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RISK OF LIVER CANCER FROM VCM COULD HAVE BEEN OVERSTATED SAYS REPORT

A preliminary report published today suggests that the hazard from the chemical VCM to workers employed in the manufacture of PVC or PVC products and to the general public living around the plants involved might not be as great as was first supposed. VCM (vinyl chloride monomer) is the gas used in the manufacture of polyvinyl chloride (PVC). The report, published today (October 7) in the British Medical Journal, is written by Dr. Peter Baxter of the Health and Safety Executive's Employment Medical Advisory Service (EMAS) and three other medical experts.

In 1974, medical findings from the US indicated for the first time that workers engaged in the manufacture of PVC were at risk from developing liver cancer (angiosarcoma). Urgent action by the Health and Safety Executive in collaboration with both sides of the chemical industry resulted in levels of exposure to VCM being drastically reduced in the six British plants involved.

The report says that out of a total of 47 reported cases of angiosarcoma of the liver in the ten-year period 1963-73, in only 14 was the diagnosis verified and out of these only one could be confidently associated with workplace exposure to VCM. It also says that the overall incidence of angiosarcoma did not appear to be geographically linked with the location of factories dealing with the chemical, although there was one confirmed case of angiosarcoma in a man who had lived within half-a-mile of a PVC factory for six years before his death. There was no indication of angiosarcoma having arisen through swallowing minute amounts of VCM, for example, from plastic food wrappings.

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Out of 47 deaths in the period which were attributed to angiosarcoma, says the report, 37 had sufficient information supplied by hospitals for the data to be scrutinised by the panel of medical experts. Where the cause of death could be definitively agreed as angiosarcoma (14 cases), full occupational and residential case histories were obtained and analysed in 12 whose next-of-kin could be traced. In the one case where workplace exposure could be associated with the worker's fatal illness, he had been exposed to VCM levels probably exceeding 200 parts per million in air for over 20 years. (The current agreed level in this country for worker exposure which is enforced by the Factory Inspectorate is ten parts per million in air over an eight-hour day.)

The authors of the paper point out that their findings are generally reassuring in that not only does the annual incidence of angiosarcoma appear to be in single figures, in a population of about 50 million, but exposure to VCM seems to have been responsible for only one death over the whole ten-year period. However they say that there remains a possibility that angiosarcoma may be associated with VCM at low exposures so a close watch on the occurrence of this tumour should be maintained.

The paper, "Angiosarcoma of the liver in Great Britain, 1963-73", gives the results of a preliminary study, which is now being extended to include all known cases of angiosarcoma occurring from 1974 onwards. This survey is being undertaken by EMAS, as is a full survey of all causes of death among workers engaged in PVC manufacture. This work parallels studies set up in a number of industrialised countries since 1974.

An EMAS spokesman commented: "These findings give us grounds to hope that this chemical will turn out to be less of a cancer risk than was originally supposed when the American findings were announced. The single case of a man living near a PVC factory who died from angiosarcoma is insufficient evidence to draw any conclusions at this stage."

The period 1963-73 was chosen for study in order to discover the frequency of angiosarcoma of the liver and to evaluate any trends on its incidence before the time when a relationship between occupational exposure to VCM and liver cancer became known in 1974.

A first report of the full survey of all causes of death in men engaged in PVC manufacture in Great Britain was published in the British Journal of Industrial Medicine in February 1977. It showed that up to the end of 1974 there were two deaths from angiosarcoma of the liver involving workers exposed to VCM: one, a man who died in 1971, is included in the present report; the other occurred in 1974 and is outside the study period of the present report. Since then no other cases of angiosarcoma are known to have occurred among British workers engaged in PVC manufacture.



Ontario

Ministry of
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Data Sheet No. 21

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VINYL CHLORIDE MONOMER

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Description

Vinyl chloride monomer (VCM) is manufactured by thermal dehydrochlorination of ethylene dichloride or by hydrochlorination of acetylene. It can be polymerised to form polyvinyl chloride (PVC), or copolymerised with other monomers to form copolymer plastic materials. It has been used in the United States of America but not in Canada as a propellant in pressurised spray containers.

It is a colourless flammable gas at normal conditions of temperature and pressure but it is usually stored and transported as a liquid under its own vapour pressure. It has a pleasant ethereal odour and is practically insoluble in water, but soluble in alcohol, ether and carbon tetrachloride.

Chemical Formula	$\text{CH}_2 = \text{CHCl}$
Molecular Weight	62.5
Boiling Point	-13.37°C (7.9°F)
Density (Vapour)	2.15 (Air = 1.00)
(Liquid)	0.9121 g/ml $20/20^\circ\text{C}$
Flash Point	-78°C (-108°F)
Auto-ignition Temp.	472°C (882°F)
Explosive Limits	4-22% by volume in air

Occupational Exposure

Exposure to vinyl chloride may occur in the manufacture of the monomer and also in the polymerisation process. Loading and unloading of tank cars and trucks also represents an exposure risk. The polymerisation process is the main source of exposure especially when cleaning the polymerisation kettle. The polymer usually contains unreacted VCM which is partially given off in the drying process, packaging operation and storage. Residual monomer may be given off during mixing, compounding and extrusion of polyvinyl chloride. Excessive heat leads to decomposition of PVC and the formation of hydrochloric acid gas, carbon monoxide, carbon dioxide and possibly traces of phosgene and other gases.

