7-12-74

Statement
by
The Goodyear Tire & Rubber Company

Goodyear to OSH submission on Proposed Permanent Standard

For the following reasons, The Goodyear Tire & Rubber Company is submitting in writing its statement on the proposed standard for occupational exposure to vinyl chloride, and is foregoing its allotted time for oral testimony at the Department of Labor hearing:

1. The company, prior to this statement, had three of its people testify at the hearing. Paul Beebe, Jr., development manager, films and flooring division, gave testimony as part of the SPI portion. William R. Miller, manager, corporate safety, and Dr. C.W. Wadelin, section head, analytical services, offered testimony during the RMA segment.

2. Medical reports at Goodyear operations already have been covered by Dr. Selikoff's group.

3. Bulk of material in this statement of most value is contained in appendices and tables.

4. Submitting written testimony will not burden the record, and is done with the intent of expediting the hearing.

After reading the statement that follows, if members of the Labor Department hearing committee have questions that they feel call for oral answers, Goodyear personnel certainly will be available to offer any additional clarification required.

Goodyear is a multinational company with annual sales of approximately $5 billion. The company's major activities are in tires, industrial rubber products, automotive and aircraft wheels and brakes and numerous other related products.

In our chemical operations we produce various synthetic rubbers, rubber latex, polyester resin and rubber chemicals in addition to PVC resin. We estimate that Goodyear will sell more than $100 milli n worth of PVC and fabricated PVC products during 1974 -- about 2 per cent of total annual sales.

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Nearly 20 per cent of the resin we make is used by other divisions of the company. Approximately 2,000 Goodyear employes are engaged in the manufacture of PVC resin or in making products which use it.

The remaining 80 per cent is sold to 300 customers, many of whom operate small businesses.

Should it become necessary for Goodyear to discontinue PVC resin production, 2,000 jobs within the company would be eliminated. And many times that number by our customers.

Goodyear operates two PVC resin producing plants, one at Niagara Falls, N.Y., and another at Plaquemine, La. Until 1966 we produced vinyl chloride monomer at Niagara Falls by the acetylene/hydrochloric acid process. We now purchase VCM from suppliers using the more modern ethylene-chlorine process.

During the question period following Dr. Selikoff's testimony, there arose a question concerning chlorine in the atmosphere. We did use HCl in the production of VCM until 1967. The monomer process did involve venting detectable quantities of HCl. There is also a discernable background of Cl or HCl in the HF area. We have no evidence to indicate that chlorine is a factor in empl ye health problems, but its presence during the early periods cannot be ignored.

The Niagara Falls plant was built in 1946 with an initial annual capacity of 1,400 long tons. Present capacity is 50,000 l ng t ns. Several different types of homo polymer resins are manufactured in the plant by the emulsion and the suspension processes.

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We have produced PVC compounds at Niagara Falls since 1971. Rubber chemicals also are produced in an area separated from the PVC plant. Functions such as maintenance, utilities, laboratory and administrative are common to all manufacturing operations. Total employment at Niagara Falls is 465 persons, 345 of them engaged exclusively or predominantly with PVC production.

The Plaquemine plant started in 1969 with a capacity of 20,000 long tons a year, and soon will be producing more than 100,000 long tons annually. VCM is brought into the plant by pipeline on a continuous basis eliminating tank car unloading and necessitating only small storage of the monomer. Plaquemine uses a bulk polymerization process licensed to Goodyear by Rhone-Progil of France, a two-step batch process in which no water phase is involved, eliminating drying of the finished product.

When we learned last January of a possible connection between vinyl chloride monomer and angiosarcoma we began a program of physical examinations of employes at Niagara Falls and Plaquemine and a review of the medical records of past employes.

Screening tests for liver function among Plaquemine employes has revealed no abnormalities and a heightened medical surveillance program is continuing. Because the reactors at Plaquemine are in an open structure, and the process and equipment are new, we believe that past levels of employe exposure to VCM has been low.

Although the instruments used to monitor VCM prior to March were not sensitive to lower levels of VCM, the measurements did indicate that worker exposure was well within 200 ppm TWA level. Recent surveys of all operators n an 8-hour TWA basis shows a mean of 7 ppm with a range of 1 to 28 ppm.

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During the same period spot checks showed a range of 0 to 159 ppm with an average of 13 ppm.

The reactor building currently in operation is an open structure. The 8 hour TWA mean for all operators working in this building is 8 ppm with a range of 1.4 to 28 ppm over a 27-day period. While there is some difference in job-to-job TWA levels, the major difference is in day-to-day variations on a given j b. The data summary is given in Appendix 1 which is attached to this testimony.

Being an open structure means that very little improvement in exposure levels can be accomplished by forced ventilation. Rather, any reduction in the level of VCM in the reactor building must be accomplished by reducing emissions. A recent survey which is summarized in Appendix II of this testimony shows that of the total 3.3% loss of VCM in the process, 1.6% is in fugitive emissions, the remainder being vent losses.

