

Formaldehyde: Hazards and Precautions

Formaldehyde (also called formic aldehyde or methyl aldehyde) is used as a tissue preservative or organic chemical reagent. Formaldehyde itself is a colorless gas, but it is more commonly purchased and used in aqueous solution (called formalin solution), with a maximum concentration of 40%. Formalin solutions often contain some amount of methanol as well. Both formaldehyde gas and solutions have a characteristic pungent, unpleasant odor.

Because of formaldehyde's hazards, Cal/OSHA has enacted specific regulations regarding its safe handling. (A summary of Title 8 CCR Section 5217 regarding formaldehyde is included in this Fact Sheet.)

Health hazards

When present in the air at a concentration above 0.1 part per million, formaldehyde can cause watery eyes, nausea, coughing, chest tightness, wheezing, skin rashes, allergic reactions, and burning sensations in the eyes, nose, and throat. Formaldehyde has been shown to cause cancer in laboratory animals and may cause cancer in humans. It also may cause birth defects. It is highly toxic if swallowed, inhaled, or absorbed through skin or mucous membranes. Formaldehyde reacts vigorously with oxidizers and, at its highest concentrations, is a combustible liquid. In addition, formaldehyde reacts with hydrochloric acid (HCl) to produce bis (chloromethyl) ether vapor, a very potent carcinogen.

Eye and skin exposure

Formaldehyde is corrosive, and the eyes are especially vulnerable. An air concentration of two parts per million (2 ppm) is quickly irritating to the eyes, and 20 ppm can cause permanent clouding of the cornea after only one exposure. Formaldehyde is also a sensitizing agent. Subsequent exposures can produce symptoms more quickly and at lower concentrations. Symptoms of exposure may include coughing, eye or skin irritation, allergic reactions, vomiting, and diarrhea.

Inhalation of vapor

Exposure to concentrations of formaldehyde in air greater than 25 ppm can cause severe injury, including fatal pulmonary edema (water in the lungs). Cal/OSHA limits employees' exposure to airborne concentrations of formaldehyde to an average of 0.75 ppm over an 8-hour workday. Formaldehyde's odor threshold (the lowest concentration you can smell) is about 1 ppm. As a sensitizer, subsequent formaldehyde exposures can produce symptoms more quickly and at lower concentrations, while olfactory fatigue can significantly raise the odor threshold concentration. Symptoms of exposure may include coughing, allergic reactions, difficulty breathing, vomiting, and diarrhea.

Safety precautions

Employee Information and Training

Employees who handle formaldehyde must receive documented training on the hazards of formaldehyde and what to do in case of an exposure or spill. A Material Safety Data Sheet (MSDS) for formaldehyde should be kept in the work area where formaldehyde



Safety precautions, contd.

is being used. The MSDS and this Fact Sheet are excellent tools for training employees on the hazards of formaldehyde. MSDSs are available from the web at www.ehs.berkeley.edu. Laboratory use must be described in the laboratory Chemical Hygiene Plan.

Exposure Monitoring

Exposure monitoring may be required to ensure that employees are not over-exposed. Contact EH&S (642-3073) for assistance in determining exposure monitoring needs in your laboratory if you work with formaldehyde.

Ventilation

Formaldehyde should always be used with adequate ventilation, preferably in a fume hood, to minimize inhalation of vapor formaldehyde.

Eye Protection

Always use chemical goggles or a face shield when handling formaldehyde to minimize the risk of even a small splash or vapor exposure to the corneas.

Body Protection

Wear a laboratory coat and never wear shorts or open-toed shoes when handling formaldehyde.

Gloves

Medium or heavyweight nitrile, neoprene, natural rubber, or PVC gloves should be worn when handling concentrated formaldehyde. Disposable (exam) nitrile gloves may be used when handling dilute concentrations (10% or less). If you have questions about selecting gloves, contact an industrial hygienist at EH&S (642-3073).

Gloves that have not been contaminated with formaldehyde may be discarded in the regular trash. Disposable gloves contaminated with formaldehyde must be thoroughly rinsed before being discarded in the regular trash. Heavily contaminated gloves must be disposed of as chemical waste.

Safe Work Practices

Be sure that formaldehyde solutions are clearly labeled with the chemical's name and hazards. As with any laboratory chemical, do not mouth pipette formaldehyde solutions. Do not eat, drink, or smoke where formaldehyde is handled, processed, or stored, since the chemical can be swallowed. Always wash hands thoroughly after using formaldehyde, even if gloves are worn.

