or Leak:

- Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
- Stop leak if you can do it without risk.
- Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container.
- Keep combustibles (wood, paper, oil, etc.) away from spilled material.

Small Spill:

- Cover with DRY earth, DRY sand or other non-combustible material followed with plastic sheet to minimize spreading or contact with rain.
- Use clean, non-sparking tools to collect material and place it into loosely covered plastic containers for later disposal.
- Prevent entry into waterways, sewers, basements or confined areas.

Immediate Precautionary Measure:

Isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids.

Spillage Disposal:

Evacuate danger area! Consult an expert! Personal protection: chemical protection suit including self-contained breathing apparatus. Do NOT let this chemical enter the environment. Do NOT absorb in saw-dust or other combustible absorbents. Collect leaking liquid in sealable containers. Absorb remaining liquid in dry sand or inert absorbent. Then store and dispose of according to local regulations. Cautiously neutralize remainder with lime or soda ash.

Disposal Methods: See Section 13 for more details.

Preventive Measures:

Personal precautions, protective equipment and emergency procedures: Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Environmental precautions: Do not let product enter drains.

Antidote and Emergency Treatment:

Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR as necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention.

SECTION 7: HANDLING AND STORAGE

Non-fire Spill Response:

Excerpt from ERG Guide 137 [Substances - Water-Reactive - Corrosive]:

Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container. Keep combustibles (wood, paper, oil, etc.) away from spilled material.

SMALL SPILL: Cover with DRY earth, DRY sand or other non-combustible material followed with plastic sheet to minimize spreading or contact with rain. Use clean, non-sparking tools to collect material and place it into loosely covered plastic containers for later disposal. Prevent entry into waterways, sewers, basements or confined areas. (ERG, 2024)

Safe Storage: Dry. Separated from food and feedstuffs and incompatible materials. See Chemical Dangers. Store only in original packaging.

Storage Conditions: Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Smoking, open lights, flames, and spark-producing tools shall not be permitted near sulfuric acid carboys, drums, tank cars, or metal storage tanks because of the possible production of explosive mixtures of hydrogen during storage.

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Protective Clothing:

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer when there is NO RISK OF FIRE.
- Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.

Control parameters:

ACGIH Time-Weighted Average (TLV-TWA):	0.0002 ppm or 02 mg/m^3 ,8-hr TWA
Short-Term Exposure Limit (TLV-STEL):	0.003 ppm or 3 mg/m^3
IDLH- Immediately Dangerous to Life and Health:	0.015 ppm or 15 mg/m^3
OSHA PEL-Permissible Exposure Limit:	0.001 ppm or 1 mg/m^3, 8-hr TWA

Effects of Short-Term Exposure:

The substance is very corrosive to the eyes, skin and respiratory tract. Corrosive on ingestion. Exposure could cause asphyxiation due to swelling in the throat. Inhalation of high concentrations may cause lung oedema, but only after initial corrosive effects on the eyes and the upper respiratory tract have become manifest. Inhalation may cause asthma-like reactions (RADS). Medical observation is indicated.

Effects of Long-Term Exposure:

Repeated or prolonged contact with skin may cause dermatitis. Repeated or prolonged inhalation may cause effects on the lungs. Risk of tooth erosion upon repeated or prolongated exposure to an aerosol of this substance. Mists of this strong inorganic acid are carcinogenic to humans.

Personal Protective Equipment (PPE):

Eye/face protection: Tightly fitting safety goggles. Face shield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection: Handle with gloves.

Body Protection: Complete suit protecting against chemicals. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection: Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multipurpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Molecular Weight : 98.07 g/mol
Physical State : Liquid (Thick Oily Liquid.)
Appearance : Clear, Colorless
Odor : Odorless, but has a choking odor when hot.
Boiling Point/ Range, ^{0}C : 554 °F or 290°C at 760 mmHg

Melting/Freezing Point, ^{0}C : 51 °F or 10 ^{0}C

Vapor Pressure at : <1 mm Hg Vapor Pressure @ 40 ^{0}C

Vapor Density (Air=1) : 3.4 - Heavier than air; will sink

Density : 1.39 at 68 °F or 20^{O}C - Denser than water; will sink

Solubility in Water : Soluble in Cold Water, Ethyl Alcohol & Ethyl Ether

Specific Gravity, (Water-1) : 1.84 g/cu cm

Viscosity : 21 mPa.s at 25 °C

Corrosivity : Strongly corrosive

Critical Temperature : 655 °C

Heat of Vaporization : 56 kJ/mole

Odor Threshold : 0.15 mmHg

SECTION 10: STABILITY & REACTIVITY

Reactivity : Air and Water Reactions: Reaction with water is negligible unless acid strength is above 80-90% then heat from hydrolysis is extreme, may cause severe burns [Merck, 11th ed. 1989]. During sulfonation of mononitrobenzene by fuming sulfuric acid, a leak from an internal cooling coil permitted water to enter the reaction tank. A violent eruption occurred due to the heat of solution.

Reactive Group: Acids, Strong Oxidizing

Reactivity Alerts: Strong Oxidizing Agent, Known Catalytic Activity, Water-Reactive

Thermal decomposition generates Corrosive vapors

Stability : The Product Is Stable.

Hazardous Incompatible materials : Reactive with Bases, halides, organic materials, carbides, fulminates, nitrates, picrates, cyanides, chlorates, alkali halides, zinc salts, permanganates,

Hazardous Combustion/
Decomposition Products : Extremely corrosive in presence of aluminum, copper, stainless steel (316). Highly corrosive in presence of stainless-steel (304). Non-corrosive in presence of glass.

SECTION 11: TOXICOLOGICAL INFORMATION

Toxicity Summary:

IDENTIFICATION AND USE: Sulfuric acid is a colorless, oily liquid. It is used in manufacture of fertilizers, explosives, dyestuffs, other acids, parchment paper, glue, purification of petroleum, pickling of metal.

HUMAN EXPOSURE AND TOXICITY: Sulfuric acid is corrosive to the skin, eyes and mucous membranes. Sulfuric acid is not considered as an allergen by skin contact in humans. Acute exposure of human volunteers to 100 ug/cu m of sulfuric acid resulted in increased mucociliary clearance of particles from the large proximal airways; at higher levels 100 ug/cu m, the opposite occurred. Clearance from the distal airways was reduced at both levels. Eye damage as a result of contact with sulfuric acid from car batteries has been reported. The most common injuries were conjunctival and corneal chemical burns, and iritis. Death can occur from dermal burns from sulfuric acid exposure.

ECOTOXICITY STUDIES: The toxicity of sulfuric acid to aquatic life is a function of the resulting pH. A pH of 4.0 gave pronounced gill irritation and 3.5 caused death of sunfish, bass, and carp. The concentration of hydrogen ion which caused 50% mortality of bluegill in 96 hr (96 hr LC50) was between 3.5 and 3.0. In fish the major causes of toxicity seem to be related to disruption of sodium balance and respiration.

Health Effects: Sulfuric acid at a high concentration can cause very serious damage upon contact, as it not only causes chemical burns via hydrolysis, but also secondary thermal burns via dehydration. It burns the cornea and can lead to permanent blindness if splashed onto eyes. Accordingly, it rapidly attacks the cornea and can induce permanent blindness if splashed onto eyes. If ingested, it damages internal organs irreversibly and may even be fatal. Inhalation of sulfuric acid spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Sulfuric acid is also a known carcinogen. Sulfuric acid may be toxic to kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes and teeth.

Exposure Routes: inhalation, ingestion, skin and/or eye contact

Target Organs: Eyes, skin, respiratory system, teeth

Classification acc. to GHS

- Toxicity:
  - Acute toxicity: Shall not be classified as acutely toxic.
  - Carcinogenicity: Shall not be classified as carcinogenic.
  - Reproductive toxicity: Shall not be classified as a reproductive toxicant.
- Skin corrosion/irritation: Causes severe skin burns and eye damage.
- Eye damage/eye irritation: Causes serious eye damage.
- Respiratory or skin sensitization: Shall not be classified as a respiratory or skin sensitizer.

Treatment: The mainstay of treatment of any acid burn is copious irrigation with large amounts of tap water. To be most effective, treatment should be started immediately after exposure, preferably before arrival in the emergency department. Remove any contaminated clothing. Do not attempt to neutralize the burn with weak reciprocal chemicals (i.e. alkali for acid burns), because the heat generated from the chemical reaction may cause severe thermal injury.

SECTION 12: ECOLOGICAL INFORMATION

Birds sprayed directly in field pens with both dilute (about 2.1 Molar solution) and undiluted (about 7.03 Molar solution) forms of Enquik (N-TAC, Sulfuric Acid, Monourea adduct) exhibited dermal toxicity effects to areas that were not covered by feathers. Specifically, the eyes and feet were burned by the sulfuric acid released. The birds also showed a significant increase in hemorrhagic enteritis (a severe irritation of the gastrointestinal tract).

