

VINYL CHLORIDE MONOMER SURVEY

AT

BORDEN CHEMICAL
Division of Borden, Incorporated
511 Lancaster Street
Leominster, Mass. 01453

MAY 1974

SURVEY REPORT

U. S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

Surveillance & Analysis Division
Needham Heights, Mass. 02194

COLORITE 016896

PREFACE TO REGIONAL MONITORING REPORTS
ON VINYL CHLORIDE

This is a preliminary report and should not be construed to represent Agency policy. When reading this document it should be recognized that this information was obtained in a very short period of time using sampling and analysis methods that have received only a limited amount of pretesting. The methods utilized were based on the Agency's best scientific judgment and represent, in the Agency's opinion, the best methods available. However, they have not been thoroughly tested for accuracy and precision under field conditions. The actual sampling and analysis methods were based on previous analytical studies in which similar chemicals were evaluated.

Prior to and during the actual vinyl chloride sampling and measurement only limited quality control and standardization of procedures could be applied in the time available. It is important to recognize that the methods utilized are interim procedures which are subject to further modification. In addition, the methods should not be construed as EPA recommended methods.

The nature of the PVC manufacturing process results in the escape of vinyl chloride in pulses; therefore, high levels may appear in grab samples taken at the time of these releases, and very low levels may be present at intervening times. So, too, changes in air movement may influence concentrations at a given station at any one time. Therefore, it is important to recognize that the vinyl chloride data reported in this document are preliminary in nature and are subject to change as additional monitoring is performed under more representative and standardized conditions.

VCM STUDY
Borden Chemical
Leominster, Mass.

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VCM STUDY
Borden Chemical
Leominster, Mass.

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VCM Study
Borden Chemical
Leominster, Mass. .

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VINYL CHLORIDE MONOMER SURVEY
Borden Chemical
Division of Borden Incorporated
511 Lancaster Street
Leominster, Mass. 01453

OVERVIEW

In response to a request from Glen E. Schwietzer, Director of the Office of Toxic Substances, regarding regional vinyl chloride monomer (VCM) surveys, Region I's Surveillance and Analysis Division conducted a survey at Borden Chemical. The survey encompassed 24-hour sampling each day on May 9, 10 and 13, 1974. During these times, samples were collected of the ambient air, aerated lagoon waste water discharge, residual sludge, and raw process water. The "Method for Vinyl Chloride (VC) in Industrial Waste Water Effluents and Atmospheric Emissions" attached to the VCM Memo from Mr. Willis B. Foster, Deputy Assistant Administrator for Monitoring Systems was used as a guide and followed whenever practicable and/or possible. The purpose of the study was to help determine whether ambient air VCM levels surrounding a typical polyvinyl chloride (PVC) plant are sufficiently high to pose a health problem to the surrounding neighborhoods and whether concentrations in the waste water and/or sludge could pose an ultimate disposal problem.

BACKGROUND

At an initial meeting between Borden Incorporated and the U. S. Environmental Protection Agency (EPA) personnel on April 19, 1974, it was agreed that Borden would be the polyvinyl chloride manufacturer participating in Region I's VCM study. Borden had no objection to the waste water and sludge sampling program and asked to split these samples, as well as all air samples with EPA. They were going to run independent

analyses in their own laboratory. This was agreed. During the survey, Borden was most cooperative, assigning Mr. Russell Mercier as overseer of Borden's portion of the project and liaison between Borden and Donald Porteous, Region I's coordinator for the project.

MANUFACTURING PROCESSES

Borden Chemical in Leominster manufactures industrial organic chemicals (SIC 2818). Production at Borden is carried on 24-hours per day, seven days per week. The plant is divided into three production areas: the PVC manufacturing plant, the PVC compounding plant, and the Polyco plant. The PVC manufacturing plant produces a complete line of homopolymer-copolymer resins, blending resins, and packaging and pipe compounds. Approximately 100,000 tons of PVC are produced annually. VCM is only used in the manufacturing of PVC and in none of the other processes. The PVC compounding plant mixes the PVC resin with modifiers and stabilizers to produce clear PVC pellets for blow molding. The Polyco plant produces latexes of polyvinyl acetate, polyvinyl chloride, and acrylics; vinyl acetate monomer; and glacial acetic acid.

Figure 1 shows the plant layout. Appendix 1 describes the liquid PVC polymerization process carried out at Borden. A process-flow diagram is also included.

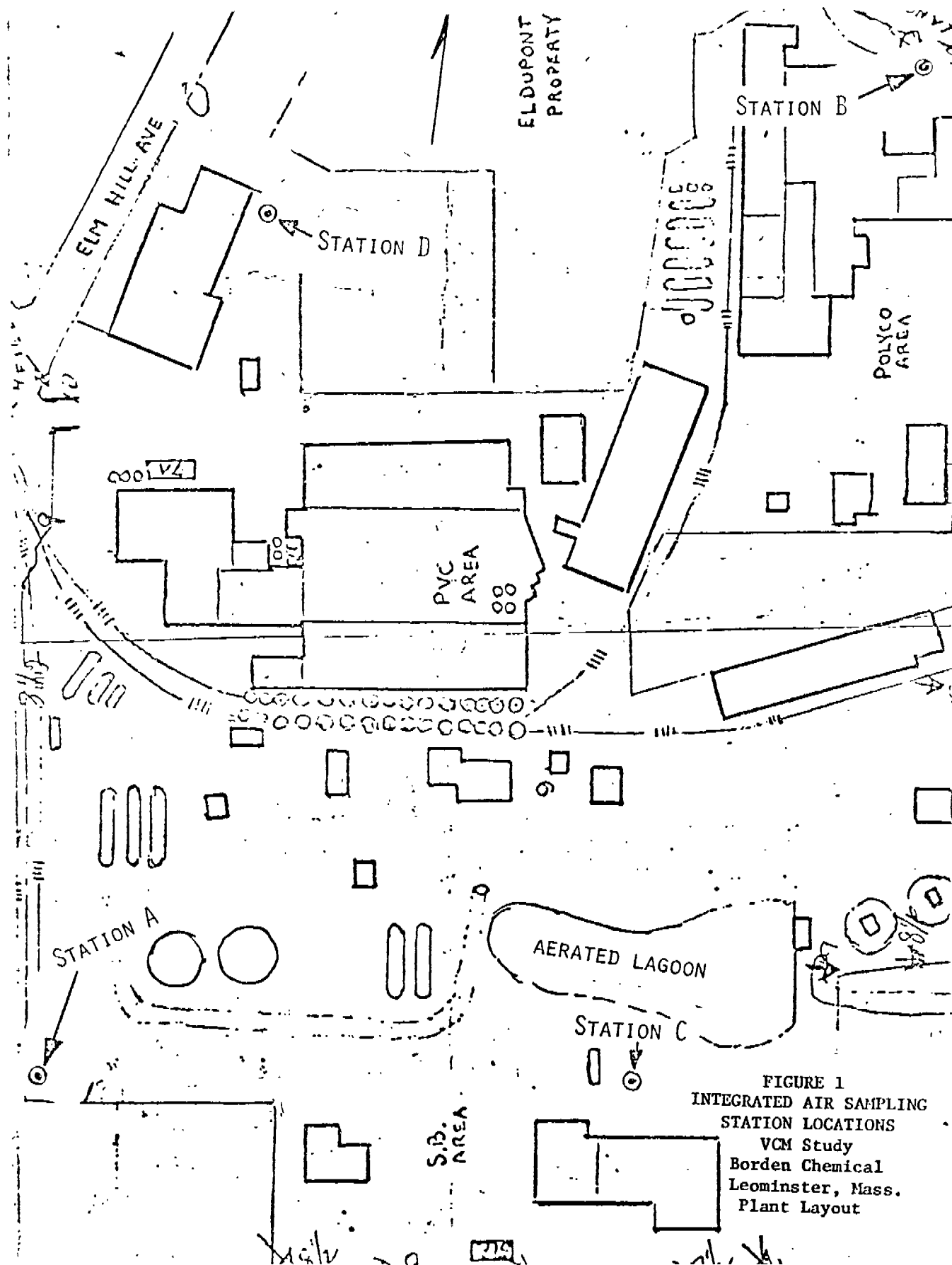


FIGURE 1
 INTEGRATED AIR SAMPLING
 STATION LOCATIONS
 VCM Study
 Borden Chemical
 Leominster, Mass.
 Plant Layout

WATER, SLUDGE AND WASTE WATER

Waste Water Sources and Treatment Facilities

Sanitary wastes and storm drainage are discharged into the municipal systems. Cooling water is recycled through cooling towers. Waste discharges to the aerated lagoon include waste process water, washdown, spillage, and boiler blowdown. The effluent from this lagoon is metered through a six-inch Parshall flume into the city of Leominster's waste water treatment facility.

