Glycol Ethers

GLYCOL ETHERS (1) (2-METHOXYETHANOL, 2-ETHOXYETHANOL, AND 2-BUTOXYETHANOL)

Hazard Summary

Glycol ethers have many uses; these include use as solvents and as an ingredient in cleaning compounds, liquid soaps, and cosmetics. Acute (short-term) exposure to high levels of the glycol ethers in humans results in narcosis, pulmonary edema, and severe liver and kidney damage. Chronic (long-term) exposure to the glycol ethers in humans may result in neurological and blood effects, including fatigue, nausea, tremor, and anemia. No information is available on the reproductive, developmental, or carcinogenic effects of the glycol ethers in humans. Animal studies have reported reproductive and developmental effects from inhalation and oral exposure to the glycol ethers. EPA has not classified the glycol ethers 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 inhalation chronic toxicity of 2-methoxyethanol, 2-ethoxyethanol, and 2-butoxyethanol and the RfC, and EPA's Health Effects Assessment for Glycol Ethers. (4) Other secondary sources include Hazardous Substances Data Bank (HSDB), a database of summaries of peer-reviewed literature (2), and the Registry of Toxic Effects of Chemical Substances (RTECS), a database of toxic effects that are not peer reviewed. (3)

Uses

- The glycol ethers are used as solvents for resins, lacquers, paints, varnishes, gum, perfume, dyes, inks, as a constituent of paints and pastes, cleaning compounds, liquid soaps, cosmetics, and hydraulic fluids. (1)
- 2-Butoxyethanol is used in the production of cleaning agents and as a general solvent. (8)

Sources and Potential Exposure

- The general public may be exposed to the glycol ethers through the use of consumer products such as cleaning compounds, liquid soaps, and cosmetics. (1)
- Occupational exposure to the glycol ethers may occur for workers in the chemical industry. (1)

Assessing Personal Exposure

- No information is available on the assessment of personal exposure to 2-methoxyethanol and 2ethoxyethanol.
- Metabolites of 2-butoxyethanol can be measured in urine. (8)

Health Hazard Information

Acute Effects:

- Acute exposure to high levels of the glycol ethers in humans results in narcosis, pulmonary edema, and severe liver and kidney damage. (1)
- Acute exposure to lower levels of the glycol ethers in humans causes conjunctivitis, upper respiratory tract

- irritation, headache, nausea, and temporary corneal clouding. (1)
- Animal studies have reported adverse effects on weight gain, peripheral blood counts, bone marrow, and lymphoid tissues from acute, inhalation exposure to 2-methoxyethanol. (2)
- Acute animal tests in rats have shown 2-methoxyethanol to have moderate acute toxicity from inhalation and oral exposures. (3)

Chronic Effects (Noncancer):

- Chronic exposure to the glycol ethers in humans results in fatigue, lethargy, nausea, anorexia, tremor, and anemia. (1,5,7)
- Animal studies have reported anemia, reduced body weight gain, and irritation of the eyes and nose from inhalation exposure. (4)
- Anemia and effects to the thymus, spleen, bone marrow, liver, and kidneys were reported in animals following oral exposure to the glycol ethers. (4,10)
- EPA has not established a Reference Dose (RfD) for 2-methoxyethanol, 2-ethoxyethanol, or 2-butoxyethanol. (5,7,8)

2-Methoxyethanol

- The Reference Concentration (RfC) for 2-methoxyethanol is 0.02 milligrams per cubic meter (mg/m³) based on testicular effects in rabbits. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation 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 RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (5)
- EPA has medium confidence in the study on which the RfC was based because it is a well-designed subchronic study in two species; medium confidence in the database because the lowest-observed-adverse-effect level (LOAEL) identified in the key study was not corroborated in other studies; and, consequently, medium confidence in the RfC. (5)
- EPA has calculated a provisional RfD of 0.001 milligrams per kilogram body weight per day (mg/kg/d) for 2-methoxyethanol based on testicular effects in rabbits. The provisional RfD is a value that has had some form of Agency review but is not on IRIS.(6) 2-Ethoxyethanol
- The RfC for 2-ethoxyethanol is 0.2 mg/m based on decreased testis weight, seminiferous tubule degeneration, and decreased hemoglobin in rabbits. (7)
- EPA has medium confidence in the study on which the RfC was based because of its short duration; medium confidence in the database because several other studies of rats and rabbits have corroborated the reproductive effects observed in the principal study; and, consequently, medium confidence in the RfC. (7)
- EPA has calculated a provisional RfD of 0.4 mg/kg/d for 2-ethoxyethanol based on decreased body weight in rats. (6)
 - 2-Butoxyethanol
- EPA has calculated a provisional RfC of 0.02 mg/m³ for 2-butoxyethanol based on hematological effects in rats. (6)

Reproductive/Developmental Effects:

- No information is available on the developmental effects of the glycol ethers in humans.
- A possible effect on sperm quality and testes size in workers exposed to glycol ethers has been reported. (5.7)
- Animal studies have reported testicular damage, reduced fertility, maternal toxicity, early embryonic death, birth defects, and delayed development from inhalation and oral exposure to the glycol ethers. (2,4,5,7)

Cancer Risk:

- No information is available on the carcinogenic effects of the glycol ethers in humans.
- An animal study reported no increase in tumor incidence in rats and mice exposed to 2-ethoxyethanol by gavage (experimentally placing the chemical in the stomach). (9)
- · Another animal study reported pheochromocytoma of the adrenal medulla in female rats, hemangiosarcoma of the liver in male mice, and forestomach squamous cell papilloma or carcinoma in female mice exposed to 2-butoxyethanol by inhalation. (11)
- EPA has not classified the glycol ethers for carcinogenicity.

