DR-0114-1986 VINYL CHLORIDE REPORT

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THIS REPORT DOES NOT SUBSTITUTE FOR AN MSDS AND IS NOT INTENDED FOR INCLUSION IN WRITTEN HAZARD COMMUNICATION PROGRAM MANUALS

IT IS DESIGNED AS A REFERENCE TO HELP PRESENTERS PREPARE FOR AND PRESENT OCCUPATIONAL HEALTH/RTK TRAINING SESSIONS USING PICCS (Pictographic Chemical Communication System) MATERIALS

PICCS-based training aids including introductory videotapes, overhead projection transparencies, and PICCS sets on specific chemical materials and chemical groups may be obtained by calling Octavia Cabey, H & E S Information Center, (517) 636-0244 (overheads also available via TIME reporting system). Presenter training (eg. Train The Trainer Workshops) is also available.

ALL PICCS PRESENTERS SHOULD READ AND UNDERSTAND THIS REPORT BEFORE CONDUCTING EMPLOYEE TRAINING ON THIS MATERIAL.

The information in this report is arranged in the same sequence as in PICCS training sets. Titles from the PICCS sets have been inserted into this report to guide you.

This report and the PICCS sets of visuals on this material present recommendations for protective equipment and methods based on available information. ACTUAL PROTECTION REQUIREMENTS ARE SET BY OPERATING UNITS and may vary somewhat from the recommendations due to such considerations as physical surroundings and other chemical materials present.

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G E N E R A L
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DOW Registory Number: DR-0114-1986
NAMES
Common: VINYL CHLORIDE
SYNONYMS: CHLOROETHENE
VCM
MONOCHLOROETHYLENE

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PICCS PAGE 1: "BASIC HANDLING PRECAUTIONS"
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CHEMICAL AND PHYSICAL PROPERTIES
This data compiled from various sources and not verified.

APPEARANCE: GAS (COLORLESS)

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MOLECULAR WEIGHT: 62.5
BOILING POINT: -13.8 C
MELTING POINT: -153.71 C
VAPOR PRESSURE: 2590 torr @ 20 C
MAX AIRBORNE CONC: 2.15
FLASH POINT: -78 C (0 C)
STABILITY/REACTIVITY: may produce peroxides
ODOR DESCRIPTION: sweet, ethereal (threshold varies greatly)
WARNING PROPERTIES
- Odor is inadequate warning of excessive exposure.
- Reported odor thresholds vary greatly (300-4000 ppm).

"GENERAL HAZARDS"

POTENTIAL HEALTH EFFECTS

This section presents a general summary of the hazard of the subject chemical or mixture to the eyes or skin and by inhalation or ingestion. The hazard levels given are based upon the levels of overexposure that might reasonably occur in a controlled industrial or occupational setting with properly trained adult workers. Accidents and other rare or severe circumstances were not considered in assigning these general hazard levels, since any chemical can produce extreme damage if the dose is sufficiently high. This section is intended only as a general hazard guide for prudent work practice conditions.

ICON REPRESENTATION:
- A single short exposure of the eyes can cause injury but generally not of a severe or permanent nature.
- A single short exposure of the skin to the liquid can cause injury but generally not of a severe or permanent nature.
- A single short exposure by inhalation may cause severe injury but generally not of a permanent nature.
- A single short exposure by ingestion generally will not cause injury unless exposure is particularly intense.

(Hazard classifications shown by icons above based upon effects information given below under "PICCS Page 2".)

"ACCEPTED EXPOSURE LIMITS"

Vinyl chloride: ACGIH TLV is 5 ppm, Ala. OSHA PEL is 1 ppm.

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DEFINITIONS:

TLV-TWA: Threshold Limit Value Time-Weighted Average concentration for a normal 8-hr. workday and a 40-hr. workweek to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

CEILING: A special TLV concentration that should not be exceeded even instantaneously.

STEL: A special TLV concentration to which workers can be exposed continuously for a short period of time without suffering from (1) irritation, (2) chronic or irreversible tissue damage, or (3) narcosies sufficient to increase likelihood of accidental injury, impair self-rescue, or reduce work efficiency provided TLV_TWA is not exceeded.

PEL: Permissible Exposure Limit concentration usually meaning a work-shift TWA.

WEEL: Workplace Environmental Exposure Level meaning the same as a TLV_TWA.