Soil Adsorption / Mobility:

The pKa of sulfuric acid is 1.92 at 25 °C (1), indicating that this compound will exist almost entirely in anion form in the environment (as the sulfate ion). Sulfuric acid dissociates readily in water to form sulfate ions and hydrated protons; at pH 3.92 the dissociation is 99% (1). Sulfuric acid is totally miscible in water (1) suggesting a low Koc value (2) and high mobility in soil (3). The ionization of sulfuric acid also implies that sulfuric acid, itself, will not adsorb on particulate material or soil surfaces.

SECTION 13: DISPOSAL CONSIDERATION

Waste treatment methods:

Waste treatment-relevant information: Recycling/reclamation of other inorganic materials. Regeneration of acids.

Sewage disposal-relevant information: Do not empty into drains. Avoid release to the environment. Refer to special instructions/safety data sheets.

Waste treatment of containers/packaging: It is a dangerous waste; only packaging which are approved (e.g. acc. to ADR) may be used. Completely emptied packages can be recycled. Handle contaminated packages in the same way as the substance itself.

Disposal Methods:

Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in air, soil or water; effects on animal, aquatic and plant life; and conformance with environmental and public health regulations. If it is possible or reasonable use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination.

SECTION 14: TRANSPORTATION INFORMATION

DOT ID and Guide: 1830 137

DOT Emergency Guidelines:

/GUIDE 137 SUBSTANCES - WATER-REACTIVE - CORROSIVE/ Health: CORROSIVE and/or TOXIC; inhalation, ingestion or contact (skin, eyes) with vapors, dusts or substance may cause severe injury, burns or death. Fire will produce irritating, corrosive and/or toxic gases. Reaction with water may generate much heat that will increase the concentration of fumes in the air. Contact with molten substance may cause severe burns to skin and eyes. Runoff from fire control or dilution water may cause pollution. /Sulfuric acid; Sulfuric acid, with more than 51% acid; Sulphuric acid; Sulphuric acid, with more than 51% acid; Sulfuric acid, spent; Sulphuric acid, spent/

Standard Transportation Number: 49 300 40; Sulfuric acid

Shipment Methods and Regulations:

No person may /transport/ offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177)/

Packaging and Labelling:
Unbreakable packaging. Put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs.

UN Classification: UN Hazard Class- 8; UN Pack Group- II

SECTION 15: REGULATORY INFORMATION

Clean Water Act Requirements: Sulfuric acid is designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. This designation includes any isomers and hydrates, as well as any solutions and mixtures containing this substance.

CERCLA Reportable Quantities: Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 1000 lb or 454 kg. The toll-free number of the NRC is (800) 424-8802. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV.D.3.b).

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:

A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, PubChem, Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS), Safe Work Australia

MATERIAL SAFETY DATA SHEET OF METHANOL

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name	:	**METHANOL**
Chemical Formula	:	CH_3OH
CAS no.	:	67-56-1
UN No.	:	1230
Synonymous	:	Carbinol, Hydroxy methane, Methyl Alcohol, Methyl Hydroxide, Methylic Alcohol, Methylol, Pyroligneous Spirit, Wood Alcohol, Wood Spirit.
HAZCHEM Code	:	2WE
Label/ Class	:	Hazard Class 3 Flammable Liquid
General Use	:	Methanol has a wide range of uses, primarily as a chemical feedstock and a fuel source. It is also used as solvent, antifreeze and used as a fuel, especially in biodiesel and in some industrial applications like boilers and cook stoves.

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :

Signal Word : Danger

GHS Hazard Statements :
H225 (> 99.9%): Highly Flammable liquid and vapor [Danger Flammable liquids]
H301 (99.9%): Toxic if swallowed [Danger Acute toxicity, oral]
H311 (99.9%): Toxic in contact with skin [Danger Acute toxicity, dermal]
H331 (99.4%): Toxic if inhaled [Danger Acute toxicity, inhalation]
H370 (> 99.9%): Causes damage to organs [Danger Specific target organ toxicity, single exposure]

Precautionary Statement Codes:

P210, P233, P240, P241, P242, P243, P260, P261, P262, P264, P270, P271, P280, P301 + P316, P302 + P352, P303 + P361 + P353, P304 + P340, P308 + P316, P316, P321, P330, P361 + P364, P370 + P378, P403 + P233, P403 + P235, P405, and P501

(The corresponding statement to each P-code can be found at the GHS Classification page.)

NFPA Hazard Classification
NFPA 704 Diamond :

Diamond	Hazard	Value	Description
	◆ Health	1	Can cause significant irritation.
	◆ Flammability	3	Can be ignited under almost all ambient temperature conditions.
	◆ Instability	0	Normally stable, even under fire conditions.
	◇ Special		

Health Hazards:
Excerpt from ERG Guide 132 [Flammable Liquids - Corrosive]: May cause toxic effects if inhaled or ingested. Contact with substance may cause severe burns to skin and eyes. Fire will produce irritating, corrosive and/or toxic gases. Vapors may cause dizziness or asphyxiation, especially when in closed or confined areas. Runoff from fire control or dilution water may cause environmental contamination. (ERG, 2024). Exposure to excessive vapor causes eye irritation, head- ache, fatigue and drowsiness. High concentrations can produce central nervous system depression and optic nerve damage. 50,000 ppm will probably cause death in 1 to 2 hrs. Can be absorbed through skin. Swallowing may cause death or eye damage. (USCG, 1999).

Fire Hazards:
Flammable/combustible material. May be ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.). Vapor explosion hazard indoors, outdoors or in sewers. Those substances designated with a (P) may polymerize explosively when heated or involved in a fire. Runoff to sewer may create fire or explosion hazard. Containers may explode when heated. Many liquids will float on water. (ERG, 2024).

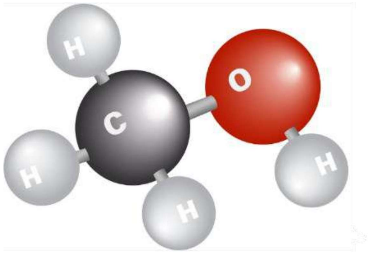
Explosion Hazards:
- Mixtures of methanol vapor and air are explosive.
- Agent presents a vapor explosion and poison (toxic) hazard indoors, outdoors, or in sewers.
- Run-off to sewers may create an explosion hazard.
- Containers may explode when heated.

Hazards Summary:
Methanol is released to the environment during industrial uses and naturally from volcanic gases, vegetation, and microbes. Exposure may occur from ambient air and during the use of solvents. Acute (short-term) or chronic (long-term) exposure of humans to methanol by inhalation or ingestion may result in blurred vision, headache, dizziness, and nausea. No information is available on the reproductive, developmental, or carcinogenic effects of methanol in humans. Birth defects have been observed in the offspring of rats and mice exposed to methanol by inhalation. EPA has not classified methanol with respect to carcinogenicity.

Skin, Eye, and Respiratory Irritations :
Methanol is irritating to the eye and causes conjunctivitis, chemosis, iritis, and corneal opacity. Methanol was reported to be a mild eye irritant. However, in another study, undiluted methanol caused moderate corneal opacity in three of six rabbits and conjunctival redness in all six rabbits. A 50% aqueous methanol solution caused minimal to no effects, and a 25% aqueous solution caused no effects.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Structural Formula :



Name	:	Methanol
Molecular Formula	:	CH_3OH
Molecular Weight	:	32.04 g/mol
Chemical Family	:	Alcohol chemical family
CAS No	:	67-56-1

Hazard Classes and Categories:	Flammable liquids - Category 2 Acute toxicity (Oral) - Category 4 Serious eye damage/eye irritation - Category 2 Reproductive toxicity - Category 1B Specific target organ toxicity - Single exposure - Category 1 (central nervous system, visual organs, systemic toxicity), Category 3 (narcotic effects) Specific target organ toxicity - Repeated exposure - Category 1 (central nervous system, visual organs)

SECTION 4: FIRST-AID MEASURES

Eyes:
First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

Skin:
IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, IMMEDIATELY call a physician and be prepared to transport the victim to a hospital for treatment.

Inhalation:
IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing.

Ingestion:
DO NOT INDUCE VOMITING. Volatile chemicals have a high risk of being aspirated into the victim's lungs during vomiting which increases the medical problems. If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center. IMMEDIATELY transport the victim to a hospital. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. DO NOT INDUCE VOMITING. IMMEDIATELY transport the victim to a hospital. (NTP, 1992)

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : 11^{0}C or 52°F
Auto Ignition Temperature : 464^{0}C or 867 °F
LEL : 6 %
UEL : 36.5 %
Flammability Classification : Class IB Flammable Liquid

Suitable Extinguishing Media : Use water spray, powder, alcohol-resistant foam, carbon dioxide. In case of fire: keep drums, etc., cool by spraying with water.

Unsuitable Extinguishing Media: Do not use a solid (straight) water stream as it may scatter and spread fire.