In order to meet the 1976 target 10 ppm max., a TWA mean f 5 ppm or less will be required. To meet this level will require capturing virtually all of the vent losses and also a substantial reduction in the 1.6% fugitive loss. While projects to accomplish these goals are being pursued vigorously, not all technology is now in sight.

All Niagara Falls employes have been given thorough medical examinations by a medical team from New York City's Mt. Sinai Hospital and local physicians. The results have been reported by Dr. Selikoff and Dr. Nicholson in their testimonies. While there were some indications of abnormal liver functions there were no indications f tumor development among active empl yes. An ongoing medical program has been established.

An extensive review of the medical records of deceased Niagara Falls employes was undertaken earlier this year and revealed three deaths attributed to angiosarcoma. These deaths were disclosed publicly and reported to NIOSH as they became known to us: One on March 1 and the other two on March 22. They involved:

*The 1968 death of a 59-year-old man (SK) who worked 12 years in the plant's original (1946) reactor area, three years in the new reactor area (added in 1957) and two years in resin finishing.

*The 1961 death of a 41-year-old man (RJ) who worked for 10 years in the original (1946) monomer production and reactor buildings and another four years in other plant areas where VCM concentration was lower.

*The 1970 death of a 60-year-old man (DP) employed 23 years as a supervisor in the original (1946) reactor and monomer area, nine of which he also spent supervising the new monomer and reactor facility. We estimate that he spent two-thirds of his time in the older facility.

With confirmation of these deaths, we began a study at Niagara Falls aimed at determination of the VCM levels in the areas where these men worked and during the years when they worked there.

Our best estimates -- based on available statistical data plus extensive interviews of 24 long-time Niagara Falls employes -- indicate that the time weighted average exposure for the years that the three deceased men were employed was approximately 500 ppm in the original (1946) monomer and reactor areas, approximately 150 ppm in the newer (1957) monomer and reactor areas and less than 20 ppm in the resin finishing area.

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Using these figures weighted for the amount of time that each of these men spent in the various areas we estimate their average exposure to be:

Employe no. 1 - 380 ppm TWA for 17 years SK

Employe no. 2 - 360 ppm TWA for 14 years RJ

Employe no. 3 - 450 ppm TWA for 23 years DP

In arriving at these estimates of exposure, we used a threshold odor level of 450 ppm. Because recent information indicates an odor threshold considerably higher than 450 ppm in areas where VCM is present, our estimates may be quite conservative.

Since April we have been engaged at Niagara Falls in extensive monitoring -- both on an area basis and on an individual worker basis. By correcting emissions and improving ventilation and work practices, we have drastically reduced the level of VCM.

Since the issuance of the temporary OSHA standard on April 5, 1974, we generally have been able to stay within the 50 ppm ceiling, although surges have necessitated the use of masks for short periods.

Trouble spots such as leaking compressor seals and valves have been pinpointed and corrected. Work practices have been thoroughly reviewed and those procedures that permitted VCM to be vented to the atmoshpere were changed to minimize worker exposure. Substantial improvements in the plant ventilation systems have been made to remove VCM from the work area.

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Current samplings using gas chromatography in both of the plant reactor buildings now show a time weighted average mean of 9 ppm of VCM. The range of the samples -- excluding periods when masks were worn -- was 1 to 45 ppm. Based on these data, we conclude that the exposure during the working life of the three employes who were found to have angiosarcoma was at least 40 times greater than it would be under the emergency standard of a 50 ppm ceiling.

I emphasize that I am talking about a PVC producing plant. Theoretically it would be possible to approach a 50 ppm time weighted average while staying within a 50 ppm ceiling. Such would be possible if the release of VCM were consistent and the ventilation constant. The nature of the PVC reactor operations, together with the fugitive nature of VCM, causes peaks and valleys in the exposure curve. Occasional short term surges also must be expected. In our opinion a 50 ppm ceiling in a closed reactor building can be equated to a mean TWA of 10 ppm with the range of TWA samples covering from just detectable to 25 ppm -- depending upon the assignment of the employe and the number of fugitive emissions in his area.

While there are no data which support a position of a "safe" level of exposure to VCM from the standpoint of worker health, we believe there is conclusive evidence that the level of exposure has been reduced -- at least in our Niagara Falls plant -- to a level that is so small by comparison with previous levels as to make worker exposure within acceptable limits.

Putting it another way: Under today's conditions and within the emergency standard, 600 years would b required for a worker to reach the same total exposure to VCM as was experienced by the three angiosarcoma victims at Niagara Falls.

