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ENVIRONMENTAL ASPECTS OF VINYL/POLYVINYL CHLORIDE 41361
US EPA NATIONAL ENVIRONMENTAL RESEARCH CENTER 2545

OCTOBER 15, 1974 51.5

COMMENTS

General

1.1 Summary

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- 7th par. Analysis of vinyl chloride usually reveals trace amounts of organic impurities such as acetylene, 1,3 butadiene, methyl chloride, and ethylene dichloride. Vinylidene(?) and vinyl acetate are introduced in the polymerization process. Polyvinyl chloride contains residual entrapped VCM in the parts per million range. The entrapped VCM concentration is dependent upon the production process and can range from nil to 1,000 to 2,000 ppm which may be liberated during storage or fabrication.
- 17th par. The paragraph infers that vinyl chloride is the only cause of angiosarcoma in man. The number of angiosarcoma cases in the United States has been variously estimated as 25 to 75 per year. The fifteen cases related to VCM exposure have occurred since 1961. The primary fact is that a significant number occurred in one plant in one geographical area. In the high population density

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General

The report was obviously written by several groups without overall control of direction or conclusions. There is a great deal of overlap between the various sections.

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northeast, every case of angiosarcoma could be a community case if nearness to PVC resin is a criteria.

19th par. The conclusion in this paragraph is based on limited studies in the Louisville, Kentucky area and is not supported by the broader epidemiological survey done by Tabershaw/Cooper Associates.

1.2 Conclusions

1.

2.

However, cases of liver angiosarcoma have been reported among workers exposed to VCM but not directly involved in PVC production, raising the question of effects at lower levels of exposure.

This conclusion ignores the fact that angiosarcoma occurs in man for other reasons than VCM exposure. The presence of VCM in these cases is an assumption not supported by facts.

3. Observations among workers and in experimental animals indicate there is a multiple cancer risk from exposure to vinyl chloride.

1.2 Conclusions (cont'd.)

3.

The conclusion that human data exists indicating a multiple cancer risk is based on studies done in small worker populations without use of control groups. Such work lacks credence.

4.

5. The EPA studies showed one sample out of many that reached 33 ppm. In normal good analytical practice where 90% of the samples were less than 1 ppm, the existence of one sample at 33 ppm would be viewed as an accident or an error in technique. The one 33 ppm result is given weight far beyond its value in the conclusion.

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7. Interim methodology is available for monitoring VCM in the atmosphere, but its precision and accuracy have not been demonstrated in low VCM concentrations (<10 ppb).

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11.

12. The emissions data is not sufficiently accurate to serve as a basis for the formulation of a quantitative emissions control strategy. This conclusion is very true. Only plants with continuous monitors can obtain this data.

13. The practicality and effectiveness of carbon adsorption systems, surveillance-maintenance programs, and deep stripping of the polymer remain to be demonstrated as commercially visible control techniques. This true statement also applies to ozone oxidation and incineration.

2. Introduction

1st par. In the absence of appropriate premarket testing appropriate premarket testing is only revealed by retrospective analyses.

4th par. Vinyl chloride may be disseminated on a broad scale as an unreacted monomer entrapped in finished products

This statement implies a hazard to finished plastic products based on no data. If all PVC resin produced contained 1,000 ppm of free VCM (which all do not), the health hazard contribution from this area would still be insignificant as compared to VCM and PVC resin plants.

4.1

4.1.1 Spectrophotometry

At lease one installation of infrared spectrometry, using the Fourier transformation, has been installed in a plant with multipoint detectors. Sensitivity of less than 1 ppm is claimed.

4.1.2

4.1.3

4.1.4 Sample collection.

4.1.5 Liquid scrubbers.

4.1.6 Solid scrubbers.

4.1.7 Sample preparation.

4.1.7 Environmental appraisal.

6.

5.1

5.2

Table

5.2.2 PVC Polymer Plant Emissions Data

The process data for the Firestone Tire and Rubber Company and the B. F. Goodrich Company is in error. Neither operates a solution polymerization process. Both manufacture suspension resin for solution application; i.e., lacquer-type coatings.

Union Carbide Corporation produces vinyl resins by suspension, emulsion, and solution polymerization.

5.2.3

5.3.2 Summary

In all the monitoring data, only one sample shows 33 ppm or even near it. A more scientific approach would be to discount this sample as an error. Errors must occur as frequently in EPA's laboratories as they do elsewhere.

This is substantiated by the discussion of duplicate samples which were analyzed in two different laboratories. These duplicate analyses disagreed markedly.

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5.4 Estimates of Air Quality Concentrations

7.

Estimates made by diffusion equations have not been substantiated by actual test data. This estimate is nothing more than a mathematical exercise. Union Carbide Corporation's actual monitoring has been factorially less than diffusion calculations.