Hazard Combustion Products : Carbon monoxide, carbon dioxide

Fire Fighting:
Excerpt from ERG Guide 131 [Flammable Liquids - Toxic]:
CAUTION: The majority of these products have a very low flash point. Use of water spray when fighting fire may be inefficient. CAUTION: Methanol (UN1230) will burn with an invisible flame. Use an alternate method of detection (thermal camera, broom handle, etc.).
SMALL FIRE: Dry chemical, CO$_2$, water spray or alcohol-resistant foam.
LARGE FIRE: Water spray, fog or alcohol-resistant foam. If it can be done safely, move undamaged containers away from the area around the fire. Dike runoff from fire control for later disposal. Avoid aiming straight or solid streams directly onto the product.

Fire involving tanks, Rail tank cars or Highway tanks: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks in direct contact with flames. For massive fire, use unmanned master stream devices or monitor nozzles; if this is impossible, withdraw from area and let fire burn. (ERG, 2024)

Firefighting Hazards: Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire.

Advice for firefighters: Wear self-contained breathing apparatus for firefighting if necessary.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Public Safety: ERG 2024, Guide 131 (Methyl alcohol)

- CALL 911. Then call emergency response telephone number on shipping paper. If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.
- Keep unauthorized personnel away.
- Stay upwind, uphill and/or upstream.
- Ventilate closed spaces before entering, but only if properly trained and equipped.

Isolation and Evacuation:
Excerpt from ERG Guide 131 [Flammable Liquids - Toxic]:
Immediate Precautionary Measure: Isolate spill or leak area for at least 50 meters (150 feet) in all directions.
SPILL: Increase the immediate precautionary measure distance, in the downwind direction, as necessary.
FIRE: If tank, rail tank car or highway tank is involved in a fire, isolate for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024)

Spillage Disposal:
Evacuate danger area! Consult an expert! Remove all ignition sources. Ventilation. Personal protection: complete protective clothing including self-contained breathing apparatus. Do NOT wash away into sewer. Collect leaking and spilled liquid in covered containers as far as possible. Absorb remaining liquid in sand or inert absorbent. Wash away remainder with plenty of water. Store and dispose of according to local regulations.

Cleanup Methods:
Accidental Release Measures: Personal precautions, protective equipment and emergency procedures: Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas. Environmental precautions: Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Methods and materials for containment and cleaning up: Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations.

Spills on Land: Contain, if possible, by forming mechanical or chemical barriers to prevent spreading. Absorb on sand, vermiculite or other absorbent and shovel into metal containers for disposal. Application of universal gelling agent to immobilize the spill, or the use of fly ash or cement powder to absorb the liquid bulk should also be considered. Other recommended sorbent materials are activated carbon and a universal sorbent material.

Spills in Water: After containment, a universal gelling agent can be injected to solidify trapped mass to increase the effectiveness of berms. Activated carbon can be applied at 10% the spilled amount over region occupied by 10 mg/L or greater concentrations. Then use mechanical dredges or lifts to remove immobilized masses of pollutants.

Disposal Methods: See section – 13.

Appropriate engineering controls: Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

SECTION 7: HANDLING AND STORAGE

Non-fire Spill Response:
Excerpt from ERG Guide 131 [Flammable Liquids - Toxic]:
Eliminate all ignition sources (no smoking, flares, sparks or flames) from immediate area. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor-suppressing foam may be used to reduce vapors.
Small Spill: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Use clean, non-sparking tools to collect absorbed material.
Large Spill: Dike far ahead of liquid spill for later disposal. Water spray may reduce vapor, but may not prevent ignition in closed spaces. (ERG, 2024)

Safe Storage: Separated from incompatible materials. Cool. Fireproof. Keep in a well-ventilated room.

Storage Conditions: Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Keep away from food, drink and animal feeding stuffs. Keep out of the reach of children. Ground container and transfer equipment to eliminate static electric sparks. Comply with all national, state, and local codes pertaining to the storage, handling, dispensing, and disposal of flammable liquids. Permanently installed fire-extinguishing equipment should be provided in large storage facilities. Water cannons are generally installed in storage tank farms to cool steel constructions and neighboring tanks in the event of fire. Large tanks should have permanently installed piping systems for alcohol-resistant fire-extinguishing foams.

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Protective Clothing: ERG 2024, Guide 131 (Methyl alcohol)

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer when there is NO RISK OF FIRE.
- Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.

Control parameters:

REL-TWA (10 Hour Time-Weighted Average)	200 ppm (260 mg/cu m)
REL-STEL (15 Minute Short Term Exposure Limit)	250 ppm (325 mg/cu m)
PEL-TWA (8-Hour Time Weighted Average)	200 ppm (260 mg/cu m)
Immediately Dangerous to Life or Health (IDLH)	6000 ppm (NIOSH, 2024)
TLV-TWA (8-Hour Time Weighted Average)	200 ppm
TLV-STEL (15 min Short Term Exposure Limit)	250 ppm
Occupational Exposure Limits (OEL)	260 mg/m

Inhalation Risk: A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20 °C.

Effects of Short-Term Exposure:

The substance is irritating to the eyes, skin and respiratory tract. The substance may cause effects on the central nervous system. This may result in loss of consciousness. Exposure could cause blindness and death. The effects may be delayed. Medical observation is indicated.
Methanol is not suspected to be a carcinogen. Chronic or repeated exposure to methanol is suspected to be a developmental toxicity risk. It is unknown whether chronic or repeated exposure to methanol is a reproductive toxicity risk. Methanol may cause birth defects of the central nervous system in humans. Chronic poisoning from repeated exposure to methanol vapor may produce inflammation of the eye (conjunctivitis), recurrent headaches, giddiness, insomnia, stomach disturbances, and visual failure. The most noted health consequences of longer-term exposure to lower levels of methanol are a broad range of effects on the eye. Inflammatory changes and irritation of the skin (dermatitis), occurs with chronic or repeated exposure to methanol.

Effects of Long-Term Exposure:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the central nervous system. This may result in persistent or recurring headaches and impaired vision.

Allowable Tolerances: Residues of methyl alcohol are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest. Use: solvent.

Personal Protective Equipment (PPE):

Eye/Face Protection	:	Eye/face protection: Face shield and safety glasses. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).
Skin Protection	:	Wear appropriate chemical resistant clothing (with long sleeves) and appropriate chemical resistant gloves.
Respiratory Protection	:	Use a positive-pressure air-supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection.

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Physical Description	:	Methanol appears as a colorless fairly volatile liquid.
Odor	:	Slight alcoholic odor when pure; repulsive, pungent odor when crude
Boiling Point	:	64.7^{0}C or 148.3 °F at 760 mm Hg
Melting/Freezing point	:	-97.6^{0}C or -144 °F
Solubility in water	:	Greater than or equal to 100 mg/mL at 21^{o}C or 70 °F
Density	:	0.792 at 68 °F or 20^{o}C - Less dense than water; will float
Vapor Pressure at	:	100 mmHg at 70.2 °F; 237.87 mmHg at 100 °F (NTP, 1992)
Vapor Density (Air=1)	:	1.11 - Heavier than air; will sink (air = 1)
Viscosity	:	0.544 mPa.s at 25 °C
Heat of Combustion	:	726.1 kJ/mole
Heat of Vaporization	:	37.34 kJ/mole at 25 °C
Critical Temperature	:	240.0 °C
Critical Pressure	:	78.5 atm
Odor Threshold	:	Low: 4.2 [ppm] High: 5960.0 [ppm]

SECTION 10: STABILITY & REACTIVITY

Stability	:	Stable under recommended storage conditions.
Air and Water Reactions	:	Highly flammable. Soluble in water in all proportions.
Reactive Group	:	Alcohols and Polyols, Amines, Phosphines, and Pyridines
Reactivity Alerts	:	Highly Flammable

Reactivity Profile : METHANOL reacts violently with acetyl bromide [Merck 11th ed. 1989]. Mixtures with concentrated sulfuric acid and concentrated hydrogen peroxide can cause explosions. Reacts with hypochlorous acid either in water solution or mixed water/carbon tetrachloride solution to give methyl hypochlorite, which decomposes in the cold and may explode on exposure to sunlight or heat. Gives the same product with chlorine. Can react explosively with isocyanates under basic conditions.

Conditions to Avoid : Heat, flames, sparks, ignition sources, incompatibles.

Incompatible Materials : Acid chlorides, acid anhydrides, oxidizing agents, alkali metals, reducing agents, acids.

Hazardous Decomposition Products : Carbon dioxide, carbon monoxide, irritants, toxic gas, formaldehyde

Hazardous Polymerization : Will not occur.

