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MONITORING THE CONCENTRATION OF VINYL CHLORIDE IN THE WORK PLACE OR AMBIENT AIR

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Monitoring the concentration of vinyl chloride in the work place air is currently required by the U.S. Department of Labor's Occupational Safety and Health Administration under the temporary standard for vinyl chloride, and will continue to be required under the permanent standard as promulgated in the Federal Register of October 4, 1974, and scheduled to become effective January 1, 1975. In addition, the Environmental Protection Administration will issue regulations requiring ambient air monitoring or setting specific limits on vinyl chloride emissions. The current and future OSHA regulations cover the vinyl chloride producer, the resin manufacturer, and the resin processor or fabricator who makes finished or semi-finished products.

OSHA regulations require monitoring of areas where employees may be exposed to vinyl chloride emissions or to polyvinyl chloride resins under a definite written program which includes the possibility of employee observers; the keeping of complete and accurate records for long periods of time, stating dates, levels, and type of equipment used; and with very high (95%) confidence levels for such monitoring procedures.

The method of analysis and the details of the program are at this time, within the above framework, left up to the employer.

Any monitoring system must take into consideration the following factors:

Potential for exposure to vinyl chloride is obviously higher for an employer manufacturing, using, or handling vinyl chloride monomer. This potential for exposure is relatively lower for a polyvinyl chloride resin user.

Response time is important for the employer working with vinyl chloride monomer. If an over-limits emission occurs, he must take action immediately to protect the employees. A resin user is concerned only with the potential release of the vinyl chloride monomer contained in the resin as a raw material. He is far less likely to have an emergency which would expose employees to high concentrations of vinyl chloride monomer.

Sensitivity to low concentrations of vinyl chloride by the monitoring system is required in all cases. Such sensitivity is 0.25 ppm. in air under the permanent standard.

- Flexibility of the monitoring system is of considerable importance, particularly, in a small business. With relatively few resources, such a company must be prepared to cope with regulations from EPA, as well as OSHA, on vinyl chloride as well as other materials.
- Specificity of the monitoring system to vinyl chloride, such as a manufacturer of suspension vinyl chloride homopolymer, i.e., PVC. Data from an organic vapor analyzer should be adequate. The vinyl chloride monomer producer; the lacquer formulator; or any other manufacturer who works with other monomers or solvents needs to know the concentration of vinyl chloride and not the concentration of vinyl chloride plus naphtha or vinyl acetate.
- OSHA requirements also are a factor. The monitoring data should be acceptable to the compliance officer. The data should be comparable with the data from tests he performs. While not a part of the vinyl chloride standard, the employer should be able to monitor nuisance dusts as per OSHA requirement. Resin dust in the work space air may well be a factor in any OSHA inspection.

Vinyl resin processors or users should consider their monitoring needs as they relate to the following categories:

1. *When measurable amounts of vinyl chloride monomer exist or are likely to exist in the work space air.* Polyvinyl chloride resins produced by the suspension or bulk polymerization process generally contain amounts of unconverted vinyl chloride monomer ranging from 0.01 to 0.2 per cent, depending on the particle size of the resin, the porosity of the particle, and the vendor's plant operation. This contained unconverted monomer weathers out of the resin slowly during storage, and is driven out by heat in the initial processing steps. Processors of this type of resin will likely find high concentrations of vinyl chloride monomer in storage areas, bins, bags, hopper cars or trucks, blenders, intensive mixers, "Banbury" mixers, extruders or calenders. The results of monitoring are likely to indicate needs for improved ventilation, changes in work practices, or changes in processing equipment. These resin users must monitor the

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work space air vinyl chloride concentration, so that they can take appropriate action to protect their employees as well as meet the OSHA standard for monitoring.

2. *When no measurable amounts of vinyl chloride monomer exist or are likely to exist in the work space air.* Polyvinyl chloride resins produced by the dispersion or solution polymerization process or vinyl resin compound that has already been hot processed generally contain 0 to 0.001 per cent free vinyl chloride monomer. Further hot processing, manufacture of organosols or plastisols, or the formulation of lacquers results in very little, if any, release of vinyl chloride monomer into the work space air. These resin users are concerned only with sufficient monitoring to meet OSHA requirements. They are not exempt from them even though the likelihood of detecting vinyl chloride monomer in the work space air is remote. Resin users in this category might consider contracting out the monitoring work if commercial laboratory facilities are available, since needs are minimal.

