

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO	H. Johnson	AT	Piscataway	Date	December 23, 1980
FROM	J. P. Sandstedt	AT	Piscataway	COMPTO	Dr. R. T. Gottesman w/o Mr. I. Wakeman
SUBJECT	VCM Analytical Procedures				

The Environmental Protection Agency has proposed to revise its test methods for vinyl chloride. Attached please find copy of this proposal.

As you are aware Tenneco Chemicals currently uses TCI analytical procedures to accomplish these analyses. While I recognize that this proposal probably does not effect our operations, I would appreciate your careful review of the proposal, comparing it with TCI methods and, if necessary, the original EPA methods.

The comment period is due to close January 19, 1981. Therefore, I would request your earliest possible consideration of these methods.

J. P. Sandstedt
J. P. Sandstedt

JPS: ch

Att.

Federal Register

**Tuesday
November 18, 1980**

Part II

Environmental Protection Agency

**National Emission Standards for
Hazardous Air Pollutants**

COLORITE 017075

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 61

[AP-FRL 1563-1]

National Emission Standards for Hazardous Air Pollutants

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: On June 7, 1977 (42 FR 29005) the Administrator promulgated amendments to the national emission standards for the hazardous air pollutant vinyl chloride. The Administrator also promulgated amendments to Appendix B—Test Methods, of this part. Since the promulgation of Method 106—Determination of Vinyl Chloride from Stationary Sources and Method 107—Determination of Vinyl Chloride Content of Inprocess Wastewater Samples and Vinyl Chloride Content of Polyvinyl Chloride Resin, Slurry, Wet Cake, and Latex Samples, several improvements in the methods have been developed. These revisions incorporate those improvements.

DATE: Comments must be received by January 19, 1981.

ADDRESSES: Comments should be submitted (in duplicate if possible) to: Central Docket Section (A-130), Attention: Docket No. A-80-50, U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460.

FOR FURTHER INFORMATION CONTACT: Roger Shigehara, Emission Measurement Branch (MD-19), U.S. Environmental Protection Agency, Research Triangle Park, N.C. 27711; telephone number (919) 541-2237.

SUPPLEMENTARY INFORMATION: These revised procedures differ from the previous methods as follows: Method 106—(1) sample bag size can range from 50 to 100 liters rather than the single size bag previously required, and (2) analysis audit and chromatograph with resolution quality assurance requirements are added. These requirements are contained in Appendix C, 40 CFR Part 61, as proposed with the National Emission Standard for Benzene Emissions from Maleic Anhydride Plants (45 FR 26680). Method 107—(1) a head space vial pre-pressurizer is added to obtain correct head space gas equilibrium, (2) different chromatograph columns are suggested for analysis, and (3) chromatograph resolution quality assurance requirements are added.

The Administrator finds that notice and public procedure is unnecessary

because the revisions are minor and technical. These revisions are issued under the authority of Section 114 of the Clean Air Act as amended (42 U.S.C. 7414).

Dated: November 10, 1980.

Douglas Costle,
Administrator

40 CFR Part 61 is amended by revising Test Methods 106 and 107 of Appendix B to read as follows:

Appendix B—Test Methods

Method 106—Determination of Vinyl Chloride From Stationary Sources

Introduction

Performance of this method should not be attempted by persons unfamiliar with the operation of a gas chromatograph, nor by those who are unfamiliar with source sampling, because knowledge beyond the scope of this presentation is required. Care must be exercised to prevent exposure of sampling personnel to vinyl chloride, a carcinogen.

1. Applicability and Principle.

1.1 Applicability. The method is applicable to the measurement of vinyl chloride in stack gases from ethylene dichloride, vinyl chloride, and polyvinyl chloride manufacturing processes. The method does not measure vinyl chloride contained in particulate matter.

1.2 Principle. An integrated bag sample of stack gas containing vinyl chloride (chloroethene) is subjected to gas chromatographic (GC) analysis using a flame ionization detector (FID).

2. Range and Sensitivity.

This method is designed for the 0.1 to 50 ppm range. However, common GC instruments are capable of detecting 0.02 ppm vinyl chloride. With proper calibration, the upper limit may be extended as needed.

3. Interferences.

The chromatographic columns and the corresponding operating parameters herein described normally provide an adequate resolution of vinyl chloride; however, resolution interferences may be encountered on some sources. Therefore, the chromatograph operator shall select the column and operating parameters best suited to his particular analysis requirements, subject to the approval of the Administrator. Approval is automatic, provided that the tester produces confirming data through an adequate supplemental analytical technique, such as analysis with a

different column or GC/mass spectroscopy, and has the data available for review by the Administrator.

4. Apparatus

4.1 Sampling (see Figure 106-1). The sampling train consists of the following components:

4.1.1 Probe. Stainless steel, Pyrex glass, or Teflon tubing (as stack temperature permits) equipped with a glass wool plug to remove particulate matter.

4.1.2 Sample Lines. Teflon, 6.4-mm outside diameter, of sufficient length to connect probe to bag. Use a new unused piece for each series of bag samples that constitutes an emission test, and discard upon completion of the test.

4.1.3 Quick Connects. Stainless steel, male (2) and female (2), with ball checks (one pair without), located as shown in Figure 106-1.

4.1.4 Tedlar Bags. 50- to 100-liter capacity, to contain sample. Aluminized Mylar bags may be used if the samples are analyzed within 24 hours of collection.

BILLING CODE 5500-26-28

*Mention of any trade or specific product does not constitute endorsement by the U.S. Environmental Protection Agency.