IHG: Industrial Hygiene Guide is the internal Dow guideline for 8-hr. TWA exposure to airborne concentrations of materials. The lower value of TLVs, WEELs, PELs, or IHGs are used by Dow unless specifically noted otherwise.

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PICCS PAGE 2: "POTENTIAL EFFECTS OF EXPOSURE TO HAZARDOUS AMOUNTS"
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This section includes possible adverse effects which could occur if this material is not handled in the recommended manner.

EYE EFFECTS

If the liquid under pressure were to contact the eye severe injury to the cornea and soft tissues might result (R-1).
- If liquid contacts eye, evaporation may cause frostbite-type injury due to rapid cooling.

SKIN EFFECTS

If the liquid under pressure were to contact skin a frost-bite type burn could result (R-1). Skin absorption unlikely since material is a gas at room temperature.
If liquid contacts skin, evaporation may cause frost-bite type injury due to rapid cooling.
- Skin absorption is unlikely due to physical properties.

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SITE ORAL EFFECTS

Under room temperature conditions VCM is a gas so the likelihood of ingestion is essentially nil.
- Ingestion is unlikely due to physical state.

ACUTE INHALATION EFFECTS

Early animal experiments were limited to short-term exposures to VCM vapors varying between 50,000 and 400,000 ppm (R-2, R-3, R-4, R-5, R-6, R-7, R-9) in mice, rats, guinea pigs, rabbits and dogs: anesthesia, deep narcosis, cardiac arrhythmias and lethal effects were observed in this range of exposure but no relevant organ pathology was noted except for congestive and hemorrhagic changes in lungs, liver and kidneys on fatal events. 2-hour LC50's are reported as follows: 413,000 ppm in mice, 150,000 in rats, ≥30,000 ppm in guinea pigs, and 117,000 in rabbits (R-32). The primary acute physiological effect of VCM is depression of the central nervous system which begins to occur at concentrations of 8,000-10,000 ppm in humans (R-7). Two cases of accidental industrial fatalities have been reported (Danziger in R-7). There have been suggestions of a delayed carcinogenic response following massive acute exposures (R-9).
- A single brief (minutes) inhalation exposure to easily attainable concentrations may cause serious adverse effects, even death.
- Signs and symptoms of excessive exposure may be anesthetic or narcotic effects.
- Signs and symptoms of excessive exposure may be central nervous system effects.

SUBCHRONIC EFFECTS

Torkelson et al (R-10) conducted repeated exposure studies on animals for 7 hrs/day, 5 days/week for 4.5 to 6 months. At 500 ppm rats showed increased liver weights and histopathology. At 100 and 200 ppm rats showed increased liver weights but no changes were observed in dogs and guinea pigs. All species tolerated 50 ppm for 6 months with no observed adverse effects. Repeated exposures for 1 hr/day at 100 and 200 ppm showed no observable effects. Liver effects that were observed in this study were mild and apparently reversible since they were not observed in rats kept 6-8 weeks after the 6 month exposures ceased. See CHRONIC section also.
- Excessive exposure may cause lung, liver and kidney effects.
- Repeated exposures have been reported to produce changes in bone, skin and vascular system, particularly in the extremities of the body.

PHARMACOKINETICS/METABOLISM

Numerous studies indicate that probably a reactive metabolite, not vinyl chloride per se, is responsible for its toxicity. Although some inhaled vinyl chloride is excreted unchanged, depending on the dose, a varying fraction is metabolized. The metabolism of vinyl chloride has been the subject

...numerous recent studies which need confirmation and interpretation. Currently it is thought that vinyl chloride is metabolized by epoxidation with subsequent production of chloroacetaldehyde. Further oxidation and conjugation with glutathione are responsible for the metabolites found in urine. Gehring et al. analyzed the metabolic and carcinogenic data from man and laboratory animals. Using several models to predict the incidence in man from animal data, they found that all models overpredicted unless corrections were made for rates of metabolism and for surface area of the different species (R-33).