Physical Properties

- The glycol ethers are colorless liquids with a slight odor. (1)
- The chemical formula for 2-methoxyethanol is C₃H₈O₂, and the molecular weight is 76.1 g/mol. (4)
 The vapor pressure for 2-methoxyethanol is 9.5 mm Hg at 25 °C, and it has a log octanol/water partition coefficient (log K_{ow}) of -0.74. (4)
- The chemical formula for 2-ethoxyethanol is C H O , and the molecular weight is 90.10 g/mol. (9)
 The vapor pressure for 2-ethoxyethanol is 5.5 mm Hg at 25 °C, and it has a log K of -0.10. (9)

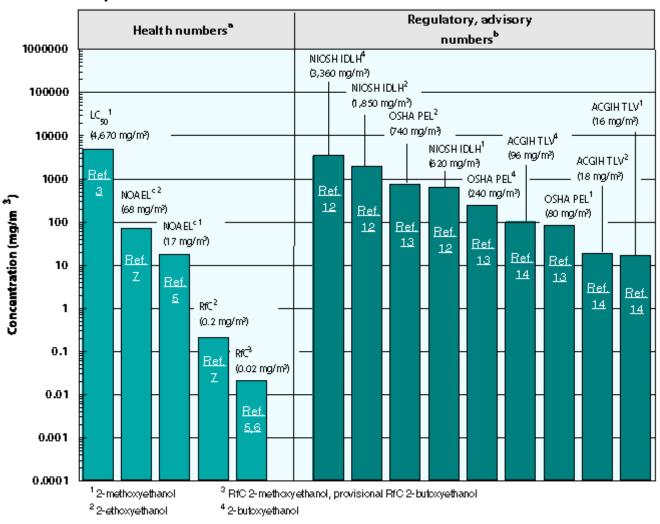
- The chemical formula for 2-butoxyethanol is C H O, and the molecular weight is 118.17 g/mol. (8)
 The vapor pressure for 2-butoxyethanol is 0.88 mm Hg at 25 °C, and it has a log K ow of 0.83. (8)

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m 3 : mg/m 3 = (ppm) × (molecular weight of the compound)/(24.45). For 2-methoxyethanol: 1 ppm = 3.1 mg/m^3 . For 2-ethoxyethanol: 1 ppm = 3.7 mg/m^3 . For 2-butoxyethanol: 1 ppm = 4.8 mg/m.

Health Data from Inhalation Exposure

Glycol Ethers



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 IDLH -- National Institute of Occupational Safety and Health'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.

Summary created in April 1992, updated January 2000

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

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 and ACGIH numbers are advisory.

These NOAELs are from the critical studies used as the basis for the EPA RfCs.

- 1. M. Sittig. Handbook of Toxic and Hazardous Chemicals and Carcinogens. 2nd ed. Noyes Publications, Park Ridge, NJ. 1985.
- 2. U.S. Department of Health and Human Services. Hazardous Substances Data Bank (HSDB, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
- 3. U.S. Department of Health and Human Services. Registry of Toxic Effects of Chemical Substances (RTECS, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
- 4. U.S. Environmental Protection Agency. Health Effects Assessment for Glycol Ethers. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1984.
- 5. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) on 2-Methoxyethanol. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.
- 6. U.S. Environmental Protection Agency. Health Effects Assessment Summary Tables. FY 1997 Update. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1997.
- 7. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) on 2-Ethoxyethanol. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.
- 8. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for 2-Butoxyethanol and 2-Butoxyethanol Acetate. U.S. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1998.
- 9. U.S. Environmental Protection Agency. Health and Environmental Effects Profile for 2-Ethoxyethanol. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1985.
- 10. National Toxicology Program (NTP). Toxicological Studies of Ethylene Glycol Ethers: 2-Methoxyethanol, 2-Ethoxyethanol, 2-Butoxyethanol (CAS Nos. 109-86-4, 110-80-5, 111-76-2) Administered in Drinking Water to F344/N Rats and B6C3F1 Mice. TOX-26. 1993.
- 11. National Toxicology Program (NTP). Toxicology and Carcinogenesis Studies of 2-Butoxyethanol (CAS No. 111-76-2) in F344/N Rats and B6C3F1 Mice (Inhalation Studies). TR-484. 1998.
- 12. National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 1997.
- 13. Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Standards, Toxic and Hazardous Substances. Code of Federal Regulations. 29 CFR 1910.1000. 1998.
- 14. American Conference of Governmental Industrial Hygienists (ACGIH). 1999 TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents. Biological Exposure Indices. Cincinnati, OH. 1999.
 - 1. * There are many glycol ether compounds; however, this fact sheet focuses on the three glycol ether compounds for which there is the most toxicological information.