The majority of waste water to the lagoon comes from the PVC manufacturing plant. The major sources of waste water from the PVC manufacturing process include: 1. concentrates from the PVC centrifuges, and 2. cleanup and washdown from process areas. Since VCM is only used in the PVC manufacturing process, the other sources of waste to the lagoon are not enumerated here.

Screenings are trucked away as required and disposed of in the city's sanitary landfill. The lagoon is dredged approximately every three years with the sludge also being trucked away to the city's sanitary landfill.

Sampling Program

Per the VCM memo, only the waste water discharge point identified in the NPDES Permit was sampled for VCM. This was the lagoon effluent at the Parshall flume and is designated BC-01. Grab sludge samples from the lagoon were also collected near the lagoon outlet and designated BC-02. The plant's city water supply was also

sampled prior to deionization and designated BC-03. Table #1 describes the water, sludge, and waste water sampling program conducted during the survey.

Waste water samples were composited by hand proportional to flow. The one-hour sampling frequency was satisfactory due to the size of the lagoon (5-day detention) which made it fairly immune to instantaneous or shock-flow phenomena. Water and waste water samples were hand dipped and the glass containers completely filled, leaving no air space between the sample and the teflon-lined cover. The sludge samples were obtained with an Eckman dredge and hand packed in glass bottles so no air space was left between the sludge and the teflon-lined cover. Samples were refrigerated immediately after sampling and remained so until ready to be analyzed at Region I's laboratory in Needham, Massachusetts. (NERL) All samples were transported by car from Borden to NERL.

Results

The vinyl chloride concentrations detected in the water, sludge, and waste water samples are shown in Appendix 2 together with the associated waste water flows out of the lagoon into the city's sewer system during the study period.

The sludge extract from sample 4007-1 was confirmed as containing vinyl chloride using a Finnigan Gas Chromatograph/Mass Spectrometer unit.

AIR

Meteorology

Wind speed and direction were obtained at the site using a recording anemometer. Temperature and barometric pressure were also taken on site.

Table 1
VCM Study
Borden Chemical
WATER, SLUDGE AND WASTE WATER SAMPLE SITES

SITE	SAMPLE TYPE	COLLECTION INTERVAL	SAMPLE CONTAINER	NUMBER OF SAMPLES TO BE ANALYZED		SITE DESCRIPTION	UNIVERSAL TRANSVERSE MERCATOR GRID (UTM)	
				DAILY	TOTAL		E	N
BC-01	24 hour composite	hourly	Glass bottle with Teflon lined cover	1	3	The aerated lagoon effluent at the 6" Parshal flume	274550	4709800
BC-02	GRAB	1 every other sampling day	Glass bottle with Teflon lined cover	(See note under collection interval)	2	The aerated lagoon sludges near the outlet	274600	4709800
BC-03	GRAB	once daily	Glass bottle with Teflon lined cover	1	3	The city water intake at the boiler house building #30) before deionization		

The prevailing winds are primarily from the northwest and secondly from the southwest direction, and the survey was set up accordingly. During the survey, however, the wind was out of the westerly directions only on the last day of sampling. The first two days found the wind from almost all directions except the northwest and southwest. Due to the time limitation on this project, the luxury of choosing to sample only on days when the wind was favorable was not afforded. There also appeared to be micrometeorological phenomena occurring during the survey as, at times, plumes were seen to be blowing in different directions.

Light intermittent rain showers occurred late Thursday night and continued into Friday. Heavy rains occurred from Sunday at midnight until about 0300 hours on Monday.

Wind speed and direction graphs are shown in Figures 2 and 3. Average direction and speed were chosen and plotted at half-hour intervals. All meteorological data are included in Appendix 3.

Air Emissions Sources

Possible VCM emission points in the PVC manufacturing process are vents from the poly or reaction vessels, vents from the unreacted monomer recovery system, vents from the polymerization work area, vents from the blending tanks, and vents from the dryers following centrifugation. There are over one hundred vents of varying sizes and flow rates which, at any specific point in time, could be a significant source of VCM emissions.

Ambient Air Monitoring Program

The ambient air monitoring program was set up as requested in the VCM memo. Two methods were used: grab samples using glass gas

