LABORATORY CHEMICAL SAFETY SUMMARY: FORMALDEHYDE

Substance Formaldehyde
(Methanal; 37% aqueous solution (usually containing 10 to 15% methanol) is called formalin; solid polymer is called paraformaldehyde)
CAS 50-00-0

Formula HCHO

Physical Properties Clear, colorless liquid
Formaldehyde: bp -19 °C, mp -92 °C; Formalin: bp 96 °C, mp -15 °C
Miscible with water

Odor Pungent odor detectable at 1 ppm
Vapor Density ~1 (air = 1.0)

Vapor Pressure Formaldehyde: 10 mmHg at -88 °C
Formalin: 23 to 26 mmHg at 25 °C

Flash Point 50 °C for formalin containing 15% methanol

Autoignition Temperature 424 °C for formalin containing 15% methanol

Toxicity Data
LD_{50} oral (rat) 500 mg/kg
LD_{50} skin (rabbit) 270 mg/kg
LC_{50} inhal (rat) 203 mg/m^3 (2 h)
PEL (OSHA) 1 ppm (1.5 mg/m3)
TLV-TWA (ACGIH) 0.3 ppm (ceiling)(0.37 mg/m^3)
STEL (OSHA) 2 ppm (2.5 mg/m^3)

Major Hazards Probable human carcinogen (OSHA "select carcinogen"); moderate acute toxicity; skin sensitizer.

Toxicity
Formaldehyde is moderately toxic by skin contact and inhalation. Exposure to formaldehyde gas can cause irritation of the eyes and respiratory tract, coughing, dry throat, tightening of the chest, headache, a sensation of pressure in the head, and palpitations of the heart. Exposure to 0.1 to 5 ppm causes irritation of the eyes, nose, and throat; above 10 ppm severe lacrimation occurs, burning in the nose and throat is experienced, and breathing becomes difficult. Acute exposure to concentrations above 25 ppm can cause serious injury , including fatal pulmonary edema. Formaldehyde has low acute toxicity via the oral route. Ingestion can cause irritation of the mouth, throat, and stomach, nausea, vomiting, convulsions, and coma. An oral dose of 30 to 100 mL of 37% formalin can be fatal in humans. Formalin solutions can cause severe eye bums and loss of vision. Eye contact may lead to delayed effects that are not appreciably eased by eye washing.

Formaldehyde is regulated by OSHA as a carcinogen (Standard 1910.1048) and is listed in IARC Group 2A ("probable human carcinogen"). This substance is classified as a "select carcinogen" under the criteria of the OSHA Laboratory Standard. Prolonged or repeated exposure to formaldehyde can cause dermatitis and sensitization of the skin and respiratory tract. Following skin contact a symptom-free period may occur in sensitized individuals. Subsequent exposures can then lead to itching, redness, and the formation of blisters.

In accordance with the OSHA Laboratory Standard requirements for select carcinogens, use of formaldehyde requires air monitoring (measurement) to determine exposure levels and development of specific protocols for use and storage.

Flammability and Explosibility
Formaldehyde gas is extremely flammable; formalin solution is a combustible liquid (NFP A rating = 2 for 37% formaldehyde (15% methanol), NFP A rating = 4 for 37% formaldehyde (methanol free). Toxic vapors may be given off in a fire. Carbon dioxide or dry chemical extinguishers should be used to fight formaldehyde fires.

Reactivity and Compatibility
Formaldehyde may react violently with strong oxidizing agents, ammonia and strong alkalis, isocyanates, peracids, anhydrides, and inorganic acids. Formaldehyde reacts with HCl to form the potent carcinogen, bis-chloromethyl ether.

Storage and Handling
Because of its carcinogenicity and flammability, formaldehyde should be handled using practices specified by the department for chemicals of these classifications. In particular, work with formaldehyde should be conducted in a fume hood to prevent exposure by inhalation, and splash goggles and impermeable gloves should be worn at all times to prevent eye and skin contact. Formaldehyde should be used only in areas free of ignition sources. Containers of formaldehyde should be stored in secondary containers in secured areas separate from oxidizers and bases.

Accidents
In the event of skin contact immediately wash with soap and water and remove contaminated clothing. In case of eye contact promptly wash with copious amounts of water for 15 min (lifting upper and lower lids occasionally) and obtain medical attention. If formaldehyde is ingested, obtain medical attention immediately. If large amounts of this compound are inhaled, move the person to fresh air and seek medical attention at once.

In the event of a small spill, remove all ignition sources, soak up the spill with absorbent material place in an appropriate labeled container, within secondary containment for hazardous waste disposal.

Disposal
Excess formaldehyde and waste material containing this substance should be placed in an appropriate container and clearly labeled. Secondary containment is required. Formaldehyde spill clean up residues and unused product are considered a Listed Hazardous Waste (U122). Formalin spill clean up residues and unused product are not considered hazardous wastes and may be drain disposed with copious amounts of water. Wastes resulting from chemical reactions involving formaldehyde may be a characteristic waste if the waste is flammable, corrosive, reactive or toxic.

The information in this LCSS has been compiled by a committee of the National Research Council from literature sources and Material Safety Data Sheets and is believed to be accurate as of July 1994. This summary is intended for use by trained laboratory personnel in conjunction with the NRC report Prudent Practices in the Laboratory: Handling and Disposal of Chemicals. This LCSS presents a concise summary of safety information that should be adequate for most laboratory uses of the title substance, but in some cases it may be advisable to consult more comprehensive references. This information should not be used as a guide to the nonlaboratory use of this chemical.