I hasten to add that I am fully aware of the hazards of any conclusions until we know more about the effects of VCM. I do hope that this discussion will put the incidence of angiosarcoma among Niagara Falls workers in proper perspective, that is: The exposure of workers developing angiosarcoma in Niagara Falls was conservatively estimated to be in the vicinity of 400 ppm TWA as compared to 9 ppm TWA when operating under today's emergency standard. Appendix 3 contains monitoring data, a summary of measurement methods used, and the procedure for estimating exposure levels.

In the last few months we have learned a great deal about the sources of VCM in our Niagara Falls and Plaquemine operating areas and much has been done to eliminate as many of these as possible. We plan to lower exposure levels still further using every availabl scientific and engineering technique.

However, technology needed to reach the proposed "no detectable" level is not now available to us. And we question that it can be developed for existing plants.

The proposed regulation permits use of breathing equipment only in the case of emergencies. Even if this restriction were lifted, continuous use of breathing equipment which would be required under the "no detectable" level proposal cannot be considered practical. Continuous use of any type of respirator -- particularly full-face, self-contained types -- would seriously impair a worker's ability t do his job and would pose unacceptable risks and worker discomfort.

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For these reasons, we see no alternative but to discontinue the operation of our two PVC plants if the "no detectable" standard were imposed. We are not convinced that medical evidence available today warrants such stringent restrictions, but we do believe that the risk -- if any -- that would be involved in setting a reasonable standard permitting continued operation of PVC producing plants would be so small as to be acceptable.

We endorse the SPI recommendation of a graduated standard which would establish a ceiling of (1) 40 ppm and a TWA of 25 ppm for the first year, a reduction to a (2) 25 ppm ceiling the second year and a 25 ppm ceiling (3) with a TWA limit of 10 ppm the third year.

These limits will involve technology not available today, but we are confident it can be developed.

The attached Appendix 4 lists the engineering projects that have been undertaken to reduce VCM in the work areas. They will eliminate the necessity to enter reactors for cleaning, reduce residual VCM in resin, recover VCM stripped from resin and improve monitoring procedures. Also listed are a number of engineering considerations now under evaluation. These programs are aimed at achieving the recommended target levels. To meet a "no detectable" level within the plants, if possible, would require engineering approaches beyond those listed.

We are spending more than $1 million on these improved production safeguards. Considerable additional expenditures will fund our medical surveillance programs.

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There are other areas in the proposed standard such as the concept of regulated areas, monitoring provisions, the use of impervious clothing, product marking and notification requirements that will per se be changed if a reasonable exposure level is adopted.

Specifically, the requirements that regulated areas be established where vinyl chloride monomer is present are far too restrictive. Because of its fugitive nature, the amount of VCM that can be transported from one area to another by dust on clothing is so small as to be negligible. The purpose of limiting the number of people authorized to enter an area where VCM is present in larger quantities -- such as a reactor area -- should be to limit exposure in case of an accidental release. This can be accomplished by designating such areas as restricted areas in which only persons who have duties in the area are permitted.

Previous testimony has pointed up that VCM contained in resin dust on clothing will dissipate to below detectable levels in minutes. Thus, the decontamination procedure specified for regulated areas is redundant.

The monitoring requirements in the proposed regulation call for a procedure that would assure any exposure for an employe be determined at a 95 per cent confidence level. This requirement is ambiguous. A more precise statement of goals taking into account the limitations of sequential monitoring is needed.

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The required use of impervious clothing should be limited to very high VCM levels or to operations of short duration where there is a potential of high levels of VCM. This type of clothing cannot be used for prolonged periods, particularly in hot climates, without extreme discomfort. Heat prostration and limitation of movement imposed by impervious clothing would create additional hazards.

We endorse the SPI position on product marking. Our experience in the use of PVC resin in films and flooring -- covered in earlier testimony -- leads us to conclude that exposure to VCM from the use of PVC resin is negligible if simple precautions in unloading, storing, and mixing are taken.

The reporting requirements are ambiguous. Reporting should follow the NIOSH March 11, 1974, definition of an emergency. Since employes have access to exposure measurements, the necessity t report in writing each incident of exposure is excessive.

A number of improvements have been made in recent weeks in lowering the VCM content of PVC resin. Appendix 5 shows data at previous versus current levels of residual monomer in the various types of resins. The drive to lower VCM content of resin started about 2 years ago when it was discovered that concentrations in the explosive range could accumulate inside of processing equipment if the residual VCM was very high. Thus the levels in early 1974 reflect a reduction from previous years.

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Our data shows that we have been able to lower the VCM level in the general purpose suspension and bulk types from a level of over 800 ppm to under 200 ppm. Modifying resins were lowered from over 1100 ppm to 320 ppm. Plastisol resins of the types we made have been low consistently with the current level averaging 4 ppm.

It should be noted that we do not produce copolymer resins, some of which we understand cause difficulty in removing VCM.

We are safely under the recommended 0.1% max at the present time and believe that we can reach a level of 0.01 max by the target date, if not sooner. It is our intent to continue to push programs designed to obtain that goal at the earliest possible date.