1 DAY BY HOURS 46 2050
 X 100 DIVISIONS
 KEUFFEL & ESSER CO.

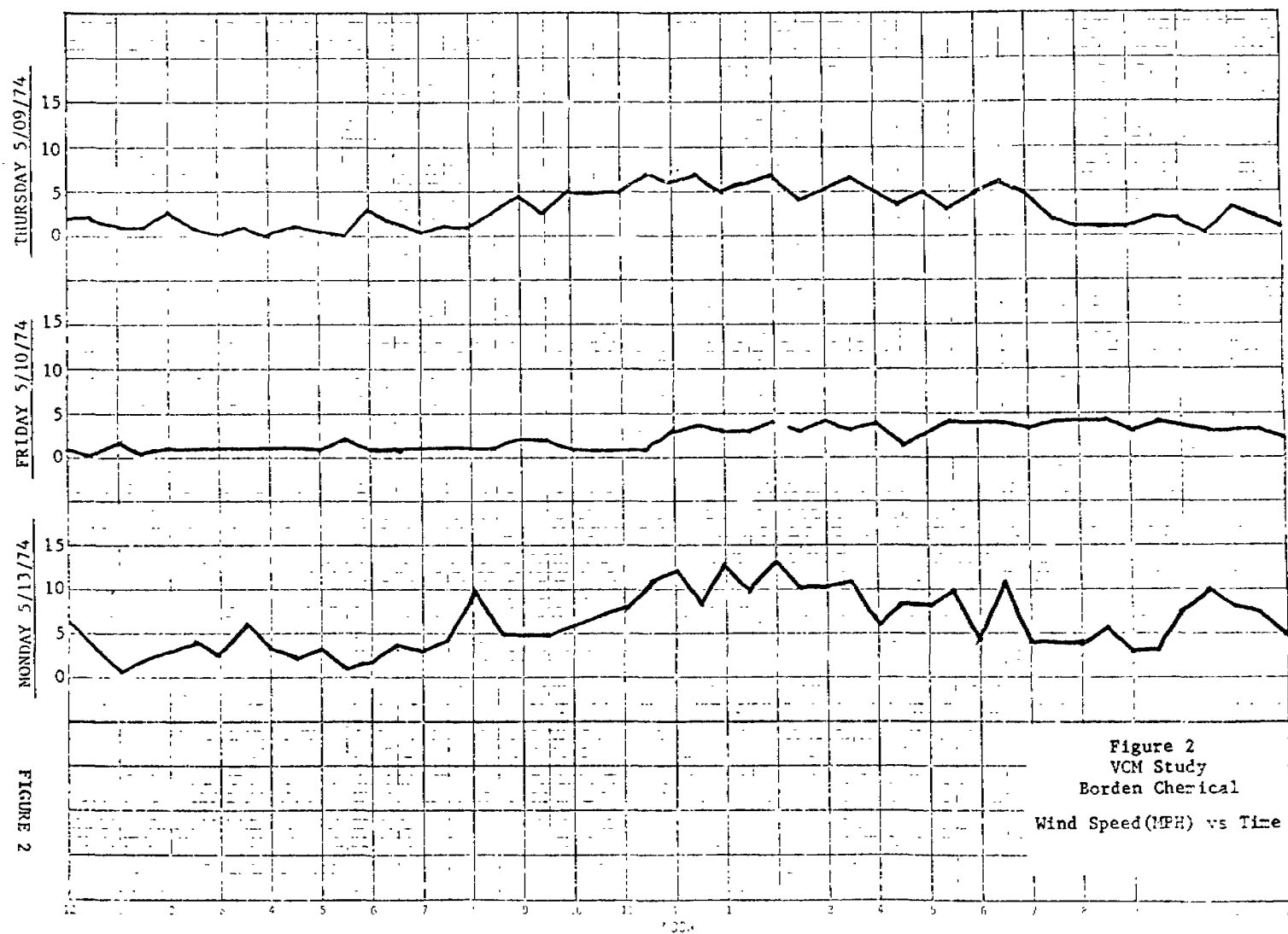
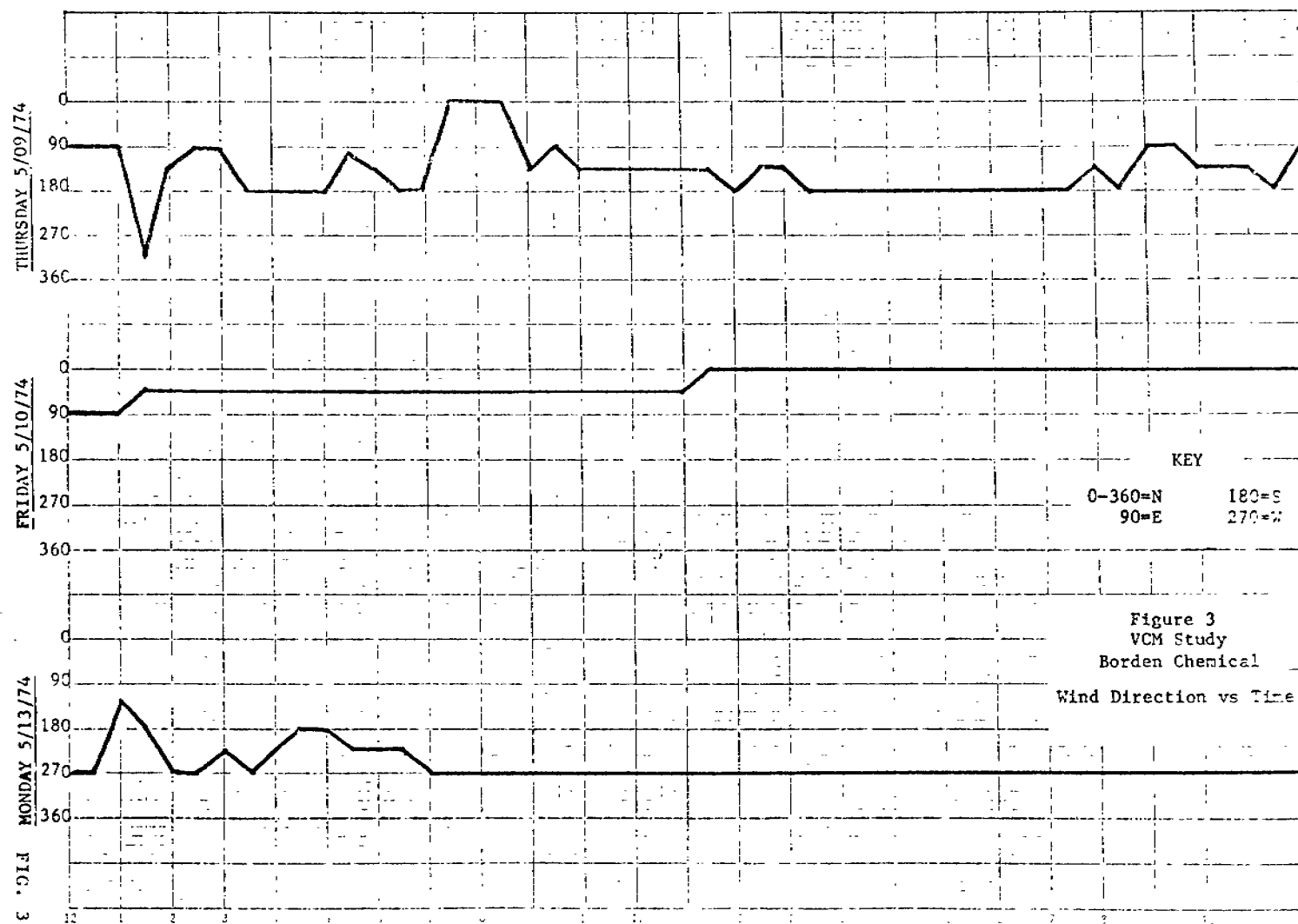


Figure 2
 VCM Study
 Borden Chemical
 Wind Speed(MPH) vs Time

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1 DAY BY HOURS 46 2050
X 100 DIPS GNS
KLEPPLE & EBBERS CO



COLORITE 016909

syringes and Tedlar bags, and 24-hour integrated samples using the charcoal columns recommended in Section 6.2.4. of the memo.

Grab Sample Site Locations

Borden is located southeast of the core city of Leominster. See Figure 4. Local topography favors a northwesterly wind direction. The prevailing wind directions this time of year range from northwest to southwest. Consequently, downwind stations were set up northeast and southeast of the plant.

Grab sample sites are shown on the overlay for Figure 4. Table 2 lists the grab sample sites. Again, the recommended distances and locations in Section 6.2.1 of the memo were used, as well as some additional sites.

All grab and integrated sample locations shown in Figures 4 and 5 are relative to the approximate center of the Borden complex and not the PVC manufacturing portion of the complex. This is important in interpreting the results at Stations A and D. That is, while Station A is approximately 0.2 miles from the center of the complex, it is closer than that to the PVC manufacturing plant. Likewise with Station D.

All grab sample locations were in residential, industrial, or residential-industrial locations, with the exception of Station L, which was in a rural setting. All grab samples were taken approximately six feet above ground level, as most of the structures nearby were only one or two stories in height. In addition to the set grab-sample locations (A-P), spot samples were taken whenever odors associated with Borden were noticed, i.e., acetate and acrylate. These locations are shown on the

FIGURE 4
 SAMPLING STATIONS
 BORDEN CHEMICAL
 DIVISION OF BORDEN INC.
 LEOMINSTER, MA.
 VINYL CHLORIDE MONOMER SURVEY
 MAY 1974
 DISTANCE INTERVAL 1000 FEET

