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PERSONAL PROTECTIVE EQUIPMENT FOR CHLORINE AND SODIUM HYDROXIDE

Edition 3

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Excerpts from this pamphlet

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CHLORINE INSTITUTE PAMPHLET 65

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2.1.4 IDLH (NIOSH)

IDLH represents the maximum concentration from which, in the event of respiratory failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing (e.g. severe eye irritation) or irreversible health effects.

2.2 Physiological Effects of Chlorine

2.2.1 General

Chlorine is a potential irritant to the eyes, skin, mucous membranes, and the respiratory system. The primary concerns with exposure to chlorine are the respiratory system followed by the eyes. The impact of exposure to chlorine is both concentration and time dependent. (Reference 5 is one of several sources providing more information on the health effects of exposure to chlorine.) The following table summarizes these health effects:

EXPOSURE LEVEL (PPM)	EFFECTS
Less than 0.5	No known acute or chronic effect.
0.5	Slight odor detectable. ACGIH 8 hour TWA.
1.0	OSHA ceiling level ACGIH STEL

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1-10	Definite odor detectable. Slight irritation of the eyes and mucous membranes of the upper respiratory tract.
15	Effects are immediate with irritation of nose, throat and eyes accompanied with coughing.
30	NIOSH IDLH
100	Potentially lethal (depending on duration of exposure).
1000	Dangerous to life after a few inhalations.

Proper personal protective equipment must be utilized to protect against these harmful effects. This pamphlet provides personal protective equipment recommendations for specific tasks.

In 1989, OSHA established a time weighted average (TWA) permissible exposure limit (PEL) per chlorine of 0.5 ppm and a short term exposure limit (STEL) PEL for chlorine of 1 ppm as part of a broad revision of its PELs. Subsequently, the Court of Appeals overturned the entire 1989 rulemaking. As a result of this court action, the only current OSHA regulation for chlorine is a 1 ppm ceiling level.

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2.2.2 Non Respiratory Effects of Exposure to Gaseous Chlorine

Gaseous chlorine absorbs in water to form both hypochlorous and hydrochloric acids. When exposed to high concentrations of chlorine gas, it can dissolve in body moisture (i.e., perspiration) to form these acids. At 3,500 ppm chlorine in air, the pH of moisture on the skin would be approximately 4. A pH of 4 is comparable to carbonated water. While a burning sensation and skin irritation can occur due to such exposure, a review of the literature has provided no specific human data to determine the concentration of chlorine required to produce such effects. As previously stated, irritation of the eye, when exposed to gaseous chlorine, begins to occur at the 1-10 ppm level.

2.2.3 Non Respiratory Effects of Exposure to Liquid Chlorine

Liquid chlorine is a refrigerated liquid. At atmospheric pressure, liquid chlorine vaporizes at -34°C (-29°F). Typically, chlorine is stored in vessels as a liquid at atmospheric or elevated pressures. Contact with liquid chlorine will cause eye and skin burns on contact, similar to frostbite.

2.2.4 After Exposure to Chlorine

If liquid chlorine contacts the skin or penetrates through the clothing, immediately flush the affected area with water for at least 15 minutes. Care should be exercised when removing the protective clothing after use to avoid inhalation of chlorine from the contaminated clothing. All personnel should seek immediate medical attention after being

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exposed (by inhalation or skin contact) to liquid chlorine or high concentrations of gaseous chlorine. Reference 6 provides more specific information concerning such treatment.

2.3 Physiological Effects of Sodium Hydroxide (10 to 50 wt%)

Sodium Hydroxide (NaOH) solutions are classified as a corrosive and can cause mild to severe irritation of the eyes, mucous membranes (nose, sinus, throat, and lungs), and skin. Exposure can occur by both direct contact with aqueous caustic solutions or entrained mists and aerosols. The degree of irritation or cell damage is related to both the concentration and temperature of the sodium hydroxide solution and the duration of the exposure.

Mild watering of the eyes is first observed at an approximate NaOH concentration in air of 1 mg/m^3. Contact with aqueous solutions as low as 1% can cause eye irritation. Increasing concentration and temperature of the NaOH solutions can cause severe irritation/burns and possible blindness. The severity can be reduced by prompt flushing of the eye with copious amounts of water and seeking immediate medical attention.

Exposure to caustic solutions, mists, or aerosols at concentrations as low as 5% NaOH can cause severe skin irritation/burn. The degree of damage can be reduced by flushing with copious amounts of water and seeking immediate medical attention. Ingestion of liquid sodium hydroxide solutions can cause severe burns to the mucous membranes of the mouth, throat, esophagus, and stomach and, therefore, must be avoided.

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Irritation of the respiratory system can start at exposure levels as low as 0.5 mg/m^3 with noticeable, but not excessive, irritation occurring at approximately 2 mg/m^3.

In 1989 OSHA established a PEL-ceiling for sodium hydroxide at 2 mg/m^3 as part of a broad revision of its PELs. Subsequently, the Court of Appeals overturned the entire 1989 rulemaking. As a result of this court action, the only current OSHA PEL for sodium hydroxide is a 2 mg/m^3 TWA. The ACGIH has established a 2 mg/m^3 ceiling level for sodium hydroxide. NIOSH has set the immediately dangerous to life or health (IDLH) concentration at 250 mg/m^3. Breathing dust, mist, or spray in excess of the PEL may cause damage to the upper respiratory tract and lungs which could produce chemical pneumonia, depending on the severity of the exposure.

3. REGULATIONS

The following OSHA regulations address personal protective equipment having potential application in chlorine and sodium hydroxide production and use facilities.

29 CFR 1910.119 - Process Safety Management of Highly Hazard Chemicals
29 CFR 1910.120 - Hazardous Waste Operations and Emergency Response
29 CFR 1910.132 - General Requirements
29 CFR 1910.133 - Eye and Face Protection
29 CFR 1910.134 - Respiratory Protection
29 CFR 1910.135 - Occupational Head Protection

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