Ethane, 1,2-dichloro-: Environment tier II assessment

27 November 2014

CAS Registry Number: 107-06-2.

- Preface
- Disclaimer
- Chemical Identity
- Physical and Chemical Properties
- Import, Manufacture and Use
- Environmental Regulatory Status
- Environmental Exposure
- Environmental Effects
- Categorisation of Environmental Hazard
- Risk Characterisation
- Key Findings
- Recommendations
- Environmental Hazard Classification
- References

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

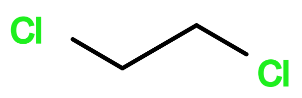
This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit: www.nicnas.gov.au.

Disclaimer

Acronyms & Abbreviations

Chemical Identity

Synonyms	Ethylene dichloride (EDC) 1,2-Dichloroethane
Structural Formula	
Molecular Formula	$C_2H_4Cl_2$
Molecular Weight (g/mol)	98.96

SMILES	C(Cl)CCl

Physical and Chemical Properties

The physical and chemical property data for ethane, 1,2-dichloro- (or ethylene dichloride) were retrieved from the databases included in the OECD QSAR Toolbox (LMC, 2013).

Physical Form	Liquid
Melting Point	-35.5°C (exp.)
Boiling Point	83.5°C (exp.)
Vapour Pressure	10 500 Pa (exp.)
Water Solubility	8600 mg/L (exp.)
Ionisable in the Environment?	No
log K_{ow}	1.48 (exp.)

Import, Manufacture and Use

Australia

No specific Australian use, import, or manufacturing information relevant to industrial uses has been identified.

The chemical is approved for use in registered pesticide products in Australia under section 14A of the *Agricultural and Veterinary Chemicals Code Act 1994* (APVMA, 2012). However, pesticide use of the chemical is beyond the scope of this assessment as this is not considered an industrial use under the *Industrial Chemicals (Notification and Assessment) Act 1989*.

International

Historically, ethylene dichloride was used as a fumigant for the treatment of pests in agriculture and in domestic situations. It has also had a range of industrial uses including as a solvent and as an additive for leaded fuel (US NLM, 2013). Currently, the primary use of the chemical is as a feedstock for the production of vinyl chloride, which is used in the production of polyvinyl chloride (PVC) plastics. This use accounts for approximately 95% of the total global production volume of ethylene dichloride. The remaining volume is used as a feedstock in the production of other chemicals, as an extraction and cleaning solvent, and as an additive in leaded fuels (OECD, 2002; WHO, 1995).

The chemical is produced in large volumes internationally, with more than 12 million tonnes produced in the United States of America in 2012 (US EPA, 2013). The chemical is registered under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) legislation in the European Union for use at volumes between 1 and 10 million tonnes per annum. Registered uses include use as a chemical intermediate, as a solvent and processing aid in closed systems, and as a fuel additive (ECHA, 2014). Approximately 500 000 tonnes of the chemical was manufactured in, or imported into, Japan in the 2011–12 financial year. Data from earlier reporting periods demonstrate an increase in annual introduction volumes over time (NITE, 2014).

Conversely, manufacture of the chemical in Canada ceased in 2006. In 2009, approximately 100 tonnes of the chemical was imported. The primary use of the chemical in Canada is for the production of vinyl chloride (Health Canada, 2012).

Environmental Regulatory Status

Australia

Ethylene dichloride is subject to reporting under the Australian National Pollutant Inventory (NPI), where it is listed as 1,2-dichloroethane. Under the NPI, emissions of ethylene dichloride are required to be reported annually by facilities that use or emit more than 10 tonnes during a reporting year (Australian Government Department of the Environment, 2013b). Emissions may be intentional, accidental or incidental releases arising through industrial processes. Additionally, emissions of the chemical from diffuse sources, such as lawn mowers and wood heaters, are also periodically estimated by state environment authorities. Diffuse emissions data are updated much less frequently than facility data (Australian Government Department of the Environment, 2013a).

