

Existing Chemicals Information Sheet

ETHENE, CHLORO-

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Chemical Abstract Service (CAS) Number: 75-01-4

Common Name

Vinyl chloride

General

Vinyl chloride is a gas used predominantly for the manufacture of polyvinyl chloride (PVC) plastics.

Background

In 2002 the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) published a list of High Volume Industrial Chemicals (HVIC) that are manufactured in and/or imported into Australia in volumes of 1000 tonnes/year or greater based on information supplied by industry. To address the increasing public demand for concise and easily accessible information on chemicals, NICNAS has undertaken a program to provide information, in the most suitable format, on those chemicals on the HVIC list deemed appropriate (e.g. excluding mixtures) for which a full independent hazard assessment has not been conducted by NICNAS. Vinyl chloride is identified as one such chemical on the HVIC list.

A literature search by NICNAS indicated vinyl chloride had been reviewed in international review programs. Thus, an information sheet was considered the most suitable format to report data on the human health effects of vinyl chloride. The data presented here are from secondary sources and though creditable publications, original publications have not been obtained and it has therefore not been possible to determine the robustness of the reported studies.

Data Sources

Data were obtained from the following sources:

1. International Programme of Chemical Safety (IPCS) (1997) Poison Information Monograph 558
2. IPCS (1999) Environmental Health Criteria 215
3. IPCS (1999) Health and Safety Guide 109
4. IPCS (2000) International Chemical Safety Card
5. OECD (Organisation for Economic Cooperation and Development) (2001) SIDS Initial Assessment Report (SIAR)

Identity and Physico-Chemical Properties

Information on identity and use was obtained from the IPCS Environmental Health Criteria 215 (1999) and the IPCS Health and Safety Guide 109 (1999).

There are a large number of synonyms for ethene, chloro- (vinyl chloride) available in the literature. Those most frequently cited are provided in Table 1.

Table 1 Synonyms of Ethene, chloro-

	Ethene, chloro-
Synonyms	Vinyl chloride; Vinyl chloride monomer; Ethylene monochloride; Monochloroethene; Monochloroethylene; 1-Chloroethylene; Chloroethene; Chloroethylene
Structural Formula	$H_2C=CHCl$

Vinyl chloride is a colourless, flammable gas with a slightly sweet odour. It is heavier than air, has relatively low solubility and can form explosive mixtures. It has a melting point of -153.8 °C, boiling point of -13.4 °C, flash point (open cup) of -78 °C and explosion limits in air of 3.8 – 29.3 vol % (20 °C).

Import, Manufacture and Use

Vinyl chloride is listed on the NICNAS HVIC List, with industrial use in the range of 100,000 to 999,999 tonnes/year. Additionally, the HVIC List contains information on the use and broad industry categories for vinyl chloride. The industry categories identified as using vinyl chloride are the chemical industry – chemicals used in synthesis and the plastics industry. Vinyl chloride use could not be specified within the HVIC use categories.

The OECD SIAR and/or IPCS reviews report that vinyl chloride is stored and transported predominantly in the form of a neat liquid under pressure. It is an industrial intermediate chemical that is converted to polyvinyl chloride (PVC) polymer and associated copolymers. It is also used for production of chlorinated solvents, primarily 1,1,1-trichloroethane. PVC is used in most industrial sectors and accounts for around one fifth of plastic material usage worldwide. The main uses of PVC are in packaging, building materials, electrical insulation, medical products, automobile components and toys.

Vinyl chloride is not sold in consumer formulations or products. Exposure is possible only in occupational settings or via PVC products containing trace amounts of vinyl chloride monomer.

Current Regulatory Status in Australia

Ethene, chloro- (vinyl chloride) is listed in:

- the National Occupational Health and Safety Commission (NOHSC) (1995) *Exposure Standards for Atmospheric Contaminants in the Occupational Environment*, with an 8-hour time weighted average exposure standard of 5 ppm (13 mg/m³);
- the NOHSC (1999) *List of Designated Hazardous Substances* as Toxic and labelled with the risk phrase R45; 'May Cause Cancer' as a category 1 human carcinogen, as well as the risk phrase R12; 'Extremely Flammable';
- the National Drugs and Poisons Schedule Committee (May 2003) *Standard for the Uniform Scheduling of Drugs and Poisons* in Schedule 7 as a Dangerous Poison and is not to be available except to authorised or licensed persons;
- the FORS (1998) *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG Code) 6th edition, with the UN Number 1086. Entries in Appendix 2 note that for transport, vinyl chloride is a liquefied, flammable, harmful gas and the gas is much denser than air.

It is the responsibility of manufacturers and importers who supply vinyl chloride for use at work to determine whether it is a hazardous substance in accordance with the National Occupational Health and Safety Commission's *Approved Criteria for Classifying Hazardous Substances* (1999). If hazardous, the manufacturer or importer has a responsibility to classify and label the substance appropriately.

Data Sources for Human Health Effects

Information on vinyl chloride was sourced primarily from the IPCS Environmental Health Criteria 215 (1999), IPCS Health and Safety Guide 109 (1999) and OECD SIAR and SIAP (2001).

The IPCS, established in 1980, is a joint venture of the United Nations Environment Programme (UNEP), the International Labour Organisation (ILO) and the World Health Organization (WHO). The overall objectives of the IPCS are to establish the scientific basis for assessment of the risk to human health and the environment from exposure to chemicals, through international peer review processes, as a prerequisite for the promotion of chemical safety, and to provide technical assistance in strengthening national capacities for the sound management of chemicals.

