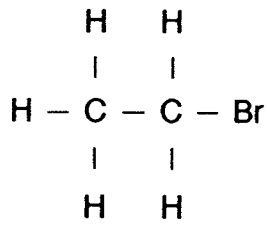
BROMOETHANE

1. Chemical and Physical Data

1.1 Synonyms

Chem. Abstr. Services Reg. No.: 74-96-4
Chem. Abstr. Name: Bromoethane
IUPAC Systematic Name: Bromoethane
Synonyms: Bromic ether; ethyl bromide; hydrobromic ether; monobromoethane

1.2 Structural and molecular formulae and molecular weight



C_2H_5Br Mol. wt: 108.97

1.3 Chemical and physical properties of the pure substance

(*a*) *Description*: Clear, colourless liquid with ethereal odour and burning taste (Great Lakes Chemical Corp., 1981; Budavari, 1989)
(*b*) *Boiling-point*: 38.4°C (Weast, 1989)
(*c*) *Melting-point*: -118.6°C (Weast, 1989)
(*d*) *Density*: 1.4604 at 20/4°C (Weast, 1989)
(*e*) *Spectroscopy data*[1]: Infrared (Sadtler Research Laboratories, 1980, prism [4631, 4632], grating [10951]; Pouchert, 1981, 1985), nuclear magnetic

[1]In square brackets, spectrum number in compilation

resonance (Sadtler Research Laboratories, 1980, proton [225, V10], C-13 [616]; Pouchert, 1974, 1983) and mass spectral data [331]) have been reported.

(*f*) *Solubility*: Soluble in water (1.067 g/100 g at 0°C, 0.914 g/100 g at 20°C), ethanol, chloroform and diethyl ether (Budavari, 1989; Weast, 1989)

(*g*) *Volatility*: Vapour pressure, 400 mm Hg at 21.0°C (Weast, 1989); relative vapour density (air = 1), 3.75 (Great Lakes Chemical Corp., 1989a)

(*h*) *Stability*: Turns yellow on exposure to air and light (Budavari, 1989)

(*i*) *Reactivity*: Reacts rapidly with metals such as sodium, potassium, calcium, powdered aluminium, zinc and magnesium (Sittig, 1985)

(*j*) *Octanol/water partition coefficient (P)*: log P, 1.61 (Chemical Information Systems, 1990)

(*k*) *Conversion factor*[1]: $mg/m^3 = 4.46 \times ppm$

1.4 Technical products and impurities

Bromoethane is available as a commercial-grade liquid with a minimum purity of 99% and maximum acidity of 5.0 ppm (as HBr) (Great Lakes Chemical Corp., 1989b).

2. Production, Use, Occurrence and Analysis

2.1 Production and use

(*a*) *Production*

Bromoethane was first synthesized in France in 1827 by Serullas from alcohol and bromine reacted with phosphorus (STN International, 1989). It can be produced commercially by the following methods: reaction of ethanol with hydrogen bromide; distillation of a mixture of hydrogen bromide, ethanol and sulfuric acid; reaction of ethanol with phosphorus and bromine; reaction of ethane with sulfur trioxide and potassium bromide at 300-325°C; and reaction of ethylene with hydrogen bromide initiated by gamma radiation (Stenger, 1978; Budavari, 1989).

Bromoethane is currently produced by three companies in France, three in the UK, two in Germany, two in Japan, two in the USA and one each in Israel, Italy and the Netherlands (Chemical Information Services, 1988).

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[1]Calculated from: mg/m^3 = (molecular weight/24.45) × ppm, assuming standard temperature (25°C) and pressure (760 mm Hg)

(b) Use

Bromoethane has been used as an ethylating agent in organic synthesis and gasoline, as a refrigerant and as an extraction solvent; it has had limited use as a local anaesthetic (Sittig, 1985; Strobel & Grummt, 1987). It has been investigated as a possible substitute for chlorofluorocarbons in compression heat pumps (Narodoslawsky & Moser, 1988).

(c) Regulatory status and guidelines

Occupational exposure limits and guidelines for bromoethane are presented in Table 1.