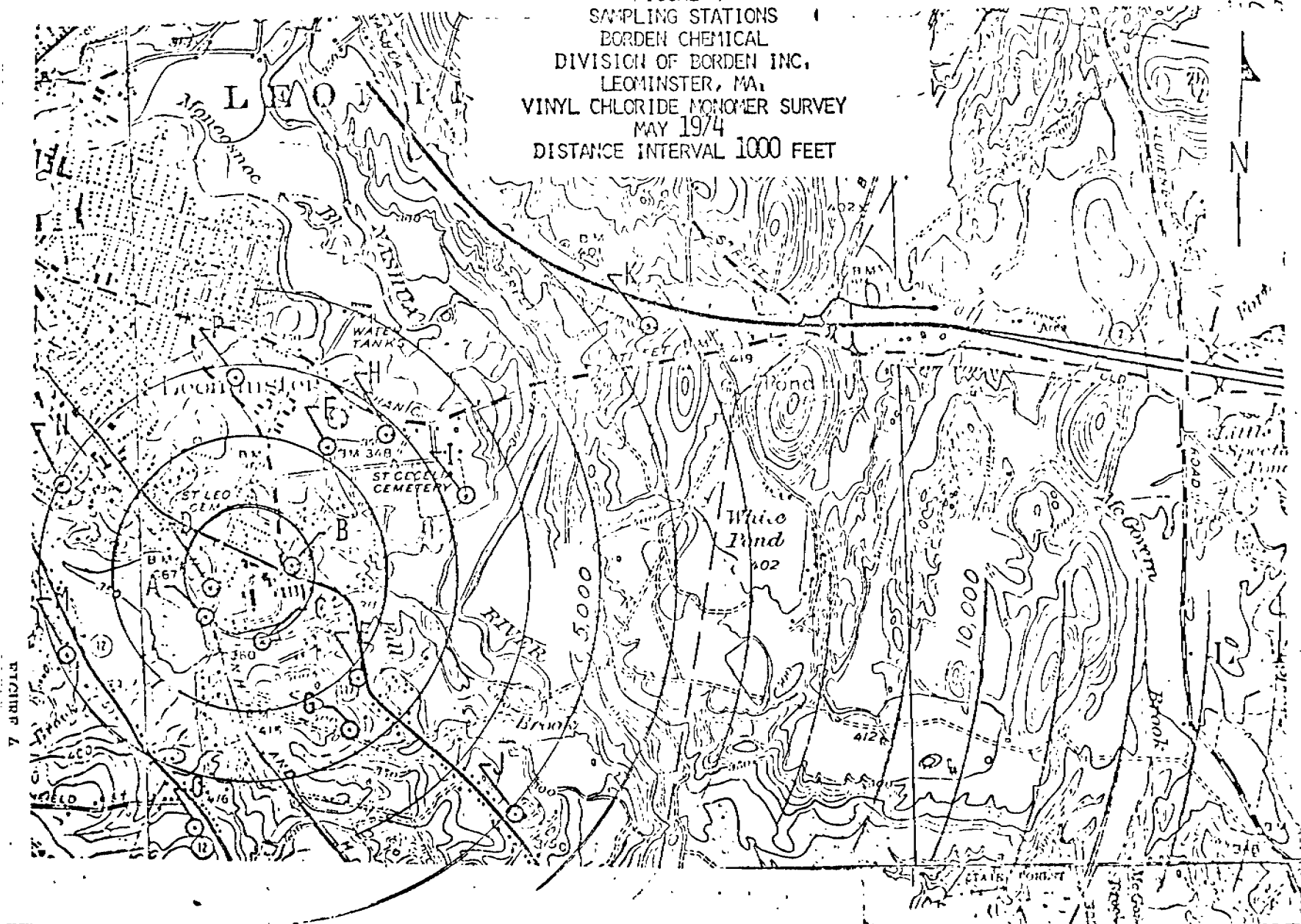


FIGURE 4
 COLORITE 016911

TABLE 2 - AIR GRAB SAMPLE LOCATIONS

SITE	<u>LOCATION</u> (UTM*)		<u>DESCRIPTION</u>
	<u>EAST</u>	<u>NORTH</u>	
A	274360	4709850	Railroad tracks at South End of Borden Chemical
B	274650	4710050	Borden Building 21 on Lancaster Street
C	274550	4709750	Borden Building 52
D	274460	4710000	Borden Building 10 - Laboratory
E	275100	4709600	Lancaster Street near Specialty Polymer Inc.
F	274850	4710500	Intersection of Florence and Howard Streets
G	275000	4709375	On the hill at the end of Sage Road
H	274990	4710550	Florence Street by softball field
I	275450	4710250	Back corner of St. Cecelia Cemetery
J	275450	4709150	Lancaster Street at top of the hill after Barnes Avenue
K	276450	4710950	Lancaster Street at top of the hill after Nashua Road
L	279100	4708600	Under the power lines on Lunenburg Road
M	273800	4709750	Central Street at Meadowbrook Acres
N	273780	4710400	Lincoln Terrace at  Sign
O	274250	4709000	Central Street at Elm Hill Road
P	274530	4710750	Viscaloid Avenue at the pool parking lot

*UTM - Universal Transverse Mercator Grid

FIGURE 5
 SPOT SAMPLING STATIONS
 BORDEN CHEMICAL
 DIVISION OF BORDEN INC.
 LEONISTON, MA.
 VINYL CHLORIDE MONOMER SURVEY
 MAY 1974
 DISTANCE INTERVAL 1000 FEET

