VINYLTRICHLOROSILANE

Document History:
Published: 2002
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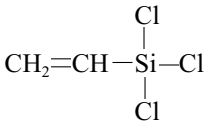
I. IDENTIFICATION

Chemical Name: Vinyltrichlorosilane
Synonyms: Trichlorovinylsilane; trichlorovinylsilicon; vinylsilicon trichloride; silane, trichlorovinyl; silane, trichloroethenyl; trichlorovinyl silicane
CAS Number: 75–94–5
DOT: UN1305
Molecular Formula: $C_2H_3Cl_3Si$
Structural Formula:



II. CHEMICAL AND PHYSICAL PROPERTIES[1-4]

Physical State and Appearance: Colorless or pale yellow liquid.
Odor Description: Sharp acid odor is like hydrogen chloride, which is a hydrolysis product of vinyltrichlorosilane.
Odor Threshold: No odor threshold is available, but it may be between 0.1 and 3 ppm based on hydrogen chloride.
Molecular Weight: 161.49
Conversion Factors: 1 mg/m³ = 0.15 ppm v/v;
1 ppm v/v = 6.6 mg/m³
Boiling Point: 91ºC (196ºF) at 760 mm Hg
Vapor Pressure: 65.9 mm Hg at 25ºC (77ºF)
Saturated Vapor Concentration: 79,000 ppm at 25ºC (77ºF)
Vapor Density (Air = 1): 5.61
Specific Gravity: 1.3
Flammability Limits: LEL 3%; UEL not reported
Flash Point (closed cup): 52ºC (126ºF)
Autoignition Temperature: 263ºC (505ºF)
Solubility in Water: Reacts with water to form HCl.
Stability and Reactivity: Reacts violently with water, moist air, or steam. Polymerizes easily, reacts with alcohol.

III. USES

It is used as a monomer for copolymers in water repellents, electrical insulating resins, and high temperature resins for paints. It is also an intermediate for silicones and a coupling agent in adhesives.[1]

IV. ANIMAL TOXICOLOGY DATA

A. Acute Toxicity

1. *Oral Toxicity*

LD_{50}, in rats: 1280 mg/kg[5]

2. *Eye Irritation*

Severe eye irritant based on 0.5 ml instilled into the eye of rabbits[5,6]

3. *Skin*

a. Absorption: LD_{50} in rabbits: 680 uL/kg (approximately 884 mg/kg)[5]
b. Irritation: Severe skin irritant based on a dose of 625 mg on rabbit skin (non-occluded)[2]
c. Sensitization: No data available.

4. *Inhalation Toxicity*

1-hr LC_{50}, rat: 1611 ppm (nominal)[7]
4-hr LC_0, rat: 2000 ppm[5]
4-hr LC_{100}, rat: 4000 ppm[5]
4-hr LC_{LO}, rat: 500 ppm[2]

In the 1 hr LC_{50} study,[7] respiratory, eye, nasal, soiling, and activity effects were noted during the 14-day observation period. However, by the end of the 14-day observation period, no significant test article-related clinical signs were noted in the surviving animals. Test article-related gross pathological findings were noted in the lungs, eyes, nasal region, intestinal tract, and

external body condition of animals who died during the 14 day observation period. At the terminal sacrifice, no significant test article-related gross pathological findings were noted in the surviving animals.

B. Subacute Toxicity

No data available.

C. Subchronic Toxicity

No data available.

D. Chronic Toxicity/Carcinogenicity

No data available.

E. Reproductive/Developmental Toxicity

No data available.

F. Genotoxicity/Mutagenicity

No data available.

G. Metabolism/Pharmacokinetics

No data available.

V. HUMAN USE AND EXPERIENCE

Although no direct data were located on the toxicity in humans, workplace exposure, or epidemiological findings, effects on humans can be predicted based on the results of animal studies. It is evident that vinyltrichlorosilane and its hydrolysis products will cause corrosive damage to the skin, eyes, and respiratory tract. Warnings about these anticipated effects have been reported in several references.[1-4] The vapor of vinyltrichlorosilane reacts with moisture in the air and with the aqueous fluid of mucous surfaces, producing hydrogen chloride. It is generally held that workers are protected by maintaining the concentration of vinyltrichlorosilane vapor below the level that produces an irritating concentration of hydrogen chloride. The American Conference of Governmental Industrial Hygienists[8] (ACGIH) Threshold Limit Value (TLV®) and the OSHA[9] permissible exposure limit (PEL) for exposure to hydrogen chloride are a 5 ppm ceiling, a concentration that is low enough to avoid injury but may cause slight or moderate respiratory irritation. Most people can detect hydrogen chloride at 1 ppm.[4]

