

Safety Data Sheet

Vinyl chloride

Division of Safety
National Institutes
of Health



· WARNING!

THIS COMPOUND IS ABSORBED THROUGH THE SKIN AND THE RESPIRATORY TRACT. IT IS TOXIC, CARCINOGENIC, AND MUTAGENIC. IT IS FLAMMABLE AND EXPLOSIVE. AVOID FORMATION AND BREATHING OF AEROSOLS OR VAPORS.

LABORATORY OPERATIONS SHOULD BE CONDUCTED IN A FUME HOOD, GLOVE BOX, OR VENTILATED CABINET.

AVOID SKIN CONTACT: IF EXPOSED, WASH WITH SOAP AND WATER. AVOID WASHING THE SKIN WITH SOLVENTS AND ELEVATING ITS TEMPERATURE.

FOR EYE EXPOSURE, IRRIGATE IMMEDIATELY WITH LARGE AMOUNTS OF WATER. FOR INGESTION, DRINK PLENTY OF MILK OR WATER. INDUCE VOMITING. FOR INHALATION, REMOVE VICTIM PROMPTLY TO CLEAN AIR. ADMINISTER RESCUE BREATHING IF NECESSARY. REFER TO PHYSICIAN.

IN CASE OF LABORATORY SPILL, WEAR PROTECTIVE CLOTHING DURING CLEANUP. AVOID SKIN CONTACT OR BREATHING OF VAPORS. USE ABSORBENT PAPER TO MOP UP SPILL. AFTER THE RESIDUE HAS EVAPORATED, WASH DOWN AREA WITH SOAP AND WATER. DISPOSE OF WASTE SOLUTIONS AND MATERIALS APPROPRIATELY.

A. Background

Vinyl chloride (VC) is a colorless, highly flammable gas under normal conditions of temperature and pressure, with a characteristic odor. It is readily absorbed through lungs and skin. It has low acute toxicity but produces the characteristic "vinyl chloride disease" on prolonged exposure. VC is carcinogenic and mutagenic in humans and rodents. Its main commercial use is in the production of polymeric resins, which form an important group of modern plastics.

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Chemical and Physical Data

1. Chemical Abstract No.: 75-01-4

2. Synonyms:

VC	Vinyl C monomer
VCM	Monochloroethene
Trovidur	Monochlorethylene
Chlorethene	Ethene, chloro (9CI)
Chlorethylene	Ethylene monochloride
Chloroethylene	Vinyl chloride monomer

3. Molecular
formula:
 C_2H_3Cl

structure: $CH_2=CH-Cl$

weight:
62.50

4. Density: Liquid: 0.9013 g/cm³ (25°C); vapor (air = 1): 2.5 (25°C).

5. Absorption spectroscopy: IR and MS data are listed by Grasse and Ritchey (1975).

6. Volatility: Vapor pressure = 1.70 atm at 0°C and 3.33 atm at 20°C. (For values at lower temperatures, see p. D-175 in Weast 1981.)

7. Solubility: VC is slightly soluble in water (0.11% w/w at 25°C). It is soluble in ethanol and very soluble in ether, benzene, and carbon tetrachloride.

8. Description, appearance, and odor: Colorless, highly flammable gas with odor similar to that of ethyl chloride.

9. Boiling point: -13.9°C.

Melting point: -153.7°C.

10. Stability: Degrades above 450°C to form acetylene. Polymerizes in light and in the presence of peroxygen catalysts.

11. Chemical reactivity: Reacts with nucleophiles such as amines, thiols, water, and hydroxyl ions, with displacement of the chloride ion. In the presence of base, acetylene and hydrochloric acid

acid are produced. Produces acetaldehyde and hydrochloric acid in the presence of acid catalysts in water. Burns in air to produce hydrogen chloride, carbon monoxide, carbon dioxide, and traces of phosgene.

- 12. Flash point: -78°C (closed cup).
- 13. Autoignition temperature: 472°C.
- 14. Explosive limits in air: 4-20% by volume.

Fire, Explosion, and Reactivity Hazard Data

- 1. Use dry chemical fire extinguishers. Fire-fighting personnel should wear air-supplied respirators with full-face masks.
- 2. VC is highly flammable; its polymerization, especially at elevated temperatures, could be explosive.
- 3. Conditions contributing to instability are elevated temperatures, light, and the presence of polymerization catalysts.
- 4. No other incompatibilities are known.
- 5. Hazardous decomposition products (under conditions of fire) are hydrogen chloride, carbon monoxide, and phosgene.
- 6. Do not expose to spark or open flame. Use nonspark tools. Safety refrigerator only.

Operational Procedures

The NIH Guidelines for the Laboratory Use of Chemical Carcinogens describe operational practices to be followed when potentially carcinogenic chemicals are used in NIH laboratories. The Guidelines should be consulted to identify the proper use conditions required and specific controls to be implemented during normal and complex operations or manipulations involving VC.

