Vinyl Chloride Monomer

Product Overview
• Vinyl chloride monomer is a colorless, odorless gas or pressurized liquid. Commercial products also contain small amounts of polymerization inhibitors.¹ For further information, see Product Description.
• Vinyl chloride monomer is used to produce polymers, primarily polyvinyl chloride (PVC) and vinyl copolymers.² For further information, see Product Uses.
• Those most likely to be exposed to vinyl chloride monomer are people who work in chemical production facilities where it is made or used. Vinyl chloride monomer is manufactured in closed systems. Safe handling of vinyl chloride monomer is supported by closed systems and employee exposure monitoring. Workplace exposure to vinyl chloride monomer is tightly controlled in the U.S. and other countries. Consumers are unlikely to be exposed to vinyl chloride monomer.³ For further information, see Exposure Potential.
• Contact with the liquefied product may cause frostbite to skin or eyes. Vinyl chloride monomer vapor may be harmful, even fatal, if inhaled. This product has caused cancer in humans and laboratory animals.⁴ For further information, see Health Information.
• Vinyl chloride monomer cannot be considered readily biodegradable. However, it may biodegrade slowly under environmental conditions. If released to the environment, it enters the atmosphere rapidly, where it is slowly removed by reaction with photochemically generated hydroxyl radicals. It would not be expected to accumulate in the food chain. Vinyl chloride monomer is nontoxic to aquatic organisms on an acute basis.⁵ For further information, see Environmental Information.
• Vinyl chloride monomer is extremely flammable and vapors may cause a flash fire. Exposure to elevated temperatures can cause the product to decompose.⁶ For further information, see Physical Hazard Information.
Manufacture of Product

- **Capacity** – Global capacity for vinyl chloride monomer was about 47 million metric tonnes (103 billion pounds) in 2010. In 2011, The Dow Chemical Company produced approximately 1.4 million metric tonnes (3.2 billion pounds) at manufacturing facilities in Oyster Creek, Texas, and Plaquemine, Louisiana, U.S.A., and through global affiliates in Schkopau, Germany.

- **Process** – Ethylene and chlorine are reacted to form dichloroethane which, in turn, is transformed into vinyl chloride monomer. A reaction diagram is shown below.

\[
H_2C=CH_2 + Cl_2 \rightarrow H_2C=CHCl \rightarrow H_2C=CH + HCl
\]

Ethylene Chlorine Dichloroethane Vinyl chloride

Product Description

Vinyl chloride monomer is a colorless, odorless gas or pressurized liquid. This product is extremely flammable. Commercial products contain small amounts of polymerization inhibitors.

Product Uses

Practically all vinyl chloride monomer is used to make polyvinyl chloride (PVC) polymers and copolymers. Polyvinyl chloride is used widely in building and construction applications because of its excellent durability, easy installation, and cost-effectiveness. Polyvinyl chloride and other vinyl copolymers are also used in medical, electronics, automotive, toys, water infrastructure, and packaging applications.

Exposure Potential

Vinyl chloride monomer is used in the production of polyvinyl chloride, which is then used to manufacture a number of industrial and consumer products. Based on the uses for this product, individuals could be exposed through:

- **Workplace exposure** – Exposure can occur either in a facility that manufactures vinyl chloride monomer or in the various industrial or manufacturing facilities that use vinyl chloride monomer. It is produced, distributed, stored, transported, and consumed in closed systems. Those working with vinyl chloride monomer in manufacturing operations could be exposed during maintenance, sampling, testing, or other procedures. Workplace exposure is tightly controlled in the U.S. and many other countries. Each manufacturing facility should have a thorough training program for employees and appropriate work processes, ventilation, and safety equipment in place to limit exposure. See Health Information.

- **Consumer exposure to products containing vinyl chloride monomer** – Dow does not sell vinyl chloride monomer for consumer use, so direct consumer contact with this product is unlikely. However, vinyl chloride monomer is used to produce polyvinyl chloride and other vinyl polymers used in food packaging, medical devices, wire coatings, automotive interiors, pipe, exterior siding, interior vinyl floors, wall and furniture coverings, and toys. Vinyl chloride monomer is consumed in the reaction to produce the vinyl polymers and is not considered a risk to consumers. Residual monomer levels in consumer products are highly regulated and tightly controlled to very low levels. See Health Information.

