

Formaldehyde

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

| Formaldehyde Hazards | |
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| Hazard | Description |
| Acute Toxicity | Formaldehyde can be highly toxic if swallowed, inhaled, or absorbed through skin. Ingestion of as little as 30 mL 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. |

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| 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. |
| Eye and Gastrointestinal 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 including 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. |

Exposure Limits & Air Monitoring

No employee at UConn should be exposed to an airborne concentration of formaldehyde that exceeds 0.75 ppm in air as an 8-hour time weighted average (TWA). In addition, no employee should be exposed to an airborne concentration of formaldehyde that exceeds two ppm in air 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.

Periodic exposure monitoring may be required to ensure employees are not being overexposed to formaldehyde in laboratories. Researchers who work with formaldehyde should contact EHS at 860-486-3613 to schedule a time for air monitoring to be conducted.

Safe Work Practices

Lab personnel must follow the work practices below when handling, storing, or disposing of formaldehyde.

1. Read and understand the safety data sheet (SDS) for formaldehyde prior to use. SDSs must be always readily accessible in the lab.
2. 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).
3. Properly label secondary containers holding formaldehyde solutions with the name and hazard warnings.
4. Store formaldehyde in an approved flammable storage cabinet with compatible chemicals.
5. Formaldehyde is incompatible with aniline, phenol, isocyanates, acid anhydrides, strong acids and bases, strong oxidizers, amines, and peroxides.
6. Keep containers of formaldehyde in closed containers away from sources of ignition (heat, flames, and sparks).
7. Use formaldehyde with adequate ventilation, preferably in a fume hood or under local exhaust ventilation, to minimize inhalation of vapors.
8. Do not mouth pipette formaldehyde solutions.
9. Store containers larger than 4 liters (1 gallon) inside a deep pan or other secondary containment bin that is large enough to contain the contents of the bottle should an accident occur.
10. Always wear appropriate personal protective equipment (PPE) while handling formaldehyde, including: ANSI Z87.1-approved tight-fitting splash goggles; lab coat or chemical-resistant apron; medium or heavyweight nitrile, neoprene, natural rubber, or PVC gloves (for solutions of formaldehyde of 10% or greater) or disposable nitrile gloves (dilute solutions of formaldehyde of less than 10%); clothing that covers the entire legs; and closed-toed footwear.
11. If working in labs with formaldehyde that have exceeded the OSHA action level, PEL, or STEL, respiratory protection may be required if engineering controls (chemical fume hood) are not available. All employees required to wear respirators in laboratories must be placed in the respiratory protection program through occupational health and safety. This requires a medical evaluation, training, and fit test prior to use. For more information, please contact EHS at 860-486-3613.

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

<https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=219&toxid=39>

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

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