United Nations

Ethylene dichloride is listed on Annex III of the *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade* (the Rotterdam Convention). The Rotterdam Convention aims to facilitate sharing of chemical information to promote shared responsibility for the international trade of certain hazardous chemicals. However, the listing of ethylene dichloride refers to pesticide use only and is not applicable to the trade of the chemical for industrial uses (UNFCCC, 1998).

OECD

The chemical was sponsored by Germany under the Cooperative Chemicals Assessment Programme (CoCAP). The 15th Screening Information Data Set (SIDS) Initial Meeting Assessment (SIAM) in 2002 agreed that the chemical was a low priority for further work (OECD, 2002).

Canada

Ethylene dichloride was included on the First Priority Substances List under the *Canadian Environmental Protection Act* in 1989, and a Priority Substances List Assessment Report for the chemical was published in 1994. The assessment concluded that the chemical was not entering the environment in a quantity or concentration that constituted a danger to the environment, but found the chemical to be toxic based on human health concerns (Government of Canada, 1994; Health Canada, 2008).

Based on this assessment, the chemical was identified as a Track 2 chemical under the Toxic Substances Management Policy. Subsequently, Environment Canada worked with the domestic manufacturer of vinyl chloride to implement life-cycle management measures in order to minimise releases of the ethylene dichloride feedstock to the environment (Environment Canada, 2013a).

The chemical was categorised as Persistent (P), not Bioaccumulative (not B) and not Inherently Toxic to the Environment (not iT_E) by Environment Canada during the Categorization of the Domestic Substances List (DSL) (Environment Canada, 2013b).

European Union

The chemical has been identified as a Substance of Very High Concern and recommended for inclusion in Annex XIV (the Authorisation List) of the REACH legislation in the European Union on the basis of its carcinogenicity (ECHA, 2011; 2012). The chemical is not currently identified as being of environmental concern.

United States of America

Use of ethylene dichloride in the United States of America (USA) in most mining, utilities and manufacturing facilities, as well as select others, is subject to reporting under the Toxics Release Inventory (TRI). Facilities must report emissions of ethylene dichloride to the United States Environmental Protection Agency (US EPA) if the facility manufactures or processes more than 25 000 pounds of the chemical (approximately 11 tonnes), or otherwise uses more than 10 000 pounds (approximately 4.5 tonnes) of the chemical in a reporting year (US EPA, 2012; 2014a; 2014b).

Environmental Exposure

Ethylene dichloride is primarily used internationally as a feedstock for the manufacture of vinyl chloride. This is not representative of the use of this chemical in Australia because vinyl chloride is not manufactured domestically. This monomer feedstock is instead imported in bulk by the sole Australian manufacturer of PVC resin (NICNAS, 2014a). Based on available international data, remaining uses of ethylene dichloride in Australia are assumed to include use as a solvent and processing aid, and in specialist leaded racing fuels (Australian Government Department of the Environment, 2014c; Falta, 2004).

The NPI reports that 130 kg of ethylene dichloride was emitted to air due to basic chemical manufacturing processes at a single facility in Sydney in 2012–13 (Australian Government Department of the Environment, 2014b). These emissions constitute the majority of industrial releases reported on the NPI for the most recent reporting year. Minor emissions (< 1 kg) were made to air by the polymer product manufacturing sector, with no emissions reported by petroleum refinery or fuel and organic liquid storage facilities (Australian Government Department of the Environment, 2014a).

The available domestic emission data indicate that environmental exposure of ethylene dichloride will predominantly be from use in chemical and polymer manufacture. Based on international use data, this is assumed to be from use as a solvent and processing aid. Modern facilities using ethylene dichloride as a solvent or processing aid are expected to operate closed systems, where emissions are typically strictly controlled to minimise risks to workers from occupational exposure. Small emissions of the chemical which do occur are expected to be made primarily to air.