MUTAGENICITY

Several studies have been conducted that demonstrate a mutagenic response to VCM or its metabolites in bacterial and yeast systems. Point mutations due to base pair substitution have been produced in various strains of S. Typhimurium by VCM in the presence of animal and human liver microsomes as a system of metabolic activation (R-18,19,20,21,22). Mutagenicity of VCM metabolites has also been demonstrated in yeast strains (R-23,24,25) and in mammalian cells (R-26). In agreement with a number of other studies, Purchase, et.al. (R-27) reported that 57 workers occupationally exposed to vinyl chloride had an increase in the incidence of chromosomal abnormalities in their lymphocytes by comparison with 24 control workers. Since that time (July 1974) threshold limit values for vinyl chloride and plant exposure levels have been reduced. In a study by Anderson et al (R-25), 2 further samples from the same population of workers have been analyzed for chromosomal aberrations 18 and 42 months after the initial sampling. At 18 months, 21 VCM workers and off-site controls were investigated as were 23 workers on 8 on-site controls at 42 months. In the second sampling there was a tendency to an increase in chromosomal abnormalities of VC-exposed workers except in those people who had changed occupation. By the third sampling, however, there was a decrease by comparison with previous samplings and the levels of abnormalities had returned to values similar to those of the controls. Thus, reduction in exposure to vinyl chloride is accompanied by a reduction in the chromosomal abnormalities to levels indistinguishable from those of controls. Levels of VC as high as 30,000 ppm in the inspired air produced no dominant lethal mutations in mice, indicating that chromosomal changes in humans would not reach the germ cells.(R-27)

- Has been shown to have mutagenic activity in bacteria.
- Results of mutagenicity tests in animals have been negative.
- An increased incidence of chromosomal abnormalities has been reported in the lymphocytes of workers exposed to vinyl chloride; the chromosomal breakage frequency returns to normal after reduction of exposure levels.

CHRONIC EFFECTS/CARCINOGENICITY

Early pioneer work was conducted by Viola et al (R-11) who exposed rats to 30,000 ppm VCM 4 hrs/day, 5 days/week for a full year. Histopathological

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examination revealed lesions similar to human acroosteolysis and nontumorous liver disease observed in PVC (polyvinyl chloride) workers 2 yrs later (R-12). Viola was also first to report carcinogenicity in animals (10th Int. Canc. Congress in Houston, Texas, May 1970). In 1970 Maltoni executed a series of studies designed to evaluate the effects of VCM exposure as affected by experimental factors such as route of administration, dose level, length of treatment, species, sex, strain and age of animals. These studies and those of many other investigators produced a wide variety of tumors, particularly at high concentrations. In a summary paper Maltoni states that liver angiosarcoma, carcinoma of the Zymbal glands, nephroblastoma, neuroblastoma, mammary adenocarcinoma, forestomach papilloma and acanthoma, extrahepatic angiosarcoma and hepatoma in the rat were correlated with exposure to vinyl chloride (R-13). Angiosarcomas were observed at 10 ppm by inhalation and 0.3 mg/kg by gavage, but none of the above tumors were seen at lower doses by either route of administration. There appeared to be marked differences between strains and species of animals with mice being more susceptible than rats which are more susceptible than hamsters. Regarding angiosarcomas of the liver, all species appear more susceptible than man. It's of interest that in 1975 Maltoni and Lefemine (R-14) reported a potential transplacental carcinogenic effect suggested by the development of subcutaneous agiosarcomas in the offspring of breeding animals exposed for 7 days during pregnancy (R-15). By far the most significant toxicological property of VCM is that of carcinogenicity. There appears to be no question that angiosarcoma of the liver has resulted from excessive vapor exposure to VCM in industry primarily while cleaning reactor vessels. Angiosarcomas in humans are consistent with the results of animal studies in which these tumors have been produced in various species in several independent studies. However, epidemiological evidence is inconsistent from one study to another regarding other cancers and chronic toxic effects such as liver injury, splenomegaly, blood changes, respiratory injury, etc. Effects most consistently observed in workmen exposed to VCM vapors industrially are: acroosteolysis, scleroderma, Raynauds syndrome or phenomenon, and angiosarcoma of the liver. VC is an A1/R45 material (confirmed human carcinogen) under MAK and in Austria, an R45 material (may cause cancer) in Norway and Sweden under SEC and a 2R/S103 material (restricted in use) in Finland. A citation relative to cancers other than angiosarcomas concerns melanoma in PVC workers (R-55).

- Has been shown to cause cancer in humans.
- Has been shown to cause cancer in laboratory animals.
- For hazard communication purposes under OSHA Standard 29 CFR Part 1910.1200, this chemical is listed as a carcinogen by NTP, IARC, and OSHA.