SECTION 11: TOXICOLOGICAL INFORMATION

Toxicity Summary:
IDENTIFICATION AND USE: Methanol is a clear colorless liquid, used in hydraulic fracturing mixtures. It is also used as dehydrator of natural gas; fuel for utility plants (methyl fuel); feedstock for manufacture of synthetic proteins by continuous fermentation; source of hydrogen for fuel cells, home-heating-oil extender.
Carcinogen Classification: No indication of carcinogenicity to humans (not listed by IARC).
Health Effects: Acute methanol poisoning in humans is characterized by an asymptomatic period of 12h to 24h followed by formic acidemia, ocular toxicity, coma, and in extreme cases death. Visual disturbances develop between 18h to 48h after ingestion and range from mild photophobia and blurred vision to markedly reduced visual acuity and complete blindness. (T10)

Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms:
Inhalation Exposure: Cough. Dizziness. Headache. Weakness. Visual disturbances. Drowsiness. Shortness of breath. Convulsions. Unconsciousness.
Skin Exposure: Dry skin. Redness.
Eye Exposure: Redness. Pain. Blurred vision.
Ingestion Exposure: Abdominal pain. Further see Inhalation.

Target Organs: Eyes, skin, respiratory system, central nervous system, gastrointestinal tract

Adverse Effects: Neurotoxin - Another CNS neurotoxin
Reproductive Toxin - A chemical that is toxic to the reproductive system, including defects in the progeny and injury to male or female reproductive function. Reproductive toxicity includes developmental effects. See Guidelines for Reproductive Toxicity Risk Assessment.

Antidote and Emergency Treatment:
Methanol poisonings can produce significant toxicity in humans, including acidosis, blindness, and death. The current mainstay of therapy is alcohol dehydrogenase (ADH) inhibition to prevent formation of formic acid and hemodialysis to correct acidosis and remove both parent compound and toxic metabolite. Folate has been recommended as an adjunctive therapy to increase formic acid oxidation into carbon dioxide and water.

Human Toxicity Excerpts:
HUMAN EXPOSURE STUDIES/ The effects of methanol vapor (249 mg/cu m; SD + 7 mg/cu m) for 75 min on neurobehavioral measures were studied in 12 healthy young men. The exposure

produced significant increases (approximately 3-fold) in blood and urine methanol levels but no changes in plasma format level. Although most of the neurobehavioral end-points were unaffected by exposure to methanol, statistically significant effects and trends were found for a cluster of variables, including the latency of the p-200 component of event-related potentials, performance on the Sternberg memory task and subjective measures of fatigue and concentration. However, the effects were small and did not exceed the normal range.

Non-Human Toxicity Excerpts:
Laboratory Animals: Acute Exposure/ The incidence of accidental or suicidal ingestion of methyl alcohol is high and methyl alcohol intoxication has high mortality. Methyl alcohol intoxication causes severe neurological sequelae and appears to be a significant problem. Methyl alcohol causes acute metabolic acidosis, optic neuropathy leading to permanent blindness, respiratory failure, circulatory failure and death. It is metabolized in the liver, and its metabolite formic acid has direct toxic effects, causing oxidative stress, mitochondrial damage and increased lipid peroxidation associated with the mechanism of neurotoxicity. Methanol is known to cause acute toxicity of the central nervous system; however, the effects on peripheral neuromuscular transmission are unknown.

Toxicological Data : LD50 Rat oral 5628 mg/kg
LD50 Mouse oral 7300 mg/kg
LD50 Rabbit oral 14.4 g/kg
LD50 Monkey oral 2-3 g/kg

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity Excerpts:
/AQUATIC SPECIES/ At 40,000-80,000 mg/L, methanol killed Chironomus dorsalis meig larvae within 2 days; 500-20,000 mg/L within 26 days. 50-200 mg/L delayed imago emergence; at emergence, limb defects or hemorrhages were observed. 250 mg/L cause morphological changes in larval development.

Ecotoxicological Data:
EC50 Water flea (Daphnia magna): & gt; 10000 mg/L 48 H
LC50 Fathead minnow (Pimephales promelas): 100mg/L 96 H
Environmental Effects: This product is not expected to be harmful to the environment.
Persistence and Degradability: Expected to be readily biodegradable.
Partition Coefficient -0.77(n-octanol/water)

Soil Adsorption / Mobility: The measured Koc for methanol is reported to be 2.75(1). According to a classification scheme (2), this estimated Koc value suggests that methanol is expected to have very high mobility in soil (SRC).

SECTION 13: DISPOSAL CONSIDERATION

Disposal Methods:

SRP: Wastewater from contaminant suppression, cleaning of protective clothing/equipment, or contaminated sites should be contained and evaluated for subject chemical or decomposition product concentrations. Concentrations shall be lower than applicable environmental discharge or disposal criteria. Alternatively, pretreatment and/or discharge to a permitted wastewater treatment facility is acceptable only after review by the governing authority and assurance that "pass through" violations will not occur. Due consideration shall be given to remediation worker exposure (inhalation, dermal and ingestion) as well as fate during treatment, transfer and disposal. If it is not practicable to manage the chemical in this fashion, it must be evaluated in accordance with

EPA 40 CFR Part 261, specifically Subpart B, in order to determine the appropriate local, state and federal requirements for disposal.

SECTION 14: TRANSPORTATION INFORMATION

DOT Emergency Guidelines:
GUIDE 131 Flammable Liquids - Toxic/ Fire or Explosion: Highly Flammable: Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks). Vapor explosion and poison hazard indoors, outdoors or in sewers. Those substances designated with a (P) may polymerize explosively when heated or involved in a fire. Runoff to sewer may create fire or explosion hazard. Containers may explode when heated. Many liquids are lighter than water.

DOT ID and Guide: 1230 131
DOT Label: Flammable Liquid Poison (international)
Shipping Name / Number DOT/UN/NA/IMO: UN 1230; Methanol
Standard Transportation Number: 49 092 30; Methanol or methyl alcohol (wood alcohol)
UN Classification: UN Hazard Class: 3; UN Subsidiary Risks: 6.1; UN Pack Group: II

Shipment Methods and Regulations:
No person may /transport, / offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177). /

SECTION 15: REGULATORY INFORMATION

CERCLA Reportable Quantities: Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 5000 lb or 2270 kg. The toll-free number of the NRC is (800) 424-8802. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV. D.3.b).

RCRA Requirements: U154; As stipulated in 40 CFR 261.33, when methanol, as a commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate, becomes a waste, it must be managed according to Federal and/or State hazardous waste regulations. Also defined as a hazardous waste is any residue, contaminated soil, water, or other debris resulting from the cleanup of a spill, into water or on dry land, of this waste. Generators of small quantities of this waste may qualify for partial exclusion from hazardous waste regulations (40 CFR 261.5).

FIFRA Requirements: Residues of methyl alcohol are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest. Use: solvent.

FDA Requirements: Methyl alcohol may be present in the following foods under the conditions specified: (a) In spice oleoresins as a residue from the extraction of spice, at a level not to exceed 50 parts per million. (b) In hops extract as a residue from the extraction of hops, at a level not to exceed 2.2 percent by weight; Provided, that: (1) The hops extract is added to the wort before or during cooking in the manufacture of beer. (2) The label of the hops extract specifies the presence of methyl alcohol and provides for the use of the hops extract only as prescribed by paragraph (b)(1) of this section.

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:
A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, PubChem, Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS), Safe Work Australia

MATERIAL SAFETY DATA SHEET OF OXYGEN

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name : **OXYGEN**

Chemical Formula : O_2

CAS no. : 7782-44-7

UN No. : 1072 (Oxygen)
1073 (Oxygen Gas, Refrigerated Liquid, Oxidizing, N.O.S. Cryogenic liquid)

Synonymous : Molecular oxygen, Dioxygen, Liquid oxygen, Pure oxygen, Oxygen, Refrigerated Liquid (Cryogenic Liquid)

HAZCH : 2S

Label /Class : 2.2 (Non-Flammable Gas), 5.1 (oxidizing)

General Use : Oxygen, a colorless, odorless, and tasteless gas, is essential for life, supporting breathing and respiration in most organisms, and is used industrially in various processes like steel production and welding. Also used in the production of synthesis gas from coal, for resuscitation and as an inhalant.

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :

Signal Word : Danger

GHS Hazard Statements : H270 (99.9%): May cause or intensify fire; oxidizer [Danger Oxidizing gases]
H280 (34.9%): Contains gas under pressure; may explode if heated [Warning Gases under pressure]
H281 (15.9%): Contains refrigerated gas; may cause cryogenic burns or injury [Warning Gases under pressure]

Precautionary Statement Codes: P220, P244, P282, P336+P317, P370+P376, P403, and P410+P403
(The corresponding statement to each P-code can be found at the GHS Classification page.)

NFPA Hazard Classification
NFPA 704 Diamond :

Diamond	Hazard	Value	Description
	◆ Health	3	Can cause serious or permanent injury.
	◆ Flammability	0	Will not burn under typical fire conditions.
	◆ Instability	0	Normally stable, even under fire conditions.
	◇ Special	OX	Possesses oxidizing properties.

