Vinylidene Chloride (1,1-Dichloroethylene)

75-35-4

Hazard Summary

Vinylidene chloride is used as an intermediate in chemical synthesis and to produce polyvinylidene chloride copolymers. The primary acute (short-term) effects in humans from vinylidene chloride exposure are on the central nervous system (CNS), including CNS depression and symptoms of inebriation, convulsions, spasms, and unconsciousness at high concentrations. Low-level, chronic (long-term) inhalation exposure of vinylidene chloride in humans may effect the liver. Animal studies indicate that chronic exposure to vinylidene chloride can affect the liver, kidneys, CNS and lungs. Human data are considered inadequate in providing evidence of cancer from exposure to vinylidene chloride. The most recent cancer classification for vinylidene chloride can be found on IRIS.

Please Note: The main sources of information for this fact sheet are the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for 1,1-Dichloroethene (1) and EPA's Integrated Risk Information System (IRIS) (4), which contains information on oral chronic toxicity and the RfD, and the carcinogenic effects of vinylidene chloride including the unit cancer risk for inhalation exposure.

Uses

- Vinylidene chloride is used as an intermediate for organic chemical synthesis. (1)
- Vinylidene chloride is also used in the production of polyvinylidene chloride copolymers. The major application of these chloride copolymers is in the production of flexible films for food packaging (SARAN® and VELON® wraps). (1)
- These copolymers are also used extensively in many types of packing materials, as flame retardant coatings for fiber and carpet backing and in piping, coating for steel pipes, and adhesive applications. (2)

Sources and Potential Exposure

- Air releases, primarily from emissions from polymer synthesis and fabrication industries, are the greatest source of ambient vinylidene chloride. (1)
- Occupational exposure to vinylidene chloride may occur by inhalation or dermal contact. (1)
- Vinylidene chloride has been detected at low levels in a number of drinking water supplies across the United States. (1)

Assessing Personal Exposure

- Measurable levels of vinylidene chloride can be detected in the breath, blood, urine, and body tissues. Determination of vinylidene chloride in breath samples by gas chromatography/mass spectrometry is the most commonly used method of monitoring exposure to vinylidene chloride. (1)

Health Hazard Information

Acute Effects:

- Studies in humans indicate that relatively high concentrations of inhaled vinylidene chloride can induce adverse neurological effects including CNS depression and symptoms of inebriation, convulsions, spasms,

and unconsciousness, and respiratory effects, such as inflammation of mucous membranes. (1,2)
- Acute animal tests in rats have shown vinylidene chloride to have high toxicity from oral exposure and moderate toxicity from inhalation exposure. (3)

Chronic Effects (Noncancer):
- Several studies have suggested that vinylidene chloride may effect the liver in humans. (1,2)
- Animal studies have shown that chronic exposure to vinylidene chloride causes effects on the kidneys, liver, CNS and lungs. (1,2,3)
- The Reference Dose (RfD) for vinylidene chloride can be found on IRIS. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily ingestion 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 RfD, the potential for adverse health effects increases. Lifetime exposure above the RfD does not imply that an adverse health effect would necessarily occur. (4)
- The California Environmental Protection Agency (CalEPA) has established a chronic reference exposure level of 0.02 milligrams per cubic meter (mg/m^3) for vinylidene chloride based on liver effects in guinea pigs. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur. (7)

Reproductive/Developmental Effects:
- No studies were located regarding developmental or reproductive effects in humans. (1,2)
- Birth defects were noted in the offspring of pregnant rats and mice that had been exposed to vinylidene chloride in air. In this study, maternal toxicity was observed at developmentally toxic concentrations. (1)

Cancer Risk:
- No relationship between the occurrence of cancer in humans and occupational exposure to vinylidene chloride has been demonstrated. However, only three studies are available and these studies are limited by small population sizes and short observation periods. (1,2)
- One study showed an increase in kidney and mammary tumors in mice exposed to vinylidene chloride via inhalation, while a drinking water study showed an increase in adrenal tumors in male rats. (1,2)
- A study by the National Toxicology Program (NTP) did not show an increase in tumors in rats and mice exposed to vinylidene chloride via gavage (experimentally placing the chemical in the animal's stomachs).(8)
- EPA uses mathematical models, based on animal studies, to estimate the probability of a person developing cancer from breathing air containing a specified concentration of a chemical. EPA calculated an inhalation unit risk estimate of 5.0×10^{-5} $(\mu g/m^3)^{-1}$. EPA estimates that, if an individual were to continuously breathe air containing vinylidene chloride at an average of 0.02 $\mu g/m^3$ (2 x 10^{-5} mg/m^3) over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million increased chance of developing cancer as a direct result of breathing air containing this chemical. Similarly, EPA estimates that breathing air containing 0.2 $\mu g/m^3$ (2 x 10^{-4} mg/m^3) would result in not greater than a one-in-a-hundred thousand increased chance of developing cancer, and air containing 2.0 $\mu g/m^3$ (2 x 10^{-3} mg/m^3) would result in not greater than a one-in-ten thousand increased chance of developing cancer. For a detailed discussion of confidence in the potency estimates, please see IRIS. (4)
  EPA has calculated an oral cancer slope factor of 0.6 $(mg/kg/d)^{-1}$. (4)
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Physical Properties