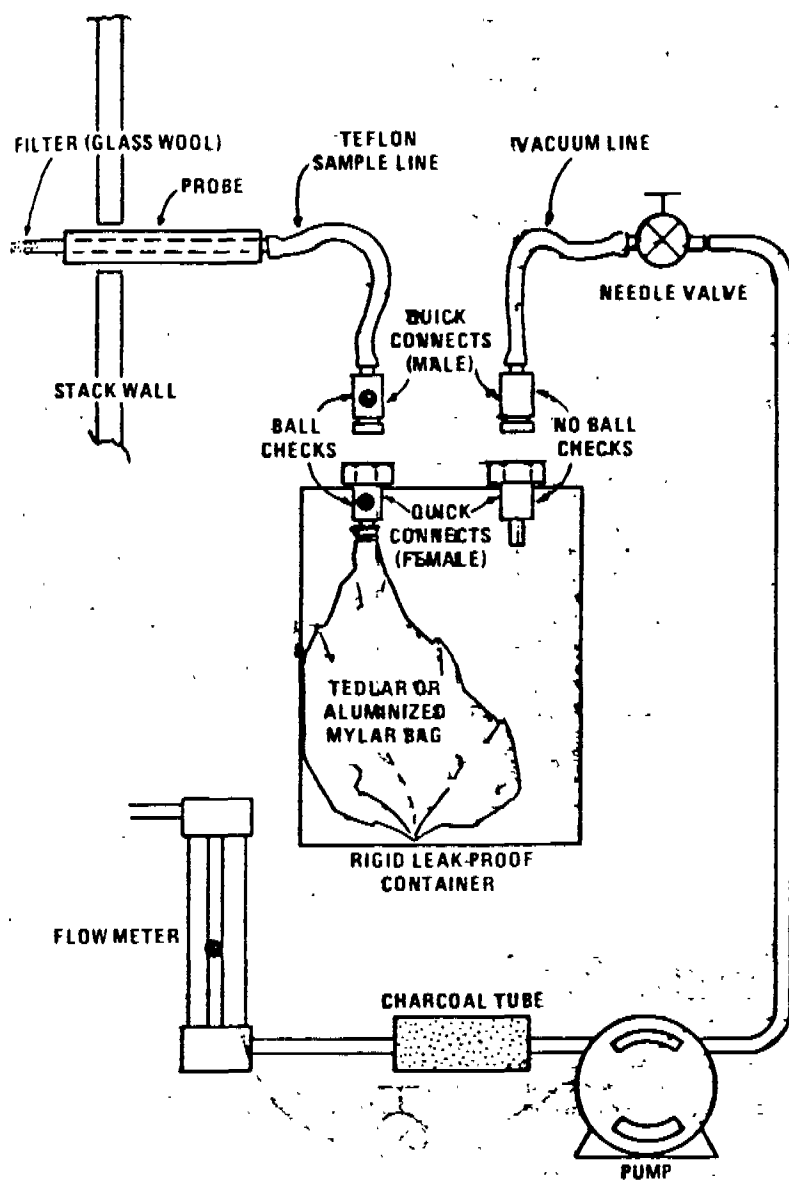


Figure 106-1. Integrated-bag sampling train. (Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.)

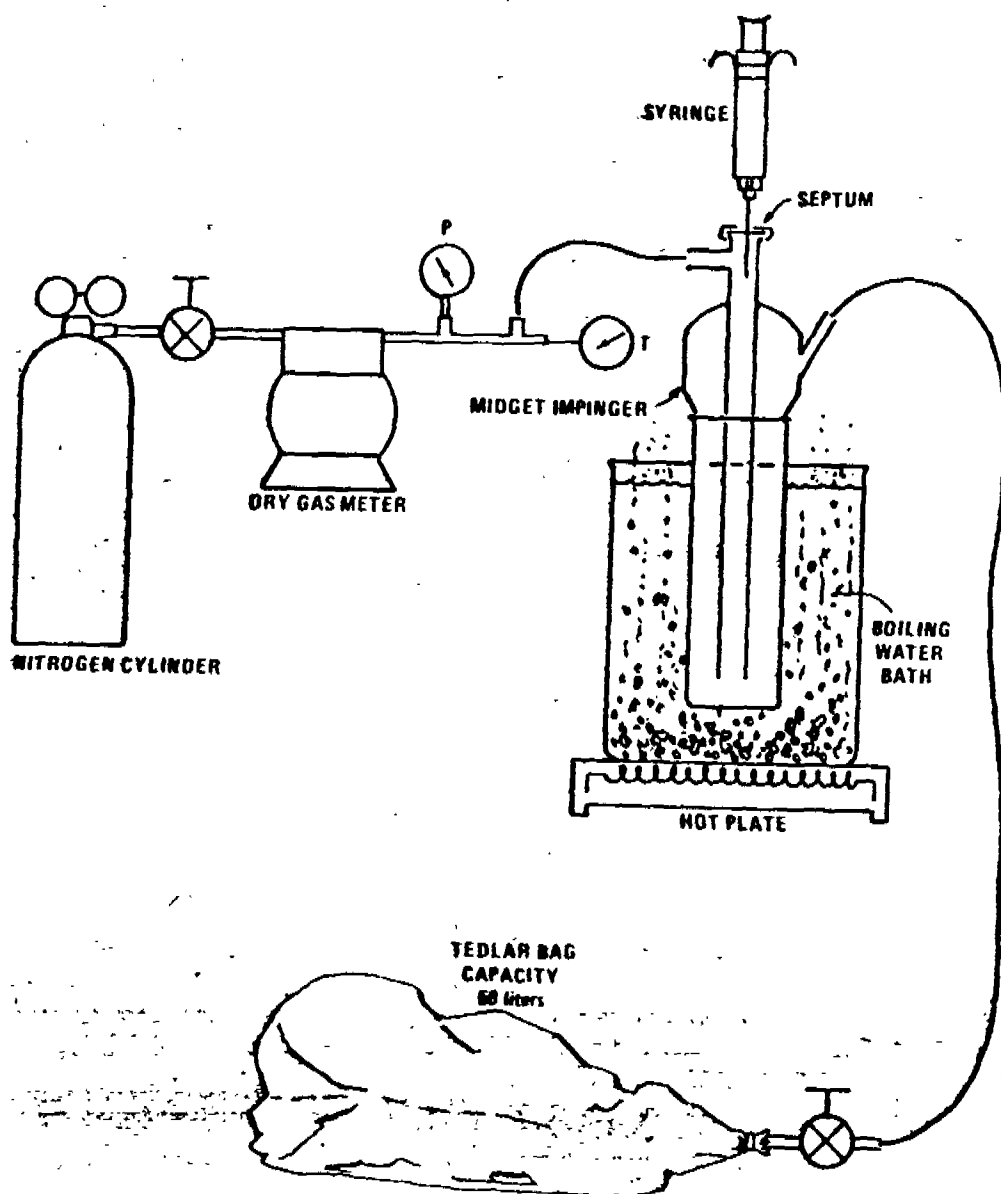


Figure 106-2. Preparation of standards (optional).

ILLINOIS CODE 220-20-C

4.1.5 Bag Containers. Rigid leakproof containers for sample bags, with covering to protect contents from sunlight.

4.1.6 Needle Valve. To adjust sample flow rates.

4.1.7 Pump. Leak-free, with minimum of 2-liter/min capacity.

4.1.8 Charcoal Tube. To prevent admission of vinyl chloride, and other organics to the atmosphere in the vicinity of samplers.

4.1.9 Flow Meter. For observing sampling flow rate; capable of measuring a flow range from 0.10 to 1.00 liter/min.

4.1.10 Connecting Tubing. Teflon, 6.4-mm outside diameter, to assemble sampling train (Figure 106-1).

4.2 Sample Recovery. Teflon tubing, 6.4-mm outside diameter, to connect bag to gas chromatograph sample loop for sample recovery. Use a new unused piece for each series of bag samples that constitutes an emission test, and discard upon conclusion of analysis of those bags.

4.3 Analysis. The following equipment is required:

4.3.1 Gas Chromatograph. With FID, potentiometric strip chart recorder and 1.0- to 5.0-ml heated sampling loop in automatic sample valve. The chromatographic system shall be capable of producing a response to 0.1-ppm vinyl chloride that is at least as great as the average noise level. (Response is measured from the average value of the base line to the maximum of the waveform, while standard operating conditions are in use.)

4.3.2 Chromatographic Columns. Columns as listed below. The analyst may use other columns provided that the precision and accuracy of the analysis of vinyl chloride standards are not impaired and he has available for review information confirming that there is adequate resolution of the vinyl chloride peak. (Adequate resolution is defined as an area overlap of not more than 10 percent of the vinyl chloride peak by an interferent peak. Calculation of area overlap is explained in Appendix C, Supplement A: "Determination of Adequate Chromatographic Peak Resolution.")

