Ethylene Dibromide (Dibromoethane)

106-93-4

Hazard Summary

Exposure to ethylene dibromide primarily occurs from its past use as an additive to leaded gasoline and as a fumigant. Ethylene dibromide is extremely toxic to humans. The chronic (long-term) effects of exposure to ethylene dibromide have not been well documented in humans. Animal studies indicate that chronic exposure to ethylene dibromide may result in toxic effects to the liver, kidney, and the testis, irrespective of the route of exposure. Limited data on men occupationally exposed to ethylene dibromide indicate that long-term exposure to ethylene dibromide can impair reproduction by damaging sperm cells in the testicles. Several animal studies indicate that long-term exposure to ethylene dibromideincreases the incidences of a variety of tumors in rats and mice in both sexes by all routes of exposure. EPA has classified ethylene dibromide as a Group B2, probable human carcinogen.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (4), which contains information on the carcinogenic effects of ethylene dibromide including the unit cancer risk for inhalation exposure, and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for 1,2-Dibromoethane. (1)

Uses

- Ethylene dibromide was used in the past as an additive to leaded gasoline; however, since leaded gasoline is now banned, it is no longer used for this purpose. (1)
- Ethylene dibromide was used as a fumigant to protect against insects, pests, and nematodes in citrus, vegetable, and grain crops, and as a fumigant for turf, particularly on golf courses. In 1984, EPA banned its use as a soil and grain fumigant. (1)
- Ethylene dibromide is currently used in the treatment of felled logs for bark beetles and termites, and control of wax moths in beehives. (1)
- Ethylene dibromide is also used as an intermediate for dyes, resins, waxes, and gums. (1)

Sources and Potential Exposure

- Possible sources of ethylene dibromide emissions to the ambient air are production and processing facilities. (1)
- Exposure could occur from inhalation of ambient air near industries that use ethylene dibromide or through the ingestion of contaminated drinking water. (1)

Assessing Personal Exposure

- There is no known reliable medical test to determine whether someone has been exposed to ethylene dibromide. (1)

Health Hazard Information

Acute Effects:

- Clinical signs in humans and animals related to acute inhalation exposure to ethylene dibromide are depression and collapse. Ethylene dibromide is a severe skin irritant that can cause blistering. (1,2)
- Exposure to high concentrations of ethylene dibromide through inhalation, ingestion, or skin contact can result in death. Changes in the liver and kidney are reported in humans who died from ingestion of ethylene dibromide. (1,2)
- Tests involving acute exposure of rats have shown ethylene dibromide to have high acute toxicity from oral exposure, while moderate acute toxicity resulted from inhalation exposure. (3)

Chronic Effects (Noncancer):

- The chronic effects of exposure to ethylene dibromide have not been extensively documented in humans. In one case in which a worker breathed ethylene dibromide for several years, he developed bronchitis, headache, and depression. His health improved after he stopped breathing air contaminated with ethylene dibromide. (1,2)
- Animal studies indicate that prolonged exposure to ethylene dibromide may result in toxic effects to the liver, kidney, and the testis whether by inhalation, ingestion, or skin contact. (1,2)
- EPA has not established a Reference Dose (RfD) or a Reference Concentration (RfC) for ethylene dibromide. (4)
- EPA has calculated a provisional RfC of 0.0002 milligrams per cubic meter (mg/m^3) for ethylene dibromide based on reproductive effects in humans. 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. The provisional RfC is a value that has had some form of Agency review, but it does not appear on IRIS. (5)

Reproductive Effects/Developmental:

- Developmental effects have not been documented in humans. Limited data on men occupationally exposed to ethylene dibromide indicate that long-term exposure to ethylene dibromide can impair reproduction by damaging sperm cells in the testicles. (1,2)
- Animals that breathed or ate food containing ethylene dibromide for short or long periods were less fertile than control animals or had abnormal sperm. Pregnant animals that were sick from exposure to ethylene dibromide have had pups with birth defects. (1,2)

Cancer Risk:

- Two cancer studies on workers exposed to ethylene dibromide have been carried out. Neither study reported a statistically significant increase in cancer mortality; however these studies are considered inadequate due to confounding factors. (4)
- Several animal studies indicate that long-term exposure to ethylene dibromide increases the incidences of a variety of tumors in rats and mice in both sexes by inhalation, by gavage (the placing of ethylene dibromide experimentally in the stomach), or by administration to the skin. (4)
- EPA has classified ethylene dibromide as a Group B2, probable human carcinogen. (4)
- EPA uses mathematical models, based on animal studies, to estimate the probability of a person developing cancer from breathing air containing a specified concentration of a chemical. EPA has calculated an inhalation unit risk estimate of 2.2×10^{-4} $(\mu g/m^3)^{-1}$. EPA estimates that, if an individual were to continuously breathe air containing ethylene dibromide at an average of 0.005 $\mu g/m^3$ (5×10^{-6} mg/m^3) over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million increased chance of developing cancer as a direct result of breathing air containing this chemical. Similarly, EPA estimates that continuously breathing air containing 0.05 $\mu g/m^3$ (5×10^{-5} mg/m^3) would result in not greater than a one-in-hundred thousand increased chance of developing cancer, and air containing 0.5 $\mu g/m^3$ (5×10^{-4} mg/m^3) would result in not greater than a one-in-ten thousand increased chance of

developing cancer in their lifetime. For a detailed discussion of confidence in the potency estimates, please see IRIS. (4)

- EPA has calculated an oral cancer slope factor of 85 $(mg/kg/d)^{-1}$. (4)