Table 1. Occupational exposure limits and guidelines for bromoethane[a]

Country	Year	Concentration (mg/m^3)	Interpretation[b]
Argentina	1985	1100	TWA and STEL
Australia	1985	890	TWA
		1110	STEL
Austria	1987	890	TWA
Belgium	1989	890	TWA
		1110	STEL
Brazil	1987	695	TWA
Canada	1986	890	TWA
		1110	STEL
Denmark	1987	890	TWA
Finland	1987	890	TWA
		1115	STEL
Germany	1989	890	TWA
Hungary	1985	50	TWA
		250	STEL (30 min)
Indonesia	1987	890	TWA
Italy	1987	145	TWA
Netherlands	1986	890	TWA
Poland	1985	50	TWA
Romania	1985	400	TWA
		500	STEL
Switzerland	1987	890	TWA
UK	1987	890	TWA
	1987	1110	STEL (10 min)
USA ACGIH	1989	891	TWA
		1110	STEL
OSHA	1989	890	TWA
		1110	STEL
USSR	1987	5	TWA

Table 1 (contd)

Country	Year	Concentration (mg/m^3)	Interpretation[b]
Venezuela	1987	800	TWA
		1110	STEL
Yugoslavia	1987	890	TWA

[a]From Cook (1987); American Conference of Governmental Industrial Hygienists (ACGIH) (1989); US Occupational Safety and Health Administration (OSHA) (1989); United Nations Environment Programme (1990)

[b]TWA, time-weighted average; STEL, short-term exposure limit

2.2 Occurrence

(*a*) *Natural occurrence*

Macroalgae collected near the Bermuda Islands (*Fucales sargassum*) and at the Cape of Good Hope (*Laminariales laminaria*) showed a specific pattern of emission of volatile organohalides into the air. The main components were bromoform, bromodichloromethane and chlorodibromomethane; a minor component was bromoethane (Class *et al.*, 1986).

(*b*) *Air*

Bromoethane was not found (detection limit, < 1 ppt) in six air samples taken near the surface of the Pacific Ocean at several sites in the northern hemisphere (Hoyt & Rasmussen, 1985).

(*c*) *Water and sediments*

Bromoethane was detected (but not quantified) in headspace analysis of seven out of ten seawater samples collected in 1983 (Hoyt & Rasmussen, 1985).

In a two-year study of trace organic compounds in drinking-water in Philadelphia, PA, Suffet *et al.* (1980) tested samples derived from two surface water (river) sources and collected at four sites. Bromoethane was identified in one of 13 samples collected at the two sites originating from the Delaware River but in neither of the three samples originating from the Schuylkill River. No quantitative analysis was performed.

2.3 Analysis

Selected methods for the analysis of bromoethane in air, breath and water are presented in Table 2.

Table 2. Methods for the analysis of bromoethane

Sample matrix	Sample preparation	Assay procedure[a]	Limit of detection[b]	Reference
Air	Adsorb on activated charcoal; desorb (2-propanol); inject aliquot	GC/FID	0.02 mg/m^3	Eller (1985)
	Draw through tube; compare reaction with standard chart	Colorimetric	NR	Lodge (1989a); SKC Inc. (1989)
	Collect cryogenically into stainless-steel bottle; inject sample	GC/EC-FI-FPD/GC/MS	1 ppt (4.5 ng/m^3)	Hoyt & Rasmussen (1985)
Seawater	Collect in a vacuum extraction flask; pressurize with zero air; inject headspace sample	GC/EC-FI-FPD/GC/MS	1 ppt (1 ng/l)	Hoyt & Rasmussen (1985)
Breath	Collect in plastic bag; evacuate cell; draw sample in and scan	FT-IR	10 ppm (45 mg/m^3)	Lodge (1989b)
Water	Put in sample vessel; place probe into headspace; measure peak intensity of fragment ions	MIMS	1 ppb (μg/l)	Wenhu *et al.* (1987)

[a]GC/FID, gas chromatography/flame ionization detection; GC/EC-FI-FPD/GC-MS, gas chromatography/electron capture-flame ionization-flame photometric detection/gas chromatography-mass spectrometry; FT-IR, Fourier transform-infrared spectroscopy; MIMS, membrane introduction mass spectroscopy

3. Biological Data Relevant to the Evaluation of Carcinogenic Risk to Humans

3.1 Carcinogenicity studies in animals (Table 3)

(*a*) *Inhalation*

Mouse: Groups of 50 male and 50 female B6C3F$_1$ mice, nine weeks old, were exposed to 100, 200 or 400 ppm bromoethane (446, 890 or 1780 mg/m3; > 98% pure) by whole-body inhalation for 6 h per day on five days per week for 103 weeks. Survival at 105 weeks was: males—control, 35/50; low-dose, 37/50; mid-dose, 30/50; high-dose, 34/50; females—control, 36/50; low-dose, 37/50; mid-dose, 36/50; high-dose, 22/50. Uterine neoplasms reduced the survival in high-dose female mice. Adenomas of the uterine endometrium occurred in 0/50 control, 1/50 low-dose, 1/47 mid-dose and 6/48 high-dose female mice, and adenocarcinomas occurred in 0/50

