HAZARDOUS SUBSTANCE FACT SHEET

Common Name: **CHLORINE DIOXIDE**

CAS Number: 10049-04-4
DOT Number: NA 9191 (Hydrate, frozen)
DOT Hazard Class: FORBIDDEN (Not Hydrate)
5.1 (Oxidizer)

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HAZARD SUMMARY

* Chlorine Dioxide can affect you when breathed in.
* Contact can irritate the skin and eyes causing watery eyes and seeing halos around the lights.
* Breathing Chlorine Dioxide can irritate the nose and throat causing coughing and wheezing.
* Breathing Chlorine Dioxide can irritate the lungs causing coughing and/or shortness of breath. Higher exposures can cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath.
* Chlorine Dioxide is a HIGHLY FLAMMABLE and REACTIVE gas and a DANGEROUS FIRE and EXPLOSION HAZARD.
* DOT regulations FORBID the transport of Chlorine Dioxide in Not Hydrate form.

IDENTIFICATION

Chlorine Dioxide is a yellow to red gas with an irritating odor similar to Chlorine. It is used to bleach wood pulp, textiles and oils, in processing flour, and for water purification.

REASON FOR CITATION

* Chlorine Dioxide is on the Hazardous Substance List because it is regulated by OSHA and cited by ACGIH, DOT, NIOSH, DEP, IRIS and EPA.
* This chemical is on the Special Health Hazard Substance List because it is FLAMMABLE and REACTIVE.
* Definitions are provided on page 5.

HOW TO DETERMINE IF YOU ARE BEING EXPOSED

The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information and training concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) requires private employers to provide similar training and information to their employees.

* Exposure to hazardous substances should be routinely evaluated. This may include collecting personal and area air samples. You can obtain copies of sampling results from your employer. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).
* If you think you are experiencing any work-related health problems, see a doctor trained to recognize occupational diseases. Take this Fact Sheet with you.
* ODOR THRESHOLD = 0.1 ppm.
* The range of accepted odor threshold values is quite broad. Caution should be used in relying on odor alone as a warning of potentially hazardous exposures.

WORKPLACE EXPOSURE LIMITS

OSHA: The legal airborne permissible exposure limit (PEL) is 0.1 ppm averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is 0.1 ppm averaged over a 10-hour workshift and 0.3 ppm, not to be exceeded during any 15-minute work period.

ACGIH: The recommended airborne exposure limit is 0.1 ppm averaged over an 8-hour workshift and 0.3 ppm as a STEL (short term exposure limit).

WAYS OF REDUCING EXPOSURE

* Where possible, enclose operations and use local exhaust ventilation at the site of chemical release. If local exhaust ventilation or enclosure is not used, respirators should be worn.
* Wear protective work clothing.
* Wash thoroughly immediately after exposure to Chlorine Dioxide and at the end of the workshift.
* Post hazard and warning information in the work area. In addition, as part of an ongoing education and training effort, communicate all information on the health and safety hazards of Chlorine Dioxide to potentially exposed workers.
This Fact Sheet is a summary source of information of all potential and most severe health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

HEALTH HAZARD INFORMATION

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to Chlorine Dioxide:

* Contact can irritate the skin and eyes causing watery eyes and seeing halos around lights.
* Breathing Chlorine Dioxide can irritate the nose and throat causing coughing and wheezing.
* Breathing Chlorine Dioxide can irritate the lungs causing coughing and/or shortness of breath. Higher exposures can cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to Chlorine Dioxide and can last for months or years:

Cancer Hazard
* According to the information presently available to the New Jersey Department of Health and Senior Services, Chlorine Dioxide has not been tested for its ability to cause cancer in animals.

Reproductive Hazard
* There is limited evidence that Chlorine Dioxide may damage the developing fetus.

Other Long-Term Effects
* Chlorine Dioxide can irritate the lungs. Repeated exposure may cause bronchitis to develop with cough, phlegm, and/or shortness of breath.

