

Ethylene Glycol

107-21-1

Hazard Summary

Ethylene glycol has many uses, including as antifreeze in cooling and heating systems, in hydraulic brake fluids, and as a solvent. Acute (short-term) exposure of humans to ethylene glycol by ingesting large quantities causes three stages of health effects: central nervous system (CNS) depression, followed by cardiopulmonary effects, and later renal damage. The only effects noted in one study of individuals exposed to low levels of ethylene glycol by inhalation for about a month were throat and upper respiratory tract irritation. Rats and mice chronically (long-term) exposed to ethylene glycol in their diet exhibited signs of kidney toxicity and liver effects. Several studies of rodents exposed orally or by inhalation showed ethylene glycol to be fetotoxic. An epidemiologic study on renal cancer mortality did not find an increased risk for workers exposed to ethylene glycol. EPA has not classified ethylene glycol for carcinogenicity.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (7), which contains information on oral chronic toxicity and the RfD, and the carcinogenic effects of ethylene glycol, and the Agency for Toxic Substances and Disease Registry's Toxicological Profile for Ethylene Glycol and Propylene Glycol. (2)

Uses

- Ethylene glycol is used as antifreeze in cooling and heating systems, in hydraulic brake fluids, as an industrial humectant, as an ingredient of electrolytic condensers, as a solvent in the paint and plastics industries, in the formulations of printers' inks, stamp pad inks, and inks for ballpoint pens, as a softening agent for cellophane, and in the synthesis of safety explosives, plasticizers, synthetic fibers (Terylene, Dacron), and synthetic waxes. (4)
- Ethylene glycol is also used to de-ice airport runways and aircraft. (2)

Sources and Potential Exposure

- Dermal or inhalation exposure to workers may occur during the manufacture or use of the chemical. (1)
- Ethylene glycol may be discharged into wastewater from its production and use. It may also enter the environment from its uses in deicing airplane runways and from spills and improper disposal of used antifreeze, coolant, and solvents containing ethylene glycol. (1,2)

Assessing Personal Exposure

- Urinalysis for oxalic acid, an ethylene glycol metabolite, may be useful in diagnosis of poisoning by oral exposure. (3)

Health Hazard Information

Acute Effects:

- Acute exposure of humans to ethylene glycol by ingesting large quantities causes three stages of health effects. CNS depression, including such symptoms as vomiting, drowsiness, coma, respiratory failure, convulsions, metabolic changes, and gastrointestinal upset are followed by cardiopulmonary effects and

later renal damage. (2,4,5)

- Acute animal tests in rats, mice, rabbits, and guinea pigs have demonstrated ethylene glycol to have moderate acute toxicity by inhalation or dermal exposure and low to moderate acute toxicity by ingestion. (6)

Chronic Effects (Noncancer):

- The only effects were noted in a study of individuals exposed to low levels of ethylene glycol by inhalation for about a month were throat and upper respiratory tract irritation. (2)
- Rats chronically exposed to ethylene glycol in their diet exhibited signs of kidney toxicity and liver effects. (5,7)
- Ocular irritation and lesions and pulmonary inflammation have been observed in rats, rabbits, and guinea pigs subchronically exposed by inhalation. (5)
- EPA has not established a Reference Concentration (RfC) for ethylene glycol. (7)
- The Reference Dose (RfD) for ethylene glycol is 2.0 milligrams per kilogram body weight per day (mg/kg/d) based on kidney toxicity 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. (7)
- EPA has high confidence in the study on which the RfD was based because it was a well-conducted lifetime study by a relevant route and defined a no-observed-adverse-effect level (NOAEL) and lowest-observed-adverse-effect level (LOAEL); high confidence in the database because it contains another chronic rat study and a monkey study that support the NOAEL and LOAEL and it also contains data that indicate that the RfD is protective of teratogenic and reproductive effects; and, consequently, high confidence in the RfD. (7)
- The California Environmental Protection Agency (CalEPA) has calculated a chronic reference exposure level of 0.4 milligrams per cubic meter (mg/m^3) based on eye and respiratory tract irritation in humans. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur. (8)

Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of ethylene glycol in humans.
- Several studies of rodents exposed orally or by inhalation showed ethylene glycol to affect animal fetuses. Fetotoxicity manifested as increased preimplantation loss, delayed ossification, and an increased incidence of fetal malformations were reported. The inhalation study, however, noted continuous grooming of the fur, resulting in a high rate of exposure by ingestion as well. (2,5,7)

Cancer Risk:

- An epidemiologic study on renal cancer mortality did not find an increased risk for workers exposed to ethylene glycol. (2)
- A study by the NTP did not find an increased incidence of tumors in mice exposed to ethylene glycol in the diet. (9)
- EPA has not classified ethylene glycol for carcinogenicity.