control, 2/50 low-dose, 3/47 mid-dose and 19/48 high-dose females; squamous-cell carcinomas of the uterine endometrium occurred in 0/50 control, 1/50 low-dose, 1/47 mid-dose and 3/48 high-dose female mice. The proportion of female mice with uterine endometrium neoplasms (0/50 control, 4/50 low-dose, 5/47 mid-dose, and 27/48 high-dose) was significantly increased over that in controls at all exposure concentrations (low-dose, $p = 0.017$; mid-dose, $p = 0.035$; high-dose, $p < 0.001$, trend test; $p < 0.001$, incidental tumour test). Alveolar/bronchiolar adenomas occurred in 5/50 control, 6/50 low-dose, 8/50 mid-dose and 9/50 high-dose males, and alveolar/bronchiolar carcinomas occurred in 2/50 control, 0/50 low-dose, 5/50 mid-dose and 6/50 high-dose male mice. The proportion of high-dose male mice with alveolar/bronchiolar neoplasms was significantly increased relative to that in controls ($p = 0.049$, pairwise comparison; $p = 0.012$, trend test, incidental tumour test) (National Toxicology Program, 1989).

Rat: Groups of 50 male and 50 female Fischer 344 rats, eight to ten weeks old, were exposed to 100, 200 or 400 ppm bromoethane (446, 890 or 1780 mg/m^3 bromoethane; > 98% pure) by whole-body inhalation 6 h per day on five days per week for 104 weeks. Survival at 106 weeks was: males—control, 17/50; low-dose, 26/50; mid-dose, 26/50; high-dose, 21/50; females—control, 19/50; low-dose, 29/50; mid-dose, 24/50; high-dose, 22/50. Adrenal medullary phaeochromocytomas (benign and malignant combined) occurred in 8/48 control, 23/47 low-dose, 18/50 mid-dose and 21/49 high-dose male rats. The proportion of low and high-dose male rats with phaeochromocytoma was significantly greater than that in controls (low-dose, $p = 0.013$; high-dose, $p = 0.007$, incidental tumour test); however, there was disproportionate sampling of the adrenal medulla among control and exposure groups (numbers of adrenal medullas examined microscopically: control, 66; low-dose, 82; mid-dose, 85; high-dose, 86). When statistical analyses were performed using as denominators the number of medullas examined microscopically [to reduce observation bias], the p values were 0.022 (low-dose) and 0.027 (high-dose). Granular-cell tumours of the brain occurred in 0/49 control, 3/50 low-dose, 1/50 mid-dose and 1/50 high-dose male rats; these incidences are not significant. The incidences of these tumours in historical controls were 0/297 in the study laboratory and 4/1928 in all National Toxicology Program laboratories. Glial-cell tumours of the brain (glioma, astrocytoma or oligodendroglioma) occurred in 0/49 control and 3/50 low-dose male rats and 0/50 control, 1/50 low-dose, 1/48 mid-dose and 3/50 high-dose female rats ($p = 0.045$, trend test); the incidences of these tumours in historical controls were: males—study laboratory, 3/297; all National Toxicology Program studies, 13/1928; females—study laboratory, 1/297; all National Toxicology Program laboratories, 23/1969). Gliosis was reported in one rat in each of the low- and high-dose male groups and control and high-dose female groups. The incidence of mammary gland neoplasms (all histological types)

was significantly decreased in high-dose female rats (control, 18/50; low-dose, 15/50; mid-dose, 10/48; high-dose, 7/50; $p = 0.011$, pairwise comparison; $p = 0.004$, trend test, incidental tumour test). Inflammation, epithelial hyperplasia and squamous metaplasia of the nasal cavity mucosa were increased in frequency in exposed rats (National Toxicology Program, 1989).

(*b*) *Subcutaneous administration*

Rat: Groups of 20 female CB hooded rats, six weeks old, were given a single subcutaneous injection of bromoethane [purity unspecified] in trioctanoin at 1.25, 4.2 or 12.5 mmol/kg bw (136, 460 or 1362 mg/kg bw). Twenty female rats given trioctanoin alone were used as controls. Survival at 96 weeks after injection was: low-dose, 18/20; mid-dose, 17/20; high-dose, 17/20 [survival of controls not given]. No sarcoma was seen at the injection sites in either treated or control rats (Dipple *et al.*, 1981). [The Working Group noted that only single injections were given and the small number of animals.]