TERATOGENIC EFFECTS

VCM appears not to be teratogenic in laboratory animals. Jones et al (R-16) exposed mice, rats and rabbits to 500 ppm VCM 7 hrs daily during organogenesis. Mice were also exposed to 50 ppm and rats and rabbits to 2500 ppm. Maternal toxicity was observed mostly in mice, but the exposure produced no significant embryonal or fetal toxicity or teratological effects. Ungvary et al (R-17) exposed pregnant rats continuously to 1500 ppm during first,

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second or third trimesters of pregnancy with no teratogenic effects. Exposure during the 1st trimester only resulted in fetal mortality and other fetotoxic effects, but no teratology. Available data indicate that VCM is not teratogenic to humans.
- Birth defects are unlikely. Exposures having no effect on the mother should have no effect on the fetus. Did not cause birth defects in animals; other effects were seen in the fetus only at doses which caused toxic effects to the mother.

REPRODUCTIVE EFFECTS

OTHER EFFECTS

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ICCS PAGE 3. "PROTECTION"
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VENTILATION
- Control airborne concentrations below the exposure guideline.
- Use only with adequate ventilation.
- Local exhaust ventilation may be necessary for some operations.

INGESTION
- Use good personal hygiene. Do not consume or store food in the work area. Wash hands before smoking or eating.

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"PERSONAL PROTECTION"
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HANDLING PRECAUTIONS AND PROTECTIVE EQUIPMENT
These recommended precautions are intended for use during normal operating conditions; emergency conditions could require additional precautions.
EXPLANATION OF POTENTIAL EXPOSURE CATEGORIES

The following categories are based on the conditions of use or manufacture and the physical properties of the material and should be used to determine the appropriate handling precautions for potential eye, skin and inhalation exposures. They are intended to be used for different work tasks -not necessarily for a job classification because the exposure potential may vary during the work day.

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W: No more than minor amount of contact is likely.
(For example: work around closed systems; use of ventilated equipment; handling of material in small amounts or with very low vapor pressure)

MODERATE: Moderate amount of contact could occur.
(For example: sampling, packaging, or dumping of materials with moderate to low volatility or dustiness; similar handling of material with high volatility or dustiness but with some ventilation provided)

HIGH: High amount of contact is possible, even if for brief periods.
(For example: sampling, packaging or dumping of materials with high volatility or dustiness without ventilation; manually cleaning, draining or repairing equipment; changing filters; cleaning spills)

LOW EXPOSURE POSSIBLE
EYE - Use safety glasses.
SKIN - No precautions other than clean body-covering clothing should be needed.
INHALATION - For escape purposes, carry an approved air-purifying respirator on person at all times.

MODERATE EXPOSURE POSSIBLE
EYE - Use safety glasses.
SKIN - Use protective clothing impervious to this material. Selection of specific items such as gloves, boots, apron, or full-body suit will depend on operation.
INHALATION - Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required for certain operations, use an approved air-purifying respirator.

HIGH EXPOSURE POSSIBLE
EYE - Use chemical goggles.
- If vapor exposure causes eye discomfort, use a full-face, supplied-air respirator.
SKIN - Use protective clothing impervious to this material. Selection of specific items such as gloves, boots, apron, or full-body suit will depend on operation.
INHALATION - When airborne exposure guidelines and/or comfort levels may be exceeded, use an approved positive-pressure self-contained breathing apparatus.

PROTECTIVE EQUIPMENT INFORMATION
- There is no protective clothing test data available for this chemical. Data for related chemicals indicate that the following should be effective protective clothing materials: Nitrile butadiene rubber and Viton*.
- The following should be effective types of air-purifying respirators:

FOR MORE INFORMATION CONTACT YOUR LOCAL INDUSTRIAL HYGIENIST

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"RESCUE"

---------- EMERGENCY TREATMENT AND MEDICAL NOTES --------

EYE
- Irrigate immediately with water for at least 5 minutes.

SKIN
- No adverse effects anticipated by this route of exposure except for frostbite.

INGESTION
- No adverse effects anticipated by this route of exposure due to physical properties.

INHALATION
- Remove to fresh air. If not breathing, give mouth-to-mouth resuscitation. If breathing is difficult, give oxygen. Call a physician.

FOR ADDITIONAL INFORMATION CONTACT:
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