We strongly urge that OSHA reconsider its position as presented in the proposed standard by taking into account the serious impact that the elimination of the PVC industry would have on the nation's economy. We are firmly convinced that reasonable standards and working rules can be developed that will permit the continuation of a safe and viable PVC industry.

We appreciate this opportunity to express our views. Thank you.

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APPENDIX I

Distribution of Vinyl Chloride Concentration Data
Plaquemine, La.

In the attached tables are summarized (1) the data for levels of vinyl chloride in plant air at Plaquemine measured over the period of May 1 to June 26, 1974, and (2) eight-hour TWA values for air samples taken from the breathing zone of Plaquemine employes during the period of May 15 to June 11, 1974. Plant air data were determined from "grab" samples directly injected into the Hewlett-Packard Model 7620 Gas Chromatograph. Personnel monitoring samples were taken at the rate of 1.9 liters per minute and absorbed on 16 grams of 20 x 50 mesh Nuchar activated carbon, then desorbed in carbon disulfide prior to injection into the chromatograph.

Eliminated from the plant air data were those samples taken at work stations during periods where employes routinely wear air-line respirators -- during catalyst addition and reactor cleaning.

Table I -- Vinyl Chloride Levels in Plaquemine Areas
(non-respirator areas -- grab samples)

May 1 -- June 26, 1974

Location	Operation	Vinyl Chloride -- ppm		
		Median	Low	High
Day Tank Area	Pumping VC	3.4	0.0	71.6
Compressor 1K-1	De-gas	7.0	0.0	136.
" Compressor 2K-1	De-gas	3.0	0.6	31.4
VP Seal Discharge	De-gas	8.4	0.3	159.
Blower Discharge	During Cleaning	7.0	0.9	34.0
Popo Sampling	Before Discharge	4.5	0.0	46.5
109/209 Blind	Changing Blind	9.3	0.4	137.
Warehouse (a)	Aisle	5.2	0.0	7.7
Laboratory (b)	Workbench	4.0	Not Applicable	
" (b)	Office	1.7	"	"
" (b)	Compositing Samples	6.4	"	"
Office (b)	Center of Area	2.1	"	"

(a) Four samples only

(b) One sample only

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Table II -- Distribution of Data -- Plaquemine VC Levels
110 Grab Samples

May 1 to June 26, 1974

Minimum Value	0.0 ppm
Maximum Value	159 ppm

10%	of	samples	showed	VC	levels	of	0.5	ppm	or	less
20%	"	"	"	"	"	"	1.1	"	"	"
30%	"	"	"	"	"	"	1.7	"	"	"
40%	"	"	"	"	"	"	2.9	"	"	"
50%	"	"	"	"	"	"	4.0	"	"	"
60%	"	"	"	"	"	"	6.4	"	"	"
70%	"	"	"	"	"	"	9.7	"	"	"
80%	"	"	"	"	"	"	14.9	"	"	"
90%	"	"	"	"	"	"	26.2	"	"	"
95%	"	"	"	"	"	"	39.7	"	"	"
97.5%	"	"	"	"	"	"	71.6	"	"	"

Similarly:

3.64%	showed	VC	levels	greater	than	50	ppm	
4.55%	"	"	"	"	"	40	"	
11.8%	"	"	"	"	"	25	"	
30.0%	"	"	"	"	"	10	"	
42.7%	"	"	"	"	"	5	"	
81.8%	"	"	"	"	"	1	"	

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Table III -- Distribution of 8-HR TWA Levels
Plaquemine Employes -- 45 Samples

May 15 - June 11, 1974

Median 4.9 ppm
Range < 0.1 -- 27.9 ppm

10% of employes had TWA values of 1.2 ppm or less
20% " " " " " " 1.5 " " "
30% " " " " " " 2.3 " " "
40% " " " " " " 3.2 " " "
50% " " " " " " 4.9 " " "
60% " " " " " " 5.9 " " "
70% " " " " " " 7.8 " " "
80% " " " " " " 10.2 " " "
90% " " " " " " 14.0 " " "
95% " " " " " " 21.1 " " "
97.5% " " " " " " 27.9 " " "

Similarly:

None had TWA values greater than 50 ppm
2.2% " " " " " 25 "
22.2% " " " " " 10 "
44.5% " " " " " 5 "
91.1% " " " " " 1 "

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Table IV -- Distribution of Plaquemine TWA Values by Job Classification

Job Classification	Number of Values	Vinyl Chloride -- ppm as TWA		
		Median	Low	High
*Reactor Cleaner	21	6.3	1.4	27.9
*Poly Area Operator	4	11.4	4.2	23.7
*Outside Operator	4	3.4	1.9	14.3
Finish. Bldg. Operator	5	1.6	0.4	3.2
Loading Rack Operator	4	3.6	1.2	9.6
Control Room Operator	4	0.9	< 0.1	6.0
Supervisor	2	3.7	2.5	4.9
Tech. Supt. (in plant)	1	6.9	Not Applicable	
TOTAL	45	4.9	< 0.1	27.9