Physical Properties

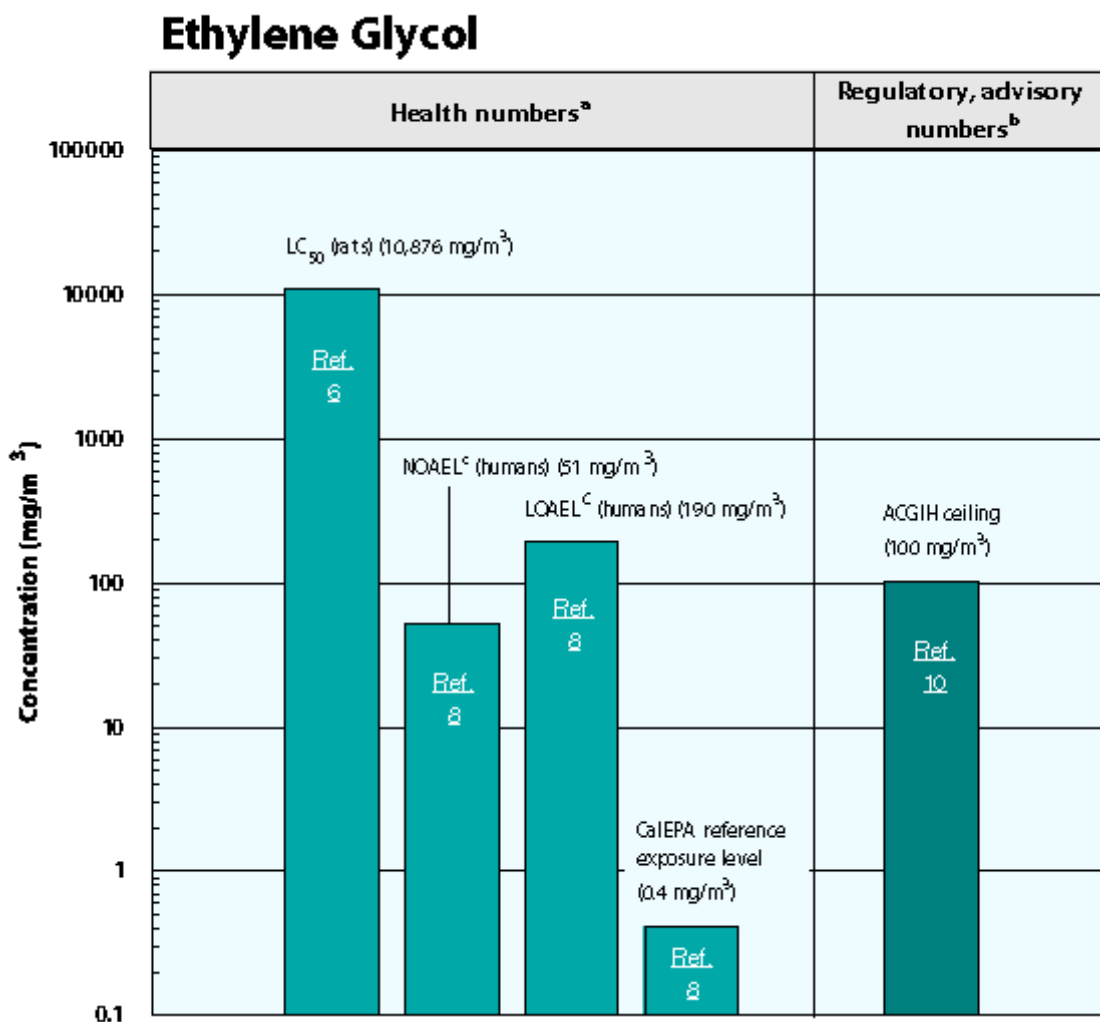
- The chemical formula for ethylene glycol is $\text{C}_2\text{H}_6\text{O}_2$, and its molecular weight is 62.07 g/mol. (4)
- Ethylene glycol occurs as a clear, slightly viscous liquid that is completely miscible with water. (1,4,5)
- Ethylene glycol is odorless. (3)
- The vapor pressure for ethylene glycol is 0.06 mm Hg at 20 °C, and its log octanol/water partition

coefficient ($\log K_{ow}$) is -1.36. (5)

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 ethylene glycol: $1 \text{ ppm} = 2.54 \text{ mg}/\text{m}^3$.

Health Data from Inhalation Exposure



ACGIH TLV ceiling --American Conference of Governmental and Industrial Hygienists' threshold limit value ceiling; the concentration of a substance that should not be exceeded during any part of the working exposure.

LC₅₀ (Lethal Concentration ₅₀)--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.

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. ACGIH numbers are advisory.

^c This NOAEL and LOAEL are from the critical study used as the basis for CalEPA's reference exposure level.

Summary created in April 1992, updated January 2000

References

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