Health Hazards : Excerpt from ERG Guide 122 [Gases - Oxidizing (Including Refrigerated Liquids)]:

Vapors may cause dizziness or asphyxiation without warning, especially when in closed or confined areas. Contact with gas, liquefied gas or cryogenic liquids may cause burns, severe injury and/or frostbite. Fire may produce irritating and/or toxic gases. (ERG, 2024)

Fire Hazards : Excerpt from ERG Guide 122 [Gases - Oxidizing (Including Refrigerated Liquids)]:

Substance does not burn but will support combustion. Some may react explosively with fuels. May ignite combustibles (wood, paper, oil, clothing, etc.). Vapors from liquefied gas are initially heavier than air and spread along ground. Runoff may create fire or explosion hazard. Containers may explode when heated. Ruptured cylinders may rocket. (ERG, 2024)

Explosion Hazard : The substance is a strong oxidant and reacts with combustible and reducing materials, causing fire and explosion hazard.

Hazards Summary : A powerful oxidizer and explosion hazard; Liquid may cause frostbite; Inhalation of 100% oxygen for 24 hours can cause pulmonary edema; Chronic exposure to high concentrations of oxygen can cause lung scarring; [CHEMINFO] Oxygen toxicity is observed in mechanically ventilated patients treated for hypoxic respiratory failure. Exposures to oxygen at FIO2 of 50 to 60% for more than 6 hours can cause lung injury including alveolar edema, formation of hyaline membranes, hypoxemia, and progressive fibrosis.

Skin, Eye, and Respiratory Irritations: Liquid: Irritant to skin & tissues. Contact with liquid will cause frostbite.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Structural Formula :

Name : Oxygen
Molecular Formula : O_2
Molecular Weight : 32 g/mol
Chemical Family : The Chalcogens
CAS No : 7782-44-7

SECTION 4: FIRST-AID MEASURES

Inhalation : Fresh air, rest. Refer for medical attention. in all but the most severe cases (pneumonia), recovery is rapid after reduction of oxygen pressure; supportive treatment should include immediate sedation, anticonvulsive therapy if needed, and rest.

Skin Contact : ON FROSTBITE: rinse with plenty of water, do NOT remove clothes. Refer for medical attention.

Eye Contact : First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.

Specific First Aid : Clothing frozen to the skin should be thawed before being removed. In case of contact with liquefied gas, only medical personnel should attempt thawing frosted parts.

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : Non-Flammable but is a strong oxidizer
Auto ignition Temperature : Not flammable
LEL : Not Applicable
UEL : Not Applicable
Flammability Classification : Non-Flammable

Excerpt from ERG Guide 122 [Gases - Oxidizing (Including Refrigerated Liquids)]:

SMALL FIRE: Dry chemical or CO_2.

LARGE FIRE: Water spray, fog or regular foam. If it can be done safely, move undamaged containers away from the area around the fire. Damaged cylinders should be handled only by specialists.

Fire Involving Tanks: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks in direct contact with flames. For massive fire, use unmanned master stream devices or monitor nozzles; if this is impossible, withdraw from area and let fire burn. (ERG, 2024)

Fire Fighting Procedures: LIQ: When fire results from a leak or flow of liq oxygen onto wood, paper, waste or another similar material, the first thing to do is stop flow if possible. For small spills, or after leak or flow of liq oxygen has been stopped, use enough water to put out fire quickly. When fire involves liq oxygen and liq fuels, control it as follows: (a) When liq oxygen leaks or flows into large quantities of fuel, shut off flow of liq oxygen, and put remaining fuel fire out with extinguishing agents suitable for use on class B fires. When fuel leaks or flows into large quantities of liq oxygen, shut off flow of fuel. (b) When fuel and liq oxygen are mixed or mixing but are not yet burning, isolate area from sources of ignition and get out quickly, allowing oxygen to evaporate. When large pools of water-soluble fuel are present, use water to dilute fuel and reduce intensity of fire. This method cannot be used with fuels which do not mix with water. Appropriate extinguishing agents may be used to put out fuel fires after the oxygen has evaporated.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Isolation and Evacuation:

Immediate Precautionary Measure: Isolate spill or leak area for at least 100 meters (330 feet) in all directions.

Large Spill: Consider initial downwind evacuation for at least 500 meters (1/3 mile).

FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024)

Spillage Disposal: Ventilation. Remove all ignition sources. Do NOT absorb in saw-dust or other combustible absorbents. NEVER direct water jet on liquid.

Cleanup Methods: Notify safety personnel of significant leaks or spills. ... Shut off oxygen source if possible. Eliminate all ignition sources. Stop or control the leak, if this can be done without undue risk. Use water spray to disperse vapors and protect personnel.

Disposal Methods: See section – 13.

Preventive Measures:

FDA and NIOSH recommend that plastic crush gaskets /on oxygen cylinders/ never be reused, as they may require additional torque to obtain the necessary seal with each subsequent use. This can deform the gasket, increasing the likelihood that oxygen will leak around the seal and ignite. The following general safety precautions should also be taken to avoid explosions, tank ruptures and fires from oxygen regulators. Always "crack" cylinder valves (open the valve just enough to allow gas to escape for a very short time) before attaching regulators in order to expel foreign matter from the outlet port of the valve. Always follow the regulator manufacturer's instructions for attaching the regulator to an oxygen cylinder. Always use the sealing gasket specified by the regulator manufacturer. Always inspect the regulator and CGA 870 seal before attaching it to the valve to ensure that the regulator is equipped with only one clean, sealing- type washer (reusable metal-bound rubber seal) or a new crush-type gasket (single use, not reusable, typically Nylon) that is in good condition. Always be certain the valve, regulator and gasket are free from oil or grease. Oil or grease contamination is widely known to contribute to ignition in oxygen systems. Tighten the T-handle firmly by hand, but do not use wrenches or other hand tools that may over-torque the handle. Open the post valve slowly. If gas escapes at the juncture of the regulator and valve, quickly close the valve. Verify the regulator is properly attached and the gasket is properly placed and in good condition.

SECTION 7: HANDLING AND STORAGE

Excerpt from ERG Guide 122 [Gases - Oxidizing (Including Refrigerated Liquids)]:

Non-Fire Response:

Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not touch or walk through spilled material. Stop leak if you can do it without risk. If possible, turn leaking containers so that gas escapes rather than liquid. Do not direct water at spill or source of leak. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Prevent entry into waterways, sewers, basements or confined areas. Allow substance to evaporate. Isolate area until gas has dispersed. CAUTION: When in contact with refrigerated/cryogenic liquids, many materials become brittle and are likely to break without warning. (ERG, 2024)

Safe Storage: Fireproof. Separated from combustible substances and reducing agents. Cool.

Storage Conditions: Gas & Liq: gaseous oxygen is stored In cylinders at a pressure of 150-160 atm, & insulated tanks are used for liquid oxygen; small quantities of liquid oxygen (2-50 l) can be stored in dewar flasks. Oxygen should be stored in an area that is at least 20 ft away from any flammable or combustible materials (especially oil & grease) or separated from them by a noncombustible barrier at least 5 ft high & having a fire-resistant rating of at least 1/2 hr. LIQ: Protect against physical damage. Isolate from combustible gas installations and combustible materials by adequate distance or by gas-tight fire-resistive barriers. Protect against overheating. Outside storage of liq oxygen tanks is recommended.

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Protective Clothing: ERG 2024, Guide 122 (Oxygen, refrigerated liquid (cryogenic liquid); Oxygen, compressed)

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer when there is NO RISK OF FIRE.
- Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.
- Always wear thermal protective clothing when handling refrigerated/cryogenic liquids.

Effects of Short-Term Exposure: The substance at very high concentrations is irritating to the respiratory tract. The substance may cause effects on the central nervous system, lungs and eyes. Rapid evaporation of the liquid may cause frostbite.

Effects of Long-Term Exposure: Repeated or prolonged inhalation of high concentrations may cause effects on the lungs.

Personal Protective Equipment (PPE):

Excerpt from ERG Guide 122 [Gases - Oxidizing (Including Refrigerated Liquids)]:

Safety goggles or face shield; insulated gloves; long sleeves; trousers worn outside boots or over high-top shoes to shed spilled liquid. Wear positive pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer when there is NO RISK OF FIRE. Structural firefighters' protective clothing provides thermal protection but only limited chemical protection. Always wear thermal protective clothing when handling refrigerated/cryogenic liquids. (ERG, 2024)

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Molecular Weight	:	32 g/mol
Physical Description	:	Oxygen is a colorless, odorless and tasteless gas. It will support life. It is noncombustible, but will actively support the burning of combustible materials.
Appearance	:	Colorless Liquid
Odor	:	Odorless
Boiling Point/ Range, ^{0}C	:	-297.3 °F or -182.94 ^{0}C at 760 mmHg
Melting/Freezing Point, ^{0}C	:	-361 °F or -218.4 ^{0}C
Vapor Pressure, ^{0}C	:	1 kPa at -211.9 °C
Vapor Density (Air=1)	:	1.43
Density	:	1.14 at -297.4 °F or 147.4 ^{0}C (USCG, 1999) - Denser than water; will sink
Solubility in Water	:	1 vol gas dissolves in 32 vol water at 20 °C
Viscosity	:	Gas: 101.325 kPa at 25 °C (0.020 75 cP); Liquid: 99.70 K (0.156 cP)
Critical Temperature	:	-118.95 °C
Critical Pressure	:	50.14 atm
Heat of Vaporization	:	50.9 cal/g at -183 °C

SECTION 10: STABILITY & REACTIVITY

Reactivity	:	Not Chemically Reactive
Reactive Group	:	Strong Oxidizing Agent
Stability	:	Stable.
Hazardous Incompatible Materials	:	Liq: Heat of water will vigorously vaporize liquid oxygen.

