Methyl Bromide (Bromomethane)

74-83-9

Hazard Summary

Methyl bromide is used as a fumigant and pesticide. Exposure may occur during fumigation activities. Methyl bromide is highly toxic. Studies in humans indicate that the lung may be severely injured by the acute (short-term) inhalation of methyl bromide. Acute and chronic (long-term) inhalation of methyl bromide can lead to neurological effects in humans. Neurological effects have also been reported in animals. Degenerative and proliferative lesions in the nasal cavity developed in rats chronically exposed to methyl bromide by inhalation. Chronic inhalation exposure of male animals has resulted in effects on the testes at high concentrations. EPA has classified methyl bromide as a Group D, not classifiable as to human carcinogenicity.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (3), which contains information on inhalation chronic toxicity of methyl bromide and the RfC, oral chronic toxicity and the RfD, and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Bromomethane. (1) Other secondary sources include The Merck Index (7) and EPA's Health Effects Assessment for Bromomethane. (5)

Uses

- The primary use of methyl bromide is as a fumigant in soil to control fungi, nematodes, and weeds; in space fumigation of food commodities (e.g., grains); and in storage facilities (such as mills, warehouses, vaults, ships, and freight cars) to control insects and rodents. (2,7,10)

Sources and Potential Exposure

- In most places, levels of methyl bromide in the air are usually < 0.025 parts per billion (ppb). Industrial areas have higher levels (ranging up to 1.2 ppb) because of releases from chemical factories. (1) Workers
- who fumigate homes and fields may be exposed to high levels of methyl bromide if proper safety precautions are not followed. (1)
- Trace amounts of methyl bromide have been detected in drinking water. (2)
- Some methyl bromide is formed naturally by algae or kelp in the ocean. (1)

Assessing Personal Exposure

- The main breakdown product of methyl bromide (the bromide ion) can be measured in blood samples; this test is useful only if it is done within 1 to 2 days following exposure. (1)

Health Hazard Information

Acute Effects:

- Studies in humans indicate that the lung may be most severely injured by the acute inhalation exposure of methyl bromide. Breathing high concentrations of methyl bromide may cause pulmonary edema, impairing respiratory function. (1,3)

- Acute exposure by inhalation of methyl bromide frequently leads to neurological effects in humans. Symptoms of acute exposure in humans include headaches, dizziness, fainting, apathy, weakness, confusion, speech impairment, visual effects, numbness, twitching, and tremors; in severe cases paralysis and convulsions are possible. Acute exposure may produce delayed effects. Symptoms may improve without treatment in less serious cases. (1,3)
- Methyl bromide is irritating to the eyes, skin, and mucous membranes of the upper respiratory tract. Dermal exposure to methyl bromide can cause itching, redness, and blisters in humans. (1)
- Kidney damage has been observed in humans who have inhaled high levels of methyl bromide. (1)
- Inhalation of methyl bromide may cause the liver to become swollen and tender, but no significant injury to the liver has been observed in humans. (1)
- Injury to the heart has been observed in mice and rats exposed to high concentrations of methyl bromide by inhalation. (1,3)
- Tests involving acute exposure of rats and mice have demonstrated methyl bromide to have high acute toxicity from inhalation and oral exposure. (4)

Chronic Effects (Noncancer):

- Data from an occupational study suggest that mild functional neurological impairment may result in humans chronically exposed to methyl bromide by inhalation exposure, but this is not conclusive due to concurrent exposure to other chemicals and inadequate quantitation of exposure levels and durations. (1,3,5)
- Neurological effects, including lethargy, forelimb twitching, tremors, and paralysis, have also been observed in animal studies. (3,6)
- Degenerative and proliferative lesions in the nasal cavity developed in rats chronically exposed to methyl bromide by inhalation. (3)
- The Reference Concentration (RfC) for methyl bromide is 0.005 milligrams per cubic meter (mg/m^3) based on degenerative and proliferative lesions of the olfactory epithelium of the nasal cavity. 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. (3)
- EPA has medium confidence in the study on which the RfC was based because even though the study was well conducted, it did not identify a no-observed-adverse-effect level (NOAEL); high confidence in the database because there is a chronic inhalation study in two species supported by subchronic inhalation studies in several species and because data are available on the developmental and reproductive effects of bromomethane as well as its pharmacokinetics following inhalation exposure; and, consequently, high confidence in the RfC. (3)
- The Reference Dose (RfD) for methyl bromide is 0.0014 milligrams per kilogram body weight per day (mg/kg/d) based on epithelial hyperplasia of the forestomach in rats. (3)
- EPA has medium confidence in the study on which the RfD was based because it used the preferred route of administration for derivation of an oral RfD, the study was adequately conducted, and the determination of epithelial hyperplasia of the forestomach was independently confirmed; medium confidence in the database; and, consequently, medium confidence in the RfD. (3)

Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of methyl bromide in humans.
- Information from animal studies suggest that methyl bromide does not cause birth defects and does not interfere with normal reproduction except at high exposure levels. (1)
- Chronic inhalation exposure of male animals has resulted in effects on the testes at high concentrations. (1,3)

- Inhalation exposure of animals during gestation has not resulted in significant developmental effects, even when there was severe maternal toxicity. (1,3,5)

Cancer Risk:

- In a human mortality study, a higher incidence of death from testicular cancer was identified in men occupationally exposed to methyl bromide. However, methyl bromide could not be established as the causative agent because the individuals in the study were exposed to a wide variety of brominated chemicals. (1,3,5)
- There was no evidence of carcinogenic activity in mice in a National Toxicology Program (NTP) chronic inhalation study. (6)
- EPA has classified methyl bromide as a Group D, not classifiable as to human carcinogenicity, based on inadequate human and animal data. (3,5)

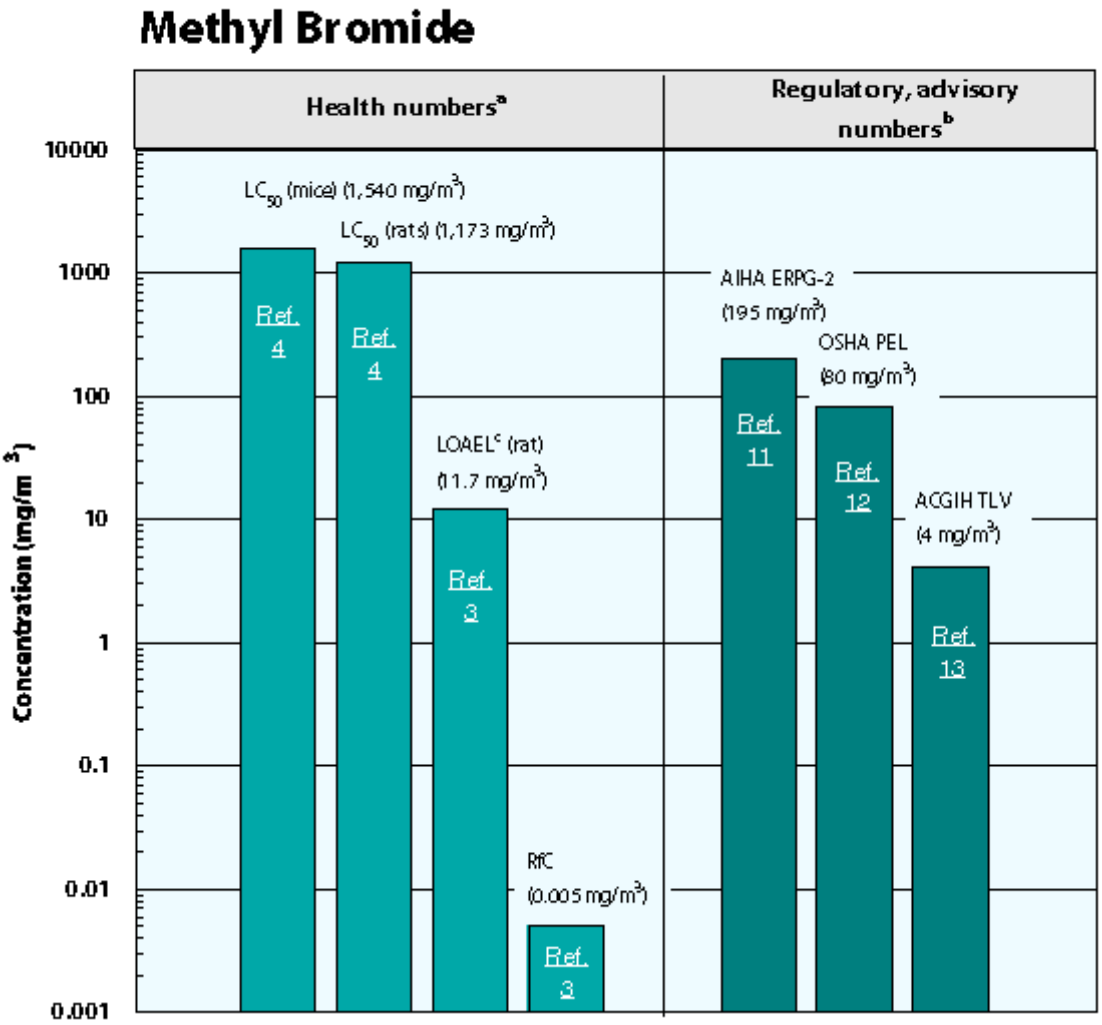
Physical Properties

- The chemical formula for methyl bromide is CH_3Br, and it has a molecular weight of 94.95 g/mol. (7)
- Methyl bromide occurs as a colorless and highly volatile gas that is slightly soluble in water. (7,8)
- Methyl bromide is practically odorless but has a sweetish chloroform-like odor at high concentrations with an odor threshold of 80 mg/m^3. (3,7,9)
- The vapor pressure for methyl bromide is 1,420 mm Hg at 20 °C, and it has a log octanol/water partition coefficient (log K_{ow}) of 1.1. (1)

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m^3: $mg/m^3 = (ppm) \times (\text{molecular weight of the compound})/(24.45)$. For methyl bromide: 1 ppm = 3.9 mg/m^3.

Health Data from Inhalation Exposure



AIHA ERPG--American Industrial Hygiene Association's emergency response planning guidelines. 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 effect.

LC_{50} (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.

LOAEL--Lowest-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 ACGIH and AIHA numbers are advisory.

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

References

Summary created in April 1992, updated January 2000

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