(*c*) *Intraperitoneal administration*

Mouse: In a screening assay based on the enhanced induction of lung tumours, groups of 10 male and 10 female strain A/He mice, six to eight weeks old, were injected intraperitoneally three times per week with three dose levels of bromoethane [purity unspecified] in tricaprylin for a total of 24 injections (total doses, 11, 27.5 or 55 mmol/kg bw [1200, 3000 or 6000 mg/kg bw]). A group of 160 mice given tricaprylin only were used as controls. All surviving animals were killed 24 weeks after the first injection. Survival at that time was 154/160 in the tricaprylin vehicle control, 19/20 in the low-dose, 16/20 in the mid-dose and 20/20 in the high-dose groups. The proportions of mice with lung tumours were 34/154, 4/19, 4/16 and 6/20 in the four groups, respectively; the average numbers of lung tumours per mouse were 0.22 ± 0.07 (SE), 0.21 ± 0.05, 0.31 ± 0.08 and 0.35 ± 0.08. In positive control groups given a single intraperitoneal injection of 10 or 20 mg urethane, the numbers of mice with lung tumours were 19/19 and 18/18, respectively and the average numbers of lung tumours per animal were 8.1 ± 2.3 and 17.8 ± 4.32 (Poirier *et al.*, 1975).

3.2 Other relevant data

(*a*) *Experimental systems*

(i) *Absorption, distribution, metabolism and excretion*

Rats given 2.3-11 mmol/kg bw (250-1200 mg/kg bw) bromoethane in olive oil by gavage eliminated 66.7-74.5% of the dose in the expired air within 5-11 h. When rats

Table 3. Summary of carcinogenicity studies of bromoethane in experimental animals

Reference	Species/ strain	Sex	Dose schedule	Experimental parameter/ observation	Group 0	1	2	3	Significance	Comments
National Toxicology Program (1989)	Mouse $B6C3F_1$	M	6 h/day, 5 d/week, inhalation, 103 weeks	Dose (ppm)	0	100	200	400		
				Survival (105 weeks)	35/50	37/50	30/50	34/50		
				Alveolar/bronchiolar						
				Adenoma	5/50	6/50	8/50	9/50	$p = 0.049$	Increase
				Carcinoma	2/50	0/50	5/50	6/50		
		F		Dose (ppm)	0	100	200	400		
				Survival (105 weeks)	36/50	37/50	36/50	22/50		
				Uterine						
				Adenoma	0/50	1/50	1/47	6/48	$p = 0.017$ low-dose	Increases, also causing death at high dose
				Adenocarcinoma	0/50	2/50	3/47	19/48	$p = 0.035$ mid-dose	
				Squamous-cell carcinoma	0/50	1/50	1/47	3/48	$p < 0.001$ high-dose	
Poirier *et al.* (1975)	Mouse strain A/He	M F	3 d/week, i.p. inj., tricaprylin, 24 doses	Total dose (mmol/kg)	0	11	27.5	55		Sexes pooled for analysis; screening test in strain in which lung adenomas are common (±SE)
				Survival (24 weeks)	154/160	19/20	16/20	20/20		
				Lung adenomas	34/154	4/19	4/16	6/20		
				Lung adenomas per mouse	0.22 ±0.07	0.21 ±0.05	0.31 ±0.08	0.35 ±0.08		
National Toxicology Program (1989)	Rat F344	M	6 h/d, 5 d/week, inhalation, 104 weeks	Dose (ppm)	0	100	200	400		
				Survival (106 weeks)	17/50	26/50	26/50	21/50		
				Adrenal medullary phaeochromocytoma	8/48	23/47	18/50	21/49	$p = 0.013$ low-dose $p = 0.112$ mid-dose $p = 0.007$ high-dose	Increases
				Granular-cell tumour of the brain	0/49	3/50	1/50	1/50		
				Glial-cell tumour of the brain	0/49	3/50	0/50	0/50		
				Alveolar/bronchiolar neoplasm	0/48	0/49	4/48	1/48		

Table 3 (contd)