*TWA mean for reactor building 8.5 ppm -- range 1.4 to 27.9 ppm

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APPENDIX 2

Plaquemine

Fugitive Loss Estimations

1. Production of PVC

   8,637,000 #/mo
   = 12,000 #/hr prime PVC

2. VC used (efficiency over several months) 104.8 #VC/100# PVC

   12,000 #/hr PVC x 1.048 = 12,576 #/hr VC

   Total VC losses = 576 #/hr

3. Nash Pump Losses

   Estimate From Batch Weight Loss Experience - 200 #/BA

   Average Loss 180#/hr (1 BA every 1 hour & 15 mins)

4. Day Tank Vent Losses - 20% VC in inert gas vent

   Approximately - 22 #/hr

5. VC lost in Nash Pump Seal Water

   18,000 #/hr water at 195 ppm (solubility) = 3.5 #/hr VC

6. VC Lost between Popo and Railcars

   400 ppm out of Popo
   200 ppm into railcar
   200 ppm = .003; 0.003 x 12,000 #/hr = 2.2 #/hr

7. Emergency Vents ---------- VC and PVC

   Approximately 9,000 #/mo from exp. data
   = 12.5 #/hr

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8. By-products (cleanings, etc)

Jan. 1, 1974 to June 1, 1974 ------- 501,000
= 100,200 #/mo
= 140 #/hr

9. Scrap to Dump ---------- 36,000# in 5 mo.
= 10 #/hr

10. Fugitive Losses

576#/hr	total no shipped as prime PVC
-180	Nash pump
396	
- 22	day tank vent
374	
- 3.5	Nash Pump Seal Water
370.5	
- 2.4	From Popo to Railcar
368.1	
- 12.5	Avg From Emergency Vents
355.6	
-140	#/hr by-products (solid)
215.6	
- 10	#/hr Scrap to Dump (solid)
205.6	
- 8.5	Dust Loss (solid)
197.1	Fugitive Loss

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APPENDIX 3

VINYL CHLORIDE LEVELS AT NIAGARA FALLS PLANT FROM 1946 to 1974

During the early years of VCM and PVC production at Niagara Falls the major safety consideration was the possibility of fire, and explosion anaesthetic effects. Work practices and ventilation were designed primarily to meet this threat. Where instrumentation was used to measure VCM levels, this equipment was of the "explosion meter" type. Thus there is no finite data to establish the exposure of these early employes to VCM.

Table I shows the chronology of portable detectors used to monitor for VCM. The sensitivity of the various instruments is also shown. During the period of 1946-1967 when the MSA Explosimeter was used to monitor for maintenance or vessel entry permits, a "blip" (probably less than 720 ppm) was cause for further ventilation before a permit was issued.

TABLE I

VCM TEST METERS

1946-1967	MSA Explosimeter Lowest reading on scale, 2% of LEL, or 720 ppm - not accurate at this level.
1968-1971	Davis Vaportester Lowest reading on a X10 scale was 0.2% of LEL or 72 ppm - not accurate at this level.
1972-1973	Johnson & Williams SS PK Tester Scale reads 26 ppm per division but not accurate below 50 ppm. Zero drift often in excess f 50 ppm.
1974	Century OVA #98 Portable FID Testers Not specific for VCM. Reads d wn to 1 ppm. We calibrate with certified gas at 50 and at 5 ppm.

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In order to approximate the levels which existed during the past years an interview procedure was used, during which 24 workers, selected on the basis of long service (15 to 28 years), long operating building exposure (13 to 27-½ years), indicated their work practices, per cent of work assignments in each area, and their detection of air-borne VCM by smell, dizziness, or, in one case, unconsciousness. While realizing that this procedure may lead to estimates correct perhaps only to an order of magnitude, we believe that the results of the survey present a marked contrast with the conditions of VC exposure encountered at the plant today, at the same time verifying the belief held by many that the angiosarcoma cases detected to date resulted from what we now recognize as gross, prolonged exposures to vinyl chloride.

The data in the attached table indicate the probable TWA values for men working in the buildings designated during the time span indicated.

The three cases of angiosarcoma discovered to date occurred in men who had prolonged work assignments in Buildings C-1 and E-1, areas of the highest exposure.

Work practices which increased potential exposure to VCM in the early years of plant operation were revealed by the following interview responses:

1. Most men ate food in every building during their employment period.

2. None ever used a respiratory device during the performance of their normal duties.

3. While all showered at the end of each shift, none ever took a shower as a result of VCM contact with their clothing.

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Reactor cleaning, too, enhanced VCM exposure. Responses showed that all men who had cleaned reactors smelled VCM at some time during this procedure, and half of these became dizzy a few times during their service while cleaning reactors, indicating temporary levels above 1000 ppm. The use of air movers reduced this concentration, as shown by measurements taken with a Davis Vapotester in 1967-68 which indicated maximum levels of 350 ppm typically.