As with all simplifications, there is a large number of resin users who clearly fit neither category or who are not sure where they fit. These resin users or processors should query their resin or compound suppliers regarding the vinyl chloride content of the resin or resins being purchased. Since this content varies with the type of resin and the vendor, it is wise to make such inquiries thoroughly and carefully.

Resin users or processors in Category No. 1 should consider a basic industrial hygiene laboratory consisting of the following items:

- A chromatograph with a flame ionization detector, such as Model 511 supplied by Analytical Instrument Development, Inc., Avondale, Pennsylvania 19311 for about \$7,000 including accessory equipment.

This instrument is sensitive to less than 0.1 ppm. vinyl chloride, and is generally useful for a variety of other solvent monitoring operations.

Several portable sampling pumps, such as the Mine Safety Appliance "Monitaire" pump. These may be clipped to a worker's belt for personal sampling of vinyl chloride in air or dust in air. These pumps, including a battery charger, cost approximately \$280 each.

Analytical balance sensitive to 0.01 milligram.

An assortment of sample tubes, syringes, and other glassware for sample collection.

The laboratory should be well ventilated with a hood for employee protection. Other facilities might include equipment for sample pump calibration and preparation of standard samples.

This description is intended to portray only the broad outlines of such a laboratory. The actual outfitting of a laboratory is best left to a chemist or industrial hygienist.

Analytical methods for determining vinyl chloride concentrations in air as ceiling values or time weighted averages as well as the concentration of vinyl chloride in resin are given in the Appendix. Vendor's descriptions of the specific equipment items are also included.

Resin users or processors in Category No. 2 could use the same type laboratory facilities described for Category No. 1 users, or they could reduce the equipment cost by use of the following:

- A Century Systems Corporation Portable Organic Vapor Analyzer with Flame Ionization Detector, Model OVA-98.

This analyzer has good sensitivity, good reproducibility, and is easy to operate. It costs approximately \$3,000. The main disadvantage is that it is sensitive to all organic vapors, including vinyl chloride; thus, if other vapors are present, the reading translated to vinyl chloride concentration will be higher than the actual concentration.

Century Systems Corporation is currently offering this instrument with chromatographic capability at a cost of approximately \$3,500. The instrument with this option is specific for vinyl chloride or certain other solvents. This option, while relatively untested in the field, appears to be useful for the resin processor with limited laboratory facilities (see data sheet in Appendix.)

- One or more portable sample pumps with equipment for gravimetric sampling of air borne dusts, such as the Mine Safety Appliance Pump described previously. These cost approximately \$200 each.
- Analytical balance sensitive to 0.01 milligram for dust monitoring weighings.

These facilities would have to be supplemented with other laboratory equipment selected by the chemist or industrial hygienist. Methods of analysis and operating instructions for the equipment should be obtained from the vendor of the equipment purchased.

The equipment and analytical instruments list-

ed are precision measuring devices; therefore, they need to be operated and maintained by skilled, knowledgeable technicians. Again, like any other precision measuring device, they should be calibrated and tested with standard samples either prepared in the laboratory or purchased from a commercial supplier of such samples.

This booklet attempts to review the factors involved in vinyl chloride monitoring and their application to a resin processor. It also suggests equipment and methods of analysis for consideration. Its principal purpose is to stimulate thoughts and plans with regard to the problem of monitoring vinyl chloride monomer concentrations.

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APPENDIX

1. Department of Labor, Occupational Safety and Health Administration: Exposure to Vinyl Chloride, *Federal Register*, Volume 39, No. 194, pp. 35890-35898, Friday, October 4, 1974.
2. Vendors' Publications on Analytical Instruments:
 - Century Systems Corporation, Portable Organic Vapor Analyzer, Model OVA-98.
 - Analytical Instrument Development, Inc., Portable Flame Photometric Gas Chromatograph, Model 511.
 - Mine Safety Appliances Company, Model S Monitaire Sampler.
3. Methods of Analysis for Determining Vinyl Chloride in Air and in Resin:
 - Vinyl Chloride, Determination in Air by Gas Chromatography.
 - Vinyl Chloride, Determination in Air by Adsorption on Activated Charcoal and Analysis by Gas Chromatography.
 - Determination of Residual Vinyl Chloride Monomer in Vinyl Resins.
 - Dust, Determination of Total and Respirable Airborne Dust by Membrane Filter Sampling and Gravimetric Analysis.