SECTION 11: TOXICOLOGICAL INFORMATION

Exposure Routes: The substance can be absorbed into the body by inhalation.
Symptoms:
<u>Inhalation Exposure:</u> Cough. Dizziness. Sore throat. Visual disturbances.
<u>Skin & Eye Exposure:</u> on contact with liquid: Frostbite.

Antidote and Emergency Treatment:

Contact with liquid oxygen: Remove victim from source of contact. Flush affected areas with lots of tepid water (Do not apply directly to affected area). Loosely apply dry sterile, bulky dressings to protect area from infection/injury. Get medical attention. /Liquid oxygen/.

Basic treatment: Establish a patent airway (oropharyngeal or nasopharyngeal airway, if needed). Suction if necessary. Watch for signs of respiratory insufficiency and assist ventilations if necessary. Administer oxygen by nonrebreather mask at 10 to 15 L/min. Monitor for pulmonary edema and treat if necessary. Monitor for shock and treat if necessary. For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with 0.9% saline (NS) during transport. Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool. Do not attempt to neutralize because of exothermic reaction. Cover skin burns with dry, sterile dressings after decontamination. /Oxidizers/

Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious, has severe pulmonary edema, or is in severe respiratory distress. Early intubation, at the first sign of upper airway obstruction, may be necessary. Positive-pressure ventilation techniques with a bag valve mask device may be beneficial. Consider drug therapy for pulmonary edema .... Monitor cardiac rhythm and treat arrhythmias as necessary.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity Studies:

Human Exposure and Toxicity: /Human Exposure Studies/ "Hyperbaric" is an atmospheric pressure greater than that at sea level. This increase in pressure, often associated with diving, is opposite of the decrease in atmospheric pressure associated with aviation and mountain climbing (hypobaric). Partial pressures of O_2 are higher in hyperbaric, and lower in hypobaric, atmospheres. Increased O_2 pressures result in hyperoxygenation of the blood (increased dissolved O_2) and allows for improved O_2 delivery to tissues. Hyperbaric O_2 has a number of important uses in medicine. However, the toxicity of increased O_2 pressures is also evident in human and animal studies.

Animal Studies: Acute Exposure/ /Dogs inhaling pure O_2 at atmospheric pressure/poisoning begins after 36 hr, causes distress within 48 hr, and death in 60 hr. Ninety per cent O_2 in air requires double exposure period for similar results; in 80% oxygen in air the animals did not die but were ill at the end of a continuous exposure of 1 wk. A decline in O_2 saturation of blood, rise in hemoglobin, lung congestion and edema, right-heart failure, and liver congestion were frequent findings in oxygen poisoning.

SECTION 13: DISPOSAL CONSIDERATION

Disposal Methods:

The most favorable course of action is to use an alternative chemical product with less inherent propensity for occupational exposure or environmental contamination. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations.

Remove waste containers or leaking cylinders to exhaust hood or outdoors away from combustibles and allow to discharge at moderate rate. Tag cylinder to indicate defect, close valve and return to supplier. /Liquid and compressed oxygen/

SECTION 14: TRANSPORTATION INFORMATION

Shipping Name: UN 1072; Oxygen, compressed
UN 1073; Oxygen, refrigerated liquid (cryogenic liquid)

DOT Label: Non-Flammable Gas Oxidizer

DOT Emergency Guidelines:

/GUIDE 122: GASES - OXIDIZING (INCLUDING REFRIGERATED LIQUIDS)/ Fire or Explosion: Substance does not burn but will support combustion. Some may react explosively with fuels. May ignite combustibles (wood, paper, oil, clothing, etc.). Vapors from liquefied gas are initially heavier than air and spread along ground. Runoff may create fire or explosion hazard. Containers may explode when heated. Ruptured cylinders may rocket. /Oxygen; Oxygen, compressed; Oxygen, refrigerated liquid (cryogenic liquid)/

Standard Transportation Number: 49 043 70; Oxygen (gas administering apparatus, hospital or surgical, with cylinders of oxygen), 49 043 80; Oxygen (lifesaving apparatus), 49 043 50; Oxygen (Oxygen gas, compressed), 49 043 60; Oxygen, cryogenic liquid (oxygen gas, liquid, other than compressed)

Shipment Methods and Regulations:

No person may /transport, / offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177). /

Packaging and Labelling: Special insulated container.

UN Hazard Class: 2.2; UN Subsidiary Risks: 5.1

SECTION 15: REGULATORY INFORMATION

EPA Consolidated List of Lists
No regulatory information available.

CISA Chemical Facility Anti-Terrorism Standards (CFATS)
No regulatory information available.

OSHA Process Safety Management (PSM) Standard List
No regulatory information available.

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:
A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, Public Chemical Information (PubChem) - National Institutes of Health (NIH) -National Library of Medicine (NLM), Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS).

MATERIAL SAFETY DATA SHEET OF NITROGEN

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name : **NITROGEN**
Chemical Formula : N_2
CAS no. : 7727-37-9
UN No. : 1977 (Cryogenic Liquid),
1066 (Gas)
Synonymous : Nitrogen (Cryogenic Liquid), Nitrogen (Refrigerated Liquid), Diatomic Nitrogen, Dinitrogen, Molecular Nitrogen, Nitrogen Gas, Nitrogen (Compressed Gas)
HAZCH : 2T
Label /Class : 2.2
General Use : Liquid nitrogen is used for a wide range of applications due to its extremely low temperature and low reactivity, including cryotherapy, food preservation, cooling superconductors, cryopreservation of biological samples, and more

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :

Signal Word : Warning
GHS Hazard Statements : H280 (69.6%): Contains gas under pressure; may explode if heated [Warning Gases under pressure]
H281 (26.5%): Contains refrigerated gas; may cause cryogenic burns or injury [Warning Gases under pressure]
Precautionary Statement Codes: P282, P336+P317, P403, and P410+P403
(The corresponding statement to each P-code can be found at the GHS Classification page.)

NFPA Hazard Classification
NFPA 704 Diamond :

Diamond	Hazard	Value	Description
	Health	3	Can cause serious or permanent injury.
	Flammability	0	Will not burn under typical fire conditions.
	Instability	0	Normally stable, even under fire conditions.
	Special		

Health Hazards : Excerpt from ERG Guide 120 [Gases - Inert (Including Refrigerated Liquids)]:

Vapors may cause dizziness or asphyxiation without warning, especially when in closed or confined areas. Vapors from liquefied gas are initially heavier than air and spread along ground. Contact with gas, liquefied gas or cryogenic liquids may cause burns, severe injury and/or frostbite. (ERG, 2024)

Fire Hazards : Non-flammable gases. Containers may explode when heated. Ruptured cylinders may rocket. (ERG, 2024)

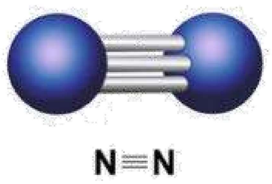
Hazards Summary : A simple asphyxiant; liquid nitrogen can cause frostbite.

MATERIAL SAFETY DATA SHEET OF NITROGEN

(As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Structural Formula :



Name : Liquid Nitrogen
Molecular Formula : N_2
Molecular Weight : 28.014 g/mol
Chemical Family : Cryogenic Liquids/ Gas
CAS No : 7727-37-9

SECTION 4: FIRST-AID MEASURES

Inhalation : Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.
Skin Contact : On FROSTBITE, rinse with plenty of water, do NOT remove clothes. Refer for medical attention
Eye Contact : First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Specific First Aid : Clothing frozen to the skin should be thawed before being removed. In case of contact with liquefied gas, only medical personnel should attempt thawing frosted parts.

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : Not Flammable
Auto ignition Temperature : Not flammable
LEL : Not Applicable
UEL : Not Applicable
Flammability Classification : Non-Flammable

Excerpt from ERG Guide 120 [Gases - Inert (Including Refrigerated Liquids)]

FIRE INVOLVING TANKS: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks in direct contact with flames. (ERG, 2024)

Suitable extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Isolation and Evacuation:

Immediate Precautionary Measure: Isolate spill or leak area for at least 100 meters (330 feet) in all directions.

LARGE SPILL: Consider initial downwind evacuation for at least 100 meters (330 feet).

FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024)

Spillage Disposal: Ventilation. Personal protection: self-contained breathing apparatus.

Cleanup Methods: Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal. Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided. Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

Disposal Methods: See section – 13.