TABLE 2

Vinyl Chloride Levels in Operating Buildings

Time Span		C-1	C-2	E-1	E-2	F-1	F-3	K
1946-1972	TWA	500	140	500	150	20	-	-
1973	Number of Readings	77	73	582	597	222	73	85
	TWA (ppm)	50	5	50	25	125	5	175
	Maximum reading (ppm)	2800	200	3000	2800	2460	200	2240
Jan, 1974	Number of Readings	9	9	63	80	27	8	9
	TWA (ppm)	64	8	25	17	93	44	17
	Maximum Reading (ppm)	300	60	504	168	840	300	100
April 8, 1974 to May 21, 1974	Number of Readings*	306	131	935	1068	528	328	132
	TWA (ppm)	8	4	7	6	10	8	7
	Maximum Reading (ppm)	246	35	43	34	50	65	46

*Exclusive of Reactor Cleaning.

Work Functions:
C-1 - Tank Car Unloading, VC pumping, VCM production until 1967
C-2 - " " " " " " " " "
E-1 - Polymerization, Monomer Recovery
E-2 - " " "
F-1 - Filter, Apron driers
F-3 - Filter, Rotary drier
K - Filter, Spray drier

Comments on Tables 3 to 6

The data in the attached tables represent (1) total hydrocarbon levels in plant air, expressed as parts per million vinyl chloride, over the period April 8 to June 27, 1974, and (2) results of personnel monitoring surveys, including both ten-minute and eight-hour TWA values for vinyl chloride measured in the period April 17 to June 28, 1974.

Total hydrocarbon values were measured as "instantaneous" samples using a Century OVA meter. The data presented do not cover excursions, but represent normal conditions.

Personnel monitoring data were obtained in samples of air obtained from the breathing zone of employes during their normal assignments. Samples taken in 250 ml glass tubes were injected directly into a gas chromatograph, either at Niagara Falls or in our Akron laboratories. Samples absorbed on carbon were desorbed in carbon disulfide prior to injection into the chromatograph.

Table 3 -- Area Sampling Results -- Niagara Falls, N.Y.
April 8 - June 27, 1974

(Century OVA Meter)

Time Period - 1974	Upwind Reading	Building Readings E-1	E-2	F-1	C-1	C-2	K	F-3
Average of All Readings (as ppm Vinyl Chloride)								
4/8-4/17	4.9	14.7	12.6	-	38.9	9.1	14.2	14.7
4/27-5/7	6.2	11.7	11.4	-	10.1	10.6	14.2	12.8
5/17-5/25	4.8	9.3	9.2	-	6.7	7.9	10.3	10.9
6/5-6/13	3.7	7.0	7.9	8.2	5.5	5.7	6.2	10.5
6/14-6/27	3.8	7.6	7.7	9.2	5.5	6.0	7.3	7.0
4/8-6/27	4.8	10.5	9.7	13.1	7.2	7.9	10.5	11.6
Number of Readings	240	1678	1229	398	310	153	154	215
Maximum Reading Recorded (as ppm Vinyl Chloride)								
4/8-4/17	7	45	32	-	500	30	45	42
4/27-5/7	13	28	40	-	24	40	49	33
5/17-5/25	18	35	40	-	21	22	27	45
6/5-6/13	6	20	35	40	10	10	16	55
6/14-6/27	5	27	45	35	12	11	50	20
4/8-6/27	18	50	45	275	500	40	50	55

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Note: These data do not cover excursions, but represent r utine conditions.

Table 4 -- Vinyl Chloride Levels Inside Niagara Falls Reactors

April 8 -- June 27, 1974

Time Period - 1974	Century OVA Readings as ppm Vinyl Chloride					
	Average*		Maximum*		Mimimum*	
	E-1	E-2	E-1	E-2	E-1	E-2
4/8-4/17	33.0	27.1	115	35	15	14
4/18-4/26	27.5	--	40	--	15	--
4/27-5/7	29.8	33.1	48	46	6	15
5/8-5/16	34.2	--	45	--	10	--
5/17-5/25	25.9	29.8	46	45	7	10
5/26-6/4	20.8	--	45	--	7	--
6/5-6/13	21.8	31.0	41	60	4	15
6/14-6/27	20.3	29.7	40	48	5	10
4/8-6/27	26.5	30.6	115	60	4	10

* A total of 193 readings were taken in E-1 reactors; 98 readings in E-2 reactors.

100258

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Table 5 -- Personnel Monitoring Data -- Niagara Falls, N.Y.