- **Environmental releases** – In the event of a spill, the focus is on containing the spill to prevent contamination of soil, surface water, or groundwater. Respiratory protection is necessary for cleaning up spills and leaks. Because vinyl chloride monomer is sparingly soluble in water and highly volatile, if released to soil or water, it will quickly volatilize to the atmosphere, where it will be slowly removed by reaction with photochemically generated hydroxyl radicals. Vinyl chloride monomer is not considered readily biodegradable, however, numerous studies have shown that it biodegrades under environmental conditions. Vinyl chloride monomer is practically nontoxic to aquatic organisms on an acute basis. See Environmental, Health, and Physical Hazard Information.
• **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, vinyl chloride monomer should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. An approved positive-pressure, self-contained breathing apparatus (SCBA) with a full-face mask is recommended for emergency work. Vinyl chloride monomer is extremely flammable. Eliminate all sources of ignition immediately. Use only explosion-proof equipment; ground and bond all containers and handling equipment. Vapors may travel a long distance and ignition and/or flashback may occur. See Environmental, Health, and Physical Hazard Information.

• **In case of fire** – Deny any unnecessary entry into the area and consider the use of unmanned hose holders. Use water spray or fog, carbon-dioxide or dry-chemical extinguishers, or foam to fight the fire. Use of a direct water stream may spread the fire. Firefighters should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective firefighting clothing. The public should be warned of downwind vapor explosion hazards. Vapors are heavier than air and may travel a long distance and accumulate in low-lying areas. Keep vapors out of sewers. Immediately withdraw all personnel from the area in case of rising sounds from venting safety devices or discolorations of the container. Keep fire water out of waterways and sewers to minimize the potential for environmental damage. Follow emergency procedures carefully. See Environmental, Health, and Physical Hazard Information.

For more information, see the relevant Safety Data Sheet.

**Back to top**

**Health Information**

**Eye contact** – Contact with liquefied vinyl chloride monomer may cause frostbite.

**Skin contact** – Contact with liquefied vinyl chloride monomer may cause frostbite.

**Inhalation** – Brief exposure (minutes) to easily attainable concentrations may cause adverse effects. May cause pulmonary edema (fluid in the lungs). May cause central nervous system effects. Symptoms may include headache, dizziness and drowsiness, progressing to loss of coordination and unconsciousness.

**Ingestion** – Because vinyl chloride monomer is a vapor at room temperature, ingestion is unlikely.

**Repeated exposure** – In humans, effects have been reported on the liver. In animals, effects have been reported on the liver, kidney, and lungs. Repeated exposures have been reported to produce changes in bone, skin, and the vascular system, particularly to the extremities.

**Cancer information** – Vinyl chloride monomer has caused cancer in humans and in laboratory animals.

**Other** – Vinyl chloride monomer has been found to be toxic to the fetus in laboratory animals, but only at doses that were toxic to the mother.

For more information, see the relevant Safety Data Sheet.

**Back to top**

**Environmental Information**

Because vinyl chloride monomer is sparingly soluble and highly volatile, if introduced to soil or water, it will quickly volatilize to the atmosphere, where it will be slowly removed by reaction with photochemically generated hydroxyl radicals.

Vinyl chloride monomer has a high potential for mobility in soil. Vinyl chloride monomer is not considered readily biodegradable based on stringent test guidelines recommended by the Organization for Economic Cooperation and Development (OECD). However, numerous studies have shown it is biodegradable under environmental conditions.

Vinyl chloride monomer is not likely to accumulate in the food chain (low bioaccumulation potential) and is practically nontoxic to fish and aquatic organisms on an acute basis (LC50 or EC50 >100 mg/L for the most sensitive species tested).

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Physical Hazard Information
Avoid temperatures above 400°C (752°F). Elevated temperatures can cause vinyl chloride monomer to decompose. Toxic gases are released during decomposition. Decomposition products depend upon temperature, air supply, and the presence of other materials. Decomposition products can include hydrogen chloride and trace amounts of phosgene.

Vinyl chloride monomer is an extremely flammable vapor and liquid. Vapors are heavier than air and may travel a long distance and accumulate in low lying areas. Ignition and/or flashback may occur. When vinyl chloride monomer is stored in closed containers, a flammable atmosphere can develop. Flammable mixtures of vinyl chloride monomer are readily ignited even by static discharge. Electrically ground and bond all equipment.

Avoid contact with air (oxygen), moist air, strong oxidizers, and metals such as aluminum, aluminum alloys, and copper.

For more information, see the relevant Safety Data Sheet.

Back to top
References

8. The Vinyl Institute web site: Vinyl Info: How is Vinyl Made?, (http://www.vinylinfo.org/vinyl-info/about-vinyl/how-is-vinyl-made/).

Back to top
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Back to top