4.3.2.1 Column A. Stainless steel, 2.0 m by 3.2 mm, containing 80/100-mesh Chromasorb 102.

4.3.2.2 Column B. Stainless steel, 2.0 m by 3.2 mm, containing 20 percent GE SF-96 on 80/80-mesh Chromasorb P AW; or stainless steel, 1.0 m by 3.2 mm containing 80/100-mesh Porapak T. Column B is required as a secondary column if acetaldehyde is present. If used, column B is placed after column A.

The combined columns should be operated at 120°C.

4.3.3 Flow Meters (2). Rotameter type, 100-ml/min capacity, with flow control valves.

4.3.4 Gas Regulators. For required gas cylinders.

4.3.5 Thermometer. Accurate to 1°C, to measure temperature of heated sample loop at time of sample injection.

4.3.6 Barometer. Accurate to 5 mm Hg, to measure atmospheric pressure around gas chromatograph during sample analysis.

4.3.7 Pump. Leak-free, with minimum of 100-ml/min capacity.

4.3.8 Recorder. Strip chart type, optionally equipped with either disc or electronic integrator.

4.3.9 Planimeter. Optional, in place of disc or electronic integrator on recorder, to measure chromatograph peak areas.

4.4 Calibration. Sections 4.4.2 through 4.4.4 are for the optional procedure in Section 7.1.

4.4.1 Tubing. Teflon, 6.4-mm outside diameter, separate pieces marked for each calibration concentration.

4.4.2 Tedlar Bags. Sixteen-inch-square size, with valve; separate bag marked for each calibration concentration.

4.4.3 Syringes. 0.5-ml and 50- μ l, gas tight, individually calibrated to dispense gaseous vinyl chloride.

4.4.4 Dry Gas Meter, With Temperature and Pressure Gauges. Singer model DTM-115 with 802 index, or equivalent, to meter nitrogen in preparation of standard gas mixtures, calibrated at the flowrate used to prepare standards.

5. Reagents.

Use only reagents that are of chromatograph grade.

5.1 Analysis. The following are required for analysis.

5.1.1 Helium or Nitrogen. Zero grade, for chromatographic carrier gas.

5.1.2 Hydrogen. Zero grade.

5.1.3 Oxygen or Air. Zero grade, as required by the detector.

5.2 Calibration. Use one of the following options: either 5.2.1 and 5.2.2 or 5.2.3.

5.2.1 Vinyl Chloride. Pure vinyl chloride gas certified by the manufacturer to contain a minimum of 99.9 percent vinyl chloride, for use in the preparation of standard gas mixtures in Section 7.1. If the gas manufacturer maintains a bulk cylinder supply of 99.9+ percent vinyl chloride, the certification analysis may have been performed on this supply rather than on each gas cylinder prepared from this bulk supply. The date of gas cylinder preparation and the certified analysis

must have been affixed to the cylinder before shipment from the gas manufacturer to the buyer.

5.2.2 Nitrogen. Zero grade, for preparation of standard gas mixtures as described in Section 7.1.

5.2.3 Cylinder Standards (3) Gas mixture standards (50-, 10-, and 5-ppm vinyl chloride in nitrogen cylinders). The tester may use cylinder standards to directly prepare a chromatograph calibration curve as described in Section 7.2.2. If the following conditions are met: (a) The manufacturer certifies the gas composition with an accuracy of ± 3 percent or better (see Section 5.2.3.1), (b) The manufacturer recommends a maximum shelf life over which the gas concentration does not change by greater than ± 5 percent from the certified value; (c) The manufacturer affixes the date of gas cylinder preparation, certified vinyl chloride concentration, and recommended maximum shelf life to the cylinder before shipment to the buyer.

5.2.3.1 Cylinder Standards Certification. The manufacturer shall certify the concentration of vinyl chloride in nitrogen in each cylinder by (a) directly analyzing each cylinder and (b) calibrating his analytical procedure on the day of cylinder analysis. To calibrate his analytical procedure, the manufacturer shall use, as a minimum, a three-point calibration curve. It is recommended that the manufacturer maintain (1) a high-concentration calibration standard (between 50 and 100 ppm) to prepare his calibration curve by an appropriate dilution technique and (2) a low-concentration calibration standard (between 5 and 10 ppm) to verify the dilution technique use. If the difference between the apparent concentration read from the calibration curve and the true concentration assigned to the low-concentration calibration standard exceeds 5 percent of the true concentration, the manufacturer shall determine the source of error and correct it, then repeat the three-point calibration.

5.2.3.2 Verification of Manufacturer's Calibration Standards. Before using a standard, the manufacturer shall verify each calibration standard (a) by comparing it to gas mixtures prepared (with 99 Mol percent vinyl chloride) in accordance with the procedure described in Section 7.1 or (b) by having it analyzed by the National Bureau of Standards. The agreement between the initially determined concentration value and the verification concentration value must be within ± 5 percent. The manufacturer must reverify all calibration standards on a time interval

consistent with the shelf life of the cylinder standards sold.

5.2.4 Audit Cylinder Standards (2). Gas mixture standards with concentrations known only to the person supervising the analysis of samples. The audit cylinder standards shall be identically prepared as those in Section 5.2.3 (Vinyl chloride in nitrogen cylinders). The concentrations of the audit cylinders should be: one low-concentration cylinder in the range of 5 of 20 ppm vinyl chloride, and one high-concentration cylinder in the range of 20 to 50 ppm. When available, the tester may obtain audit cylinders by contacting: Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Quality Assurance Division (MD-77), Research Triangle Park, North Carolina 27711. If audit cylinders are not available at the Environmental Protection Agency, the tester must secure an alternative source.

6. Procedure.

6.1 Sampling. Assemble the sample train as shown in Figure 106-1. Perform a bag leak check according to Section 7.3.2, join the quick connects as illustrated, and determine that all connections between the bag and the probe are tight. Place the end of the probe at the centroid of the stack and start the pump with the needle valve adjusted to yield of flow that will fill over 50 percent of bag volume in the specified sample period. After allowing sufficient time to purge the line several times, connect the vacuum line to the bag and evacuate the bag until the rotameter indicates no flow. Then reposition the sample and vacuum lines and begin the actual sampling, keeping the rate proportional to the stack velocity. At all times, direct the gas exiting the rotameter away from sampling personnel. At the end of the sample period, shut off the pump, disconnect the sample line from the bag, and disconnect the vacuum line from the bag container. Protect the bag container from sunlight.

6.2 Sample Storage. Keep the sample bags out of direct sunlight. When at all possible, analysis is to be performed within 24 hours, but in no case in excess of 72 hours of sample collection. Aluminized Mylar bag samples must be analyzed within 24 hours.

6.3 Sample Recovery. With a new piece of Teflon tubing identified for that bag, connect a bag inlet valve to the gas chromatograph sample valve. Switch the valve to receive gas from the bag through the sample loop. Arrange the equipment so the sample gas passes from the sample valve to 100-ml/min rotameter with flow control valve followed by a charcoal tube and a 1-in.

H₂O pressure gauge. The tester may maintain the sample flow either by a vacuum pump or container pressurization if the collection bag remains in the rigid container. After sample loop purging is ceased, allow the pressure gauge to return to zero before activating the gas sampling valve.