VI. RATIONALE

The toxic effects of vinyltrichlorosilane are qualitatively similar to those of hydrogen chloride; each causes severe tissue burns by all routes of exposure. When one mole of vinyltrichlorosilane reacts with water, three moles of hydrogen chloride are released so it would be expected that the inhalation toxicity of these two chemicals would be very similar in their effects on the upper respiratory system with vinyltrichlorosilane being about three times as toxic as hydrogen chloride on a molar (ppm) basis. Comparative studies in rats on the qualitative and quantitative effects of a one hour inhalation exposure to vinyltrichlorosilane and to hydrogen chloride showed marked similarities.[7,10] The rat 1 hr LC_{50} is 1611 ppm for vinyltrichlorosilane and the rat 1 hr LC_{50}s for hydrogen chloride are 2910–3124 ppm[11] and 3627 ppm.[10] These data indicate that vinyltrichlorosilane may be slightly less acutely toxic than would be predicted based on the hydrogen chloride produced upon hydrolysis. The 1-hr LC_{50}s for hydrogen chloride divided by three gives approximately 1000–1200 ppm vs. the 1600 ppm measured for vinyltrichlorosilane. The TLV® and PEL values for hydrogen chloride are both 5 ppm ceilings. This would suggest that a suitable OEL value would be 5 ppm divided by 3 (1.67 ppm) or approximately 1 ppm as a ceiling. This OEL is also consistent with the existing WEELs of 0.5 and 1 ppm as ceilings for the two chemically similar chlorosilanes, trichlorosi-lane, and methyltrichlorosilane.

VII. RECOMMENDED OEL

Based on the considerations given above, it is recommended that the OEL Guide for vinyltrichlorosilane be set at 1 ppm as a ceiling.

VIII. REFERENCES

1. The following databases were searched in developing the 2002 WEEL:
   TOXNET
2. **MDL Information Systems:** "Material Safety Data Sheet for Vinyltrichlorosilane." Nashville, TN: MDL Information Systems, 1998.
3. **Dow Corning Corporation:** "Material Safety Date Sheet for Vinyltrichlorosilane." Midland, MI: Dow Corning Corporation, 1998.
4. **Dow Corning Corporation:** "Properties and Essential Information for Handling and Use of Chlorosilanes." Midland, MI: Dow Corning Corporation, 1989.
5. **Smyth, H.F., C.P. Carpenter, C.S. Weil, and Y.C. Pozzani:** Range Finding Toxicity Data. *Arch. Ind. Hyg. Occ. Med.* 10:61–68 (1954).
6. **Grant W.M.:** *The Toxicology of the Eye, 2nd Ed.* Springfield, IL: Charles C. Thomas, 1974.
7. **Dow Corning Corporation:** *An Acute Whole Body Inhalation Toxicity Study of Vinyltrichlorosilane in Fischer 344 Rats* by G. Kolesar, L. Dochterman, S. Mudgett, M. Macomber, and J. Tobin. (Report Number: 1997–I0000–44079). Midland, MI: Dow Corning Corporation, 1999. pp. 1–141.
8. **American Conference of Governmental Industrial Hygienists:** *1999 TLVs® and BEIs® Documentation of the Threshold Limit Values and*

Biological Exposure Indices. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, 1999.

9. "Limits for Air Contaminants." *Code of Federal Regulations* Title 29, Part 1910.1000, Table Z-1-A. 1990.
10. **Dow Corning Corporation:** *An Acute Whole Body Vapor Inhalation Toxicity Study With Hydrogen Chloride in Albino Rats* by W. Siddiqui, G. Kolesar, and S Mudgett. (Report Number: 1999–I0000–46029). Midland, MI.: Dow Corning Corporation, 1999. pp. 1–107.
11. **American Industrial Hygiene Association:** *Emergency Response Planning Guidelines – Hydrogen Chloride.* Fairfax, Va.: American Industrial Hygiene Association, 1999.