5.5 Transformation, Transport, and Removal

6 Environmental Exposure and Receptor Risk

The presumption that respirable PVC dust contains measurable amounts of VCM is in error. Resin dust in the range of .3 micron to 10 microns contains no detectable VCM. Only large resin particles, 50 to 150 microns, contain VCM, and these are neither dust nor respirable.

Peak exposures to vinyl chloride in occupational situations may, at times in the past, have exceeded 1,000 ppm although the highest weighted average exposures were probably in the 250-500 ppm range.

This statement is in error since it was based on the presumption that the threshold odor limit for VCM was 250 ppm. Data submitted by Union Carbide Corporation showed the threshold

odor limit was nearly 2,000 ppm; thus, the concentrations quoted could be higher by a factor of 8.

For populations residing in the vicinity of industrial sources preliminary data, described earlier, show peak exposure of 33 ppm and 24-hour samples as high as 1-2 ppm.

The statement of 33 ppm peak is based on one unsubstantiated sample; thus, again undue weight is given potentially poor data.

Table
6.1.1 Relative Importance of Vinyl Chloride Sources for the General Adult Population (mg VCM)

The correct unit is μg ; not mg.

Table
6.1.2 Frequency of Liver Angiosarcoma Among Deceased Vinyl Chloride Workers

The mortality data from the Tabershaw/Cooper Associates study is conspicuous by its absence. This data has been published and subjected to critical review.

7. 1. 6. 1

Toxicity of Polyvinyl Chloride

9.

The free radical content and the level of residual vinyl chloride monomer of PVC resins and plastic end products could effect their toxicity, including potential for carcinogenic activity.

This observation is based on no facts. PVC contains very little, if any, free radicals. The nature of the polymerization chain termination precludes this situation. The residual monomer problem occurs only with suspension and bulk polymerized resins and is a temporary situation. PVC will not give off monomer through depolymerization; thus, the emission is limited to the amount left in the manufactured resin. Resin particles of 10 microns or less usually contain no monomer within 24 hours of manufacture.

7. 1. 6. 2

Toxicity of Pyrolytic Products of PVC

Pyrolytic products of PVC have been well identified in a number of published studies. The presence of known carcinogens has not been confirmed. The primary products of pyrolysis are hydrogen chloride, carbon, and some light hydrocarbons.

7. 3. 22

The odor threshold for vinyl chloride in air is approximately 2,000 ppm, not 250 ppm, per Union Carbide Corporation testimony. The estimated historical exposure of workers, where odor was

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7.3.22

(cont'd.)

10.

used as means of estimation is 8 to 10 times that reported with peaks to 10,000 ppm.

7.3.23

The comments regarding fabricating plants do not distinguish between types of resin used and the fabricating technique. Plants based on plastisol technology generally have nil VCM concentration.

As noted in a previous comment, Union Carbide Corporation data indicates that respirable PVC dust contains no measurable amounts of monomer; thus, employee exposure via this route is negligible.

7.3.24

The questions regarding health studies are very well taken. While there are no published reports, data from control groups tend to duplicate that of the VCM exposed workers. The similarity of exposed workers and control groups is disparaged since control groups come from the same plant or area. When control groups are chosen from outside the area, then uniformity of evaluation becomes a problem.

There is a great deal of health study work to be done on a scientific basis as opposed to an emotional basis.

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7.4 Ecology7.5 Vinyl Chloride in PerspectiveTable
7.5.1

Table 7.5.1 is confused. Polyvinyl acetate, polyvinyl alcohol, polyvinyl butyral, and polyvinyl formal have no relationship to vinyl chloride unless one is concerned about the vinyl group ($C = C$). If this is the case, then ethylene, propylene, styrene, acrylates, etc. should have been included.

When carcinogenic studies were undertaken, they were of insufficient exposure duration or involved too limited a number of animals to provide conclusive negative results.

Within the emotional framework of the carcinogen problem and the desire for zero cases, there are no facilities in the world large enough to hold all the animals required to provide conclusive negative results. The author's statement sounds good but it infers that the impossible is possible; i.e., prove a negative result.

8.0 Control Technology and Remedial Actions

8.1 Introduction

Controls for VCM production do not include activated carbon adsorption or ozone oxidation. The introduction implies these exist.

The discussion of emission control would be more meaningful if finite numbers were used. The citing of percentage reductions without the base number leads to misunderstanding. In repeated reference to carbon adsorption and ozone oxidation leads one to assume these are established technology. Carbon adsorption is being tested on a limited scale, and ozone oxidation is not being tested at all.

8.3.4 Solution polymerization is a proprietary process of Union Carbide Corporation that in no way resembles the emission characteristics of the suspension process or the emulsion process.

RNWheelerJr/ra

February 10, 1975

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