- 1. Chemical inactivation: No validated method reported.
- 2. Decontamination: Turn off equipment that could be affected by VC or the materials used for cleanup. If more than 1 g has been released or if there is any uncertainty regarding the procedures to be followed for decontamination, call the NIH Fire Department (dial 116) for assistance. Use absorbent paper to mop up spill. After the residue has evaporated, wash surfaces with copious quantities of water. Glassware should be rinsed (in a hood) with acetone, followed by soap and water. Animal cages should be washed with water.
- 3. Disposal: No waste streams containing VC shall be disposed of

in sinks or general refuse. Surplus VC or chemical waste streams contaminated with VC shall be handled as hazardous chemical waste and disposed of in accordance with the NIH chemical waste disposal system. Nonchemical waste (e.g., animal carcasses and bedding) containing VC shall be handled and packaged for incineration in accordance with the NIH medical-pathological waste disposal system. Potentially infectious waste (e.g., tissue cultures) containing VC shall be packaged for incineration, as above. Burnable waste (e.g., absorbent bench top liners) minimally contaminated with VC shall be handled as potentially infectious waste and packaged for incineration, as above. Absorbent materials (e.g., associated with spill cleanup) grossly contaminated shall be handled in accordance with the chemical waste disposal system. Radioactive waste containing VC shall be handled in accordance with the NIH radioactive waste disposal system.

4. Storage: VC is usually stored in pressure cylinders, which carry their own safety instructions. Solutions of VC in organic solvents may be stored under deep-freeze conditions. Avoid exposure to ultraviolet light or strong sunlight.

Monitoring and Measurement Procedures Including Direct Field Measurements and Sampling for Subsequent Laboratory Analysis

1. Sampling: VC is absorbed on charcoal in glass or stainless steel tubes or on silica gel or porous polymer packings (Tenax, GC, Chromosorbs, Porapak Q). The preferred method for water sampling is charcoal or polymer adsorption and thermal desorption (Bellar et al., 1976).
2. Separation and analysis: Desorption is carried out either with carbon disulfide (for charcoal) or hexane (for polymers) (Hill et al., 1976). Thermal desorption with nitrogen offers better recoveries and reduced health hazard (Severs and Skory, 1975; Russell and Shadoff, 1977). VC is determined by GC combined with MS, electron capture, flame ionization, chemiluminescence, or halogen-specific detectors with good sensitivity. The GC-FID system has been developed into an automatic sampling and analysis system for air concentrations down to 0.1 ppm (Ahlstrom et al., 1975). The chemiluminescent reaction of VC with ozone eliminates many interferences and has a detection limit of about 50 ppb (McClenny et al., 1976). Colorimetric methods are less reliable.

Biological Effects (Animal and Human)

1. Absorption: The principal route of absorption of VC is through the lungs, though it is also readily absorbed through the skin.
2. Distribution: No data; apparently little or no VC is retained, as such, in the animal body because of its rapid metabolism or excretion in unchanged form.

Metabolism and excretion: When large doses of VC are administered by inhalation, injection, or percutaneous absorption, much of it is rapidly exhaled unchanged (Green and Hathway, 1975; Watanabe et al., 1976a, 1976b; Baretta et al., 1969). The remainder is either metabolized to CO₂ or combined with the thiol group of glutathione; the product (in acetylated form) is excreted in the urine. A second identified urinary metabolite is thiodiglycolic acid. At low doses, such as 10 ppm in air, most of the VC is metabolized. Present evidence indicates that two intermediate metabolites, chlorooxirane and its rearrangement product chloroacetaldehyde, are the ultimate carcinogens in VC metabolism (Elmore et al., 1976; Guengerich and Watanabe, 1979). Chlorooxirane forms covalent adducts with nucleosides of DNA (Zajdela et al., 1980).

Toxic effects: VC is an established human carcinogen (Althouse et al., 1980). The acute oral LD50 of VC in the rat is 500 mg/kg. In animals, VC inhalation produces narcosis with cardiac arrhythmia; at high doses, death results, with pulmonary edema and fibrosis and liver and kidney congestion and necrosis. Occupational studies in man exposed to VC and its polymers have shown the appearance of a distinct "vinyl chloride disease," which is an occupational acro-osteolysis (Veltman et al., 1975; Lange et al., 1975). The more common symptoms include upper abdominal complaints, tiredness, dizziness, paresthesia, thrombocytopenia, splenomegaly, and reticulocytosis. There are abnormal chest x-rays and diminished pulmonary function, particularly in smokers. Liver lesions (fibrosis, portal hypertension) may persist for over 2 to 5 years after cessation of exposure.

Carcinogenic effects: VC inhalation in rats, mice, and hamsters produces metastasizing Zimbal gland carcinomas, hepatic angiosarcomas, bronciolo-alveolar adenomas, nephroblastomas, and neuroblastomas. In humans, repeated occupational exposure to VC causes hepatic angiosarcomas (Falk et al., 1974; Makk et al., 1974).

Mutagenic and teratogenic effects: VC (or its metabolite[s]) is mutagenic in bacterial systems, but not in rodents on inhalation. In humans, chromosome aberrations have been found in workers in VC plants; a higher proportion of fetal deaths has been found in male workers' wives.

Emergency Treatment

Skin and eye exposure: For skin exposure, remove contaminated clothing and wash with soap and water. Splashes of VC on the skin may result in local frostbite. For eye exposure, irrigate immediately with copious quantities of running water for at least 15 minutes.

Ingestion of VC solutions: Drink plenty of milk or water. In-

duce vomiting.

3. Inhalation: Remove victim promptly to clean air. Administer rescue breathing if necessary.
4. Refer to physician. Consider treatment for pulmonary irritation.

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