Environmental Fate

Partitioning

Ethylene dichloride is expected to partition to the atmosphere when released from industrial uses.

Ethylene dichloride is a neutral organic chemical which is readily soluble in water and highly volatile. The measured Henry's Law constant for the partitioning of ethylene dichloride from water to air is 120 Pa-m^3/mol at 25°C (LMC, 2013), indicating that the chemical is highly volatile from water and moist soil. The measured organic carbon normalised adsorption coefficient (K_{OC}) value for the chemical is 33 L/kg (LMC, 2013), which indicates that it is very highly mobile in soil. However, evaporative losses are expected to dominate the partitioning behaviour of the chemical when it is released onto soil.

Calculations with a standard multimedia partitioning (fugacity) model assuming equal and continuous distributions to air, water and soil compartments (Level III approach) predict that the chemical will partition approximately equally between the air compartment (31%), the water compartment (38%) and the soil compartment (31%). However, with sole release to the atmosphere, the model predicts that 97% of the chemical will remain in the air compartment (US EPA, 2008). The latter scenario is expected to be the more likely route of release of the chemical to the environment from current industrial uses.

Degradation

Ethylene dichloride is slow to degrade in the environment.

The processes responsible for the degradation of ethylene dichloride in the atmosphere depend strongly on the geographical location of the emission and the season. Emissions in the tropics are more likely to result in the chemical passing through the troposphere to reach the stratosphere, where photolysis may occur (WMO, 2014). As emission locations move away from the tropics, oxidation by hydroxyl radicals is considered to be the major degradation process. The most recent estimate of the lifetime for the chemical in the troposphere based on removal by indirect photo-oxidation is 65 days (WMO, 2011).

Ethylene dichloride is slow to undergo degradation in water. If present in surface waters, the chemical is more likely to volatilise. The chemical is not expected to be readily biodegradable under aerobic or anaerobic conditions, with one study finding no degradation over four months using an acclimated anaerobic system (Howard, 1990; WHO, 1995). The estimated half-life for hydrolysis of this chemical at neutral pH and 25°C is 72 years (WHO, 1995).

The biodegradation of ethylene dichloride in groundwater has been more thoroughly investigated. Under anaerobic conditions, the chemical can be mineralised to water and carbon dioxide through oxidation reactions catalysed by microorganisms. However, the mean measured half-life for the biodegradation of the chemical in groundwater under anaerobic conditions is in the range of 63 to 165 days (Lawrence, 2006). Under simulated groundwater conditions, the estimated half-life for hydrolysis is 23 years (WHO, 1995).

Bioaccumulation

Ethylene dichloride is not expected to bioaccumulate in aquatic biota.

A measured bioconcentration factor (BCF) value of 2 L/kg is available for the fish *Lepomis macrochirus* (LMC, 2013). The low measured bioconcentration factor in fish together with the low octanol/water partition coefficient and high volatility of the chemical from water indicate that ethylene dichloride does not pose a bioaccumulation hazard to aquatic organisms.

Transport

Ethylene dichloride undergoes long-range transport through the atmosphere.

Ethylene dichloride is a highly volatile chemical with a comparatively long lifetime in the atmosphere. There are no natural sources of the chemical (Health Canada, 2012; WHO, 1995). However, the chemical has been detected in multiple air-monitoring studies, including at mid-ocean sampling sites far from the sources of industrial emissions (Howard, 1990 ; WHO, 1995). The chemical has also been detected and quantified at all levels through the troposphere from the marine boundary layer to the upper troposphere (WMO, 2011). These data confirm that the chemical can undergo long-range transport in the environment.

Predicted Environmental Concentration (PEC)

A PEC was not calculated for this chemical, as a significant body of high quality environmental monitoring data for ethylene dichloride are available from multiple sites around the world.