MEDICAL

Medical Testing
For those with frequent or potentially high exposure (half the PEL or greater), the following are recommended before beginning work and at regular times after that:

* Lung function tests

If symptoms develop or overexposure is suspected, the following is recommended:

* Consider chest x-ray after acute overexposure.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures
* Because smoking can cause heart disease, as well as lung cancer, emphysema, and other respiratory problems, it may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.

WORKPLACE CONTROLS AND PRACTICES

Unless a less toxic chemical can be substituted for a hazardous substance, ENGINEERING CONTROLS are the most effective way of reducing exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure. Using respirators or protective equipment is less effective than the controls mentioned above, but is sometimes necessary.

In evaluating the controls present in your workplace, consider: (1) how hazardous the substance is, (2) how much of the substance is released into the workplace and (3) whether harmful skin or eye contact could occur. Special controls should be in place for highly toxic chemicals or when significant skin, eye, or breathing exposures are possible.

In addition, the following controls are recommended:

* Where possible, automatically pump Chlorine Dioxide from cylinders or other storage containers to process containers.
* Before entering a confined space where Chlorine Dioxide may be present, check to make sure that an explosive concentration does not exist.

Good WORK PRACTICES can help to reduce hazardous exposures. The following work practices are recommended:

* Workers whose clothing has been contaminated by Chlorine Dioxide should change into clean clothing promptly.
* Contaminated work clothes should be laundered by individuals who have been informed of the hazards of exposure to Chlorine Dioxide.
* Eye wash fountains should be provided in the immediate work area for emergency use.
* If there is the possibility of skin exposure, emergency shower facilities should be provided.
* On skin contact with Chlorine Dioxide, immediately wash or shower to remove the chemical. At the end of the workshift, wash any areas of the body that may have contacted Chlorine Dioxide, whether or not known skin contact has occurred.
* Do not eat, smoke, or drink where Chlorine Dioxide is handled, processed, or stored, since the chemical can be swallowed. Wash hands carefully before eating, drinking, smoking, or using the toilet.

PERSONAL PROTECTIVE EQUIPMENT

WORKPLACE CONTROLS ARE BETTER THAN PERSONAL PROTECTIVE EQUIPMENT. However, for some jobs (such as outside work, confined space entry, jobs done only once in a while, or jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Clothing
* Avoid skin contact with Chlorine Dioxide. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation.
* Safety equipment manufacturers recommend Neoprene, Nitrile, Butyl Rubber, Viton® and Responder® as protective materials for Chlorine.
* All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection
* Wear non-vented, impact resistant goggles when working with fumes, gases, or vapors.
* Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.

Respiratory Protection
IMPROPER USE OF RESPIRATORS IS DANGEROUS.

Such equipment should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

* Where the potential exists for exposure over 1 ppm, use a NIOSH approved full facepiece respirator with a cartridge specific for Chlorine Dioxide. Increased protection is obtained from full facepiece powered-air purifying respirators.

* If while wearing a filter or cartridge respirator you can smell, taste, or otherwise detect Chlorine Dioxide, or if while wearing particulate filters abnormal resistance to breathing is experienced, or eye irritation occurs while wearing a full facepiece respirator, leave the area immediately. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
* Be sure to consider all potential exposures in your workplace. You may need a combination of filters, prefilters or cartridges to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
* Where the potential exists for exposure over 2.5 ppm, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
* Exposure to 5 ppm is immediately dangerous to life and health. If the possibility of exposure above 5 ppm exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

