SIDS INITIAL ASSESSMENT PROFILE

CAS No.	74-83-9
Chemical Name	Methyl bromide
Structural Formula	CH_3Br

RECOMMENDATIONS

The chemical is currently of low priority for further work in the SIDS program as it is subject to with-drawl under international activity (Montreal Protocol).

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

Metabolism studies with radiolabeled methyl bromide show that it is rapidly metabolized and excreted. The primary route of excretion is exhalation as CO2 with lesser amount of radioactivity excreted in the urine and feces. Tissue distribution upon inhalation exposure showed that the liver contained the highest levels of radiolabel with appreciable amounts found in the lungs, nasal turbinates and kidneys. Upon oral or intraperitoneal injection, the liver was also the main organ for appreciable radiolabel with lesser amounts seen in the kidneys, testes, lung, heart, stomach and spleen.

Methyl Bromide (bromomethane) exhibits moderate acute toxicity by the oral and inhalation routes. The oral LD 50 in rats ranged from 104 to 214 mg/kg. Toxicity by the inhalation route is both time and concentration dependent. In mice, LC 50 values ranged from 1700 ppm (6,630 mg/m^3) for a 30 minute exposure to 405 ppm (1,575 mg/m^3) for a 4-hour exposure. Similarly in rats, the LC_{50} for a 30-minute exposure was reported as 2833 ppm (11,049 mg/m^3) while that for an 8-hour exposure was 302 ppm (1,178 mg/m^3). In repeated dose studies (4 weeks to 6 months duration) NOAELs of 5 – 33 ppm (20 - 129 mg/m^3) have been observed in inhalation studies using rats, mice, rabbits and dogs. Effects observed included decreased body weight, neurobehavioral changes and hematologic and clinical chemistry effects. Neurotoxic effects seen in experimental animals have included decreased locomotor activity, hyperactivity, depression, lethargy, ataxia, gait disturbances, tremor and convulsions. Methyl bromide was evaluated in 4 inhalation developmental toxicity studies (1 in rats, 3 in rabbits). No developmental effects were reported in these studies at exposure concentrations up to 70 ppm (273 mg/m^3) in both rats and rabbits. In one rabbit study, equivocal fetal effects were seen at a maternally toxic concentration of 80 ppm (312 mg/m^3). In a reproductive study by the inhalation route, no effects on reproductive performance were seen at exposure concentrations up to 90 ppm (351 mg/m^3). Neonate effects were limited to reduced body weights at day 28 post partum in F2 pups at 30 and 90 ppm (117 and 351 mg/m^3). The weight-of-evidence for all genetic toxicity testing indicates that methyl bromide is genotoxic, inducing gene mutations, chromosome mutations, DNA effects and other genotoxic effects both *in vitro* and *in vivo.* However, long-term and reproductive tests *in vivo* show no evidence of carcinogenic response. Methyl bromide is not considered to have produced heritable effects as no such effects were seen in reproductive studies in rats, or developmental studies in rats or rabbits at methyl bromide concentrations that did not induce maternal toxicity. This conclusion is further supported by negative results seen in the dominant lethal study in male rats.

In long-term inhalation bioassays, there were no statistically significant increases in tumors in rats exposed to concentrations up to 90 ppm (351 mg/m^3) for 29 months and mice exposed to concentrations up to 100 ppm (390

mg/m^3) for 2 years. The primary histological changes in both species were degeneration and hyperplasia of the nasal olfactory epithelium. Further, no evidence of oncogenicity was seen in a two-year dietary study in rats in which the animals were fed microencapsulated methyl bromide in order to maintain dietary concentrations.

Human exposure to methyl bromide may occur through inhalation of the gas or inadvertent contact with the liquid. The primary effects of methyl bromide in humans are on the nervous system, lung, nasal mucosa, kidney, eye, and skin. Effects on the central nervous system include blurred vision, mental confusion, numbness, tremors, and speech defects. Topical exposure can cause skin irritation, burns, and eye injury. Exposure to high levels of methyl bromide causes pulmonary edema. Central nervous depression with respiratory paralysis and/or circulatory failure is the immediate cause of death generally preceded by convulsions and coma.