Reference	Species/ strain	Sex	Dose schedule	Experimental parameter observation	Group				Significance	Comments
					0	1	2	3		
National Toxicology Program (1989) (contd)		F		Dose (ppm)	0	100	200	400		
				Survival (106 weeks)	19/50	29/50	24/50	22/50		
				Glial-cell tumour of the brain	0/50	1/50	1/48	3/50	$p = 0.045$	Increases
				Alveolar/bronchiolar adenoma	0/50	0/48	0/47	3/49		
				Mammary neoplasms combined	18/50	15/50	10/48	7/50	$p = 0.011$	Decreases
Dipple *et al.* (1981)	Rat CB hooded	F	Single s.c. inj. in trioctanoin	Dose (mmol/kg)	0	1.25	4.2	12.5		
				Survival (90 weeks)	Not given	18/20	17/20	17/20		No injection-site sarcoma

were given 1.4 mmol/kg bw in five doses of 25 mg/kg at hourly intervals (total dose, 150 mg/kg) or single doses of 4.6 mmol/kg bw (500 mg/kg) or 7.3 mmol/kg bw (800 mg/kg) bromoethane by intraperitoneal injection in olive oil, 73-89% of the dose was eliminated in the expired air by 6 h (Miller & Haggard, 1943).

Williams (1959) reported that 73-89% of a dose of bromoethane injected into rats was eliminated unchanged in the expired air. When bromoethane was given orally in oil at 0.25-1.0 g/kg, 67-76% was eliminated unchanged in the expired air and 34-38% was converted to inorganic bromide.

Enzymatic dehalogenation of bromoethane in the presence of glutathione or cysteine was demonstrated in rat liver extracts (Heppel & Porterfield, 1948).

Bromoethane bound to rat liver cytochrome P450 and inhibited its activity by 27% in microsomes of phenobarbital-induced rats (Ivanetich *et al.*, 1978).

(ii) *Toxic effects*

The toxicology of bromoethane has been reviewed (Torkelson & Rowe, 1981; National Toxicology Program, 1989).

Intraperitoneal LD_{50}s of 2850 mg/kg bw for mice and 1750 mg/kg bw for rats were reported [vehicle unspecified] (Torkelson & Rowe, 1981). The 1-h LC_{50}s of bromoethane were estimated to be 27 000 ppm [120.42 g/m^3] in male Sprague-Dawley rats and 16 200 ppm (72.25 g/m^3) in male CF-1 mice (Vernot *et al.*, 1977). The 4-h LC_{50}s in female Fischer 344/N rats and female B6C3F$_1$ mice were 4681 and 2723 ppm (20.88 and 12.1 g/m^3), respectively. All male and female Fischer 344/N rats died during or after a 4-h exposure to 10 000 ppm (44.6 g/m^3), and exposure concentrations of 10 000 and 5000 ppm (22.3 g/m^3) were lethal to all male and female B6C3F$_1$ mice, respectively (National Toxicology Program, 1989). Guinea-pigs died after inhalation of 14% by volume bromoethane for 10 min and 2.4% for 90 min, whereas all survived inhalation of 1.2% for 90 min (Sayers *et al.*, 1929). Signs of toxicity were increased respiration rate, hyperactivity, loss of coordination, dyspnoea, loss of consciousness and lung and liver congestion.

All male and female Fischer 344/N rats and B6C3F$_1$ mice exposed by inhalation to 4000 ppm (17.8 g/m^3) and 2000 ppm (8.9 g/m^3) bromoethane for 6 h per day on five days per week for two weeks died. Signs of toxicity were prostration, dyspnoea, lachrymation, haemorrhage and congestion in the respiratory tract. Some of these symptoms were also observed after exposure to 1000 ppm (4.46 g/m^3). In 14-week studies, male and female Fischer 344/N rats and B6C3F$_1$ mice were exposed to 100-1600 ppm (0.45-7.14 g/m^3) bromoethane by inhalation for 6 h per day on five days per week. The high dose resulted in some deaths and reduced body weights of the surviving animals; signs of toxicity in both species included ataxia and atrophy of thigh muscles and uterus. In rats, tremors, paresis, mineralization and degeneration in the brain, atrophy of the testis, haemosiderosis of the spleen and

some depletion of bone-marrow haematopoietic cells were also observed. Involution of the ovary was observed in mice at the high and mid-doses (see below) (National Toxicology Program, 1989).

(iii) *Effects on reproduction and prenatal toxicity*

In the 14-week inhalation studies in $B6C3F_1$ mice and Fischer 344 rats described above, severe testicular atrophy was observed in all rats, but not in mice, at 1600 ppm (7.14 g/m^3) bromoethane but not at lower concentrations. Four of ten male rats in the 1600-ppm group died. In female mice, but not in rats, the size and number of corpora lutea in the ovary were decreased at 1600 ppm (7/10 animals) and at 800 ppm (3.57 g/m^3, 3/9 animals) (National Toxicology Program, 1989).