Storage

Store formaldehyde in labeled, chemically compatible containers, away from heat and flame. Always place large-volume containers on a low, protected shelf or in another location where they will not be accidentally spilled or knocked over. Containers larger than 4L (1 gallon) should be stored inside a deep pan or other secondary containment. Do not store formaldehyde bottles in any area where a leak would flow to a drain.

Waste Disposal

Place formaldehyde waste in a chemically compatible container with a sealed lid and label clearly. Complete a Materials Packing List (MPL) and send the indicated copies of the MPL to EH&S, or complete an electronic MPL online and submit at mpl.ehs.berkeley.edu. All biological materials preserved in formaldehyde must also be disposed of in this manner, not in medical waste containers. Drain disposal of dilute



Emergency procedures

aqueous solutions containing formaldehyde is permitted to the limit of 100 grams of solute per laboratory per day (for example, 1 liter of 10% formalin or 10 liters of 1% formalin). This limit applies only as long as no other hazardous chemical is present in the solution. Call EH&S (642-3073) if you need MPL forms or have questions about the disposal of formaldehyde waste. See the EH&S Fact Sheet, "Unwanted Hazardous Chemicals," for general instructions on disposing of hazardous materials.

Formaldehyde Spills

If formaldehyde is spilled outside a chemical fume hood, evacuate the area, close the laboratory doors, and post the area to prevent others from entering. If the incident occurs during regular work hours (Monday to Friday, 8 a.m. to 5 p.m.), call EH&S (642-3073) for assistance in cleaning up the spill. After hours, call UCPD (642-6760); they will contact EH&S responders. Provide information or other assistance to emergency responders as requested.

Inhalation of Formaldehyde Vapor

If someone inhales a high concentration of formaldehyde vapor, immediately move the person to fresh air and call Tang Center's Urgent Care Clinic (642-3188). When Tang Center is closed, contact Alta Bates Medical Center (204-1303) or go to their emergency room at 2450 Ashby Avenue, Berkeley. If the person is having trouble breathing, call 911 for immediate medical attention.

Splash of Formaldehyde to Eyes or Skin

For eye or skin exposure, immediately flush with plenty of water for at least 15 minutes. Remove contaminated clothing and contact Tang Center. In case of ingestion, call 911 for immediate medical attention. As with all accidents, report any exposure as soon as possible to your supervisor.

EH&S can help

EH&S staff are available to train your employees on the hazards and precautions of working with formaldehyde. We can also perform exposure monitoring in your workplace. Material Safety Data Sheets about formaldehyde-containing products are available on the EH&S web site (www.ehs.berkeley.edu).

Cal/OSHA has set the following limits and requirements for work with formaldehyde:

- No worker may be exposed to airborne concentrations over 0.75 ppm as an 8-hour time-weighted average (TWA) without the use of a respirator. This is known as the Permissible Exposure Limit (PEL).
- In addition, no worker may be exposed to airborne concentrations over 2.0 ppm, averaged over any 15-minute period, without the use of a respirator. This is known as the Short Term Exposure Limit (STEL).
- Wherever airborne concentrations exceed 0.5 ppm when averaged over an 8-hour period (known as the Action Level), workers must receive free medical surveillance. Other requirements include annual documented worker training on formaldehyde hazards and worker exposure monitoring at least every 6 months.

Summary of the Cal/OSHA formaldehyde standard (Title 8 CCR §5217)



- All work involving potential airborne exposure to formaldehyde must be evaluated by EH&S to determine employee exposures. Contact EH&S immediately if your work has not already been evaluated.
- Workers must handle formaldehyde in a fume hood if one is available. A respirator must be used if a fume hood or other engineering control isn't available and the air concentration exceeds either the PEL or STEL.
- Workers must wear gloves, eye protection, and a lab coat when working with formaldehyde.
- Laboratory use should be described in the laboratory Chemical Hygiene Plan.
- Everyone using formaldehyde must receive annual documented training on:
 - The hazards and symptoms of overexposure to formaldehyde
 - A description of the processes in which formaldehyde is used
 - An explanation of the applicable safe work practices
 - The contents of the Cal/OSHA formaldehyde standard and the appropriate MSDS(s)
 - The purpose and contents of the medical surveillance program
 - Instructions for handling spills and other emergencies
 - The importance of engineering controls
 - The purpose, proper use, and limitations of personal protective clothing
- Suspected exposure incidents must be reported to EH&S at 642-3073 for follow-up evaluation.