6.4 Analysis. Set the column temperature to 100°C and the detector temperature to 150°C. When optimum hydrogen and oxygen flow rates have been determined, verify and maintain these flow rates during all chromatograph operations. Using zero helium or nitrogen as the carrier gas, establish a flow rate in the range consistent with the manufacturer's requirements for satisfactory detector operation. A flow rate of approximately 40 ml/min should produce adequate separations. Observe the base line periodically and determine that the noise level has stabilized and that baseline drift has ceased. Purge the sample loop for 30 seconds at the rate of 100 ml/min, then activate the sample valve. Record the injection time (the position of the pen on the chart at the time of sample injection), sample number, sample loop temperature, column temperature, carrier gas flow rate, chart speed, and attenuator setting. Record the barometric pressure. From the chart, note the peak having the retention time corresponding to vinyl chloride, as determined in Section 7.2.1. Measure the vinyl chloride peak area, A_m , by use of a disc integrator, electronic integrator, or a planimeter. Measure and record the peak height, H_m . Record A_m and the retention time. Repeat the injection at least two times or until two consecutive values for the total area of the vinyl chloride peak do not vary more than 5 percent. Use the average value for these two total areas to compute the bag concentration.

Compare the ratio of H_m to A_m for the vinyl chloride sample with the same ratio for the standard peak that is closest in height. If these ratios differ by more than 10 percent, the vinyl chloride peak may not be pure (possibly acetaldehyde is present) and the secondary column should be employed (see Section 4.3.2.2).

6.5 Determination of Bag Water Vapor Content. Measure the ambient temperature and barometric pressure near the bag. From a water saturation vapor pressure table, determine and record the water vapor content of the bag as decimal figure. (Assume the relative humidity to be 100 percent unless a less value is known.)

7. Preparation of Standard Gas Mixtures, Calibration, and Quality Assurance.

7.1 Preparation of Vinyl Chloride Standard Gas Mixtures. (Optional Procedure—delete if cylinder standards are used.) Assemble the apparatus shown in Figure 106-2. Evacuate a 16-inch-square Tedlar bag that has passed a leak check (described in Section 7.3.2) and meter in 5.0 liters of nitrogen. While the bag is filling, use the 0.5-ml syringe to inject 250 μ l of 99.9+ percent vinyl chloride gas through the wall of the bag. Upon withdrawing the syringe, immediately cover the resulting hold with a piece of adhesive tape. The bag now contains a vinyl chloride concentration of 50 ppm. In a like manner use the 50 μ l syringe to prepare gas mixtures having 10- and 5-ppm vinyl chloride concentrations. Place each bag on a smooth surface and alternately depress opposite sides of the bag 50 times to further mix the gases. These gas mixture standards may be used for 10 days from the date of preparation, after which time new gas mixtures must be prepared. (Caution: Contamination may be a problem when a bag is reused if the new gas mixture standard is a lower concentration than the previous gas mixture standard.)

7.2 Calibration.

7.2.1 Determination of Vinyl Chloride Retention Time. (This section can be performed simultaneously with Section 7.2.2.) Establish chromatograph conditions identical with those in Section 6.4 above. Determine proper attenuator position. Flush the sampling loop with zero helium or nitrogen and activate the sample valve. Record the injection time, sample loop temperature, column temperature, carrier gas flow rate, chart speed, and attenuator setting. Record peaks and detector responses that occur in the absence of vinyl chloride. Maintain conditions with the equipment plumbing arranged identically to Section 6.3, and flush the sample loop for 30 seconds at the rate of 100 ml/min with one of the vinyl chloride calibration mixtures. Then activate the sample valve. Record the injection time. Select the peak that corresponds to vinyl chloride. Measure the distance on the chart from the injection time to the time at which the peak maximum occurs. This quantity divided by the chart speed is defined as the retention time. Since other organics may be present in the sample, positive identification of the vinyl chloride peak must be made.

7.2.2 Preparation of Chromatograph Calibration Curve. Make a gas chromatographic measurement of each gas mixture standard (described in Section 5.2.3 or 7.1) using conditions identical with those listed in Sections 6.3

and 6.4. Flush the sampling loop for 30 seconds at the rate of 100 ml/min with one of the standard mixtures, and activate the sample valve. Record the concentration of vinyl chloride injected (C_s), attenuator setting, chart speed, peak area, sample loop temperature, column temperature, carrier gas flow rate, and retention time. Record the barometric pressure. Calculate A_s , the peak area multiplied by the attenuator setting. Repeat until two consecutive injection areas are within 5 percent, then plot the average of those two values versus C_s . When the other standard gas mixtures have been similarly analyzed and plotted, draw a straight line through the points derived by the least squares method. Perform calibration daily, or before and after each set of bag samples, whichever is more frequent.

7.3 Quality Assurance.

7.3.1 Analysis Audit. Immediately after the preparation of the calibration curve and prior to the sample analyses, perform the analysis audit described in Appendix C, Supplement B: "Procedure for Field Auditing GC Analysis."

7.3.2 Bag Leak Checks. Checking of bags for leaks is required after bag use and strongly recommended before bag use. After each use, connect a water manometer and pressurize the bag to 5-10 cm H₂O (2-4 in H₂O). Allow to stand for 10 min. Any displacement in the water manometer indicates a leak. Also, check the rigid container for leaks in this manner.

Note.—An alternative leak check method is to pressurize the bag to 5-10 cm H₂O or 2-4 in. H₂O and allow it to stand overnight. A deflated bag indicates a leak.

For each sample bag in its rigid container, place a rotameter in-line between the bag and the pump inlet. Evacuate the bag. Failure of the rotameter to register zero flow when the bag appears to be empty indicates a leak.

8. Calculations.

8.1 Determine the sample peak area, A_s , as follows:

$$A_s = A_p \cdot A$$

Where:

A_s = Measured peak area.

A = Attenuation factor.

8.2 Vinyl Chloride Concentrations. From the calibration curve described in Section 7.2.2, select the value of C_s that corresponds to A_s , the sample peak area. Calculate the concentration of vinyl chloride in the bag, C_b , as follows:

$$C_b = \frac{C_s P_r T_1}{P_1 T_r (1 - B_w)} \quad \text{Eq. 106-2}$$

Where:

P_r = Reference pressure, the laboratory pressure recorded during calibration, mm Hg.

T_1 = Sample loop temperature on the absolute scale at the time of analysis, °K.

P_1 = Laboratory pressure at time of analysis, mm Hg.

T_r = Reference temperature, the sample loop temperature recorded during calibration, °K.

B_w = Volume fraction of water vapor content of the bag sample, as analyzed.

9. References.

1. Brown, D.W., E.W. Loy, and M.H. Stephenson. Vinyl Chloride Monitoring Near the B. F. Goodrich Chemical Company in Louisville, Kentucky. Region IV, U.S. Environmental Protection Agency, Surveillance and Analysis Division, Athens, GA. June 24, 1974.

2. G.D. Clayton and Associates. Evaluation of a Collection and Analytical Procedure for Vinyl Chloride in Air. EPA Contract No. 68-02-1408, Task Order No. 2. EPA Report No. 75-VCL-1. December 13, 1974.

