

THE FACTS ABOUT CHLORINE

TECHNICAL INFORMATION

Note to reader: This fact sheet is intended to provide general awareness and education on a specific chemical agent. For information on preparedness and response (e.g., for first responders and emergency medical personnel), please refer to the following Department resources:

Chemical Terrorism Preparedness and Response Card

(http://www.health.state.ny.us/nysdoh/bt/chemical_terrorism/pdf/chemical.pdf)

Chemical Terrorism Wall Chart

(http://www.health.state.ny.us/nysdoh/bt/chemical_terrorism/pdf/poster.pdf)

What is chlorine?

Chlorine (Cl_2) is among the ten highest volume chemicals manufactured in the United States. It is produced commercially by electrolysis of sodium chloride brine. Chlorine is used in industry and in household cleaning products. Chlorine was also the first poison gas to be used as a weapon during World War I.

Some of the chemical/physical properties of chlorine include:

- Chlorine is a yellow-green gas at room temperature.
- Chlorine has a pungent, irritating odor similar to bleach that is detectable at low concentrations.
- The density of chlorine gas is approximately 2.5 times greater than air, which will cause it to initially remain near the ground in areas with little air movement.
- Chlorine is not flammable, but may react explosively or form explosive compounds with many common substances (including acetylene, ether, turpentine, ammonia, natural gas, hydrogen, and finely divided metals).
- Chlorine is slightly water soluble, and reacts with moisture to form hypochlorous acid (HClO) and hydrochloric acid (HCl).
- Chlorine is commonly pressurized and cooled for storage and shipment as an amber-colored liquid.

How is chlorine used?

Chlorine has a variety of uses. It is used to disinfect water and is part of the sanitation process for sewage and industrial waste. During the production of paper and cloth, chlorine is used as a bleaching agent. It is also used in cleaning products, including household bleach which is chlorine dissolved in water. Chlorine is used in the preparation of chlorides, chlorinated solvents, pesticides, polymers, synthetic rubbers, and refrigerants.

How can people be exposed to chlorine?

Given the ubiquity and volume of chlorine in industrial and commercial locations, widespread exposures could occur from an accidental spill or release, or from a deliberate terrorist attack.

Because chlorine is a gas at room temperature, exposure occurs via inhalation. People may also

be exposed to chlorine through skin or eye contact, or through ingestion of chlorine-contaminated food or water.

What is chlorine's mechanism of action?

The health effects of chlorine are primarily due to its corrosive properties. The strong oxidizing effects of chlorine cause hydrogen to split from water in moist tissue, resulting in the release of nascent oxygen and hydrogen chloride which produce corrosive tissue damage. The oxidation of chlorine may also form hypochlorous acid, which will penetrate cells and react with cytoplasmic proteins to destroy cell structure.

What are the immediate health effects of chlorine exposure?

The health effects resulting from most chlorine exposures begin within seconds to minutes. The severity of the signs and symptoms caused by chlorine will vary according to amount, route and duration of exposure.

Inhalation: Most chlorine exposures occur via inhalation. Low level exposures to chlorine in air will cause eye/skin/airway irritation, sore throat and cough. Chlorine's odor provides adequate early warning of its presence, but also causes olfactory fatigue or adaptation, reducing awareness of one's prolonged exposure at low concentrations. At higher levels of exposure, signs and symptoms may progress to chest tightness, wheezing, dyspnea, and bronchospasm. Severe exposures may result in noncardiogenic pulmonary edema, which may be delayed for several hours.

Ingestion: Since chlorine is a gas at room temperature, it is unlikely that a severe exposure will result from ingestion. However, ingestion of chlorine dissolved in water (e.g., sodium hypochlorite or household bleach) will cause corrosive tissue damage of the gastrointestinal tract.

Eye/Dermal Contact: Low level exposures to chlorine gas will cause eye and skin irritation. Higher exposures may result in severe chemical burns or ulcerations. Exposure to compressed liquid chlorine may cause frostbite of the skin and eyes.

Children may receive a larger dose than adults exposed to environments with the same levels of chlorine gas because they have greater lung surface area-to-body weight ratios and increased minute volumes-to-weight ratios. In addition, they may be exposed to higher levels than adults in the same location because of their shorter height and the higher levels of chlorine gas that may be found nearer the ground.

How is chlorine poisoning treated?

There is no antidote for chlorine poisoning. If contact with liquid chlorine occurs, immediate decontamination of skin and eyes with copious amounts of water is important. This should be done cautiously for patients whose exposure has resulted in frostbite. Chemical burns which result from chlorine exposure should be treated as thermal burns.

Inhalational chlorine poisoning is treated with supportive care and can include administration of humidified oxygen, bronchodilators and airway management. Pulmonary edema may be delayed and, therefore, patients should be monitored for up to 24 hours following severe inhalation exposures. It is important to maintain ventilation and oxygenation, monitor arterial blood gases and/or pulse oximetry, and consider positive airway pressure as a treatment option. Most people recover following exposure to chlorine gas.

Will laboratory tests assist in making treatment decisions if someone has been exposed to chlorine?

The diagnosis of chlorine poisoning will primarily be based upon clinical examination and patient history, not laboratory testing. While laboratory testing for chlorine exposure is not useful in assisting treatment decisions, routine studies to monitor blood count, glucose and electrolytes may be useful for evaluating complications.

How can I get more information about chlorine?

Call the following numbers, or visit the websites listed among the “Sources”.

- Centers for Disease Control and Prevention Public Response Hotline (1-888-246-2675)
- Agency for Toxic Substances and Disease Registry (1-888-422-8737)
- Regional Poison Control Center (1-800-222-1222)

Sources:

Agency for Toxic Substances and Disease Registry. 2002. ToxFAQs for Chlorine. Division of Toxicology, U.S. Department of Health and Human Services. Public Health Service; Atlanta, GA.

<http://www.atsdr.cdc.gov/tfacts172.html>

Agency for Toxic Substances and Disease Registry. 2003. Medical Management Guidelines for Chlorine. Division of Toxicology, U.S. Department of Health and Human Services. Public Health Service; Atlanta, GA.

<http://www.atsdr.cdc.gov/MHMI/mmg172.html>

Centers for Disease Control and Prevention. 2003. Public Health Emergency Preparedness and Response Sheets. U.S. Department of Health and Human Services. Public Health Service; Atlanta, GA.

<http://www.bt.cdc.gov/agent/agentlistchem.asp>

Chlorine. In: Sifton DW (Ed.), *Physicians' Desk Reference Guide to Biological and Chemical Warfare Response, 1st ed.* (pp. 48-49). Montvale, NJ: Thomson/Physicians' Desk Reference, 2002.

This fact sheet is based on the most current information. It may be updated as new information becomes available.

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