Environmental air monitoring studies conducted by the Japanese Ministry of the Environment in 2001 detected the chemical in 97 of 98 air samples taken, with concentrations ranging from 2.3 to 620 nanograms per cubic metre (ng/m^3) (NITE, 2014). The chemical was also detected in air sampling conducted in Ottawa, Canada in 2002–3 at concentrations up to 710 ng/m^3 (Zhu, et al., 2005). However, it should be noted that these data do not discriminate between chemical released due to industrial use and chemical released from other sources. Air monitoring studies conducted in the USA have failed to detect the chemical at concentrations above the limit of detection for the method used (BAAQMD, 2012).

Although significant quantities of ethylene dichloride are not expected to be released to, or partition to, the water compartment as a result of current industrial use, the chemical may be present in groundwater due to historical use. Groundwater contamination with ethylene dichloride has occurred in many locations globally, including at Botany Industrial Park in Sydney where the chemical was produced until 1998 (Orica, 2004; 2013). Due to the persistence of the chemical in groundwater, its high mobility in soil, and carcinogenicity in humans, groundwater contamination is of particular concern. However, as health concerns for this chemical are now widely recognised, modern industrial facilities employ appropriate storage and disposal practices to minimise leaks and emissions (eg. Standards Australia, 2004).

Environmental Effects

Effects on the Atmosphere

The potential for ethylene dichloride to significantly contribute to ozone depletion or global warming is expected to be low.

Volatile halogenated organic chemicals with long atmospheric lifetimes can contribute to the depletion of the ozone layer due to the release of reactive halogen species in the stratosphere. Generally, the potential for ethylene dichloride to reach the stratosphere is expected to be limited, based on the lifetime of the chemical in the troposphere. However, if the chemical is released in the tropics, convective transport may deliver the chemical more directly into the lower stratosphere. There is growing evidence to suggest that the so-called very short-lived substances (VSLS) may contribute to halogen loads in the stratosphere in this way (WMO, 2011; 2014). It is noted that the atmospheric lifetime of ethylene dichloride is considered short only by comparison with the very long lifetimes associated with ozone depleting chemicals which have now been phased out of used due to their adverse effects on the ozone layer.

The impact of ozone depleting chemicals on the stratospheric ozone layer is typically reported in terms of the ozone depletion potential (ODP) metric. However, this concept is traditionally considered inappropriate for short-lived gases (WMO, 2011; 2014) and an ODP for ethylene dichloride is not available. Therefore, the impact of the chemical on stratospheric ozone cannot be quantitatively determined in this assessment. However, based on the available data, the World Meteorological Organization currently concludes that changes in VSLS emissions will likely cause only small changes in stratospheric ozone in the near future (WMO, 2014).

Halocarbons with long atmospheric lifetimes can also contribute to global warming by absorbing radiation emitted from Earth and thus trapping the energy in the atmosphere (radiative forcing). The amount of global warming that can be caused by a substance is typically reported in terms of the global warming potential (GWP) metric. However, this concept is also traditionally considered inappropriate for short-lived gases (WMO, 2011), and a GWP for ethylene dichloride is not available. Therefore, the amount of global warming caused by the chemical cannot be quantitatively determined in this assessment. However, the global warming potential of the chemical is not expected to be significant based on the current scientific understanding of this process.

Effects on Aquatic Life

Ethylene dichloride has low to moderate acute toxicity in fish and aquatic invertebrates, with higher chronic toxicity in aquatic invertebrates. The chemical has low toxicity to algae.