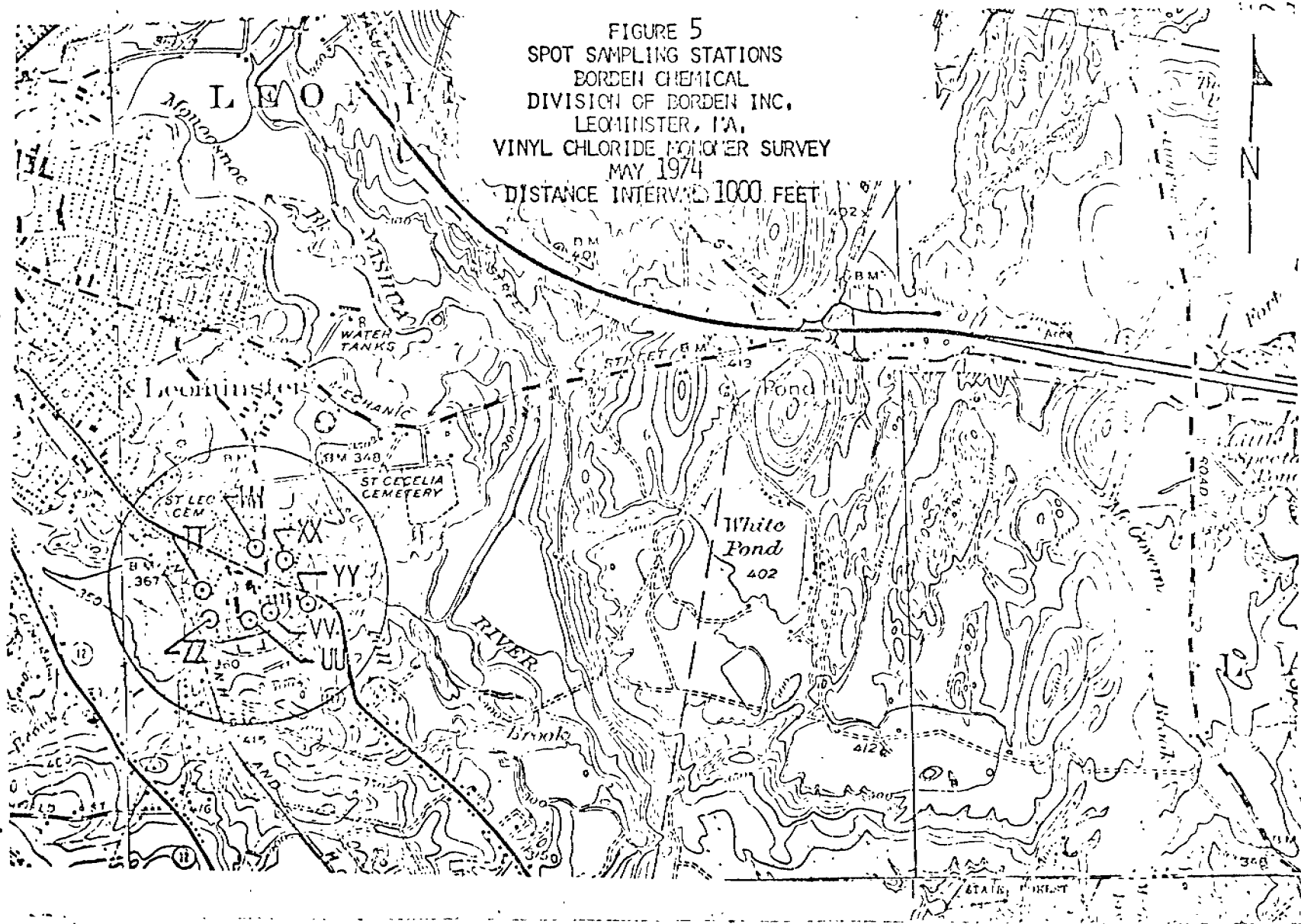


FIGURE 5

COLORITE 016913

TABLE 3
VCM Study
Borden Chemical
RANDOM AIR GRAB STATION LOCATIONS

<u>LOCATION</u> (UTM*)			<u>DESCRIPTION</u>
<u>SITE</u>	<u>EAST</u>	<u>NORTH</u>	
TT	274460	4710000	Same as Station D
UU	274550	4709800	Same as BC-01
VV	274750	4709850	Borden Building 30 - Boiler plant
WW	274650	4710050	Station B
XX	274750	4710050	Intersection of Lancaster and Howard Streets
YY	274850	4710900	Boiler House Road
ZZ	274350	4709850	Close to Station A

*UTM - Universal Transverse Mercator Grid

overlay for Figure 5 and described in Table 3. Samples from Stations A through F were taken at two-hour intervals beginning at 0800 hours and ending at 2000 hours, while spot samples were taken wherever and whenever odors were noticed. Twenty milliliter glass air tight syringes and 6"x6" Tedlar bags were used for taking the grab samples. The minimum samples requested in the VCM memo were all taken in Tedlar bags as recommended. In place of pulling the walls of the bag apart for sampling, a specially-designed evacuator chamber was used to fill the bags. Region I's Technical Support Branch designed and built the evacuator chambers. All samples were sealed and kept out of direct sunlight from the time of collection until analyses. All samples were returned to NERL by car. Analyses on bag samples were done within 48 hours and syringes within 24 hours of collection.

Integrated Air Sample Site Locations

Integrated air samples were taken for 24 hours each day of the survey. The locations were at Borden's property lines: upwind, downwind, and at 90° angles to the usually prevailing northwesterly wind directions. See Figure 1 and Figure 4 overlay. Samples were taken five to six feet above ground level using the charcoal column apparatus and air flow recommended in Section 6.2.4 of the VCM memo. Air flow through the columns were checked with a rotometer at the beginning and end of each sampling period and are included with the integrated sample analyses. The integrated air sample locations A, B, C, and D are the same as for the grab samples.

Results

Results of the grab and integrated air samples are shown in Appendix 3.

The VCM concentrations for the charcoal column analyses (Appendix 3) were arrived at using the following:

1) Assume the flow through the column varied linearly over each 24-hour sampling period.

2) Average the two values

$$\frac{\text{Beginning air flow} + \text{end air flow}}{2} = \text{Average air flow}$$

3) Multiply the average air flow through the column by 1440, the number of minutes in a 24-hour day to arrive at total daily air flow.

4) Divide the VCM found in the column by the total daily air flow to arrive at the VCM concentration.

The conversion used to change the VCM concentrations from micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) to parts per million by volume (ppm_V) was 3.6×10^{-4} , i.e., $(\mu\text{g}/\text{m}^3) \times (3.6 \times 10^{-4}) = \text{ppm}_\text{V}$.

The vinyl chloride standards of 0.1, 0.5, 2.5 and 5.0 ppm for the 24-hour integrated air samples were prepared in carbon disulfide. The 2.5 ppm standard (see Figure 6) was disregarded because of its large deviation from the other standards. Within the limited time frame of this study the accuracy and precision have not yet been determined.

The following samples were confirmed as containing vinyl chloride on our Finnigan Gas Chromatograph/Mass Spectrometer unit:

40078-3	air-grab
#2	air-grab
Boiler House Rd.	air-grab

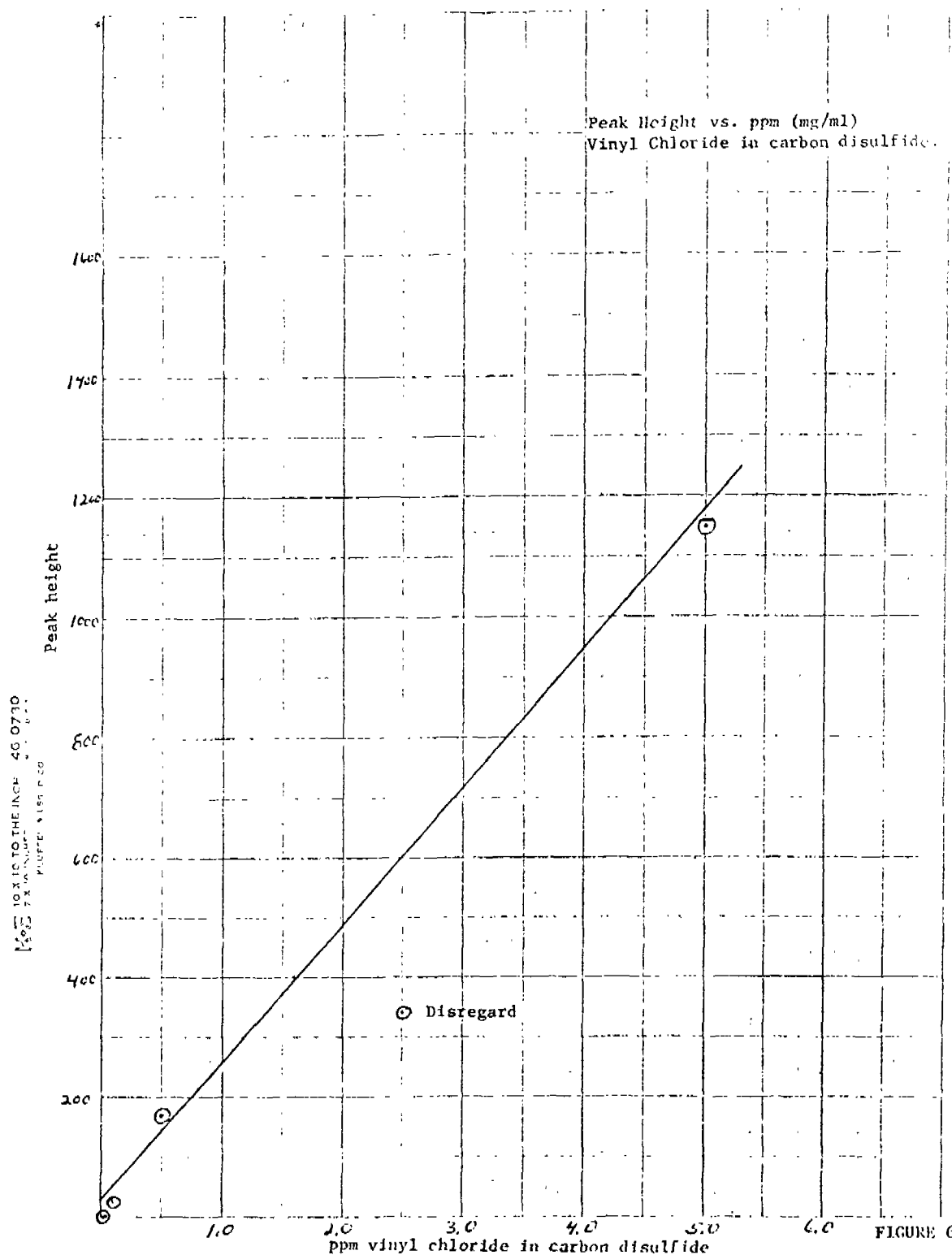


FIGURE 6

APPENDIX 1

APPENDIX 1

The Suspension PVC Polymerization Process

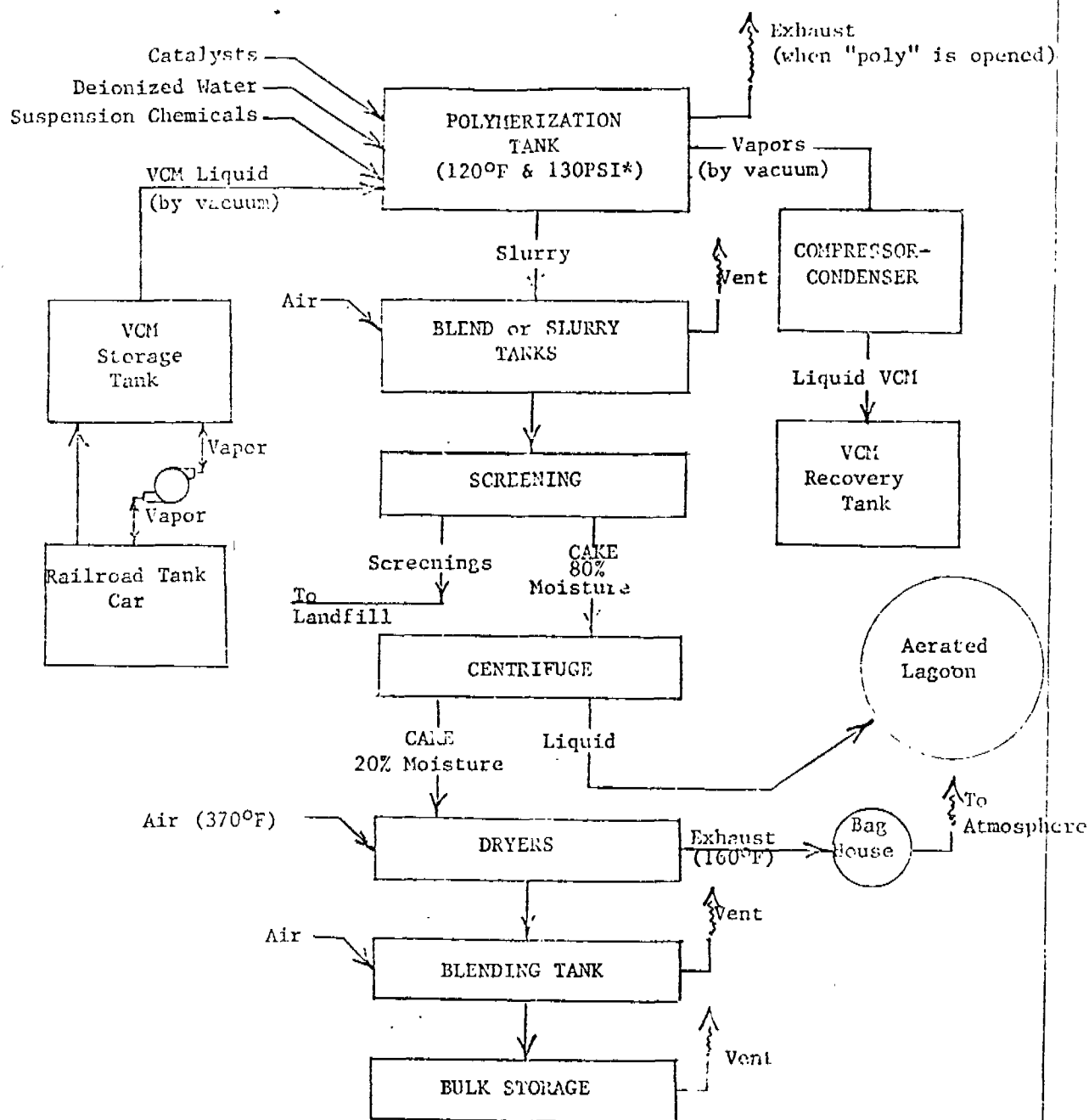
The Suspension polymerization process is shown in the attached flow diagram and described below:

VCM Storage Spheres - At Borden, there are two VCM storage spheres, each with a capacity of 230,000 gallons. Liquid VCM is brought in by rail. The VCM gas in the spheres is pumped into the railroad car which forces the liquid VCM out of the car into the spheres. When all the liquid is drawn out, a vacuum is drawn on the line and excess gas vapors in the railroad car are sucked back into the spheres. A positive pressure of approximately 2 psi is left in the car to prevent air from entering the car.

Polymerization Tank - First the poly*, which has a capacity of 5200 gallons, is charged with deionized water and some chemicals such as EDTA** and buffering agents. The poly is then heated and a vacuum drawn to cause boiling which eliminates air from the system. Air inhibits the polymerization process. The suspension chemicals and catalysts are then added. At approximately 85 psi and 120°F, the monomer is added. The system is brought up to 120°F and 130 psi for polymerization to occur. By the end of the reaction time, the pressure drops to about 50 psi. The poly is then vented to the condenser and compressor for unreacted monomer recovery. The temperature is lowered in the condenser and the VCM, now being in liquid form, is recovered and sent to the recovery tank. The poly is opened and a portable vent is placed in the poly to vent any remaining gases to the atmosphere. The polymer is then shipped as a slurry to the blend or slurry tanks.

*Polymerization Tank

**Disodium ethylenediamine tetraacetate



APPENDIX 1
FIGURE 1
SUSPENSION POLYVINYL CHLORIDE PROCESS
SCHEMATIC DIAGRAM

* At polymerization

FIGURE 1-1

Blend or Slurry Tanks- The polymer from different batches are held here and then screened and sent to the centrifuge.

Centrifuge-Heat Drying - After screening, the slurry enters the centrifuge at about 80% cake moisture and exits at about 20% cake moisture. The water lost is discharged to the aerated lagoon. The solids from the centrifuge then enter the air dryers and are virtually completely dried.

Blending Tanks-Bulk Storage - Several batches of polyvinyl chlorides are mixed together to assure uniformity and then sent to the bulk storage facilities for shipment. Each bulk storage tank has a volume of 5600 ft.³

APPENDIX 2

APPENDIX 3

APPENDIX 3
ANALYTICAL DATA
AMBIENT AIR GRAB SAMPLES
BORDEN CHEMICAL
LEOMINSTER, MASSACHUSETTS

Sample Number	Date	Time (Hour)	Site	Wind Speed (MPH)	Wind Direction (Degrees)	Air Temp. (°F)	Barometric Pressure (inches)	Container Type*	VCM Conc. ppm	Approx. Miles to Plant	Site Inhabitant
40060-01	5/9/74	0820	A	3.5	0	52	29.82	B	K0.06	0.2	Industrial
40060-02		1010	A	5	135	59	29.78	S	K0.06	0.2	
40060-03		1135	A	7	135	60	29.75	B	K0.06	0.2	
40060-04		1645	A	3.5	180	60	29.71	S	0.28	0.2	
40060-05		1830	A	6	180	60	29.70	S	K0.06	0.2	
40060-06		2021	A	1	135	54	29.72	S	K0.06	0.2	
3-1 40078-01	5/10/74	0755	A	1	45	48	29.63	B	K0.06	0.2	
40078-02		0755	A	1	45	48	29.63	B	K0.06	0.2	
40078-03		1210	A	3	0	49	29.57	B	0.24	0.2	
40078-04		1420	A	3	0	51	29.55	S	6.0	0.2	
40078-05		1830	A	4	0	50	29.57	S	K0.06	0.2	
40078-06		2010	A	4	0	50	29.59	S	1.20	0.2	
38275-01	5/13/74	0745	A	11	270	55	29.16	B	K0.06	0.2	
38275-02		0745	A	11	270	55	29.16	B	K0.06	0.2	
38275-03		1215	A	12	270	55	29.21	B	K0.06	0.2	
38275-04		1630	A	8	270	52	29.37	S	K0.06	0.2	
38275-05		2007	A	4	270	54	29.50	S	K0.06	0.2	
40061-01	5/9/74	0800	B	1	0	52	29.82	B	No data	0.1	
40061-02		0800	B	1	0	52	29.82	B	K0.06	0.1	
40061-03		0915	B	4	135	59	29.78	S	K0.06	0.1	
40061-04		1350	B	7	135	61	29.73	B	K0.06	0.1	
40061-05		1605	B	5	180	60	29.71	S	K0.06	0.1	
40061-06		1832	B	5	135	60	29.70	S	K0.06	0.1	
40061-07		2015	B	1	135	54	29.72	S	K0.06	0.1	