April 17 -- June 28, 1974

Description of Value	250 ml Glass	10 min Carbon	All Short-Term Samples	8-HR TWA
Number of Samples	94	74	168	31
Minimum Value -- ppm	0.1	Nil	Nil	< 0.04
Maximum Value -- ppm	160	55	160	100
VCM (ppm) -- 10% of samples	0.6	< 1	< 1	3
20 " "	1	< 1	< 1	4
30 " "	2	1	1,8	5
40 " "	2	2	2	8.
50 " "	3	3	3	12
60 " "	5	3.8	5	14
70 " "	7	6	6	16
80 " "	12	9	10	20
90 " "	22	12	15	24
95 " "	42	25	37	28
97.5 " "	60	44	55	100
Percentage of values above 50 ppm	4.3	1.4	3.0	6.5
" " " " 40 "	6.4	2.7	4.8	6.5
" " " " 25 "	9.6	4.1	7.1	9.7
" " " " 10 "	20.2	16.2	18.5	51.7
" " " " 5 "	39.4	31.6	35.7	67.8
" " " " 1 "	73.4	66.2	70.2	93.7

100260

Table 6 -- Distribution of Personnel Monitoring Data By Job Function and/or Area

k Area or ıction	Ten Minute-Glass & Carbon Tubes						8-HR TWA					
	Total Samples	No. >40 ppm	No. >25 ppm	Vinyl Chloride Ave ppm	Vinyl Chloride Max ppm	Vinyl Chloride Min ppm	Total Samples	No. >25 ppm	No. >10 ppm	Vinyl Chloride Ave ppm	Vinyl Chloride Max ppm	Vinyl Chloride Mi pp
ıctor Cleaning	20	6	9	33.1	160	2	6	0	5	15.7	22	
.ch Transfer	23	1	2	8.3	75	1	3	0	1	7.7	12	
ıctor Area	23	0	0	5.0	22	1	5	0	2	10.0	24	
ıp Room	12	0	0	5.8	9	< 1	1	0	0	5.0	--	-
ıtrol Room	11	0	0	6.0	12	2	2	1	1	18.0	28	
ılding Supervisor	--	--	--	--	--	--	3	1	1	22.0	51	
ger	13	0	0	4.9	13	< 1	2	0	0	4.5	6	
Dryer	9	1	1	14.6	60	3	3	0	3	17.3	24	1
ak Room	7	0	0	1.2	2	< 1	--	--	--	--	--	--
ker Room	7	0	0	1.3	2	0.4	--	--	--	--	--	--
ch Room	6	0	0	1.8	7	Nil	--	--	--	--	--	--
n Office	7	0	0	1.7	5	Nil	1	0	0	< 0.04	--	--
ehouse	7	0	0	2.0	5	< 1	2	0	0	2.1	3.6	0.(
ex	10	0	0	1.3	10	< 0.1	--	--	--	--	--	--
oratory	6	0	0	0.6	1	Nil	--	--	--	--	--	--
ntenance Shop	7	0	0	0.6	2	0.1	--	--	--	--	--	--
ft Monitor	--	--	--	--	--	--	3	1	3	44.0	100	1(

Engineering
changes
in
~~[illegible]~~
next
new
OSHA
VCM
standards

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APPENDIX 4

Engineering Considerations

Conformance to new VCM exposure criteria ultimately depends on finding engineering solutions to the loss of VCM into the plant surroundings.

The following Sections A and B list engineering projects in-progress or recently completed, which were done to minimize the loss of VCM to the atmosphere. Section C lists items for future consideration and development. Section D is a brief statement on preventative maintenance.

Section A. Goodyear Niagara Falls PVC Plant

1. Solvent Cleaning System for PVC Reactors

In the past, personnel have entered reactors to clean them by removing left-over quantities of PVC resin adhering to reactor walls and heat transfer surfaces. The new system allows reactors to be cleaned by ~~spraying~~ solvent into the reactors to dissolve remaining PVC resin. No entry into the reactor is necessary.

Project completion mid-1975
Project cost $300,000

2. Improved Ventilation in Reactor Buildings

Involved installation of twelve new fans with a capacity of 12,000 CFM each. These fans are t be used for emergency ventilation when the monitoring system indicates an excessive VCM level in the work area.

Project status . . . . . complete
Project cost $18,000

3. VCM Detection

Installation of four VCM Detectors.

Project status . . . . . complete
Project cost $12,000

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Section A. (con't)

4. Central Vacuum Cleaning System

Eliminate accumulation of PVC dust in the drying areas.

Project completion . . . . . Sept., 1974
Project cost $21,000

5. Exhaust System

Remove VCM fumes from nine storage tanks (10,000 gallons each).

Project completion . . . . . Sept., 1974
Project cost $5,400

6. Hewlett-Packard Chromatograph

Measurement of VCM concentration in various working areas.

Project status . . . . . complete
Project cost $9,000

7. Reactor Ventilation

Provide a permanent ventilation system (ducts) to remove VCM fumes from reactors before and during manual cleaning and repair reactors.