Acute toxicity

The following median lethal concentration (LC50) and median effective concentration (EC50) values for model organisms across three trophic levels were referenced in the OECD SIDS Initial Assessment Report (SIAR) for 1,2-dichloroethane and the databases included in the OECD QSAR Toolbox (LMC, 2013; OECD, 2002):

Taxon	Endpoint	Method
Fish	96 h LC50 = 66 mg/L	Experimental *Micropterus salmoides* (Largemouth bass) Static
Invertebrates	48 h EC50 = 99 mg/L	Experimental *Daphnia magna* (Water flea) OECD TG 202 Immobilisation observed
Algae	72 h EC50 = 130 mg/L	Experimental *Pseudokirchneriella subcapitata* (Green algae) OECD TG 201 Reduction in growth observed

Chronic toxicity

The following no-observed-effect concentration (NOEC) values for model organisms across three trophic levels were referenced in the databases included in the OECD QSAR Toolbox (LMC, 2013):

Taxon	Endpoint	Method
Fish	32 d NOEC = 29 mg/L	Experimental *Pimephales promelas* (Fathead minnow) Flow-through Reduction in growth observed
Invertebrates	21 d NOEC = 1 mg/L	Experimental *Daphnia magna* (Water flea) OECD TG 211 Reproductive toxicity observed

Taxon	Endpoint	Method
Algae	72 h NOEC = 55 mg/L	Experimental *Pseudokirchneriella subcapitata* (Green algae) OECD TG 201 Reduction in growth observed

Effects on Terrestrial Life

Ethylene dichloride causes acute toxic effects after both ingestion and inhalation in terrestrial organisms across multiple trophic levels. The chemical also exhibits chronic inhalation toxicity in rodents.

Acute toxicity

The following oral exposure and inhalation median lethal dose (LD50) values and LC50 value for terrestrial model organisms were referenced in the OECD SIAR for 1,2-dichloroethane and the databases included in the OECD QSAR Toolbox (LMC, 2013; NICNAS, 2014b; OECD, 2002). Inhalation studies were performed using ethylene dichloride vapour:

Taxon	Endpoint	Method
Rodents	LD50 = 413 mg/kg bw	Experimental Mouse (CD-1 strain), females Single oral dose
	LC50 = 1.08×10^6 µg/m^3 (1.08 mg/L)	Experimental Mouse (OF1 strain), females Inhalation, exposed for 6 h
Insects	LD50 = 4.17×10^7 µg/m^3 (41.7 mg/L)	Experimental *Tribolium castaneum* (Red flour beetle), adults Inhalation, single exposure, reported as LD50

Chronic toxicity

The following inhalation no-observed-effect-level (NOEL) value for a terrestrial model organism was referenced in the OECD SIAR for 1,2-dichloroethane (NICNAS, 2014b; OECD, 2002). The study was performed using ethylene dichloride vapour:

Taxon	Endpoint	Method
Rodents	NOEL = 2.00×10^5 μg/m^3 (0.20 mg/L)	Experimental Rat (Sprague Dawley strain) Inhalation, multiple exposures across 540 d Multiple effects observed

Absorption of ethylene dichloride after inhalation is rapid and complete, with the chemical widely distributed in the body. Metabolism of the chemical generates products which damage DNA, resulting in chronic toxicity (WHO, 1995).

Predicted No-Effect Concentration (PNEC)

A PNEC was not calculated for the chemical.

Ethylene dichloride is expected to be primarily released to, or partition to, the air compartment as a result of current industrial uses in Australia. A PNEC for the air compartment has not been calculated because there is currently no recognised method for establishing a quantitative toxicity threshold for inhalation exposure in non-human terrestrial organisms (ECB, 2003).

The PNEC for the chemical in the water, soil and sediment compartments was not calculated as ethylene dichloride is not expected to be released to, or significantly partition to, these compartments as a result of current industrial uses. Although the chemical is listed in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, a high reliability trigger value for aquatic ecosystem protection is not available (ANZECC, 2000).

Categorisation of Environmental Hazard

The categorisation of the environmental hazards of ethane, 1,2-dichloro- according to domestic environmental hazard thresholds is presented below (EPHC, 2009; NICNAS, 2013):

Persistence

Persistent (P). Based on the atmospheric lifetime of 65 days, the chemical is categorised as Persistent.

Bioaccumulation

Not Bioaccumulative (Not B). Based on the available measured BCF value for fish, the chemical is categorised as Not Bioaccumulative.

