



# Formaldehyde Found in Building Materials

**F**ormaldehyde<sup>1</sup> is a colorless, flammable gas with a pungent, suffocating odor. It is released into the atmosphere from forest fires, automobile exhaust, and tobacco smoke; it is a significant component of smog. Very small amounts of formaldehyde are naturally produced in humans and other organisms and can naturally occur in some building materials (e.g. wood). Formaldehyde is produced industrially for use as a preservative, disinfectant, and for the manufacturing of a number of glues, resins, and other materials for building products. For industrial scale production, formaldehyde is manufactured from the oxidation of methanol (wood alcohol CAS No. 67-56-1), which is in turn derived from fossil fuels. The heavy metal silver is one of the primary catalysts used in the process. Other catalysts include a mixture of metals, including iron oxide.

Formaldehyde is a key component of several polymers used in building materials including urea formaldehyde, phenol formaldehyde (PF—or more commonly known as phenolic resin), and melamine resin. It is also a building block in the manufacture of methylene diphenyl diisocyanate (MDI).

- Urea Formaldehyde (UF—CAS #9011-05-6): An amino resin widely used as a binder in composite wood products (particleboard, plywood, and paneling), as well as in carpet;
- Phenol Formaldehyde (PF—CAS #9003-35-4): Used as a binder in fiberglass batt insulation and in composite wood products designed

for exterior use (due to its higher water resistance than urea formaldehyde). Also used increasingly as an alternative to urea formaldehyde in interior composite wood products. PF is also used as a binding agent for paper-based products such as paper composite countertops.

- Melamine resin (CAS #108-78-1): An amino resin used to make laminate countertops, glues, and fabrics. Melamine formaldehyde has recently been introduced as an alternative to UF and PF for composite wood products.
- Methylene diphenyl diisocyanate (MDI—CAS #101-68-8): used directly in composite wood and other products as a binder or glue and as a building block material (feedstock) in the production of polyurethane (PU) for both hard plastics and foams.

## Health impacts

### Cancer

Formaldehyde is targeted for elimination because it has been classified as a known carcinogen by the State of California (Proposition 65)<sup>2</sup> and the World Health Organization (International Agency for Research on Cancer).<sup>3</sup> The National Institute of Health's National Toxicology Program (NTP) states that formaldehyde is reasonably anticipated to be a human carcinogen.<sup>4</sup>

### Non-cancer

Formaldehyde causes eye, nose, and respiratory irritation and can be an asthma trigger in sensitive individuals.

Formaldehyde can cause contact dermatitis, associated with an allergic reaction to the chemical.<sup>5</sup> In addition to its own toxic properties, formaldehyde can react with other chemicals in the atmosphere to create carbon monoxide.<sup>6</sup> It is designated a Hazardous Air Pollutant by the US EPA as one of the major toxic constituents of smog.<sup>7</sup> In 1992, formaldehyde was formally listed by the California Air Resources Board (CARB) as a toxic air contaminant in California, with no safe level of exposure.<sup>8</sup>

Methanol, from which formaldehyde is made, causes eye, skin and respiratory irritation and long-term chronic exposure can damage to the central nervous system and vision.<sup>9</sup> Some of the products made with formaldehyde are chemicals of concern as well. Phenol formaldehyde, for example, is listed as a suspected immunotoxicant under the National Institute of Health's Database on Hazardous Chemicals and Occupational Diseases.<sup>10</sup>

## Occupational exposures

Formaldehyde and methanol exposure are both problems in the workplace. The Occupational Safety and Health Administration (OSHA) has established a formaldehyde standard for protective clothing and equipment that applies to all occupational exposures to formaldehyde.<sup>11</sup> The Center for Disease Control's (CDC) National Institute for Occupational Safety and Health (NIOSH) regulates occupational exposures to formaldehyde<sup>12</sup> and methanol.<sup>13</sup>

## Indoor air quality and other user exposures

Formaldehyde is one of a group of volatile organic compounds (VOCs) that

help form smog and ground level ozone in the outdoor environment. Inside of buildings, it is a growing threat to human health due to its use in a wide range of building and consumer products that release it into the indoor air environment.

Formaldehyde can be released to the user from products treated directly with formaldehyde, such as fabrics, and from products that use formaldehyde-based binders. Urea formaldehyde continues to outgas formaldehyde for years after manufacture and has been a target of green building programs and regulatory action. Products containing phenol formaldehyde also outgas formaldehyde during use, however at a far lower rate than urea formaldehyde-based products. Some paints, adhesives and other wet applied products create formaldehyde as they cure.

Methanol feedstock and heavy metal catalysts of formaldehyde manufacture are not known to remain present in the final product and hence are considered purely occupational exposure issues.

LEED™ credits buildings that source products without urea formaldehyde, however, two of the other products described here that are frequently used as alternatives to UF (PF and melamine) still expose users to formaldehyde and the third (MDI) exposes workers to formaldehyde.

## Resources

More information on formaldehyde, its health impacts, and recent regulatory actions to reduce emissions can be found in the PharosWiki entry on Formaldehyde at [www.pharosproject.net/wiki/index.php?title=Formaldehyde](http://www.pharosproject.net/wiki/index.php?title=Formaldehyde)

## ENDNOTES

- 1 Formaldehyde (CAS No. 50-00-0) is also known as methanal, methylene oxide, oxymethylene, methylaldehyde, or oxomethane and has the chemical abbreviation HCHO.
- 2 California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, "Safe Drinking Water and Toxic Enforcement Act of 1986—Chemicals Known to the State to Cause Cancer or Reproductive Toxicity" March 2008. [http://www.oehha.org/prop65/prop65\\_list/files/032108list.pdf](http://www.oehha.org/prop65/prop65_list/files/032108list.pdf).
- 3 International Agency for Research on Cancer (IARC), Monographs on Evaluation of Carcinogenic Risks for Humans—Formaldehyde. <http://monographs.iarc.fr/ENG/Meetings/88-formaldehyde.pdf>.
- 4 National Institute of Health, 11th Report on Cancer, National Toxicology Program 1998. <http://ntp-server.niehs.nih.gov/index.cfm?objectid=32BA9724-F1F6-975E-7FCE50709CB4C932>.
- 5 Isaksson M, Zimerson E, Bruze M., Occupational Dermatitis in Composite Production. *J Occup Environ Med.* April 1999, 41(4):261-6.
- 6 Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological Profile for Formaldehyde, July 1999. <http://www.atsdr.cdc.gov/toxprofiles/tp111.html>.
- 7 US EPA, 1996 National-Scale Air Toxics Assessment. <http://www.epa.gov/ttn/atw/nata>.
- 8 California Air Resources Board. Technical Support Document: Final report on the identification of Formaldehyde as a Toxic Air Contaminant. Sacramento, CA: CARB. July 1992. <http://www.arb.ca.gov/toxics/id/summary/formald.pdf>.
- 9 World Health Organization "Health and Safety Guide No. 105 Methanol" International Programme on Chemical Safety, 1997. <http://www.inchem.org/documents/hsg/hsg/v105hsg.htm>.
- 10 National Institute of Health, "Relational Database of Hazardous Chemicals and Occupational Diseases" <http://hazmap.nlm.nih.gov/hazmapadv.html>.
- 11 29 Code of Federal Regulations § 1910.1048.
- 12 National Institute for Occupational Safety and Health, "International Chemical Safety Card: Formaldehyde". <http://www.cdc.gov/niosh/ipcsneng/neng0275.html>.
- 13 National Institute for Occupational Safety and Health, "International Chemical Safety Card: Methanol." <http://www.cdc.gov/niosh/npg/npgd0397.html>.