Preventive Measures:

Local exhaust ventilation should be applied wherever there is an incidence of point source emissions or dispersion of regulated contaminants in the work area. Ventilation control of the contaminant as close to its point of generation is both the most economical and safest method to minimize personnel exposure to airborne contaminants. Ensure that the local ventilation moves the contaminant away from the worker.

SECTION 7: HANDLING AND STORAGE

Excerpt from ERG Guide 120 [Gases - Inert (Including Refrigerated Liquids)]:

Non-Fire Response:

Do not touch or walk through spilled material. Stop leak if you can do it without risk. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Do not direct water at spill or source of leak. If possible, turn leaking containers so that gas escapes rather than liquid. Prevent entry into waterways, sewers, basements or confined areas. Allow substance to evaporate. Ventilate the area. CAUTION: When in contact with refrigerated/cryogenic liquids, many materials become brittle and are likely to break without warning. (ERG, 2024).

Protective Clothing:

Safety glasses or face shield; insulated gloves; long sleeves; trousers worn outside boots or over high-top shoes to shed spilled liquid; self-contained breathing apparatus where insufficient air is present. (USCG, 1999)

Safe Storage:

Storage Conditions: Storage temperature for liquid nitrogen: -320 °F. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Since liquid nitrogen tends to cause localized oxygen enrichment due to a fractional distillation of air, containers such as formed plastics should not be used even for temporary storage of liquid nitrogen due to the resultant increase combustibility.

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Protective Clothing:
- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.
- Always wear thermal protective clothing when handling refrigerated/cryogenic liquids or solids.

Threshold Limit Values (TLV): Simple asphyxiant. /A simple asphyxiant may not be assigned a TLV because the limiting factor is the available oxygen.

Effects of Short-Term Exposure: The liquid may cause frostbite.

Personal Protective Equipment (PPE):

Eye/face protection: Face shield and safety glasses. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166 (EU). Safety glasses or face shield; insulated gloves; long sleeves; trousers worn outside boots or over high-top shoes to shed spilled liq; self-contained breathing apparatus where insufficient air is present.

Respiratory protection: Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Body Protection: Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Molecular Weight	:	28.014 g/mol
Physical State	:	Refrigerated Liquid (Cryogenic Liquid) Also appears as a colorless odorless gas. Noncombustible and nontoxic.
Appearance	:	Colorless Liquid
Odor	:	Odorless
Boiling Point/ Range, ^{0}C	:	-320.1 °F or -195.61^{O}C at 760 mmHg
Melting/Freezing Point, ^{0}C	:	-354 °F or -214.4 ^{0}C
Vapor Pressure, ^{0}C	:	-236 °C at 1Pa (solid)
Vapor Density (Air=1)	:	0.96737
Density	:	0.807 at -319.9 °F or -195.5^{O}C
Solubility in Water	:	Slightly Soluble - 18.1 mg/mL at 21 °C
Viscosity	:	22.2 at 400 K or 126.85 °C
Critical Temperature	:	-147.1 °C
Critical Pressure	:	33.5 atm
Heat of Vaporization	:	5.57 kJ/mol at 195.79 °C

SECTION 10: STABILITY & REACTIVITY

Reactivity	:	Not Chemically Reactive Nitrogen, Refrigerated Liquid (Cryogenic Liquid) is very unreactive. Nonflammable, noncombustible and nontoxic. Vapors can fill closed spaces and asphyxiate. Contact with water may result in vigorous or violent boiling and extremely rapid vaporization. If the water is hot, there is the possibility that a liquid "superheat" explosion may occur. Pressures may build to dangerous levels if the liquid contacts water in a closed container
Stability	:	Incombustible and unreactive.
Hazardous Incompatible		
Materials	:	Combines with oxygen and hydrogen on sparking, forming nitric oxide and ammonia, respectively. Combines directly with lithium, and at a red heat with calcium, strontium, and barium

to form nitrides. Forms cyanides when heated with carbon in presence of alkalies or barium oxide.

SECTION 11: TOXICOLOGICAL INFORMATION

Identification And Use: Nitrogen is an odorless, colorless, and tasteless gas that can be condensed into a white liquid. Nitrogen is not registered for current pesticide use in the U.S., but approved pesticide uses may change periodically and so federal, state and local authorities must be consulted for currently approved uses. It is used in manufacturing of ammonia, nitric acid, nitrates, cyanides, etc.; in manufacturing explosives; in filling high-temperature thermometers, incandescent bulbs; to form an inert atmosphere for preservation of materials; as a pharmaceutic aid (air displacement); and for use in dry boxes or glove bags. Liquid nitrogen is used in food-freezing processes; and in the laboratory as a coolant. Nitrogen is used by oil industry to build up great pressures in wells to force crude oil upward, and in hydraulic fracturing.

Exposure Routes: The substance can be absorbed into the body by inhalation.
Symptoms:

- Inhalation Exposure: Unconsciousness. Weakness. Suffocation.
- Skin Exposure: on contact with liquid: Frostbite.
- Eye Exposure: Pain. Severe deep burns.

Antidote and Emergency Treatment:

Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR as necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity Studies:

Human Exposure and Toxicity: Nitrogen gas is an inert substance and is present in the atmosphere at a level of 78.1%. It does not exhibit a direct toxicological effect and has no toxicological profile. It acts by simple asphyxia. If the level of nitrogen increases, this will lead to a reduction in the level of oxygen to below normal atmospheric levels of 20.8%. Nitrogen has a direct toxic action of its own, affecting brain functions and inducing a stupor or euphoria. Nitrogen induced CNS depression ("rapture of the deep" or "the martini effect") results from a direct toxic effect of high nitrogen pressure on nerve conduction and produces effects similar to alcohol intoxication. Complex reasoning, decision-making ability, motor function, and manual dexterity decrease.

Animal Studies: Neurotoxicity/ The effects of change in time pattern of nitrogen on the occurrence of high-pressure neurological syndrome on mice is discussed. Excitement threshold pressures decrease with increased concentration of nitrogen; coarse tremor onset is delayed in direct proportion to the amount of nitrogen present with the same relative potency in compression at 60 atm/hr as at 1000 atm/hr; and threshold pressure of convulsion from high pressure neurological syndrome increases with increased amount of nitrogen. A bolus effect similar to, though smaller than with coarse tremors, is seen at a compression rate of 60 atm/hr but is absent at 1000 atm/hr.

Plants: Nitrogen is an essential nutrient for plant growth and development but is unavailable in its most prevalent form as atmospheric nitrogen. Plants instead depend upon combined, or fixed, forms of nitrogen, such as ammonia and nitrate. Much of this nitrogen is provided to cropping systems in the form of industrially produced nitrogen fertilizers. Use of these fertilizers has led to worldwide, ecological problems, such as the formation of coastal dead zones. Biological nitrogen fixation, on the other hand, offers a natural means of providing nitrogen for plants. It is a critical component of many aquatics, as well as terrestrial ecosystems across our biosphere. Biological nitrogen fixation (BNF) is a key ecological process that can restore nitrogen (N) lost in wildfire and shape the pace and pattern of post-fire forest recovery.

SECTION 13: DISPOSAL CONSIDERATION

Disposal Methods:

Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in air, soil or water; effects on animal, aquatic and plant life; and conformance with environmental and public health regulations. If it is possible or reasonable use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination.

SECTION 14: TRANSPORTATION INFORMATION

Shipping Name: Nitrogen, Refrigerated Liquid, cryogenic liquid

DOT Label: Non-Flammable Gas

DOT Emergency Guidelines:

Guide 120 Gases - INERT (Including Refrigerated Liquids)/ Fire or Explosion: Non-flammable gases. Containers may explode when heated. Ruptured cylinders may rocket. /Nitrogen, refrigerated liquid (cryogenic liquid)/.
Health: Vapors may cause dizziness or asphyxiation without warning. Vapors from liquefied gas are initially heavier than air and spread along ground. Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite. /Nitrogen,
Public Safety: Call Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover. As an immediate precautionary measure, isolate spill or leak area for at least 100 meters (330 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks). Keep out of low areas. Ventilate closed spaces before entering.

Standard Transportation Number: 49 045 65; Nitrogen gas, compressed

Shipment Methods and Regulations:

No person may /transport, / offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177). /

Packaging and Labelling: Special insulated cylinder.

UN Classification: UN Hazard Class: 2.2;

SECTION 15: REGULATORY INFORMATION

FIFRA Requirements:

The insecticide nitrogen is exempted from the requirements of a tolerance when used after harvest in modified atmospheres for stored product insect control on all food commodities. Liquid nitrogen is designated by EPA as a New Pesticide Active Ingredient. Active Ingredient Number: 128934; Type of Pesticide: biochemical - insecticide/termite control; Use Site: non-food use, dry wood protection; Year: 1987.

FDA Requirements:

Substance added directly to human food affirmed as generally recognized as safe (GRAS). Nitrogen used as a general-purpose food additive in animal drugs, feeds, and related products is generally recognized as safe when used in accordance with good manufacturing or feeding practice.