HANDLING AND STORAGE

* Prior to working with Chlorine Dioxide you should be trained on its proper handling and storage.
* Chlorine Dioxide is a powerful OXIDIZER and EXPLODES on contact with CARBON MONOXIDE; HYDROCARBONS; AMINES; MERCURY; ORGANIC MATERIALS; POTASSIUM HYDROXIDE; PHOSPHORUS; CHLORINE; SULFUR; HEAT; METALS; and ALCOHOLS.
* Chlorine Dioxide reacts with WATER or STEAM to produce Hydrogen Chloride and Chloric Acid gases.
* Store in tightly closed containers in a cool, well-ventilated area away from COMBUSTIBLES.
* Chlorine Dioxide is sensitive to SHOCK and FRICTION, and unstable in LIGHT and SUNLIGHT.
* Transportation of pure Chlorine Dioxide is FORBIDDEN by DOT.
* Keep frozen when not in use. Store in tightly closed containers in a cool, dark, well-ventilated area at temperatures well below 266°F (130°C). Gas explosions may occur above 266°F (130°C).
* Sources of ignition, such as smoking and open flames, are prohibited where Chlorine Dioxide is used, handled, or stored.
* Metal containers involving the transfer of Chlorine Dioxide should be grounded and bonded.
* Use only non-sparking tools and equipment, especially when opening and closing containers of Chlorine Dioxide.
* Wherever Chlorine Dioxide is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings.
QUESTIONS AND ANSWERS

Q: If I have acute health effects, will I later get chronic health effects?
A: Not always. Most chronic (long-term) effects result from repeated exposures to a chemical.

Q: Can I get long-term effects without ever having short-term effects?
A: Yes, because long-term effects can occur from repeated exposures to a chemical at levels not high enough to make you immediately sick.

Q: What are my chances of getting sick when I have been exposed to chemicals?
A: The likelihood of becoming sick from chemicals is increased as the amount of exposure increases. This is determined by the length of time and the amount of material to which someone is exposed.

Q: When are higher exposures more likely?
A: Conditions which increase risk of exposure include physical and mechanical processes (heating, pouring, spraying, spills and evaporation from large surface areas such as open containers), and "confined space" exposures (working inside vats, reactors, boilers, small rooms, etc.).

Q: Is the risk of getting sick higher for workers than for community residents?
A: Yes. Exposures in the community, except possibly in cases of fires or spills, are usually much lower than those found in the workplace. However, people in the community may be exposed to contaminated water as well as to chemicals in the air over long periods. This may be a problem for children or people who are already ill.

Q: Who is at the greatest risk from reproductive hazards?
A: Pregnant women are at greatest risk from chemicals that harm the developing fetus. However, chemicals may affect the ability to have children, so both men and women of childbearing age are at high risk.

The following information is available from:

New Jersey Department of Health and Senior Services
Occupational Health Service
PO Box 360
Trenton, NJ 08625-0360
(609) 984-1863
(609) 984-7407 (fax)

Web address: http://www.state.nj.us/health/eho/odisweb/

Industrial Hygiene Information
Industrial hygienists are available to answer your questions regarding the control of chemical exposures using exhaust ventilation, special work practices, good housekeeping, good hygiene practices, and personal protective equipment including respirators. In addition, they can help to interpret the results of industrial hygiene survey data.

Medical Evaluation
If you think you are becoming sick because of exposure to chemicals at your workplace, you may call personnel at the Department of Health and Senior Services, Occupational Health Service, who can help you find the information you need.

Public Presentations
Presentations and educational programs on occupational health or the Right to Know Act can be organized for labor unions, trade associations and other groups.

Right to Know Information Resources
The Right to Know Infoline (609) 984-2202 can answer questions about the identity and potential health effects of chemicals, list of educational materials in occupational health, references used to prepare the Fact Sheets, preparation of the Right to Know Survey, education and training programs, labeling requirements, and general information regarding the Right to Know Act. Violations of the law should be reported to (609) 984-2202.
DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits (called TLVs) for exposure to workplace chemicals.

A carcinogen is a substance that causes cancer.

The CAS number is assigned by the Chemical Abstracts Service to identify a specific chemical.

CFR is the Code of Federal Regulations, which consists of the regulations of the United States government.

A combustible substance is a solid, liquid or gas that will burn.

A corrosive substance is a gas, liquid or solid that causes irreversible damage to human tissue or containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

A fetus is an unborn human or animal.

A flammable substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The flash point is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group that classifies chemicals according to their cancer-causing potential.