The SIDS program is a voluntary cooperative international testing program that began in 1989, operating under the auspices of the chemicals program within the Environment Health and Safety Division of the OECD. The program focuses on developing base level test information on approximately 600 poorly characterised international High Production Volume (HPV) chemicals. Data are used to "screen" the chemicals and set priorities for further testing or risk assessment/management activities. The OECD list of HPV chemicals serves as the overall priority list from which chemicals are selected for the SIDS program. These HPV chemicals include all chemicals reported to be produced or imported at levels greater than 1 000 tonnes per year in at least one Member country or in the European Union region, and are compiled by the OECD Secretariat on the basis of regular submissions by Member states.

Health and Safety Information

Vinyl chloride is readily absorbed following oral or inhalation exposure

Animal Data

Acute Toxicity

Vinyl chloride appears to be of low acute toxicity in various species when administered orally or by inhalation. The rat oral LD50 is reported to be > 4000 mg/kg body weight, and 2-hour inhalation LC50 values for mouse, rat and guinea-pig are reported to be 294, 390, and 595 mg/m³, respectively. No studies are available for assessing effects of dermal exposure.

Irritation

No studies conducted to OECD test guidelines are available for assessing the skin and eye irritation potential of vinyl chloride.

Skin Sensitisation

No studies are available for skin sensitisation.

Effects from Repeated Exposure

In repeat oral studies, liver toxicity is observed with lifetime exposure to doses ≥ 1.3 mg/kg body weight/day in rats. The no observed adverse effect level (NOAEL) for oral exposure is 0.13 mg/kg body weight/day. The NOAEL for inhalation exposure in rats, rabbits, guinea pigs or dogs is 50 ppm (128 mg/m³) for 6 months.

Genotoxicity

In vitro, vinyl chloride and/or its metabolites produce DNA damage and are positive in gene mutation and chromosome aberration assays. In vivo, vinyl chloride is positive in cytogenetic assays in somatic cells and negative in germ cell assays.

Carcinogenicity

The chemical produces liver cancer (angiosarcoma) in animals.

Reproductive toxicity

A combined reproductive-developmental study in rats shows foetal toxicity only at levels that produce maternal toxicity. The NOAEL for reproductive or developmental toxicity is ≥ 1100 ppm (2816 mg/m³) in rats.

Human Data

The primary route of exposure for humans is by inhalation.

Acute Toxicity

Anaesthetic effects are reported at levels of 12 000 ppm (30 720 mg/m³) for 5-minute exposure period.

Effects from Repeated Exposure

In humans, past occupational exposure to several hundred ppm of vinyl chloride for periods from one month to several years is associated with development of "vinyl chloride disease",

characterised by earache and headache, dizziness, unclear vision, fatigue and lack of appetite, nausea, sleeplessness, breathlessness, stomach ache, pain in the liver/spleen area, pain and tingling sensation in the arms/legs, cold sensation at the extremities, loss of libido and weight loss. Clinical symptoms also include peripheral bone lesions, peripheral circulatory changes and enlargement of the liver and spleen.

Genotoxicity

Chromosomal aberrations have been observed in peripheral lymphocytes of exposed workers in some studies.

Carcinogenicity

Liver cancer (angiosarcoma) is reported repeatedly in occupational studies of vinyl chloride exposure.

Reproductive Toxicity

Epidemiological studies have not linked chemical exposure to reproductive or developmental toxicity effects

Outcome of the IPCS (1999) and OECD Initial Assessment (2001)

The OECD SIAP report (2001) concluded that, *“The chemical is currently of low priority for further work in the SIDS Program as human exposures are controlled due to the chemical’s genotoxicity and cancer hazard and based upon OECD risk reduction measures”*.

Overall, the harmful acute and long-term effects of ethene, chloro- (vinyl chloride) exposure are well established. Acute exposure to high levels produces anaesthetic effects. Long-term exposure is associated with a characteristic set of symptoms, known as “vinyl chloride disease”. The chemical is toxic to the liver and is a known human carcinogen. Consequently, use and exposure is tightly controlled in Australia. The chemical is classified as Toxic (category 1 carcinogen), has an exposure standard for the occupational environment and is included in the Schedule of Drugs and Poisons and the Australian Dangerous Goods Code.

References

1. FORS (Federal Office of Road Safety) (1998) Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code), 6th ed. Canberra, Australian Government Publishing Service
2. IPCS (1997) Poison Information Monograph 558, Geneva, International Programme on Chemical Safety, World Health Organisation <<http://www.inchem.org/documents/pims/chemical/pim558.htm>>
3. IPCS (1999) Environmental Health Criteria 215, Geneva, International Programme on Chemical Safety, World Health Organisation <<http://www.inchem.org/documents/ehc/ehc/ehc215.htm>>
4. IPCS (1999) Health and Safety Guide 109, Geneva, International Programme on Chemical Safety, World Health Organisation <<http://www.inchem.org/documents/hsg/hsg/hsg109.htm>>
5. IPCS (2000) Chloroethene: International Chemical Safety Card 0082, Geneva, International Programme on Chemical Safety, World Health Organisation <<http://www.inchem.org/documents/icsc/icsc/eics0082.htm>>.
6. National Drugs and Poisons Schedule Committee (2003) Standard for the Uniform Scheduling of Drugs and Poisons Canberra, ACT, Australian Government Publishing Service
7. NOHSC (1995) Exposure Standards for Atmospheric Contaminants in the Occupational Environment. Canberra, ACT, Australian Government Publishing Service
8. NOHSC (1999) List of Designated Hazardous Substances. Sydney, NSW, National Occupational Health and Safety Commission.
9. OECD (2001) OECD SIDS Initial Assessment Report (SIAR), Vinyl Chloride, Paris, OECD <<http://cs3-hq.oecd.org/scripts/hpv/>>