* B - Bag
S - Syringe

COLORITE 016924

APPENDIX 3
ANALYTICAL DATA
AMBIENT AIR GRAB SAMPLES
BORDEN CHEMICAL
LEOMINSTER, MASSACHUSETTS

Sample Number	Date	Time (Hour)	Site	Wind Speed (MPH)	Wind Direction (Degrees)	Air Temp. (°F)	Barometric Pressure (inches)	Container Type*	VCM Conc. ppm	Approx. Miles to Plant	Site Inhabitant
40079-01	5/10/74	0750	B	1	45	48	29.63	B	K0.06	0.1	Industrial
40079-02		1345	B	4	0	51	29.55	B	K0.06	0.1	
40079-03		1345	B	4	0	51	29.55	B	K0.06	0.1	
40079-04		2000	B	4	0	50	29.59	S	0.17	0.1	
38276-01	5/13/74	0755	B	11	270	55	29.16	B	K0.06	0.1	
38276-02		1230	B	12	270	56	29.21	S	0.30	0.1	
38276-03		1400	B	13	270	59	29.25	B	K0.06	0.1	Ind-Res
38276-04		1400	B	13	270	59	29.25	B	K0.06	0.1	
38276-05		1805	B	4	270	57	29.43	S	K0.06	0.1	
38276-06		2005	B	4	270	54	29.50	S	K0.06	0.1	
40062-01	5/9/74	0950	C	5	135	59	29.78	B	K0.06	0.2	
40062-02		1600	C	5	180	60	29.71	S	0.22	0.2	
40062-03		1808	C	5	180	60	29.70	S	K0.06	0.2	
40080-01	5/10/74	1000	C	1	45	47	29.61	B	K0.06	0.2	
40080-02		1610	C	3.5	0	52	29.56	S	K0.06	0.2	
40080-03		1920	C	4	0	50	29.57	S	0.17	0.2	
38277-01	5/13/74	0945	C	6	270	55	29.17	B	K0.06	0.2	
38277-02		1420	C	10	270	62	29.37	B	K0.06	0.2	
38277-03		2000	C	4	270	54	29.50	S	K0.06	0.2	
40063-01	5/9/74	1005	D	5	135	59	29.78	B	0.9	0.1	
40063-02		2020	D	1	180	54	29.72	S	K0.06	0.1	
40081-01	5/10/74	1005	D	1	45	47	29.61	B	K0.06	0.1	
40081-02		1005	D	1	45	47	29.61	B	K0.06	0.1	
38278-01	5/13/74	1000	D	6	270	55	29.17	B	K0.06	0.1	
38278-02		1220	D	8	270	56	29.21	S	K0.06	0.1	
38278-03		1630	D	8	270	62	29.37	S	K0.06	0.1	
38278-04		1815	D	4	270	57	29.43	B	K0.06	0.1	

* B - Bag
S - Syringe

COLORITE 016925

APPENDIX 3
ANALYTICAL DATA
AMBIENT AND CANAL SAMPLES
BORDEN CANAL
LECHMINSTER, MASSACHUSETTS

Sample Number	Date	Time (Hour)	Site	Wind Speed (MPH)	Wind Direction (Degrees)	Air Temp. (°F)	Barometric Pressure (Inches)	Container Type*	VCM Conc. ppb	Approx. Miles to Plant	Site Inhabitant
38278-05	5/13/74	2000	D	5	270	54	29.50	S	0.19	0.1	Ind-Res
40064-01	5/9/74	0805	E	1	0	51	29.62	B	K0.06	0.4	
40064-02		1015	E	5	180	60	29.71	S	K0.06	0.4	
40064-03		1105	E	5	130	60	29.70	S	K0.06	0.4	
40082-01	5/10/74	0800	E	1	45	47	29.62	S	K0.06	0.4	
40082-02		1140	E	3	45	49	29.57	B	K0.06	0.4	
40082-03		1120	E	4	0	50	29.57	S	0.60	0.4	
40082-04		1945	E	4	0	50	29.59	S	K0.06	0.4	
38279-01	5/13/74	0900	E	11	270	55	29.16	S	K0.06	0.4	
38279-02		1140	E	12	270	56	29.21	B	0.24	0.4	
38279-03		1035	E	13	270	59	29.25	S	0.19	0.4	Residential
38279-04		1800	E	4	270	57	29.13	S	0.17	0.4	
40065-01	5/9/74	0825	F	2.5	0	52	29.1	S	K0.06	0.4	
40065-02		0940	F	2.5	90	59	29.78	S	K0.06	0.4	
40065-03		1800	F	5	130	60	29.70	S	0.18	0.4	
40083-01	5/10/74	0935	F	1	45	47	29.61	S	K0.06	0.4	
40083-02		1315	F	4	0	50	29.57	S	K0.06	0.4	
40083-03		1035	F	4	0	50	29.59	S	0.15	0.4	
38280-01	5/13/74	0810	F	11	270	55	29.16	S	K0.06	0.4	
38280-02		0940	F	6	270	55	29.17	B	K0.06	0.4	
38280-03		1410	F	13	270	59	29.15	B	0.24	0.4	Ind-Res
40066-01	5/9/74	0818	G	1	0	52	29.82	S	K0.06	0.5	
40066-02		1030	G	5	135	59	29.73	S	K0.06	0.5	
40066-03		1210	G	6	135	60	29.75	B	K0.06	0.5	
40066-04		1210	G	6	135	60	29.75	B	K0.06	0.5	
40084-01	5/10/74	0955	G	1	45	47	29.61	S	K0.06	0.5	
40084-02		1100	G	4	0	51	29.55	B	K0.06	0.5	

*B - Bag
S - Syringe

COLORITE 016926

APPENDIX 3
ANALYTICAL DATA
AMBIENT AIR GRAB SAMPLES
BORDEN CHEMICAL
LEOMINSTER, MASSACHUSETTS

Sample Number	Date	Time (Hour)	Site	Wind Speed (MPH)	Wind Direction (Degrees)	Air Temp. (°F)	Barometric Pressure (inches)	Container Type*	VCM Conc. ppm	Approx. Miles to Plant	Site Inhabitant
38281-01	5/12/74	0950	G	6	270	55	29.17	S	K0.06	0.5	Ind-Res
38281-02		1210	G	8	270	56	29.21	S	Container Broke	0.5	
38281-03		1610	G	6	270	62	29.37	B	K0.06	0.5	
40067-01	5/9/74	1145	H	6	135	60	29.75	S	K0.06	0.5	
40067-02		1425	H	4	180	61	29.73	B	K0.06	0.5	
40067-03		2004	H	1	135	54	29.72	B	K0.06	0.5	
40085-01	5/10/74	0825	H	1	45	48	29.63	S	K0.06	0.5	
40085-02		0940	H	1	45	47	29.61	S	K0.06	0.5	
40085-03		1150	H	3	45	49	29.57	S	K0.06	0.5	
40085-04		1405	H	4	0	51	29.53	S	K0.06	0.5	
40085-05		1600	H	3.5	0	52	29.56	S	K0.06	0.5	Residential
38282-01	5/13/74	1618	H	6	270	62	29.37	S	K0.06	0.5	
38282-02		1753	H	4	270	57	29.43	S	K0.06	0.5	
40068-01	5/9/74	0830	I	2.5	0	52	29.82	S	K0.06	0.7	
40068-02		1148	I	6	135	60	29.75	S	K0.06	0.7	
40068-03		1635	I	3.5	180	60	29.71	S	K0.06	0.7	
40068-04		2000	I	1	135	54	29.72	S	K0.06	0.7	
40086-01	5/10/74	1550	I	3.5	0	52	29.56	B	K0.06	0.7	
40086-02		1805	I	4	0	50	29.57	S	K0.06	0.7	
40086-03		1950	I	4	0	50	29.59	S	K0.06	0.7	
38283-01	5/13/74	0815	I	11	270	55	29.16	S	0.4	0.7	
38283-02		1145	I	12	270	56	29.21	S	K0.06	0.7	
38283-03		1615	I	6	270	62	29.37	S	K0.06	0.7	
38283-04		1750	I	4	270	57	29.43	B	K0.06	0.7	
38283-05		1940	I	4	270	54	29.50	S	0.24	0.7	

