Sources of Exposure

General Populations

- Exposure may occur by inhaling contaminated air or smoke from cigars or cigarettes.
- Exposure to very low levels via drinking water is possible but likely insignificant to health.
- Individuals living near hazardous waste sites and landfills may be exposed to higher amounts in air and drinking water.

Occupational Populations

- Occupational exposure occurs in individuals working in facilities where vinyl chloride is produced or used.
- Welding polyvinyl chloride is also a source of occupational exposure.
- Occupational exposure occurs primarily via the inhalation route of exposure.

Toxicokinetics and Biomonitoring

Toxicokinetics

- Inhalation absorption of vinyl chloride in humans is rapid. Volunteers exposed to low concentrations retained about 42% of the inhaled amount.
- There are no data regarding oral or dermal absorption in humans.
- There are no data regarding distribution of vinyl chloride in humans.
- In animals, vinyl chloride metabolites were found in the liver, kidney, spleen, and brain.
- Vinyl chloride metabolism in humans is attributed to the P-450 monooxygenases in the liver. Metabolism of vinyl chloride is saturable.
- Intermediates are detoxified primarily via glutathione conjugation and excreted in the urine as cysteine derivatives.
- Excretion of metabolites occurs mainly in the urine at low exposures. At high doses, where metabolic saturation occurs, vinyl chloride is exhaled as the parent compound.
- Vinyl chloride does not accumulate in the body.

NHANES Biomonitoring

- No data are available

Biomarkers/Environmental Levels

Biomarkers

- Vinyl chloride in exhaled air can be used as a biomarker of recent exposure, but is of limited utility for low-level exposures and must be measured shortly after exposure.
- Urinary levels of thiodiglycolic acid, a major metabolite of vinyl chloride, have been used to monitor occupational exposure to vinyl chloride, but it is not specific for exposure to vinyl chloride.

Environmental Levels

Air

- In 2013, background levels (24-hour maximum concentrations) of vinyl chloride were 0.005–2.37 ppbv at sites where vinyl chloride was detected (EPA's Air Quality System).

Water

- Analysis of surface water samples revealed levels below the lower quantification limit of 0.02 µg/L. The median concentration in groundwater samples was 1.1 µg/L between 1985 and 2001.

Sediment and Soil

- Vinyl chloride is rarely detected in soil and sediment samples, and the levels tend to be below quantification.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2022. Toxicological Profile for Vinyl Chloride. (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human

ToxGuide™ for Vinyl Chloride

CH=CH-Cl

(CAS # 75-01-4)

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U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Chemical and Physical Information

Vinyl Chloride is a Gas

- Vinyl chloride is a manufactured substance, but it can be formed in the environment when other chlorinated substances are degraded by microorganisms.
- It is a gas at room temperature with a mild sweet odor.
- Vinyl chloride can exist as liquid under pressure or at low temperatures.
- It burns easily and is unstable at high temperatures.
- Vinyl chloride is only slightly soluble in water, but it is soluble in most common organic solvents.
- The main use of vinyl chloride is in the manufacture of polyvinyl chloride (PVC), a polymer used to make a variety of plastic products including pipes, wire and cable coatings, and packaging materials.

Routes of Exposure

- Inhalation – The primary route of exposure for the general population and workers.
- Oral – No significant vinyl chloride exposure is expected from ingestion of drinking water.
- Dermal – Possible route of exposure for workers.

Vinyl Chloride in the Environment

- Vinyl chloride can be released into the environment (mainly the air) during its production or use.
- In the air, it is degraded by reaction with photochemically-generated hydroxyl radicals; its half-life is about 1–2 days.
- Liquid vinyl chloride evaporates easily. Vinyl chloride in water or soil evaporates rapidly if it is near the surface.
- Vinyl chloride can migrate to groundwater. In anaerobic groundwater, degradation occurs slowly.
- Vinyl chloride is also mobile in soil and susceptible to leaching.
- Vinyl chloride does not accumulate in plants or in animals.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- An MRL of 0.5 ppm has been derived for acute-duration inhalation exposure (≤14 days).
- An MRL of 0.02 ppm has been derived for intermediate-duration exposure (15–364 days).
- A chronic-duration inhalation MRL was not derived for vinyl chloride.

Oral

- No acute- or intermediate-duration oral MRLs were derived for vinyl chloride.
- An MRL of 0.003 mg/kg/day has been derived for chronic-duration exposure (≥365 days).

Health Effects

- Acute, high-level exposure to vinyl chloride can produce headache, dizziness, drowsiness, and loss of consciousness. Extremely high-levels can be lethal.
- Exposure of workers to high levels of vinyl chloride has resulted in altered blood flow in the hands.

Health Effects

- Long-term exposure of workers has resulted in alterations in the liver ranging from hypertrophy and hyperplasia to hepatocellular degeneration.
- Studies of workers who inhaled vinyl chloride over many years have shown an increased incidence of liver cancer.
- The Department of Health and Human Services (HHS) has categorized vinyl chloride as "known to be a human carcinogen."
- The U.S. Environmental Protection Agency (EPA) has categorized it as a "known human carcinogen" by the inhalation route; carcinogenic by the oral route; and likely to be carcinogenic by the dermal route.
- The International Agency for Research on Cancer (IARC) concluded that vinyl chloride is "carcinogenic to humans" (Group 1).

Children's Health

- Children may be exposed vinyl chloride in PVC-based toys; however, amounts may be insignificant.
- Vinyl chloride can cross the placenta and enter the blood of the fetus.
- Animal studies suggest that infants and young children might be more susceptible than adults to vinyl-chloride induced cancer