3. Midwest Research Institute. Standardization of Stationary Source Emission Method for Vinyl Chloride. EPA-600/4-77-026. May 1977.

4. Schell, W. and M.C. Sharp. Collaborative Testing of EPA Method, 106 (Vinyl Chloride) that will provide for a Standardized Stationary Source Emission Measurement Method. EPA 600/4-78-058. Emission Monitoring and Support Laboratory, Research Triangle Park, NC. October 1978.

Method 107—Determination of Vinyl Chloride Content of Inprocess Wastewater Samples, and Vinyl Chloride Content of Polyvinyl Chloride Resin, Slurry, Wet Cake, and Latex Samples

Introduction

Performance of this method should not be attempted by persons unfamiliar with the operation of a gas chromatograph, nor by those who are unfamiliar with source sampling, because knowledge beyond the scope of this presentation is required. Care must be exercised to prevent exposure of sampling personnel to vinyl chloride, a carcinogen.

*Mention of trade names or specific products does not constitute endorsement by the U.S. Environmental Protection Agency.

1. Applicability and Principle.

1.1 Applicability. This method applies to the measurement of the vinyl chloride monomer (VCM) content of inprocess wastewater samples, and the residual vinyl chloride monomer (RVCM) content of polyvinyl chloride (PVC) resins, wet cake, slurry, and latex samples. It cannot be used for polymer in fused forms, such as sheet or cubes. This method is not acceptable where methods from Section 304(h) of the Clean Water Act, 33 U.S.C. 1251 et seq (the Federal Water Pollution Control Amendments of 1972 as amended by the Clean Water Act of 1977) are required.

1.2 Principle. The basis for this method relates to the vapor equilibrium that is established between RVCM, PVC resin, water, and air in a closed system. The RVCM in a PVC resin will equilibrate rapidly in a closed vessel, provided that the temperature of the PVC resin is maintained above the glass transition temperature of that specific resin.

2. Range and Sensitivity.

The lower limit of detection of vinyl chloride will vary according to the chromatography used. Values reported include 1×10^{-7} mg and 4×10^{-7} mg. With proper calibration, the upper limit may be extended as needed.

3. Interferences.

The chromatograph columns and the corresponding operating parameters herein described normally provide an adequate resolution of vinyl chloride; however, resolution interferences may be encountered on some sources. Therefore, the chromatograph operator shall select the column and operating parameters best suited to his particular analysis requirements, subject to the approval of the Administrator. Approval is automatic provided that the tester produces confirming data through an adequate supplemental analytical technique, such as analysis with a different column or GC/mass spectroscopy, and has the data available for review by the Administrator.

4. Precision and Reproducibility.

An interlaboratory comparison between seven laboratories of three resin samples, each split into three parts, yielded a standard deviation of 2.63 percent for a sample with a mean of 2.09 ppm, 4.16 percent for a sample with a mean of 1.66 ppm, and 5.29 percent for a sample with a mean of 62.66 ppm.

5. Safety.

Do not release vinyl chloride to the laboratory atmosphere during preparation of standards. Venting or purging with VCM/air mixtures must be

held to a minimum. When they are required, the vapor must be routed to outside air. Vinyl Chloride, even at low ppm levels, must never be vented inside the laboratory. After vials have been analyzed, the gas must be vented prior to removal of the vial from the instrument turntable. Vials must be vented through a hypodermic needle connected to an activated charcoal tube to prevent release of vinyl chloride into the laboratory atmosphere. The charcoal must be replaced prior to vinyl chloride breakthrough.

a. Apparatus.

6.1 Sampling. The following equipment is required:

6.1.1 Glass Bottles. 60-ml (2-oz) capacity, with wax-lined screw on tops, for PVC samples.

6.1.2 Glass Vials. 60-ml capacity Hypo-vials, sealed with Teflon faced Tef-Bond discs, for water samples.

6.1.3 Adhesive Tape. To prevent loosening of bottle tops.

6.2 Sample Recovery. The following equipment is required:

6.2.1 Glass Vial. With seals and caps, Perkin-Elmer Corporation No. 105-0118, or equivalent. The seals must be made from butyl rubber. Silicone rubber seals are not acceptable.

6.2.2 Analytical Balance. Capable of weighing to ± 0.0001 gram.

6.2.3 Vial Sealer. Perkin-Elmer No. 105.0106 or equivalent.

6.3 Analysis. The following equipment is required:

6.3.1 Gas Chromatograph. Perkin-Elmer Corporation Model F-40, F-42, or F-45 Head-Space Analyzer, or equivalent. Equipped with backflush accessory.

6.3.2 Chromatographic Columns. Stainless steel 1 m by 3.2 mm and 2 m by 3.2 mm, both containing 50/80-mesh Porapak Q. The analyst may use other columns provided that the precision and accuracy of the analysis of vinyl chloride standards are not impaired and he has available for review information confirming that there is adequate resolution of the vinyl chloride peak. (Adequate resolution is defined as an area overlap of not more than 10 percent of the vinyl chloride peak by an interferent peak. Calculation of area overlap is explained in Appendix C, Supplement A: "Determination of Adequate Chromatographic Peak Resolution.") Two 1.83 m columns, each containing 1 percent Carbowax 1500 on Carbowax B, have been suggested for samples containing acetaldehyde.

6.3.3 Thermometer. 6 to 100°C, accurate to $\pm 0.1^\circ\text{C}$, Perkin-Elmer No. 105-0109, or equivalent.

6.3.4 Sample Tray Thermostat System. Perkin-Elmer No. 105.0103, or equivalent.

6.3.5 Septa. Sandwich type, for automatic dosing, 13 mm, Perkin-Elmer No. 105-1006, or equivalent.

6.3.6 Integrator-Recorder. Hewlett-Packard Model 33060A, or equivalent.

6.3.7 Filter Drier Assembly (3). Perkin-Elmer No. 2230117, or equivalent.

6.3.8 Soap Film Flowmeter. Hewlett-Packard No. 0101-0113, or equivalent.

6.3.9 Regulators. For required gas cylinders.

6.3.10 Headspace Vial Pressurizer. Nitrogen pressurized hypodermic needle inside protective shield. (Blueprint available from Test Support Section, Emission Measurement Branch, Office of Air Quality Planning and Standards, Environmental Protection Agency, Mail Drop 19, Research Triangle Park, N.C. 27711.)

7. Reagents.

Use only reagents that are of chromatograph grade.

7.1 Analysis. The following items are required for analysis:

7.1.1 Hydrogen. Zero grade.

7.1.2 Nitrogen. Zero grade.

7.1.3 Air. Zero grade.

7.2 Calibration. The following items are required for calibration:

7.2.1 Cylinder Standards (4). Gas mixture standards (50-, 500-, 2000- and 4000-ppm vinyl chloride in nitrogen cylinders). The tester may use cylinder standards to directly prepare a chromatograph calibration curve as described in Section 9.2, if the following conditions are met: (a) The manufacturer certifies the gas composition with an accuracy of ± 3 percent or better (see Section 7.2.1.1). (b) The manufacturer recommends a maximum shelf life over which the gas concentration does not change by greater than ± 5 percent from the certified value. (c) The manufacturer affixes the date of gas cylinder preparation, certified vinyl chloride concentration, and recommended maximum shelf life to the cylinder before shipment to the buyer.

