

Skin Irritation. Propylene dichloride on the open skin causes only mild irritation. Single short contacts will probably be without any effects. The intensity of the reaction is greatly increased when bandaged on the skin or when held close to the skin by clothing.

Eye Irritation. Propylene dichloride causes some pain and irritation when splashed into the eye. It would not be expected to cause serious or permanent injury. It should be washed out immediately with water.

4. Hygienic Standards of Permissible Exposure

The threshold limit of propylene dichloride was established by the American Conference of Governmental Industrial Hygienists, in April, 1959, at 75 p.p.m. (350 mg./cu. meter.)

5. Flammability

The flammable limits of propylene dichloride are 3.4 to 14.5 per cent in air. The ignition temperature is 557 to 570°C.

VINYL CHLORIDE, $\text{CH}_2=\text{CHCl}$ (Monochloroethene)

1. Uses and Industrial Exposures

Vinyl chloride is used as a chemical intermediate primarily as a monomer in plastic manufacture. The fire and explosion hazard is by far the dominant problem in handling vinyl chloride.

2. Physical and Chemical Properties

Physical state: gas

Molecular weight: 62.5

Specific gravity: 0.9121 (20°/4°C.)

Melting point: -153.71°C.

Boiling point: -13.8°C.

Vapor density: 2.15 (air = 1)

Vapor pressure: 2580 mm. Hg (20°C.)

Solubility: slightly soluble in water; soluble in ethanol and ethyl ether

Flash point: -78°C. (open cup)

1 mg./liter $\approx$ 391 p.p.m. and 1 p.p.m. $\approx$ 2.56 mg./cu. meter at 25°C., 760 mm. Hg

3. Physiological Response

Vinyl chloride appears to be a material of relatively low toxicity. The principal response seems to be one of central nervous system depression, which may result in symptoms of dizziness and disorientation that are somewhat similar to the response from ethyl chloride exposure. There is the possibility of some lung irritation occurring from chronic exposure as some edema is observed in acute vapor

alcohol and ethyl

at 25°C., 760

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exposure. Most investigators did not observe kidney or liver damage. One group of authors indicated some hyperemia of the liver and kidneys from acute exposure. It is concluded that the material has essentially a narcotic effect, with some lung irritation and a possibility of organ injury. There has been quite extensive use of this material in the chemical industry but no clinical reports of injury.

Acute Vapor Exposure. Patty *et al.*¹⁰⁰ reported the response of guinea pigs to single exposures to varying concentrations. The maximum time-concentrations in air for a single exposure survived by guinea pigs were as follows: 5 to 7 per cent for 1 hour and $2\frac{1}{2}$ per cent for 8 hours. The maximum time-concentration in air for a single exposure without serious disturbance was $1\frac{1}{2}$ per cent for 1 hour and 0.5 per cent for 8 hours. It will be noted that it requires a high concentration to cause death.

The same authors report that a concentration of $2\frac{1}{2}$ per cent of vinyl chloride in the air for a period of 3 minutes will cause dizziness and disorientation in exposed men. They also observed a faintly pleasant odor at this concentration. Animals that died from acute exposures showed edema of the lungs and hyperemia of the kidneys and liver.

Men exposed to vinyl chloride detected a slight odor at 4100 p.p.m. This is the lowest concentration at which an odor was detected. At 6600 p.p.m. for $\frac{1}{2}$ hour, they noticed dizziness, sleepiness, and distinct odor.

Vinyl chloride has been investigated as a possible material for anesthetic purposes by Peoples and Leake¹⁰¹ and by Oster *et al.*¹⁰² It was concluded that vinyl chloride was unsatisfactory for use as an anesthetic because of its circulatory and cardiac effects. These studies were at 10 to 20 vol. % and are hardly significant for industrial exposure.

Chronic Vapor Exposure. Essentially no investigations have been published on the response to chronic vapor exposure. Schaumann⁸⁵ exposed mice and rats and found that they tolerated a level sufficient for "light narcosis" for periods of 4 hours daily for 5 to 8 consecutive days or for 1 hour daily for 4 weeks without showing kidney or liver injury.

Torkelson *et al.*^{102a} (to be published) report repeated exposures of animals for 7 hours/day, 5 days/week. At 500 p.p.m., rats showed increased liver weight and micropathology. At 200 and 100 p.p.m., rats showed increased liver weight, but no changes could be observed in dogs or guinea pigs. All species tolerated 50 p.p.m. for 6 months. Repeated exposures for 1 hour/day at 200 or 100 p.p.m. were tolerated without observable effect.

⁸⁵ *Chemical Safety Data Sheet SD-36*, Manufacturing Chemists Assoc., Washington, D. C., 1954.

¹⁰⁰ F. A. Patty, W. P. Yant, and C. P. Waite, *Public Health Repts. U. S.*, Reprint No. 1405, 45, No. 34 (Aug., 1930).

¹⁰¹ S. A. Peoples and C. D. Leake, *J. Pharmacol. Exptl. Therap.*, 48, 284 (1933).

¹⁰² R. H. Oster, C. J. Carr, J. C. Krantz, and M. J. Sauerwald, *Anesthesiology*, 8, 358 (1947).

Skin. The boiling point of vinyl chloride is so low that if the liquid material were spilled on the skin, there is a possibility of severe cooling and possibly frost bite.

Absorption, Excretion, and Metabolism. Very little is known of the metabolism of this compound. It is apparently readily absorbed by the lungs and rapidly excreted by the lungs. The little information that is available would indicate that a large part is excreted by the lungs unchanged.

4. Hygienic Standards of Permissible Exposure

The threshold limit of vinyl chloride was established by the American Conference of Governmental Industrial Hygienists, in April, 1959, at 500 p.p.m. (1300 mg./cu. meter).

Torkelson *et al.*^{102a} suggest 100 p.p.m.

5. Flammability⁹⁸

The explosive limits of vinyl chloride are: lower, 4% and upper, 22% (by vol. in air). The autoignition temperature is 472.22°C.

6. Odor and Warning Properties

Vinyl chloride has a mild, sweetish odor. The odor is not an adequate warning property for excessive exposure.

VINYLDENE CHLORIDE, $\text{CH}_2=\text{CCl}_2$ (1,1-Dichloroethylene)

1. Uses and Industrial Exposures

Vinyldene chloride is used as a chemical intermediate, particularly as a monomer in the production of plastics.

2. Physical and Chemical Properties

Physical state: clear colorless liquid

Molecular weight: 96.95

Specific gravity: 1.218 (20°/4°C.)

Freezing point: -122.5°C.

Boiling point: 31.7°C.

Vapor density: 3.34 (air = 1)

Vapor pressure: 591 mm. Hg (25°C.)

Refractive index: 1.427 (20°C.)

Per cent in "saturated" air: 78

Density of "saturated" air: 2.8 (air = 1)

Solubility: insoluble in water; soluble in organic solvents

Flash point: -15°C. (open cup)

1 mg. liter $\approx$ 252 p.p.m. and 1 p.p.m. $\approx$ 3.97 mg. cu. meter at 25°C., 760

mm. Hg

^{102a} T. R. Torkelson, F. Oyler, and V. K. Rowe, *Am. Ind. Hyg. Assoc. J.*, **22**, 351 (1961)