Toxicity

Not Toxic (Not T). Based on the available aquatic ecotoxicity values, the chemical is categorised as Not Toxic.

Summary

Ethane, 1,2-dichloro- is categorised as:

- P
- Not B
- Not T

Risk Characterisation

Risk quotients (RQs) have not been calculated for this chemical.

The chemical has the potential to cause toxic effects in terrestrial organisms by inhalation, and also has some potential to be released to air from industrial uses in Australia. However, based on available international environmental monitoring data, the chemical is not expected to be present in air in Australia above an assumed worst-case concentration of 800 ng/m^3. This air concentration is several orders of magnitude below the concentrations of ethylene dichloride in air observed to result in chronic toxicity to terrestrial animals exposed by inhalation. Based on this analysis, emissions of ethylene dichloride from current industrial uses in Australia are not expected to pose a significant risk to the environment.

Based on the currently available scientific data regarding the ozone depleting and global warming potential of comparatively short-lived halogenated gases in the atmosphere, ethylene dichloride is not expected to pose an unreasonable risk to the air compartment.

The risks to the water, soil and sediment compartments from current industrial uses are expected to be low as the chemical is not expected to be released to, or significantly partition to, these compartments.

Based on the available data, current industrial use of the chemical is not expected to pose an unreasonable risk to the environment.

Key Findings

Australian use information for this chemical is limited. Based on the available exposure data, the majority of industrial environmental emissions in Australia are expected to result from use as an industrial solvent in closed-system manufacturing plants or small scale uses in specialty fuels. Any emissions resulting from these uses are expected to partition to the air compartment. Based on concentrations of the chemical in air determined internationally, industrial use of the chemical is not expected to pose an unreasonable risk to the environment.

The chemical is not a PBT substance according to domestic environmental hazard criteria.

Recommendations

Based on the available data, industrial use of ethylene dichloride in applications which result in minimal environmental emissions (for example, use as a solvent in closed-system manufacturing plants) is not expected to pose a concern to the environment. No further assessment is required.

Environmental Hazard Classification

In addition to the categorisation of environmental hazards according to domestic environmental thresholds presented above, the classification of the environmental hazards of ethane, 1,2-dichloro- according to the third edition of the United Nations' Globally Harmonised System of Classification and Labelling of Chemicals (GHS) is presented below (UNECE, 2009):

Hazard	GHS Classification (Code)	Hazard Statement
Acute Aquatic	Category 3 (H402)	Harmful to aquatic life
Chronic Aquatic	Category 2 (H411)	Toxic to aquatic life with long lasting effects

The chemical has been categorised as Aquatic Chronic Category 2 based on the measured chronic toxicity to aquatic invertebrates (21 d NOEC = 1 mg/L) taking into account the lack of rapid degradability and potential persistence of ethylene dichloride in surface water.

References

ANZECC (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council, Sydney, Australia. http://www.environment.gov.au/.

APVMA (2012). *Active Constituents Not Requiring Evaluation*. Australian Pesticides and Veterinary Medicines Authority, Canberra, Australia. Accessed 24 November 2014 at http://apvma.gov.au/.

Australian Government Department of the Environment (2013a). *Understanding NPI data*. Australian Government Department of the Environment, Canberra, Australia. Accessed 11 March 2014 at http://www.npi.gov.au/.

Australian Government Department of the Environment (2013b). *NPI substance list and thresholds*. Australian Government Department of the Environment, Canberra, Australia. Accessed 11 March 2014 at http://www.npi.gov.au/.

Australian Government Department of the Environment (2014a). *2012/2013 data within Australia - 1,2-Dichloroethane from All Sources*. Australian Government Department of the Environment, Canberra, Australia. Accessed 23 September 2014 at http://www.npi.gov.au/.