- Vinylidene chloride is a colorless liquid with a mild sweet odor resembling that of chloroform. (1,5)
- The chemical formula for vinylidene chloride is $C_2H_2Cl_2$ and the molecular weight is 96.95 g/mol. (1,5)

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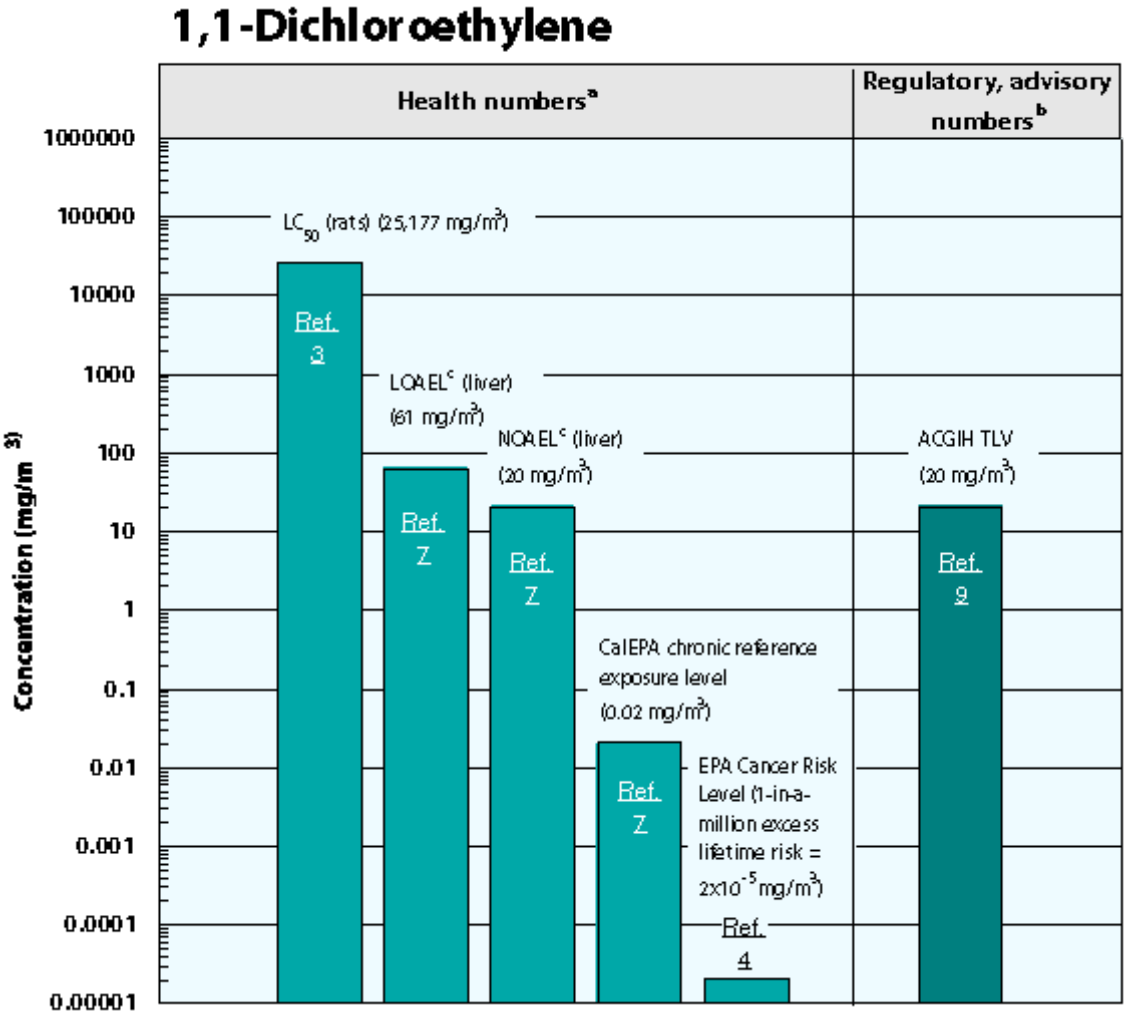
- The vapor pressure for vinylidene chloride is 591 mm Hg at 25 °C and it has a log octanol/water partition coefficient (log K_{ow}) of 1.32. (1)
- Vinylidene chloride has an odor threshold of 190 parts per million (ppm). (6)
- Vinylidene chloride is practically insoluble in water. (1,5)

Conversion Factors:
To convert concentrations in air (at 25 °C) from ppm to mg/m^3: mg/m^3 = (ppm) × (molecular weight of the compound)/(24.45). For vinylidene chloride: 1 ppm = 4.0 mg/m^3.

Health Data from Inhalation Exposure



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 effects.

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.

NOAEL--No-observed-adverse-effect level.

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. ACGIH numbers are advisory.

[c]

[c] This NOAEL and LOAEL are from the critical study used as the basis for the CalEPA chronic reference exposure level.

Summary created in April 1992, updated in January 2000

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