IRIS is the Integrated Risk Information System database of the federal EPA.

A miscible substance is a liquid or gas that will evenly dissolve in another.

mg/m³ means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A mutagen is a substance that causes mutations. A mutation is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NAERG is the North American Emergency Response Guidebook. It was jointly developed by Transport Canada, the United States Department of Transportation and the Secretariat of Communications and Transportation of Mexico. It is a guide for first responders to quickly identify the specific or generic hazards of material involved in a transportation incident, and to protect themselves and the general public during the initial response phase of the incident.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEL is the Permissible Exposure Limit which is enforceable by the Occupational Safety and Health Administration.

PIH is a DOT designation for chemicals which are Poison Inhalation Hazards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A reactive substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A teratogen is a substance that causes birth defects by damaging the fetus.

TLV is the Threshold Limit Value, the workplace exposure limit recommended by ACGIH.

The vapor pressure is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.
Common Name: CHLORINE DIOXIDE
DOT Number: NA 9191 (Hydrate, frozen)
FORBIDDEN (Not Hydrate)
DOT Hazard Class: 5.1 (Oxidizer)
NAERG Code: 143
CAS Number: 10049-04-4

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FLAMMABLE AND REACTIVE
POISONOUS GASES ARE PRODUCED IN FIRE
CONTAINERS MAY EXPLODE IN FIRE
TRANSPORT OF PURE GAS IS FORBIDDEN BY DOT

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

FIRE HAZARDS

* Chlorine Dioxide is EXPLOSIVE at concentrations over 10% and can be ignited by almost any form of ENERGY, including SUNLIGHT, HEAT or SPARKS.
* Use water only. DO NOT USE CHEMICAL or CO₂ extinguishers. Use water with caution as Chlorine Dioxide reacts with water to form Hydrogen Chloride gas.
* POISONOUS GASES ARE PRODUCED IN FIRE, including Chlorine.
* CONTAINERS MAY EXPLODE IN FIRE.
* Use water spray to keep fire-exposed cylinders cool.
* Chlorine Dioxide may ignite combustibles (wood, paper, and oil).
* If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

SPILLS AND EMERGENCIES

If Chlorine Dioxide is leaked, take the following steps:

* Evacuate personnel and secure and control entrance to the area.
* Eliminate all ignition sources.
* Ventilate area of leak to disperse the gas.
* STOP THE FLOW OF GAS. If the source of the leak is a cylinder, and the leak cannot be stopped, remove the leaking cylinder to a safe place in the open air, and repair the leak or allow the cylinder to empty. Pass the gas through a solution made up of reducing agents Sodium Bisulfite and Sodium Bicarbonate, with a trap in the line.
* Keep Chlorine Dioxide out of a confined space, such as a sewer, because of the possibility of an explosion.
* It may be necessary to contain and dispose of Chlorine Dioxide as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

* If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

FOR LARGE SPILLS AND FIRES immediately call your fire department. You can request emergency information from the following:

CHEMTREC: (800) 424-9300
NJDEP HOTLINE: 1-877-WARN-DEP

HANDLING AND STORAGE  (See page 3)

FIRST AID

For POISON INFORMATION call 1-800-222-1222

Eye Contact
* Immediately flush with large amounts of water. Continue without stopping for at least 30 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately.

Skin Contact
* Remove contaminated clothing. Wash contaminated skin with soap and water.

Breathing
* Remove the person from exposure.

PHYSICAL DATA

Vapor Pressure: Greater than 760 mm Hg at 68°F (20°C)
Water Solubility: Slightly soluble; Reactive

OTHER COMMONLY USED NAMES

Chemical Name:
Chlorine Oxide (ClO₂)

Other Names:
Chlorine Peroxide; Chloroperoxyl; Doxide 50

Nota bene:
Not intended to be copied and sold for commercial purposes.

NEW JERSEY DEPARTMENT OF HEALTH AND SENIOR SERVICES
Right to Know Program
PO Box 368, Trenton, NJ 08625-0368
(609) 984-2202