

Methanol

67-56-1

Hazard Summary

Methanol is released to the environment during industrial uses and naturally from volcanic gases, vegetation, and microbes. Exposure may occur from ambient air and during the use of solvents. Acute (short-term) or chronic (long-term) exposure of humans to methanol by inhalation or ingestion may result in blurred vision, headache, dizziness, and nausea. No information is available on the reproductive, developmental, or carcinogenic effects of methanol in humans. Birth defects have been observed in the offspring of rats and mice exposed to methanol by inhalation. EPA has not classified methanol with respect to carcinogenicity.

Please Note: The main sources of information for this fact sheet are the Hazardous Substances Data Bank (HSDB) (1), a database of summaries of peer-reviewed literature, and EPA's Integrated Risk Information System (IRIS) (5), which contains information on oral chronic toxicity and the RfD. Other secondary sources include the Handbook of Toxic and Hazardous Chemicals and Carcinogens (2) and the Registry of Toxic Effects of Chemical Substances (RTECS) (4), a database of toxic effects that are not peer reviewed.

Uses

- Methanol is primarily used as an industrial solvent for inks, resins, adhesives, and dyes. It is also used as a solvent in the manufacture of cholesterol, streptomycin, vitamins, hormones, and other pharmaceuticals. (1-3)
- Methanol is also used as an antifreeze for automotive radiators, an ingredient of gasoline (as an antifreezing agent and octane booster), and as fuel for picnic stoves. Methanol is also an ingredient in paint and varnish removers. (1-3)
- Methanol is also used as an alternative motor fuel. (6)

Sources and Potential Exposure

- Occupational exposure to methanol through inhalation and dermal contact is widespread. (1,2)
- Individuals may be exposed to methanol in the ambient air from its evaporation during solvent uses or from automobile exhaust, through the consumption of various foods, and through dermal contact with various consumer products such as paint thinners and strippers, adhesives, cleaners, and inks. (1)
- Natural emission sources of methanol include volcanic gases, vegetation, microbes, and insects; methanol is also formed during biological decomposition of biological wastes, sewage, and sludge. (1)

Assessing Personal Exposure

- Personal exposure to methanol may be monitored through the measurement of methanol in the blood and measurement of methanol and formic acid in urine. (2)

Health Hazard Information

Acute Effects:

- Acute exposure of humans to methanol by inhalation or ingestion may result in visual disturbances, such as blurred or dimness of vision, leading to blindness. Neurological damage, specifically permanent motor dysfunction, may also result. (1,2,3)
- Contact of skin with methanol can produce mild dermatitis in humans. (2)
- Tests involving acute exposure of rats, mice, and rabbits have demonstrated methanol to have low acute toxicity from oral or inhalation exposure, and moderate acute toxicity from dermal exposure. (4)

Chronic Effects (Noncancer):

- Chronic inhalation or oral exposure to methanol may result in headache, dizziness, giddiness, insomnia, nausea, gastric disturbances, conjunctivitis, visual disturbances (blurred vision), and blindness in humans. (1,6)
- Elevated levels of liver enzymes and decreased brain weight were observed in rats chronically exposed to methanol via gavage (experimentally placing the chemical in the stomach). (5)
- EPA has not established a Reference Concentration (RfC) for methanol. (5)
- The Reference Dose (RfD) for methanol is 0.5 milligrams per kilogram body weight per day (mg/kg/d) based on increased liver enzymes (SAP and SGPT) and decreased brain weight in rats. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfD, the potential for adverse health effects increases. Lifetime exposure above the RfD does not imply that an adverse health effect would necessarily occur. (5)
- EPA has medium confidence in the principal study on which the RfD was based because it was well-designed and provided adequate toxicological endpoints, but the method of administration was not ideal; low confidence in the database because it is weak, lacking data on reproductive, developmental, or other toxicological endpoints; and, consequently, medium confidence in the RfD.
- The California Environmental Protection Agency (CalEPA) has calculated a chronic inhalation reference exposure level of 10 milligrams per cubic meter (mg/m^3) based on developmental effects in mice. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur. (6)

Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of methanol in humans.
- Developmental effects have been observed in the offspring of rats and mice exposed to methanol by inhalation. These included skeletal, cardiovascular, urinary system, and central nervous system (CNS) malformations in rats and increased resorptions and skeletal and CNS malformations in mice. (1,7)

Cancer Risk:

- No information is available on the carcinogenic effects of methanol in humans or animals.
- EPA has not classified methanol with respect to carcinogenicity. (5)