7.2.1.1 Cylinder Standards Certification. The manufacturer shall certify the concentration of vinyl chloride in nitrogen in each cylinder by (a) directly analyzing each cylinder and (b) calibrating his analytical procedure on the day of cylinder analysis. To calibrate his analytical procedure, the manufacturer shall use, as a minimum, a three-point calibration curve. It is recommended that the manufacturer maintain (1) a high-concentration calibration standard (between 4000 and 8000 ppm) to prepare his calibration

curve by an appropriate dilution technique and (2) a low-concentration calibration standard (between 50 and 500 ppm) to verify the dilution technique used. If the difference between the apparent concentration read from the calibration curve and the true concentration assigned to the low-concentration calibration standard exceeds 5 percent of the true concentration, the manufacturer shall determine the source of error and correct it, then repeat the three-point calibration.

7.2.1.2 Verification of Manufacturer's Calibration Standards. Before using, the manufacturer shall verify each calibration standard by (a) comparing it to gas mixtures prepared (with 99 Mol percent vinyl chloride) in accordance with the procedure described in Section 7.1 of Method 106 or by (b) having it analyzed by the National Bureau of Standards. The agreement between the initially determined concentration value and the verification concentration value must be within ± 5 percent. The manufacturer must reverify all calibration standards on a time interval consistent with the shelf life of the cylinder standards sold.

a. Procedure.

6.1 Sampling.

6.1.1 PVC Sampling. Allow the resin or slurry to flow from a tap on the tank or silo until the tap line has been well purged. Extend and fill a 60-ml-sample bottle under the tap, and immediately tighten a cap on the bottle. Wrap adhesive tape around the cap and bottle to prevent the cap from loosening. Place an identifying label on each bottle, and record the date, time, and sample location both on the bottles and in a log book.

6.1.2 Water Sampling. Prior to use, the 60-ml vials (without the discs) must be capped with aluminum foil and muffled at 400°C for at least 1 hour to destroy or remove any organic matter that could interfere with analysis. At the sampling location fill the vials bubble-free to overflowing so that a convex meniscus forms at the top. The excess water is displaced as the sealing disc is carefully placed, with the Teflon side down, on the opening of the vial.

Place the aluminum seal over the disc and the neck of the vial, and crimp into place. Affix an identifying label on the bottle, and record the date, time, and sample location both on the vials and in a log book. All samples must be kept refrigerated until analyzed.

6.2 Sample Recovery. Samples must be run within 24 hours.

6.2.1 Resin Samples. The weight of the resin used must be between 3.5 and 4.5 grams. An exact weight must be

obtained (± 0.0001 g) for each sample. In the case of suspension resins, a volumetric cup can be prepared for holding the required amount of sample. When the cup is used, open the sample bottle, and add the cup volume of resin to the tared sample vial (tared, including septum and aluminum cap). Obtain the exact sample weight, add two drops of distilled water, and immediately seal the vial. Report this value on the data sheet; it is required for calculation of RVC. In the case of dispersion resins, the cup cannot be used. Weigh the sample in an aluminum dish, transfer the sample to the tared vial, and accurately weigh it in the vial. After pre-pressurization of the samples, condition them for a minimum of 1 hour in the 90° C bath. Do not exceed 5 hours.

Note.—Some aluminum vial caps have a center section that must be removed prior to placing into sample tray. If the cap is not removed, the injection needle will be damaged.

8.2.2 Suspension Resin Slurry and Wet Cake Samples. Decant the water from a wet cake sample, and turn the sample bottle upside down onto a paper towel. Wait for the water to drain, place approximately 0.2 to 4.0 grams of the wet cake sample in a tared vial (tared, including septum and aluminum cap) and seal immediately. Then determine the sample weight (± 0.0001 g). All samples must be pre-pressurized and then conditioned for 1 hour at 90° C. A sample of wet cake is used to determine TS (total solids). This is required for calculating the RVC.

8.2.3 Dispersion Resin Slurry and Geon Latex Samples. The materials should not be filtered. Sample must be thoroughly mixed. Using a tared vial (tared, including septum and aluminum cap) add approximately 8 drops (0.25 to 0.35 g) of slurry or latex using a medicine dropper. This should be done immediately after mixing. Seal the vial as soon as possible. Determine sample weight (± 0.0001 g). After pre-pressurization, condition the vial for 1 hour at 90° C in the analyzer bath. Determine the TS on the slurry sample (Section 8.3.5.).

8.2.4 Inprocess Wastewater Samples. Using a tared vial (tared, including septum and aluminum cap) quickly add approximately 1 cc of water using a medicine dropper. Seal the vial as soon as possible. Determine sample weight (± 0.0001 g). Pre-pressurize the vial, and then condition for 2 hours at 90° C in the analyzer bath.

8.3 Analysis

8.3.1 Preparation of Equipment. Install the chromatographic column and condition overnight at 160° C. In the first

operation, Porapak columns must be purged for 1 hour at 230° C. Do not connect the exit end of the column to the detector while conditioning. Hydrogen and air to the detector must be turned off while the column is disconnected.

8.3.1.1 Flow Rate Adjustments.

Adjust flow rates as follows:

a. **Nitrogen Carrier Gas.** Set regulator on cylinder to read 50 psig. Set regulator on chromatograph to produce a flow rate of 30.0 cc/min. Accurately measure the flow rate at the exit end of the column using the soap film flowmeter and a stopwatch, with the oven and column at the analysis temperature. After the instrument program advances to the "B" (backflush) mode, adjust the nitrogen pressure regulator to exactly balance the nitrogen flow rate at the detector as was obtained in the "A" mode.

b. **Vial Pre-Pressurizer Nitrogen.** After the nitrogen carrier is set, solve the following equation and adjust the pressure on the vial pre-pressurizer accordingly.

$$P = \frac{T_1}{T_2} \left[P_1 - \frac{P_{w1} - P_{w2}}{7.50} \right] - 10 \text{ k Pa}$$

Where:

T_1 = Ambient temperature, °K.

T_2 = Conditioning bath temperature, °K.

P_1 = Gas chromatograph absolute dosing pressure (analysis mode), k Pa.

P_{w1} = Water vapor pressure @ 90° C (525.8 mm Hg).

P_{w2} = Water vapor pressure @ 22° C (19.8 mm Hg).

7.50 = mm Hg per k Pa.

10 k Pa = Factor to adjust the pre-pressurized pressure to slightly less than the dosing pressure.

Because of gauge errors, the apparatus may over-pressurize the vial. If the vial pressure is at or higher than the dosing pressure, an audible double injection will occur. If the vial pressure is too low, errors will occur on resin samples because of inadequate time for headspace gas equilibrium. This condition can be avoided by running

several standard gas samples at various pressures around the calculated pressure, and then selecting the highest pressure that does not produce a double injection. All samples and standards must be pressurized for 60 seconds using the vial pre-pressurizer. The vial is then placed into the 90° C conditioning bath and tested for leakage by placing a drop of water on the septum at the needle hole.

c. **Burner Air Supply.** Set regulatory on cylinder to read 50 psig. Set regulator on chromatograph to supply air to burner at a rate between 250 and 300 cc/min. Check with bubble flowmeter.

d. **Hydrogen Supply.** Set regulator on cylinder to read 30 psig. Set regulator on chromatograph to supply approximately 35 $\pm$ 5 cc/min. Optimize hydrogen flow to yield the most sensitive detector response without extinguishing the flame. Check flow with bubble meter and record this flow.