Environment

Although methyl bromide is very soluble in water (16.1 g/L at 25^0C), its high vapor pressure (1893 kPa) , log K_{ow} (1.94 at 25^0C) and log K_{oc} ranging from 2.1 to 2.2 in various soil types indicates a low tendency to absorb to soils causing it to rapidly evaporate from either water or soil. Methyl bromide has a half-life in air estimated between 0.3 and 1.6 years. The primary degradation is due to photolysis. In soils, projected half-lives are in the range of 0.2 to 0.5 days. In water, a half-life of 3 hours was calculated for a model river, this half-life relates to loss due to evaporation. As a result of evaporative transfer, abiotic and biotic processes are insignificant for methyl bromide due to the short residence time. Methyl bromide does not accumulate in aquatic species based on an estimated bioconcentration factor of 4.7 calculated from an octanol/water partition coefficient of 1.19. Rainbow trout and daphnid acute toxicity studies were conducted under static conditions with no headspace over the water column. A number of studies in several fish species indicate that methyl bromide causes acute lethality at concentrations of 0.7 to 20 mg/L. The most reliable 96-hour LC50 based on measured concentrations in the trout was 3.9 mg/l with NOECs of 1.9 and 2.9 mg/l for clinical signs and mortality, respectively. In daphnids, tests under similar conditions, the 48-hour LC50 for mortality and immobilization was 2.6 mg/l. Two studies have been reported in the literature for aquatic plants with a 48h-EC50 of 5 and 3.2 mg/l. A number of chronic studies in aquatic organisms are available, however, none were considered reliable to provide definitive results.

Exposure

In the United States, processing of the chemical is done in closed systems and is a chemical intermediate and a fumigant. In 1990, worldwide consumption of methyl bromide was reported to be 67,000 tonnes or approximately 74,000 US tons. In 1987, combined US production and import totaled 23,000 to 24,000 tonnes or approximately 26,000 US tons. Methyl bromide is used as a fumigant inside dwellings, office buildings, warehouses, silos, mills, vaults, ships and freight cars to control fungi, nematodes, insects and rats. Methyl bromide is also used outdoors as a fumigant, usually under gas-proof sheeting to control pests in soil and orchards. Soil fumigation consumes the bulk of methyl bromide production. In the US methyl bromide may only be applied and used by professional, certified applicators. Primary exposure would be via the inhalation route under occupational scenarios. Since methyl bromide is a gas at room temperature and dissipates rapidly from fumigation sites, non-occupational exposure to low residual amounts may occur to persons living in areas of methyl bromide fumigation. Most countries strictly regulate the application and handling of methyl bromide during fumigation operations to limit and protect the workers and public. Dermal exposure can result from direct contact to liquid methyl bromide through accidental splashing or contact with contaminated clothing.

Recent monitoring studies in areas of high fumigation activity and coinciding with the time periods of fumigation showed ambient air concentrations of methyl bromide in the mean range of 0.099 to 7.68 ppb. Occupational exposures to methyl bromide in various types of soil fumigation show mean exposures ranging from 2 to 605 ppb.

Methyl bromide is highly regulated in various OECD countries based on its hazard data and use information. Under the Montreal Protocol, methyl bromide is considered to be an ozone depleting substance (ODS) and it has been agreed that a phase out of the consumption and production of this chemical is to occur by the year 2005 for industrialized countries. However, in order to satisfy the needs of developing countries, a decreasing level of production is authorized until 2010. Currently there are two exemptions to the 2005 phase out; they are: quarantine and pre-shipment exemption (= 18% of the uses); and critical and emergency exemptions. It should also be noted

that under the Protocol, the amount of methyl bromide used as feedstock in the manufacture of other chemicals is not considered as production. It is anticipated that methyl bromide will be further investigated by individual OECD member countries participating in the Montreal Protocol. As a result, it does not appear that further work will be necessary in the SIDS Program regarding the collection of exposure or release data from use, as the need for this information is required to be investigated for "exemptions" from the phase out.

NATURE OF FURTHER WORK RECOMMENDED

No recommendation.