*B - Bag
S - Syringe

COLORITE 016927

APPENDIX 3
ANALYTICAL DATA
AMBIENT AIR GRAB SAMPLES
BORDEN CHEMICAL
LEOMINSTER, MASSACHUSETTS

Sample Number	Date	Time (Hour)	Site	Wind Speed (MPH)	Wind Direction (Degrees)	Air Temp. (°F)	Barometric Pressure (inches)	Container Type*	VCM Conc. ppm	Approx. Miles to Plant	Site Inhabitant
40069-01	5/9/74	1207	J	6	135	60	29.75	S	K0.06	1.0	Residential
40069-02		1420	J	4	180	61	29.73	S	K0.06	1.0	
40069-03		1619	J	5	180	60	29.71	S	K0.06	1.0	
40087-01	5/10/74	1145	J	3.5	45	49	29.57	S	K0.06	1.0	
40087-02		1235	J	4	0	57	29.55	S	K0.06	1.0	
40087-03		1600	J	3.5	0	52	29.56	B	K0.06	1.0	
3-5 38284-01	5/13/74	0950	J	6	270	55	29.17	S	K0.06	1.0	
38284-02		1955	J	4	270	54	29.50	S	K0.06	1.0	
40070-01	5/9/74	1630	K	3.5	180	60	29.71	B	K0.06	1.2	
40088-01	5/10/74	0945	K	1	45	47	29.61	S	K0.06	1.2	
40088-02		1410	K	4	0	51	29.55	S	K0.06	1.2	
40088-03		1545	K	3.5	0	52	29.56	S	K0.06	1.2	
38258-01	5/13/74	1150	K	12	270	56	29.21	S	0.24	1.2	
38285-02		1415	K	13	270	59	29.25	S	K0.06	1.2	
38285-03		1945	K	4	270	54	29.50	S	K0.06	1.2	
40071-01	5/9/74	1200	L	6	135	60	29.75	S	K0.06	3.0	Rural
40071-02		1415	L	7	135	61	29.73	S	K0.06	3.0	
40071-03		1740	L	5	180	54	29.72	B	K0.06	3.0	
40071-04		1740	L	5	180	54	29.72	B	K0.06	3.0	
40089-01	5/10/74	1750	L	4	0	50	29.57	B	K0.06	3.0	
40089-02		1750	L	4	0	50	29.57	B	K0.06	3.0	
38286-01	5/13/74	0810	L	11	270	55	29.16	S	K0.06	3.0	
38286-02		1550	L	6	270	62	29.37	S	K0.06	3.0	
40072-01	5/9/74	1402	M	7	135	61	29.13	S	K0.06	0.6	Residential
40090-01	5/10/74	0815	M	1	45	48	29.63	S	K0.06	0.6	
40090-02		1205	M	3.5	45	49	29.57	S	K0.06	0.6	
40090-03		1625	M	2	0	52	29.56	S	K0.06	0.6	

*B - Bag
S - Syringe

COLORITE 016928

APPENDIX 3
ANALYTICAL DATA
RANDOM AMBIENT AIR GRAB SAMPLES
BORDEN CHEMICAL
LEOMINSTER, MASSACHUSETTS

Sample Number	Date	Time (Hour)	Site	Wind Speed (MPH)	Wind Direction (Degrees)	Air Temp. (°F)	Barometric Pressure (Inches)	Container Type*	VCM Conc. ppm	Approx. Miles to Plant	Site Inhabitant
LN-1	5/10/74	0520	TT	2	45	47	29.64	S	K0.06	0	Industrial
LN-2	5/10/74	0540	UU	2	45	47	29.64	S	0.24	0	
3	5/13/74	0605	UU	4	225	50	29.12	S	0.16	0	
LN-3	5/13/74	0635	VT	1	45	47	29.63	S	K0.06	0	
1	5/13/74	0610	WN	3	180	50	29.10	S	2.6	0	
2	5/13/74	0510	WM	3	180	50	29.10	S	1.4	0	Ind-Res
Lan. in 3-7 Front	5/13/74	1500	WW	10	270	60	29.30	S	0.11	0	
Lan & How	5/13/74	0940	XX	5	270	55	29.18	S	0.16	0.2	
Boiler House Rd	5/13/74	1235	YY	8	270	55	29.23	S	5.7	0	Industrial
Load Rack	5/13/74	1825	ZZ	11	270	57	29.47	S	K0.06	0	

*B - Bag
S - Syringe

COLORITE 016929

Appendix 3
VCM Study
Borden Chemical
AIR RESULTS (Cont.)
24 HOUR INTEGRATED AIR SAMPLES
Collected in Carbon Columns

STATION	DATE	COLUMN SECTION# NUMBER	VCM ug/	TOTAL VOLUME OF AIR m ³	VCM (ug/m ³)	(ppm by vol)
A	5/09/74	1	14.7			
		2	KO.14			
		3	KO.14			
		Total	14.7	0.28	52	0.018
	5/10/74	1	883			
		2	KO.14			
		3	KO.14			
		Total	883	0.30	2920	1.05
	5/13/74	1	87.4			
		2	18.4			
		3	KO.14			
		Total	105.8	0.25	423	0.153
B	5/09/74	1	KO.14			
		2	KO.14			
		3	KO.14			
		Total	0	0.28	0	0
	5/10/74	1	3.7			
		2	KO.14			
		3	KO.14			
		Total	3.7	0.26	14	0.005
	5/13/74	1	8.3			
		2	5.0			
		3	KO.14			
		Total	13.3	0.26	51	0.019
C	5/09/74	1	KO.14			
		2	KO.14			
		3	KO.14			
		Total	0	0.27	0	0
	5/10/74	1	6.4			
		2	KO.14			
		3	KO.14			
		Total	6.4	0.29	22	0.008
	5/13/74	1	17.0			
		2	5.5			
		3	KO.14			
		Total	22.5	0.31	73	0.026

STATION	DATE	COLUMN SECTION* NUMBER	VCM	TOTAL VOLUME OF AIR m ³	VCM	
			ug/		(ug/m ³)	(ppm by volume)
D	5/09/74	1	92			
		2	9.2			
		3	KO.14			
		Total	101.2	0.28	361	0.130
	5/10/74	1	6.9			
		2	KO.14			
		3	KO.14			
		Total	6.9	0.28	25	0.009
	5/13/74	1	6.4			
2		KO.14				
3		KO.14				
	Total	6.4	0.27	24	0.009	

*Section 1 is closest to air intake
 Section 2 is between Sections 1 and 3
 Section 3 is furthest from air intake

** "K" -- Actual value known to be less than value reported.
 The actual value is less than detectable limit and may be zero.