8.3.1.2 Temperature Adjustments.

Set temperatures as follows:

a. **Oven (chromatograph column),** 140° C.

b. **Dosing Line,** 170° C.

c. **Injection Block,** 170° C.

d. **Sample Chamber, Water Temperature,** 90° C $\pm$ 1° C.

8.1.3 Ignition of Flame Ionization Detector. Ignite the detector according to the manufacturer's instructions.

8.3.1.4 Amplifier Balance. Balance the amplifier according to the manufacturer's instructions.

8.3.2 Programming the Chromatograph. Program the chromatograph as follows:

a. **I-Dosing or Injection Time.** The normal setting is 2 seconds.

b. **A-Analysis Time.** The normal setting is approximately 70 percent of the VCM retention time. When the analysis timer terminates, the programmer initiates backflushing of the first column.

c. **B-Backflushing Time.** The normal setting is double the analysis time.

d. **W-Stabilization Time.** The normal setting is 0.5 minute to 1.0 minute.

e. **X-Number of Analyses Per Sample.** The normal setting is 1.

8.3.3 Preparation of Sample Turntable. Before placing any sample into turntable, be certain that the center section of the aluminum cap has been removed. All samples and standards must be pressurized for 60 seconds by using the vial pre-pressurizer. The numbered sample vials should be placed in the corresponding numbered positions in the turntable. Insert samples in the following order:

Positions 1 and 2—Old 2000-ppm standards for conditioning. These are

necessary only after the analyzer has not been used for 24 hours or longer.

Positions 3—500-ppm standard, freshly prepared.

Positions 4—500-ppm standard, freshly prepared.

Position 5—2000-ppm standard, freshly prepared.

Position 6—4000-ppm standard, freshly prepared.

Position 7—Sample No. 7 (This is the first sample of the day, but is given as 7 to be consistent with the turntable and the integrator printout.)

After all samples have been positioned, insert the second set of 50-, 500-, 2000-, and 4000-ppm standards. Samples, including standards, must be conditioned in the bath of 90°C for 1 hour (not to exceed 5 hours).

8.3.4 Start Chromatograph Program. When all samples, including standards, have been conditioned at 90°C for 1 hour, start the analysis program according to the manufacturer's instructions. These instructions must be carefully followed when starting and stopping a program to prevent damage to the dosing assembly.

8.3.5 Determination of Total Solids (TS). For wet cake, slurry, resin solution, and PVC latex samples, determine TS for each sample by accurately weighing approximately 3 to 4 grams of sample in an aluminum pan before and after placing in a draft oven (105 to 110°C). Samples must be dried to constant weight. After first weighing, return the pan to the oven for a short period of time, and then reweigh to verify complete dryness. TS is then calculated as the final sample weight divided by initial sample weight.

9. Calibration.

Calibration is to be performed each 8-hour period when the instrument is used. Each day, prior to running samples, the column should be conditioned by running two 2000-ppm standards from the previous day.

9.1 Preparation of Standards.

Calibration standards are prepared as follows: Place two drops of distilled water (with the use of an eyedropper) in the sample vial, then fill the vial with the VCM/nitrogen standard, rapidly seat the septum, and seal with the aluminum cap. Use a 1/4-in. stainless steel line from the cylinder to the vial. Do not use rubber or tygon tubing. The sample line from the cylinder must be purged (into a properly vented hood) for several minutes prior to fill the vials. After purging, reduce the flow rate to 600 to 1000 cc/min. Place end of tubing into vial (near bottom). Position a septum on top of the vial, pressing it against the 1/4-in. filling tube to minimize the size of the vent opening. This is

necessary to minimize mixing air with the standard in the vial. Each vial is to be purged with standard for 90 seconds, during which time the filling tube is gradually slid to the top of the vial. After the 90 seconds, the tube is removed with the septum, simultaneously sealing the vial. Practice will be necessary to develop good technique. Rubber gloves should be worn during the above operations. The sealed vial must then be pressurized for 60 seconds using the vial pre-pressurizer. Test the vial for leakage by placing a drop of water on the septum at the needle hole.

9.2 Preparation of Chromatograph Calibration Curve.

Prepare two 50-, 500-, 2000-, and 4000-ppm standard samples. Run the calibration samples in exactly the same manner as regular samples. Plot A_v , the integrator area counts for each standard sample, versus C_v , the concentration of vinyl chloride in each standard sample.

Draw a straight line through the points derived by the least squares method.

10. Calculations.

10.1 Response Factor. If the calibration curve described in section 9.2 passes through zero, a response factor, R_f , may be used to compute vinyl chloride concentrations. To compute a response factor, divide any particular A_v by the corresponding C_v .

$$R_f = A_v / C_v \quad \text{Eq. 107-1}$$

If the calibration curve does not pass through zero, the calibration curve must be employed to calculate each sample concentration unless the error introduced by using a particular R_f is known.

10.2 Residual Vinyl Chloride Monomer Concentration, (C_{rvc}) or Vinyl Chloride Monomer Concentration. Calculate C_{rvc} in ppm or mg/kg as follows:

$$C_{rvc} = \frac{A_s P_a}{R_f T_1} \left[\frac{M_v V_g}{R m} + K_p (TS) T_2 + K_w (1 - TS) T_2 \right] \quad \text{Eq. 107-2}$$

Where:

A_s = Chromatograph area counts of vinyl chloride for the sample.

P_a = Ambient atmospheric pressure, mm Hg.

R_f = Response factor in area counts per ppm VCM.

T_1 = Ambient laboratory temperature, °K.

M_v = Molecular weight of VCM (62.5 g/mole).

V_g = Volume of the vapor phase, cm³.

R = Gas constant (82360 cm³ · mm Hg/mole · °K).

m = Sample weight, g.

K_p = Henry's Law Constant for VCM in PVC @ 90°C (6.52 × 10⁻⁶ g/g/mm Hg).

TS = Total solids expressed as a decimal fraction.

T_2 = Equilibrium temperature, °K.

K_w = Henry's Law Constant for VCM in water @ 90°C (7 × 10⁻⁶ g/g/mm Hg).

Assuming the following conditions are met, these values can be substituted into equation 107-2:

P_a = 760 mm Hg.

V_g = Vial volume—sample volume (Fisher vials are 22.0 cm³ and Perkin-Elmer vials are 21.8 cm³).

T_1 = 23°C or 296°K.

T_2 = 90°C or 363°K.

$$C_{rvc} = \frac{A_s 760}{R_f 296} \left[\frac{(62.5) 21.8}{82360} + \frac{6.52 \times 10^{-6} (TS)}{1} + \frac{7 \times 10^{-6} (1-TS)}{1} \right] \quad \text{Eq. 107-2}$$

Results calculated using these equations represent concentration based on the total sample. To obtain results based on dry PVC content, divide by TS.