Physical Properties

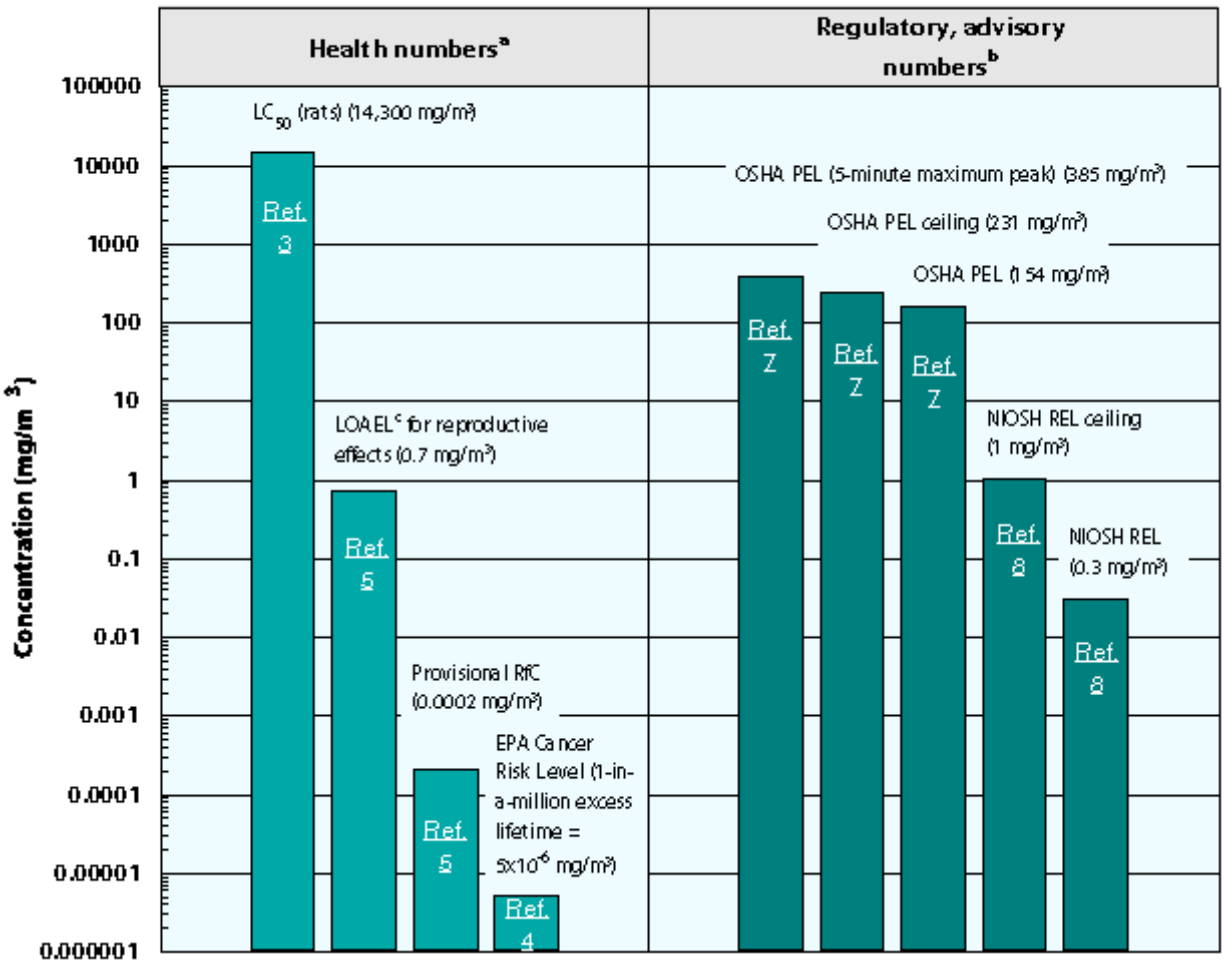
- Ethylene dibromide is a colorless liquid with a mild sweet odor, like chloroform. It is also known as 1,2-dibromomethane. (1,7)
- Ethylene dibromide is slightly soluble in water. (1,7)
- The chemical formula for ethylene dibromide is $C_2H_4Br_2$, and it has a molecular weight of 187.88 g/mol. (1,7)
- The vapor pressure for ethylene dibromide is 11.0 mm Hg at 25 °C, and it has a log octanol/water partition coefficient (log K_{ow}) of 86. (1).

  Ethylene dibromide reacts with hydroxyl radicals in the atmosphere, with a half-life for this reaction of approximately 40 days. In water, its half-life ranges from 2.5 to 13.2 years, and in soil it was detected 19 years after it had been applied. (1)

Conversion Factors (only for the gaseous form):
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 ethylene dibromide: 1 ppm = 7.7 mg/m^3.
To convert concentrations in air from $\mu g/m^3$ to mg/m^3: mg/m^3 = ($\mu g/m^3$) × (1 mg/1,000 µg).

Health Data from Inhalation Exposure

Ethylene Dibromide



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.

NIOSH ceiling --National Institute of Occupational Safety and Health's ceiling limit; NIOSH--recommended 15-min exposure limit, which should not be exceeded.

NIOSH REL--NIOSH's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

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 numbers are advisory.

[c] The LOAEL is from the critical study used as the basis for the EPA provisional RfC.

Summary created in April 1992, updated January 2000

References

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7. Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Standards, Toxic and Hazardous Substances. Code of Federal Regulations. 29 CFR 1910.1000. 1998.
8. 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.