No data on reproductive or developmental toxicity were available to the Working Group.

(iv) *Genetic and related effects* (Table 4)

Bromoethane was mutagenic to *Salmonella typhimurium* strains TA100 and TA1535 when tested in closed containers. In single studies, mutations were not induced in *Drosophila melanogaster* and chromosomal aberrations were not induced in cultured mammalian cells. One study showed an increased incidence of sister chromatid exchange in cultured Chinese hamster ovary (CHO) cells. In a study reported as an abstract, bromoethane tested in a closed container enhanced viral transformation in cultured Syrian hamster embryo cells (Hatch *et al.*, 1983).

(*b*) *Humans*

No data were available to the Working Group.

3.3 Case reports and epidemiological studies of carcinogenicity to humans

No data were available to the Working Group.

4. Summary of Data Reported and Evaluation

4.1 Exposure data

Bromoethane has limited commercial use, including that as an ethylating agent. It has been detected in ocean air as a result of emissions by marine algae.

4.2 Experimental carcinogenicity data

Bromoethane was tested for carcinogenicity in a two-year study in male and female Fischer 344 rats and $B6C3F_1$ mice by inhalation. In male rats, there was a

Table 4. Genetic and related effects of bromoethane

Test system	Result		Dose LED/HID	Reference
	Without exogenous metabolic system	With exogenous metabolic system		
SA0, *Salmonella typhimurium* TA100, reverse mutation	+	0	0.0000	Simmon (1981)[a]
SA0, *Salmonella typhimurium* TA100, reverse mutation	+	+	580.0000	Barber *et al.* (1981)[a]
SA0, *Salmonella typhimurium* TA100, reverse mutation	+	0	3500.0000	Barber *et al.* (1983)[a]
SA0, *Salmonella typhimurium* TA100, reverse mutation	-	-	5000.0000	Haworth *et al.* (1983)
SA5, *Salmonella typhimurium* TA1535, reverse mutation	+	+	580.0000	Barber *et al.* (1981)[a]
SA5, *Salmonella typhimurium* TA1535, reverse mutation	+	0	3500.0000	Barber *et al.* (1983)[a]
SA5, *Salmonella typhimurium* TA1535, reverse mutation	-	-	5000.0000	Haworth *et al.* (1983)
SA7, *Salmonella typhimurium* TA1537, reverse mutation	-	-	5000.0000	Haworth *et al.* (1983)
SA9, *Salmonella typhimurium* TA98, reverse mutation	-	-	3700.0000	Barber *et al.* (1981)[a]
SA9, *Salmonella typhimurium* TA98, reverse mutation	-	-	5000.0000	Haworth *et al.* (1983)
DMX, *Drosophila melanogaster*, sex-linked recessive lethal mutation	-	0	900.0000	Vogel & Chandler (1974)
SIC, Sister chromatid exchange, Chinese hamster CHO cells	+	+	100.0000	Loveday *et al.* (1989)
CIC, Chromosomal aberrations, Chinese hamster CHO cells	-	-	1000.0000	Loveday *et al.* (1989)

[a]Closed container

significant increase in the incidence of adrenal phaeochromocytomas, which was not dose-related. A marginal increase in the incidence of uncommon brain tumours occurred in treated females. In mice, bromoethane induced neoplasms of the uterine endometrium; a marginal increase in the incidence of lung tumours was observed in males. In a screening study by intraperitoneal injection, bromoethane did not increase the incidence of lung tumours in strain A mice.

4.3 Human carcinogenicity data

No data were available to the Working Group.

4.4 Other relevant data

Bromoethane was mutagenic in bacteria but not in insects in a single study. In other single studies, bromoethane caused sister chromatid exchange but not chromosomal aberrations in mammalian cells.

4.5 Evaluation[1]

There is *limited evidence* for the carcinogenicity of bromoethane in experimental animals.

No data were available from studies in humans on the carcinogenicity of bromoethane.

Overall evaluation

Bromoethane *is not classifiable as to its carcinogenicity to humans (Group 3).*

5. References

American Conference of Governmental Industrial Hygienists (1989) *TLVs Threshold Limit Values and Biological Exposure Indices for 1989-1990*, Cincinnati, OH, p. 23

Barber, E.D., Donish, W.H. & Mueller, K.R. (1981) A procedure for the quantitative measurement of the mutagenicity of volatile liquids in the Ames *Salmonella*/microsome assay. *Mutat. Res.*, *90*, 31-48

Barber, E.D., Donish, W.H. & Mueller, K.R. (1983) The relationship between growth and reversion in the Ames *Salmonella* plate incorporation assay. *Mutat. Res.*, *113*, 89-101

[1]For definition of the italicized terms, see preamble, pp. 30-33.