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No VCM is produced when the polymer is decomposed. PVC products do not constitute any known health hazards.

Supply

VCM is supplied in tank cars and tank trucks as a liquid under its own vapour pressure, and by pipeline under pump pressure.

Health Aspects

VCM is detectable in air by odour at 1800 to 2000 ppm. Acute exposure at 4000 ppm for five minutes or more has been reported to produce dizziness and confusion. Higher concentrations may lead to unconsciousness and death.

Chronic exposure has been reported in a few cases to cause scleroderma-like skin changes, Raynaud's syndrome, vascular changes, acro-osteolysis, thrombocytopenia, splenomegaly, esophageal varices, liver fibrosis and pulmonary disturbances. VCM has been recently reported to be carcinogenic, with angiosarcoma of the liver occurring among a small number of polymerisation workers. Acro-osteolysis has been reported as occurring in some manual cleaners of polymerisers.

Threshold Limit Value

The American Conference of Governmental Industrial Hygienists recommendation for 1973 is 200 parts per million (ppm) or 510 mg/m³. This is reported, subject to change, pending investigation underway.

For the present, the Occupational Health Protection Branch, Ontario Ministry of Health, is using a time-weighted average of 10 ppm during an eight-hour day and a ceiling level of 25 ppm as measured over a 15 minute time period.

Precautions to be Observed

Engineering

1. Operations are to be carried out in closed systems wherever possible.
2. Those operations that cannot be contained are to be fully enclosed and provided with local exhaust.
3. PVC polymer storage areas are to be adequately ventilated.
4. Adequate mechanical general exhaust is to be provided in all process areas.

5. For entry into vessels all precautions for entering confined spaces are to be followed. For certain vessels (e.g. polymerisation kettles), air supplied respirators and protective clothing may be required.
6. Monitoring of work areas is to be provided where potential high exposure may occur. Depending on the severity of the potential exposure, monitoring may be intermittent or continuous.
7. A carefully controlled maintenance program is to be carried out to reduce the possibility of leaks and spills to a minimum.
8. In clean up of spills or leaks, protective clothing including an air supplied respirator is to be worn.
9. During maintenance or repair work or any operation where a worker is liable to have a high exposure, protective clothing including an air supplied respirator is to be worn.
10. Emergency procedures are to be developed, including evacuation of personnel, for areas where it is possible to have a serious leak of VCM.
11. No food, drink, or tobacco are to be permitted in the exposure area.
12. No eating, drinking, chewing or smoking are to be permitted in the exposure area.
13. Safety showers and eye wash fountains are to be provided in VCM manufacturing, storage, loading and unloading and polymerisation areas.
14. For persons who handle PVC powder containing significant levels of VCM or who are required to wear protective clothing, the following precautions may be required:
 - (a) A double locker system is to be provided such that -
 - (i) each worker has a locker for street clothes in a "clean" locker room and a locker for work clothes in a "dirty" locker room.
 - (ii) a shower room is located between the two rooms so that each worker may take a shower before putting on street clothes.
 - (b) Each worker is to be required to wash before eating, drinking, smoking or using toilet facilities and to shower at the end of his work shift.

- (c) Laundry facilities are to be provided and each worker's clothes are to be laundered at least weekly. As an alternative disposable work clothing could be used.

Medical

1. First Aid in Acute Exposure

- Unconscious - remove from exposure and give appropriate resuscitation if necessary.
- Skin splash - remove clothes and wash skin thoroughly.
- Eye splash - wash thoroughly for twenty minutes minimum and seek medical attention.

2. Preplacement Examination

A good medical history is to be recorded to include past history of hepatitis or jaundice, past exposure to potential hepatotoxic agents such as chemicals (e.g. used at prior occupations or in hobbies), alcohol and drugs, and any treatment is to be recorded.

A clinical examination is to be carried out with specific attention paid to detecting enlargement of the liver and spleen. Liver function tests are to be done to include serum alkaline phosphatase, SGOT, SGPT and bilirubin.

Urinalysis and a PA chest X-ray (14" x 17") are to be done. Applicants with evidence of past or present abnormalities of the liver are to be excluded from exposure.

3. Periodic Examination

An annual medical examination including all the items listed under a preplacement examination is to be done for all exposed employees.

If one of the liver function tests listed above lies outside the normal range of that test, for the laboratory performing the test, by more than one standard deviation, it will be considered abnormal and the group of liver function tests are to be repeated in 4 to 6 weeks.

If the repeat group of liver function tests shows increasing abnormality of one of them or that two of them remain abnormal, consideration is to be given by the company physician to remove the employee from exposure.

If the repeat group of liver function tests is normal, a further group of liver function tests is to be done in six months and employees then having one or more abnormal tests are to have further investigation.

The employee is not to be returned to potential VCM exposure without the approval of the company physician. Employees who leave exposure to VCM and remain with the same employer are to be followed annually by the employer's medical service as long as they remain employees.

The Ministry of Health will be informed when a person starts employment at which there is potential exposure to VCM and will be informed when the exposure ceases. When an employee who has been in potential exposure to VCM ceases employment with the company, the employer will notify the Ministry of Health giving the last known address.

Employee medical records are to be retained by the company medical department for a period of forty years from date of cessation of employment with the company.

October 1974