

TOXICOLOGY AND HYGIENE OF INDUSTRIAL SOLVENTS

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This translation has been prepared for the use of Dr. A. G. Cranch and Dr. H. F. Smyth, Jr.

Page numbers of the original German text are indicated in the left margin at the beginning of the translation of each page.

In many cases nomenclature has been changed to agree with American usage. Wherever possible concentration data has been expressed in p.p.m. or volume percent (10,000 p.p.m. = 1 Vol.%), in addition to the mgm. per liter figures of the original. The conversion factor has been added to the physical properties section under each solvent name. Other editorial changes have been held to a minimum. No attempt has been made to change the descriptions to agree with current American industrial methods. Unfortunately, it has proved impossible to be consistent in the listing of literature references.

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The paralyzing effect occurs much more slowly than with chloroform. Local irritating effect when it is introduced into the gastro-intestinal tract. No corneal clouding. The antiseptic effect is stronger than with pentachloroethane (Jocchioglu, 1921).

Hexachlorethane is, without doubt, a very toxic substance. On frog hearts it proved to be 10 times more effective than pentachloroethane. No liver injury was found in dogs after inhalation (Maloff, 1923). When used in animal therapeutics, however, gastro-intestinal irritating symptoms and kidney injuries were observed (Tapernoux, 1930).

Industrial poisonings are unknown. They would come into consideration with industrial products which contain hexachlorethane, e.g. with spraying. However, the danger of a poisoning by the inhalation of vapors is slight (Literature: Binz, 1894, Kieselring, 1921, Jocchioglu, 1921, Maloff, 1923, Tapernoux, 1930).

Monochlorethylene
(Vinyl Chloride)

Formula: $\text{CH}_2 = \text{CHCl}$

Molecular weight: 62.48. 1 mg. per liter = 391 p.p.m.

General properties: b.p. -18°C . Easily soluble in alcohol and organic solvents. Combustible, but less explosive than ether. Gaseous at ordinary temperature. The odor is weak, similar to ethyl chloride, sweetish. When diluted is practically odorless. Colorless gas, hence not a solvent. Nevertheless, the substance will be treated here for the sake of comparison.

General character of effect. Local irritating effect very slight. Highly narcotic. Great distance between narcotic and dangerous concentrations. General toxic effect very slight. Metabolic injuries have not been detected as yet. Recommended especially for supplementary narcosis with laughing gas and oxygen (Schaumann, 1934).

Absorption occurs very quickly.

Distribution. In narcosis the blood contains 15-17 mg. %. Elimination occurs very quickly, more quickly than with ether or chloroform. After 10 minutes 82% was eliminated (Schaumann).

Animal experiments. According to experiments carried out by Schaumann (some of which are still unpublished), vinyl chloride is very suitable for narcosis, that is, for supplementary narcosis, on account of its slight toxicity, its wide range of effect, its low concentration in the blood and its particularly rapid elimination. Within the narcotic limiting doses heart and blood pressure are not influenced to any extent. High concentrations increase the blood pressure. There are no secondary or after-effects.

Mice and rats were able to endure slight vinyl chloride narcosis for 5-8 consecutive days for 4 hours at a time, and every day for four weeks for 1 hour at a time without liver and kidney injuries.

Dogs, which were able to endure repeated narcoses, as many as 7 in 3 weeks, each lasting 3 hours at 10 Vol. % showed no considerable organ changes in the liver and kidneys. With dogs at 20 Vol. % respiratory paralysis, strong flow of saliva, and, after narcosis, vomiting occurred.

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Further experiments were carried out by Peoples and assistants, 1933, on mice, rabbits and dogs, and by Patty and assistants, 1930, on guinea pigs. These authors obtained essentially the same results, especially in regard to the comparative harmlessness even after repeated narcosis.

According to Schaumann the narcotic limiting concentration for humans is 7 - 10 Vol. %. Above 12 Vol. % it is dangerous.

20 - 40 Vol. % is fatal for guinea pigs in a short time, 10 Vol. % is endured for several hours (Patty, Yant, Waite, 1930).

For mice the smallest concentration which is fatal in 10 minutes is 10 - 12 millimol/l = about 25 - 30 Vol. %, about 3.5 - 5 millimol/l = about 8 - 12 Vol. % is the smallest narcotic concentration (Peoples and Leake, 1933).

Death occurs due to respiratory paralysis with resultant arrest of the heart's action.

The toxic effect of vinyl chloride is much slighter than that of chloroform and that of carbon tetrachloride. According to Patty and assistants, it is about equal to that of ethyl chloride. According to Schaumann the effect on the heart is even less than that of ether.

In animal experiments the respiration is at first increased, then becomes irregular, is flattened out and slowed down, but it remains regular in narcosis.

Dissection. Hyperemia of the lungs and kidneys, pulmonary edema. Schaumann found no serious pathological changes after repeated narcosis in dogs, mice, and rats.

Effect on humans. Confusion, intoxication, burning of the soles of the feet and other subjective disturbances, head-aches. Recovery takes place very quickly (Dublin and Vane, 1935).

Industrial poisonings are not known. - Vinyl chloride is one of the least dangerous of the chlorinated hydrocarbons.

Dichlorethylene-(1.2)

Symmetrical dichlorethylene, a mixture of cis- and trans- compound.

Formula: $C_2H_2Cl_2$

Molecular weight: 96.94. 1 mg. per liter = 252 p.p.m.

General properties: b.p. about 55.0°C. Sp. gr. 1.25. Difficultly combustible, not inflammable, but can be decomposed in open flames. Very volatile.

Solvent for acetyl cellulose, resins, waxes; the manufacture of synthetic pearls, the extraction of rubber, the refrigeration industry. Was also used as a narcotic for a time.

General character of effect. Strong irritating effect, corneal clouding. Narcosis, muscular spasms. Toxic effect comparatively slight. Metabolic injuries when the effect lasts for a longer period.

The mixture consists of stereo isomers, the cis form boiling at 39°C and the trans form at 48°C.

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