SECTION 16: OTHER INFORMATION

The Information provided in this MSDS is given in good faith and is correct to the best of our knowledge and information at the date of Publication. It is designed only a guidance of safe handling, transportation, use and disposal. No Warranty is expressed or implied.

Sources Used:
A Textbook of Chemical Technology Volume–II, CAMEO Chemicals, Public Chemical Information (PubChem) - National Institutes of Health (NIH) -National Library of Medicine (NLM), Hazardous Substances Data Bank (HSDB), Hazardous Chemical Information System (HCIS).

MATERIAL SAFETY DATA SHEET OF TRANSFORMER OIL

As per schedule V of the Odisha Factories (C. OF M.A.H.) Rules, 2001

SECTION 1: IDENTITY OF MATERIAL

Material Name	:	**TRANSFORMER OIL**
Chemical Formula	:	C_nH_{2n+2}
CAS no.	:	64742-53-6
UN No.	:	None
Synonymous	:	Insulating Oil
General Use	:	Industrial Use
HAZCH	:	2PE
Label /Class	:	3

SECTION 2: HAZARDS IDENTIFICATION

Hazard Pictogram :

Signal Word	:	Danger
GHS Hazard Statements	:	H304 May be fatal if swallowed and enters airways.
Skin corrosion	:	

POTENTIAL HEALTH EFFECTS:

Eye	:	Contact may cause mild eye irritation including stinging, watering, and redness.
Skin	:	Contact may cause mild skin irritation including redness, and a burning sensation. Prolonged or repeated contact can worsen irritation by causing drying and cracking of the skin leading to dermatitis (inflammation). No harmful effects from skin absorption are expected.
Inhalation	:	Contact may cause mild skin irritation including redness, and a burning sensation. Prolonged or repeated contact can worsen irritation by causing drying and cracking of the skin leading to dermatitis (inflammation). No harmful effects from skin absorption are expected.
Ingestion	:	No harmful effects expected from ingestion.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Non- Hazardous Components					
Component / CAS No:	Percent (%)	ACGIH	OSHA	NIOSH	Other
Hydrotreated Distillate, Light Naphthenic. C15-3064742-53-6	>99	5 mg/m^3 TWA 10 mg/m^3 STEL	5 mg/m^3 TWA	2500 mg/m^3 IDLH	As oil mist, if generated 5 mg/m^3 NOHSC TWA

SECTION 4: FIRST-AID MEASURES

Eye	:	If irritation or redness develops, move victim away from exposure and into fresh air. Flush eyes with clean water. If symptoms persist, seek medical attention.

Skin : Wipe material from skin and remove contaminated shoes and clothing. Cleanse affected area(s) thoroughly by washing with mild soap and water and, if necessary, a waterless skin cleanser.

Inhalation : If respiratory symptoms develop, move victim away from source of exposure and into fresh air. If symptoms persist, seek medical attention. If victim is not breathing, clear airway and immediately begin artificial respiration. If breathing difficulties develop, oxygen should be administered by qualified personnel. Seek immediate medical attention.

Ingestion : First aid is not normally required; however, if swallowed and symptoms develop, seek medical attention.

SECTION 5: FIRE -FIGHTING MEASURES

Flash Point : > 140°C
Flammability Range : Flammable
Auto Ignition Temperature : > 270°C
LEL : 0.9%
UEL : 7.0%
Flammability Classification : Flammable
Extinguishing Media : Water Fog, Foam, Dry Chemical, Carbon Dioxide
Unusual Fire or Explosion Hazards : This material may burn, but will not ignite readily. Vapors are heavier than air and can accumulate in low areas. If container is not properly cooled, it can rupture in the heat of a fire.

Hazardous Combustion Products : Carbon Dioxide, Carbon Monoxide
Fire-Fighting Instructions : For fires beyond the incipient stage, emergency responders in the immediate hazard area should wear bunker gear. When the potential chemical hazard is unknown, in enclosed or confined spaces, or when explicitly required by DOT, a self-contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant.

SECTION 6: ACCIDENTAL RELEASE MEASURES

For non-emergency personnel: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities.

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product.

SECTION 7: HANDLING AND STORAGE

Handling : Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. The use of appropriate respiratory protection is advised when concentrations exceed any established exposure limits. Do not wear contaminated clothing or shoes. Use good personal hygiene practices.

High pressure injection of hydrocarbon fuels, hydraulic oils or greases under the skin may have serious consequences even though no symptoms or injury may be apparent. This can happen accidentally when using high pressure equipment such as high-pressure grease guns, fuel injection apparatus or from pinhole leaks in tubing of high-pressure hydraulic oil equipment.

"Empty" containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. "Empty" drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.

Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSI

Z49.1, and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

Storage : Keep container(s) tightly closed. Use and store this material in cool, dry, well-ventilated areas away from heat and all sources of ignition. Storage temperatures above 113°F may lead to thermal decomposition, resulting in the generation of hydrogen sulfide and other sulfur containing gases. Store only in approved containers. Keep away from any incompatible material. Protect container(s) against physical damage.

SECTION 8: EXPOSURE CONTROL AND PERSONAL PROTECTION

Skin : The use of gloves impervious to the specific material handled is advised to prevent skin contact and possible irritation (see manufacturers literature for information on permeability).

Eye / Face : Approved eye protection to safeguard against potential eye contact, irritation, or injury is recommended. Depending on conditions of use, a face shield may be necessary.

Respiratory : A NIOSH certified air purifying respirator with a Type 95 (R or P) particulate filter may be used under conditions where airborne concentrations are expected to exceed exposure limits (see Section 2). Protection provided by air purifying respirators is limited (see manufacturer's respirator selection guide). Use a NIOSH approved self-contained breathing apparatus (SCBA) or equivalent operated in a pressure demand or other positive pressure mode if there is potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection. A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.

Other Protective Equipment : A source of clean water should be available in the work area for flushing eyes and skin. Impervious clothing should be worn as needed. Suggestions for the use of specific protective materials are based on readily available published data. Users should check with specific manufacturers to confirm the performance of their products.

SECTION 9: PHYSICAL & CHEMICAL PROPOERTIES

Physical State : Liquid
Boiling Point/ Range, Deg.C : >200 °C
Vapor Pressure At : 160 Pa at 100 ^{O}C
Appearance : Clear and Bright
Melting/Freezing Point, Deg.C : <-40°C
Odor : Petroleum

Vapor Density (Air=1) : 0.890 Max at 20°C
Solubility : Soluble in Hydrocarbons; Insoluble in Water
Specific Gravity, (Water-1) : 0.88 @ 15.6 °C
Evaporation Rate at : Not Available
Viscosity : 8.8 cSt @ 40 °C (Typical)

SECTION 10: STABILITY & REACTIVITY

Stability : Stable under normal ambient and anticipated conditions of storage and handling.
Conditions to Avoid : Extended exposure to high temperatures can cause decomposition.
Hazardous poly Incompatibility: Oxidizing agents.
Hazardous Combustion/
Decomposition products : Carbon Dioxide, Carbon Monoxide

SECTION 11: TOXICOLOGICAL INFORMATION

Health Warnings : No Specific warnings noted. No specific acute or chronic health impact noted, but this chemical may still have adverse impact on human health, either in general or on certain individuals with pre-existing or latent health problems.

Health Effects : The substance has no evidence of carcinogenic properties.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity : The 96-hour LC50 for rainbow trout is > 1000 mg/1.
Environmental Fate : This material is not expected to be readily biodegradable.

SECTION 13: DISPOSAL CONSIDERATION

Disposal Methods:

This material under most intended uses would become used oil due to contamination by physical or chemical impurities. RECYCLE ALL USED OIL. While being recycled, used oil is regulated by 40 CFR 279. Use resulting in chemical or physical change or contamination may also subject it to regulation as hazardous waste. Under federal regulations, used oil is a solid waste managed under 40 CFR 279. However, in California, used oil is managed as hazardous waste until tested to show it is not hazardous. Consult state and local regulations regarding the proper handling of used oil. In the case of used oil, the intent to discard it may cause the used oil to be regulated as hazardous waste.

Contents should be completely used and containers emptied prior to discard. Rin sate may be considered a RCRA hazardous waste and must be disposed of with care and in compliance with federal, state and local regulations. Large empty containers, such as drums, should be returned to the distributor or a drum reconditioner. To assure proper disposal of small empty containers, consult with state and local regulations and disposal authorities.

SECTION 14: TRANSPORTATION INFORMATION

DOT Shipping Description: Not regulated
Note: Material is unregulated unless in container of 3500 gal or more then provisions of 49 CFR Part 130 apply for land shipment.
IMDG Shipping Description: Not regulated.
ICAO/IATA Shipping Description: Not regulated

SECTION 15: REGULATORY INFORMATION

CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
This material contains the following chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372:
-- None Known –

SECTION 16: OTHER INFORMATION

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