

Formaldehyde- Safe Work Practices

Introduction

Formaldehyde (a.k.a. formic aldehyde, methyl aldehyde, methylene oxide) is a common chemical used as an embalming fluid, tissue preservative, sterilizer and fumigant in laboratories. It is also commonly used to produce resins, urea-formaldehyde foam insulation, plywood, latex paints, cosmetics, particleboard, adhesives, textiles, plastics and many other products. In its purest form, formaldehyde is a colorless, highly toxic and flammable gas with the chemical formula HCHO or CH₂O. In laboratories, the gas is more commonly dissolved in water and used as an aqueous solution called *formalin*. Formalin solutions typically use up to 15% methanol as a stabilizer.

Formaldehyde is a common sensitizing agent found in laboratories that that can trigger an allergic reaction in normal tissue after single or repeated exposures. It is also classified as a known human carcinogen (cancer-causing substance) by the International Agency for Research on Cancer and as a probable human carcinogen by the U.S. Environmental Protection Agency (EPA). Researchers must understand the hazardous properties of formaldehyde so that control measures can be taken to minimize exposure.

Hazards

Acute Toxicity: Formaldehyde can be highly toxic if swallowed, inhaled or absorbed through skin. Ingestion of as little as 30 mL (1 oz.) of a solution containing 37% formaldehyde has been reported to cause death in adults.

Carcinogenicity- Formaldehyde is classified as a suspected human carcinogen, based on evidence obtained from human and/or animal studies.

Flammability: According to the Occupational Safety & Health Administration (OSHA), a 37% formaldehyde solution is classified as a *Category 4* flammable liquid with a flashpoint of 64 °C (147 °F). Formaldehyde becomes a fire or explosion hazard in the presence of heat, flames or other sources of ignition. Upon ignition, the chemical decomposes into carbon oxides (i.e. carbon monoxide, carbon dioxide), which can be hazardous to humans.

Respiratory & Skin Sensitization: Exposure to formaldehyde can lead to allergic reactions in certain individuals. Sensitization is an immune response. Therefore, some people may be easily sensitized upon repeated exposure while others may never be affected. In sensitized individuals, formaldehyde can cause asthma, contact dermatitis, anaphylactic reactions and, in rare cases, hemolysis.

Skin Corrosion: Formaldehyde can become irritating to the eyes at low concentrations. Irreversible damage (i.e., corneal ulceration or cloudiness of the eye surface, death of eye surface cells, and permanent loss of vision) can occur after a single exposure, depending on dose and level of sensitivity. Ingestion may cause corrosive injury to the gastrointestinal mucosa, with nausea, vomiting, pain, bleeding and perforation. Corrosive injuries are usually most pronounced in the pharyngeal mucosa, epiglottis, esophagus and stomach.

Skin Irritation: At concentrations near 0.1 parts per million (ppm), exposure to formaldehyde can be irritating to the skin, eyes and respiratory tract. Symptoms of exposure include coughing, wheezing, dermatitis, headaches, watery eyes, nausea, chest tightness and burning sensations in the eyes, nose and throat. Long-term exposure can result in headaches, insomnia, depression, mood changes, attention deficit and impairment of dexterity, memory and equilibrium.

Specific Target Organ Toxicity: Both formaldehyde and the methanol stabilizer are easily absorbed and can contribute to systemic toxicity. Formaldehyde has been shown to decrease fertility and increase the risk of spontaneous abortion (miscarriage) in humans. In addition to cancer, chronic exposure to formaldehyde has been linked to chronic gastritis, hematemesis (i.e. vomiting blood), inflammation of the lungs and airways, pulmonary edema, respiratory failure, renal failure and permanent alterations of nervous system function.

Stability & Reactivity

Formaldehyde is stable under recommended storage conditions. Efforts should be made to keep formaldehyde away from heat, flames and sparks. Formaldehyde is incompatible with aniline, phenol, isocyanates, acid anhydrides, strong acids, strong bases, strong oxidizing agents, amines and peroxides. Decomposition of formaldehyde under fire conditions yields carbon dioxide and carbon monoxide.