Australian Government Department of the Environment (2014b). *2012/2013 data within Australia - 1,2-Dichloroethane from Basic Chemical Manufacturing [181]*. Australian Government Department of the Environment, Canberra, Australia. Accessed 23 September 2014 at http://www.npi.gov.au/.

Australian Government Department of the Environment (2014c). *Specialist racing fuels*. Australian Government Department of the Environment, Canberra, Australia. Accessed 24 November 2014 at http://www.environment.gov.au/.

BAAQMD (2012). *Summary and Analysis of Cupertino Air Monitoring Results*. Bay Area Air Quality Management District, San Francisco, USA. Accessed 18 September 2014 at http://www.baaqmd.gov/.

ECB (2003). *Technical Guidance Document on Risk Assessment, Part II*. European Chemical Bureau, Ispra, Italy.

ECHA (2011). *Agreement of the Member State Committee on the Identification of 1,2-Dichloroethane as a Substance of Very High Concern*. European Chemicals Agency, Helsinki, Finland. http://echa.europa.eu/.

ECHA (2012). *Background document for 1,2-dichloroethane*. European Chemicals Agency, Helsinki, Finland. http://echa.europa.eu/.

ECHA (2014). *1,2-dichloroethane*. European Chemicals Agency, Helsinki, Finland. Accessed 30 April 2014 at http://apps.echa.europa.eu/.

Environment Canada (2013a). *Completed Agreements: Dow Chemical Canada Inc*. Environment Canada, Gatineau, Canada. Accessed 30 April 2014 at http://www.ec.gc.ca/.

Environment Canada (2013b). *Search Engine for the Results of DSL Categorisation*. Environment Canada, Gatineau, Canada. Accessed 21 November 2013 http://www.ec.gc.ca/.

EPHC (2009). *Environmental Risk Assessment Guidance Manual for Industrial Chemicals*. Environment Protection and Heritage Council, Canberra, Australia. Accessed 9 December 2013 at http://www.scew.gov.au/.

Falta RW (2004). Ethylene Dibromide and 1,2-Dichloroethane Contamination from Leaded Gasoline Releases. *US EPA Region 3 Leaking Underground Storage Tank (LUST) Conference*, Rocky Gap, USA. Accessed 17 September 2014 at http://info.ngwa.org/.

Government of Canada (1994). *Priority Substances List Assessment Report: 1,2-Dichloroethane*. Government of Canada, Ottawa, Canada. http://www.hc-sc.gc.ca/.

Health Canada (2008). *First Priority Substances List (PSL1) Assessments*. Health Canada,, Ottawa, Canada. Accessed 30 April 2014 at http://www.hc-sc.gc.ca/.

Health Canada (2012). *1,2-Dichloroethane in Drinking Water*. Health Canada, Ottawa, Canada. Accessed 24 November 2014 at http://www.hc-sc.gc.ca/.

Howard PH (1990). *Handbook of Environmental Fate and Exposure Data for Organic Chemicals*. Lewis Publishers, Michigan, USA.

Lawrence SJ (2006). *Description, Properties, and Degradation of Selected Volatile Organic Compounds Detected in Ground Water - A Review of Selected Literature*. United States Geological Survey, Altana, USA. http://pubs.usgs.gov/.

LMC (2013). *The OECD QSAR Toolbox for Grouping Chemicals into Categories*, v 3.1. Laboratory of Mathematical Chemistry, University "Prof. Dr. Assen Zlatarov", Burgas, Bulgaria. Available at http://oasis-lmc.org/.

NICNAS (2013). *Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework*. National Industrial Chemicals Notification and Assessment Scheme, Australian Government Department of Health, Sydney, Australia. Accessed 12 November 2013 http://www.nicnas.gov.au/.

NICNAS (2014a). *Inventory Multi-tiered Assessment and Prioritisation (IMAP) Environment Tier II Assessment for Ethene, chloro-*. National Industrial Chemicals Notification and Assessment Scheme, Australian Government Department of Health, Sydney, Australia. Accessed 23 September 2014 at http://www.nicnas.gov.au/.