11. References.

1. Residual Vinyl Chloride Monomer Content of Polyvinyl Chloride Resins, Latex, Wet Cake, Slurry and Water Samples, B. F. Goodrich Chemical Group Standard Test Procedure No. 1005-K, B. F. Goodrich Technical Center, Avon Lake, Ohio, October 4, 1979.
2. Berens, A. R., "The Diffusion of Vinyl Chloride in Polyvinyl Chloride,"

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3. Berens, A. R., "The Diffusion of Vinyl Chloride in Polyvinyl Chloride,"

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4. Berens, A. R., L. B. Crider, C. J. Tomasek and J. M. Whitney, "Analysis for Vinyl Chloride in PVC Powders by Head-Space Gas Chromatography," to be published.

5. Berens, A. R., "The Diffusion of Vinyl Chloride in Polyvinyl Chloride,"

ACS—Division of Polymer Chemistry, Polymer Preprints 15 (2): 197, 1974.

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO Mr. J. P. Sandstedt At Piscataway Date December 15, 1980

FROM Dr. R. T. Gottesman At Saddle Brook C. 2184

SUBJECT EPA Proposal -- Vinyl Chloride
Air Pollution Tests

EPA has proposed to revise its test methods for vinyl chloride under NESHAPS (45 FR76346).

The notice is reported to indicate that several improvements have been developed in the test methods since their adoption in 1977 and the Agency proposes to incorporate these improvements in these revisions.

Comments are due by January 19, 1981.

I would suggest your careful review of this proposal including consultation, if necessary, with the Analytical Department. If these proposed revisions constitute a problem to us, we should plan to offer comments by the January 19 date.

Please advise.

R. T. Gottesman

R. T. Gottesman

RTG:jmd

*C. -
Please get copy of the
above in the Register listed
above*

John

*attached
in*

The controversy over Love Canal was the "biggest trouble we've gotten into this year, on scientific grounds," she told the panel. "It has been a very unfortunate thing for the agency that we're constantly measured for that flaky chromosome study."

Wellford said "it's pretty clear now" that the Center for Disease Control, not EPA, will be doing health effects work related to Love Canal. There is "some concern," she added, that the work may be transferred to the Department of Health and Human Resources.

David M. Rosenbaum, deputy assistant administrator for radiation programs, told the advisory board that it's very difficult to get highly qualified people to bid on competitive contracts.

"Getting the best people has nothing to do with the federal contract procedure," he said. "Very often the very best people in a field won't bid at all . . . The system's just not set up to get the best."

Rosenbaum stated that environmental impact statements generated by EPA are often "terribly written, with made-up numbers." EISs are often done "on the basis of, if they're very thick and dull, no one will ever read them," Rosenbaum said, which he called "a form of middle class subsidy."

Rosenbaum said he does not contract out for EISs or policy statements. It is worth it to have the work done in-house, he said, because at least he knows "what the numbers mean."

Air Pollution

EPA PROPOSES TO REVISE TESTS FOR VINYL CHLORIDE AIR POLLUTANTS

The Environmental Protection Agency Nov. 18 proposed to revise its test methods for vinyl chloride under its national emission standards for hazardous air pollutants (45 FR 76346).

In its announcement, EPA said that several improvements have been developed in the test methods since they were adopted in 1977. The proposed revisions would incorporate the improvements, the agency stated.

Comments on the proposal should be submitted in duplicate by Jan. 19, 1981, to the Central Docket Section (A-130), Attention: Docket No. A-80-50, EPA, 401 M St. S.W., Washington, D.C. 20460.

For further information, contact Roger Shigehara, Emission Measurement Branch (MD-19), EPA, Research Triangle Park, N.C. 27711, (919) 541-2237.

Hazardous Waste

EPA TELLS OIL COMPANY TO ELIMINATE LAKE ERIE HAZARDOUS DISCHARGE THREAT

CLEVELAND — (By a BNA Staff Correspondent) — The Environmental Protection Agency Oct. 28 told the Stevenson Oil & Chemical Corporation to take immediate measures to eliminate the threat of oil and hazardous discharges into Lake Erie.

EPA Region V Administrator John McGuire said that numerous inspections at the suburban Cleveland facility have determined a "substantial threat of discharge of oil and hazardous substances" into the lake. Runoff from the two-acre site flows into a swampy area which then can flow into Lake Erie through a drainage system, he explained.

Two actions have been requested by EPA to eliminate the discharge threat. They include removal of waste material drums to an approved hazardous waste disposal site, and consultation with a contractor to remove a black, oily substance from the swampy area at the rear of the site.

This action was taken under Section 311 provisions of the Clean Water Act, which prohibits oil or hazardous substance discharges into navigable waterways. Should Stevenson be unable or unwilling to take discharge threat elimination measures, McGuire said EPA may take further action involving federal authority and funding. In that case, the owner or operator could become liable for the costs of federal remedial actions, he said.

Stevenson has a week to respond to EPA's request before further action will be considered.

Enforcement

WASTE DISPOSAL FIRM, EMPLOYEES INDICTED FOR MAIL FRAUD, CONSPIRACY

A Newark, N.J., federal grand jury Nov. 5 indicted three individuals and four companies on various mail fraud and conspiracy charges connected with their alleged failure to fulfill contracts for the proper disposal of hazardous wastes.

The indictments charged that the defendants agreed to accept waste from chemical companies and promised to dispose of the waste in accordance with requirements set by the New Jersey Department of Environmental Protection, but that they never performed the services even though payment was made.

Michael Colleton, Ridgewood, N.J., the principal operating officer of the Chemical Control Corp., was charged in the indictments with multiple counts of mail fraud. Colleton allegedly induced payments for services never performed, using the mail to further the scheme. He could face a sentence of 50 years and a fine of \$10,000 if found guilty.

John Albert and Eugene Conlon, both of North Brunswick, N.J., were charged by the grand jury with mail fraud and conspiracy in connection with an allegedly similar scheme. According to the indictments, the two men accepted payments for transporting hazardous wastes for disposal by the Chemical Control Corp., but instead stored drums of waste at a different site and in an unlawful manner. If found guilty, the two would be subject to sentences of up to 60 years imprisonment and fines of \$21,000.

The corporate defendants are the Chemical Control Corp., and its parent corporation, the Northeast Pollution Control Corp., Elizabeth, N.J., the Jersey Sanitation Co. Inc., East Brunswick, N.J., and A to Z Chemical Resource Recovery Inc., New Brunswick, N.J.

The grand jury Nov. 12, also indicted for mail fraud William Carracino, Union, N.J., the previous owner of Chemical Control.

Carracino could face a sentence of 35 years imprisonment and a \$7000 fine if found guilty.

Publications

EPA RELEASES QUARTERLY BIBLIOGRAPHY OF DOCUMENTS PUBLISHED BY AGENCY OFFICES

A quarterly abstract bulletin of Environmental Protection Agency publications is available from the agency's Center for Environmental Research Information.

The bulletin lists EPA publications by National Technical Information Service number and price, title, subject, and sponsoring EPA office. The bulletin also includes an abstract of each publication and a list of key descriptive and identifying words.

The bulletin includes EPA publications issued from July through September 1980. It is available from the center, Cincinnati, Ohio 45268.