Budavari, S., ed. (1989) *The Merck Index*, 11th ed., Rahway, NJ, Merck & Co., p. 596

Chemical Information Services (1988) *Directory of World Chemical Producers 989/90 Edition*, Oceanside, NY

Chemical Information Systems (1990) *ENVIROFATE Database*, Baltimore, MD

Class, T., Kohnle, R. & Ballschmiter, K. (1986) Chemistry of organic traces in air. VII: Bromo- and bromochloromethanes in air over the Atlantic Ocean. *Chemosphere, 15*, 429-436

Cook, W.A. (1987) *Occupational Exposure Limits—Worldwide*, Cincinnati, OH, American Industrial Hygiene Association, pp. 130, 139, 187

Dipple, A., Levy, L.S. & Lawley, P.D. (1981) Comparative carcinogenicity of alkylating agents: comparisons of a series of alkyl and aralkyl bromides of differing chemical reactivities as inducers of sarcoma at the site of a single injection in the rat. *Carcinogenesis, 2*, 103-107

Eller, P.M. (1985) *NIOSH Manual of Analytical Methods*, 3rd ed., Vol. 2 (DHHS (NIOSH) Publ. No. 84-100), Washington DC, US Government Printing Office, pp. 1011-1—1011-3

Great Lakes Chemical Corp. (1981) *Product Information: Ethyl Bromide (Bromoethane)*, West Lafayette, IN

Great Lakes Chemical Corp. (1989a) *Material Safety Data Sheet: Ethyl Bromide*, West Lafayette, IN

Great Lakes Chemical Corp. (1989b) *Product Information: Ethyl Bromide (Bromoethane)*, West Lafayette, IN

Hatch, G., Anderson, T., Elmore, E. & Nesnow, S. (1983) Status of enhancement of DNA viral transformation for determination of mutagenic and carcinogenic potential of gaseous and volatile compounds (Abstract No. Cd-26). *Environ. Mutagenesis, 5*, 442

Haworth, S., Lawlor, T., Mortelmans, K., Speck, W. & Zeiger, E. (1983) *Salmonella* mutagenicity test results for 250 chemicals. *Environ. Mutagenesis, Suppl. 1*, 3-142

Heppel, L.A. & Porterfield, V.T. (1948) Enzymatic dehalogenation of certain brominated and chlorinated compounds. *J. biol. Chem., 76*, 763-769

Hoyt, S.D. & Rasmussen, R.A. (1985) Determining trace gases in air and seawater. *Adv. chem. Ser. Mapping Strategies chem. Oceanogr., 209*, 31-56

Ivanetich, K.M., Lucas, S., Marsh, J.A., Ziman, M.R., Katz, I.D. & Bradshaw, J.J. (1978) Organic compounds: their interaction with and degradation of hepatic microsomal drug-metabolizing enzymes *in vitro*. *Drug Metab. Disposition, 6*, 218-225

Lodge, J.P., Jr, ed. (1989a) *Methods of Air Sampling and Analysis*, 3rd ed., Chelsea, MI, Lewis Publishers, pp. 171-187

Lodge, J.P., Jr, ed. (1989b) *Methods of Air Sampling and Analysis*, 3rd ed., Chelsea, MI, Lewis Publishers, Inc., pp. 78-83

Loveday, K.S., Lugo, M.H., Resnick, M.A., Anderson, B.E. & Zeiger, E. (1989) Chromosome aberration and sister chromatid exchange tests in Chinese hamster ovary cells *in vitro*: II. Results with 20 chemicals. *Environ. mol. Mutagenesis, 13*, 60-94

Miller, D.P. & Haggard, H.W. (1943) Intracellular penetration of bromide as a feature in the toxicity of alkyl bromides. *J. ind. Hyg. Toxicol., 25*, 423-433

Narodoslawsky, M. & Moser, F. (1988) New compression heat pump media as replacements for CFCs. *Int. J. Refrig., 11*, 264-268

National Toxicology Program (1989) *Toxicology and Carcinogenesis Studies of Bromoethane (Ethyl Bromide) (CAS No. 74-96-4) in F344/N Rats and B6C3F$_1$ Mice (Inhalation Studies)* (NTP Technical Report Series No. 363), Research Triangle Park, NC, US Department of Health and Human Services