NICNAS (2014b). *Inventory Multi-tiered Assessment and Prioritisation (IMAP) Human Health Tier II Assessment for Ethane, 1,2-Dichloro*. National Industrial Chemicals Notification and Assessment Scheme, Australian Government Department of Health, Sydney, Australia. Accessed 26 November 2014 at http://www.nicnas.gov.au/.

NITE (2014). *Chemical Risk Information Platform (CHRIP): 1,2-Dichloroethane*. National Institute of Technology and Evaluation, Tokyo, Japan. Accessed 30 April 2014 at http://www.safe.nite.go.jp/.

OECD (2002). *SIDS Initial Assessment Report for 14th SIAM*. Organisation for Economic Cooperation and Development, Paris, France. http://webnet.oecd.org/.

Orica (2004). *Botany Groundwater Cleanup Project: Ethylene Dichloride (EDC)*. Orica Australia Pty Ltd, Sydney, Australia.

Orica (2013). *Botany Transformation Projects*. Orica Australia Pty Ltd, Sydney, Australia. Accessed 30 April 2014 at http://www.oricabotanytransformation.com/.

Standards Australia (2004). *AS 1940-2004 The Storage and Handling of Flammable and Combustible Liquids*. Standards Australia, Sydney, Australia.

UNECE (2009). *Globally Harmonised System of Classification and Labelling of Chemicals (GHS), 3rd Revised Edition*. United Nations Economic Commission for Europe, Geneva, Switzerland. Accessed 12 November 2013 at http://www.unece.org/

UNFCCC (1998). *Kyoto Protocol to the United Nations Framework Convention on Climate Change*. United Nations Framework Convention on Climate Change, Bonn, Germany.

US EPA (2008). *Estimations Programs Interface (EPI) Suite^{TM} for Microsoft Windows®*, v 4.10. United States Environmental Protection Agency, Washington DC, USA. Available at http://www.epa.gov/.

US EPA (2012). *Is My Facility's Six-Digit NAICS Code a TRI-Covered Industry?* United States Environmental Protection Agency, Washington DC, USA. Accessed 17 April 2013 at http://www2.epa.gov/.

US EPA (2013). *Chemical Access Data Tool (CDAT)*. United States Environmental Protection Agency, Washington DC, USA. Accessed 12 November 2013 http://java.epa.gov/.

US EPA (2014a). *TRI-Listed Chemicals*. United States Environmental Protection Agency, Washington DC, USA. Accessed 3 April 2014 at http://www2.epa.gov/.

US EPA (2014b). *Basics of TRI Reporting*. United States Environmental Protection Agency, Washington DC, USA. Accessed 3 April 2014 at http://www2.epa.gov/.

US NLM (2013). *Hazardous Substances Data Bank*. United States National Library of Medicine, Bethesda, USA. Accessed 30 April 2014 at http://toxnet.nlm.nih.gov/.

WHO (1995). *Environmental Health Criteria 176: 1,2-Dichloroethane (Second Edition)*. World Health Organization, Geneva, Switzerland. Accessed 24 November 2014 at http://www.inchem.org/.

WMO (2011). Global Ozone Research and Monitoring Project - Report No. 52, *Scientific Assessment of Ozone Depletion: 2010*. World Meteorological Organization, Geneva, Switzerland. Accessed 20 November 2013 at http://www.wmo.int/.

WMO (2014). Global Ozone Research and Monitoring Project - Report No. 56, *Assessment for Decision-Makers: Scientific Assessment of Ozone Depletion: 2014*. World Meteorological Organization, Geneva, Switzerland. Accessed 18 September 2014 at http://ozone.unep.org/.

Zhu J, et al. (2005). Selected Volatile Organic Compounds in Residential Air in the City of Ottawa, Canada. *Environmental Science and Technology,* **39**, pp 3964.

Last update 27 November 2014

Share this page