Physical Properties

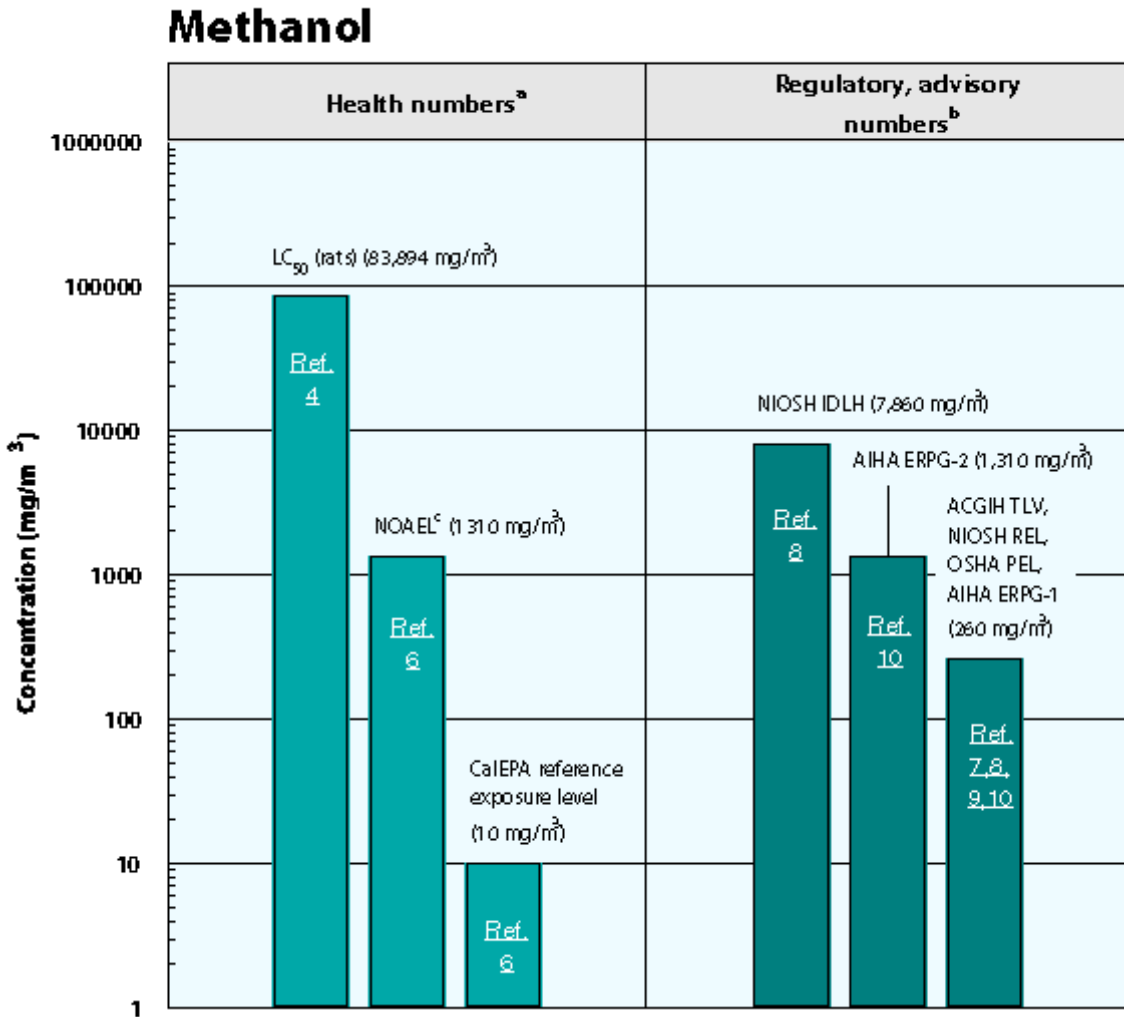
- The chemical formula for methanol is CH_3OH , and its molecular weight is 32.04 g/mol. (3)
- Methanol occurs as a flammable, mobile, colorless liquid that is miscible with water. (3)
- Methanol has a slightly alcoholic odor when pure and a repulsive, pungent odor when in its crude form; it is difficult to smell methanol in the air at less than 2,000 parts per million (ppm) ($2,622 \text{ mg}/\text{m}^3$). (1,2)
- The vapor pressure for methanol is 92 torr at 20 °C. (6)

- The log octanol/water partition coefficient ($\log K_{ow}$) is -0.77 . (1)

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m^3 : $\text{mg}/\text{m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound}) / (24.45)$. For methanol: $1 \text{ ppm} = 1.31 \text{ mg}/\text{m}^3$.

Health Data from Inhalation Exposure



AIHA ERPG --American Industrial Hygiene Association's emergency response planning guidelines. ERPG 1 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor; ERPG 2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing or developing irreversible or other serious health effects that could impair their abilities to take protective action.

ACGIH TLV --American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

LC₅₀ (Lethal Concentration₅₀) --A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

NIOSH REL --National Institute of Occupational Safety and Health's recommended exposure limit; NIOSH--recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

NIOSH IDLH -- NIOSH's immediately dangerous to life or health concentration; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

NOAEL--No observed adverse effect level.

OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

^a Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

^b Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH, ACGIH, and AIHA numbers are advisory.

^c The NOAEL is from the critical study used as the basis for the CalEPA chronic reference exposure level.

Summary created April 1992, updated January 2000

References

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10. American Industrial Hygiene Association (AIHA). The AIHA 1998 Emergency Response Planning Guidelines and Workplace Environmental Exposure Level Guides Handbook. 1998.