Poirier, L.A., Stoner, G.D. & Shimkin, M.B. (1975) Bioassay of alkyl halides and nucleotide base analogs by pulmonary tumor response in strain A mice. *Cancer Res., 35*, 1411-1415

Pouchert, C.J., ed. (1974) *The Aldrich Library of NMR Spectra*, Vol. 1, Milwaukee, WI, Aldrich Chemical Co., p. 49A

Pouchert, C.J., ed. (1981) *The Aldrich Library of Infrared Spectra*, 3rd ed., Milwaukee, WI, Aldrich Chemical Co., p. 42B

Pouchert, C.J., ed. (1983) *The Aldrich Library of NMR Spectra*, 2nd ed., Vol. 1, Milwaukee, WI, Aldrich Chemical Co., p. 59A

Pouchert, C.J., ed. (1985) *The Aldrich Library of FT-IR Spectra*, Vol. 3, Milwaukee, WI, Aldrich Chemical Co., p. 82D

Sadtler Research Laboratories (1980) *The Sadtler Standard Spectra, 1980 Cumulative Index*, Philadelphia, PA

Sayers, R.R., Yant, W.P., Thomas, B.G.H. & Berger, L.B. (1929) *Physiological Response Attending Exposure to Vapors of Methyl Bromide, Methyl Chloride, Ethyl Bromide and Ethyl Chloride* (Public Health Bulletin No. 185), Washington DC, Treasury Department, US Public Health Service

Simmon, V.F. (1981) Applications of the *Salmonella* microsome assay. In: Stich, H.F. & San, R.H.C., eds, *Short Term Tests for Chemical Carcinogens*, New York, Springer, pp. 120-126

Sittig, M. (1985) *Handbook of Toxic and Hazardous Chemicals and Carcinogens*, 2nd ed., Park Ridge, NJ, Noyes Publications, pp. 414-415

SKC Inc. (1989) *Comprehensive Catalog and Guide. Air Sampling Products for Worker Monitoring, Chemical Hazard Detection and Industrial Hygiene*, Eighty Four, PA

Stenger, V.A. (1978) Bromine compounds. In: Mark, H.F., Othmer, D.F., Overberger, C.G., Seaborg, G.T. & Grayson, M., eds, *Kirk-Othmer Encyclopedia of Chemical Technology*, 3rd ed., Vol. 4, New York, John Wiley & Sons, pp. 243-263

STN International (1989) *Beilstein Database*, Columbus, OH

Strobel, K. & Grummt, T. (1987) Aliphatic and aromatic halocarbons as potential mutagens in drinking water. III. Halogenated ethanes and ethenes. *Toxicol. environ. Chem., 15*, 101-128

Suffet, I.H., Brenner, L. & Cairo, P.R. (1980) GC/MS identification of trace organics in Philadelphia drinking waters during a 2-year period. *Water Res., 14*, 853-867

Torkelson, T.R. & Rowe, V.K. (1981) Ethyl bromide. In: Clayton, G. & Clayton, F.E., eds, *Patty's Industrial Hygiene and Toxicology*, New York, John Wiley & Sons, pp. 3483-3486

United Nations Environment Programme (1990) *International Register of Potentially Toxic Chemicals, Recommendations—Legal Mechanisms*, Geneva

US Occupational Safety and Health Administration (1989) Air contaminants—permissible exposure limits (Report No. OSHA 3112). *US Code fed. Regul.*, Part 1910.1000

Vernot, E.H., MacEwen, J.D., Haun, C.C. & Kinkead, E.R. (1977) Acute toxicity and skin corrosion data for some organic and inorganic compounds and aqueous solutions. *Toxicol. appl. Pharmacol.*, *42*, 417-423

Vogel, E. & Chandler, J.L.R. (1974) Mutagenicity testing of cyclamate and some pesticides in *Drosophila melanogaster*. *Experientia*, *30*, 621-623

Weast, R.C., ed. (1989) *CRC Handbook of Chemistry and Physics*, 70th ed., Boca Raton, FL, CRC Press, pp. C-264, D-199

Wenhu, D., Kuangnan, C., Jianli, L. & Zhenying, D. (1987) Determination of trace volatile organic compounds in water samples by membrane introduction mass spectrometry. *Shitsuryo Bunseki*, *35*, 122-132

Williams, R.T. (1959) *Detoxication Mechanisms*, 2nd ed., New York, John Wiley & Sons, p. 28