Exposure Limits & Air Monitoring

No employee at UCONN should be exposed to an airborne concentration of formaldehyde which exceeds 0.75 parts formaldehyde per million parts of air (0.75 ppm) as an 8-hour time-weighted average (TWA). In addition, no employee should be exposed to an airborne concentration of formaldehyde which exceeds two parts formaldehyde per million parts of air (2 ppm) as a 15-minute short-term exposure limit (STEL). The action level for formaldehyde is 0.5 ppm averaged over an 8-hour period. Air monitoring, medical surveillance and other special requirements are required when researchers become exposed to formaldehyde at or above the action level, permissible exposure limit, or short-term exposure limit as well as when individuals develop signs and symptoms of overexposure.

In order to ensure employees are not being overexposed to formaldehyde in laboratories, periodic exposure monitoring may be required. Researchers who work with formaldehyde should contact Environmental Health & Safety at 860-486-3613 to schedule a time for air monitoring to be conducted.

Safe Work Practices

- Read and understand the safety data sheet (SDS) for formaldehyde prior to use. Safety data sheets should be readily accessible in the lab at all times.
- Departments, professors or lab supervisors should train employees on safe work practices using formaldehyde.
- If possible, substitute less hazardous chemicals for formaldehyde (e.g. Hydrogen peroxide-based solutions often can be used as disinfectants. Ethyl alcohol, polyethylene glycol or phenoxyethanol can be used as fixatives or preservatives).
- Properly label secondary containers holding formaldehyde solutions.
- Store formaldehyde in an approved flammable storage cabinet with compatible chemicals.
- Containers of formaldehyde in should be kept in closed containers away from sources ignition.

- Use formaldehyde with adequate ventilation, preferably in a fume hood or under local exhaust ventilation, to minimize inhalation of vapors.
- Do not mouth pipette formaldehyde solutions.
- Containers larger than 4L (1 gallon) should be stored inside a deep pan or other secondary containment bin that is large enough to contain the contents of the bottle should an accident occur.

Personal Protective Equipment

Eye Protection- Tight-fitting safety goggles or a full face shield (8-inch minimum) should be worn when handling formaldehyde. Newly purchased eye and face protection should comply with the American National Standards Institute (ANSI) standard ANSI/ISEA Z87.1-2010.

Foot Protection- Closed-toed footwear is required in all laboratories with hazardous chemicals.

Hand Protection- Concentrated formaldehyde solutions (i.e. 10% or greater) should be handled with medium or heavyweight nitrile, neoprene, natural rubber or PVC gloves. Disposable (exam) nitrile gloves may be used when handling dilute (i.e. 10% or less) formaldehyde solutions. Newly purchased hand protection should comply with the American National Standards Institute (ANSI) standard ANSI/ISEA 105-2005.

Gloves should be inspected prior to each use. Gloves should be removed properly (i.e. without touching the glove's outer surface with bare skin) to avoid skin contact with the chemical. Hands should be washed properly with soap and water following glove removal. If you have questions about glove selection, contact Environmental Health & Safety at 860-486-3613.

Skin and Body Protection- In most laboratories, a lab coat or chemical-resistant apron should be worn when handling formaldehyde. Further protection for the body may be necessary depending on the concentrations of formaldehyde being used and operations being performed.

Respiratory Protection- Researchers working in labs with formaldehyde that have exceeded the OSHA action level, permissible exposure limit or short-term exposure limit may be required to wear respiratory protection. All employees required to wear respirators in laboratories must have a medical evaluation, training and a fit test prior to use. For more information, please contact Environmental Health & Safety at 860-486-3613.

References & Additional Resources

The OSHA Standard for Formaldehyde (29 CFR 1910.1048)

<http://www.osha.gov/SLTC/formaldehyde/>

The OSHA Laboratory Standard (29 CFR 1910.1450)

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10106

United States Environmental Protection Agency- An Introduction to Indoor Air Quality (IAQ)

<http://www.epa.gov/iaq/formaldehyde.html>

Agency for Toxic Substances and Disease Registry- Toxic Substances Portal-Formaldehyde

<http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=219&tid=39>

Centers for Disease Control and Prevention- Workplace Safety & Health Topics

<http://www.cdc.gov/niosh/topics/formaldehyde/>