Project completion . . . . . 3rd quarter, 1974
Project cost $6,000

8. Compressor Replacement

An older design compressor is being replaced with a new specially sealed compressor. Corbin

Project completion . . . . . Dec., 1974
Project cost $5,000

9. Sifter Ventilations

Remove VCM fumes given off at "wet sifters" in the reactor buildings.

Project status . . . . . complete
Project cost $11,000

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Section A. (con't)

10. Continuous Monitoring

Chromatograph and sample collection system is being installed to continuously monitor sixteen critical plant locations for VCM.

Project completion . . . . . Jan., 1975
Project cost $50,000

Section B. Goodyear Plaquemine PVC Plant

1. New Compressor

A new booster compressor will be installed to service the two older process areas to provide lower pressure evacuation of reactors. This will reduce the amount of VCM released to the atmosphere and permit recovery of VCM in the recovery area. Also, better evacuation of reactors after each batch will reduce residual VCM in the PVC.

Project completion . . . . . June, 1975
Project cost $83,000

2. Cleaning System for PVC Reactors

A water cleaning system will eliminate the need for operators to enter reactors for manual cleaning in a new facility now under construction.

Project completion . . . . . late, 1974
Estimated cost $200,000

3. Condenser Modifications in Recovery Area

Increase efficiency of VCM recovery.

Project status . . . . . complete
Project cost $15,000

4. Improved Piping in Transfer/Blender System

Lower residual VCM content of PVC prior to shipment

Project status . . . . . complete
Project cost $16,000

Section B. (con't)

5. Compressor Re-arrangement

In the new plant now under construction, evacuation compressors were re-piped to permit series operation, thus allowing very low pressure evacuation of reactors. Improved reactor evacuation at end of each batch will remove residual VCM from the PVC.

Project status . . . . . complete
Project cost $10,000

6. Continuous Monitoring

A chromatograph and sample collection system are being installed to continuously monitor ten critical plant locations for VCM.

Project completion . . . . . Jan., 1975
Project cost $30,000

Section C. Future Engineering Considerations

New ideas which have yet to be fully evaluated are presented in this section. It is not possible at this time to supply cost estimates as each item will require thorough engineering design before its total capital and operating cost can be defined.

1. Vent Incineration

All process and emergency vents could be tied into a common header system. At the point of vapor release to the atmosphere, an incinerating flame (2,000°F) would be used to convert any VCM to CO_2, H_2O and HCl. Exhaust gases would be water scrubbed to recover the HCl. All normal process and emergency vents except reactor emergency vents would be tied into such a system.

2. Dryer Line Modifications

In plants producing PVC using the emulsion or suspension processes, VCM is lost to the atmosphere during the drying of the PVC. Presently, rotary kiln dryers or apron dryers are used and residual VCM is lost to the hot air which passes over the PVC being dried. Possible methods to eliminate VCM release in the plant surroundings are:-

Section C. (con't)

2. Dryer Line Modifications (con't)

a. Pre-treat the resin before drying to remove VCM from the wet resin.

b. Replace open dryers with enclosed fluidized bed dryers and provide total recycle of dryer gases.

c. Install high stacks to disperse trace VCM in the atmosphere (subject to EPA air polluti n limitations).

3. Closed Loop or Dense Phase Conveying

PVC resin is transported by air conveying. Air used is often on a "once through" basis with filters to remove powder before the air is exhausted to the atmosphere. Some residual VCM is released from the polymer during conveying and this VCM exhausts to the atmosphere with the air. It would be possible to use a closed-loop air conveying system or a dense phase air conveying system to minimize the amount of air vented in the plant surroundings.

The VCM has to get out sometime. Recovery method?? What eventually happens to this VC??

4. Vacuum Release of VCM from PVC

Storage tanks for dried PVC could be designed for full vacuum operation. Each tank full of PVC could be fully evacuated and left to stand for a period of time to remove entrapped VCM. Substantial capital expenditure would be needed to provide tankage and evacuation system in a way which does not reduce plant production capacity.

5. Resin Vapor Stripping

Restrictions on the residual VCM content of PVC resin may require steam (or other vapor) stripping of resins before drying. Stripping gas containing released VCM will have to be condensed and the VCM recaptured to prevent its release to the atmosphere in the immediate plant surroundings.

6. Direct Contact Refrigerated Brine Condenser

Achieve lower temperature refrigeration of vents from VCM recovery areas.

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Section C. (con't)

7. Secondary Filters

Install secondary filters on all dust collectors to eliminate trace PVC dust discharge.

8. Reactor Cleaning at the Plaquemine PVC Plant

Methods for cleaning the older two process areas of the Plaquemine Plant are being studied. These can include either water cleaning or solvent cleaning.

9. Breathing Air Supply

During emergency or failure situations when the VCM in the plant surroundings exceeds the limits, some method of protecting workers with an auxiliary breathing apparatus will be needed. This technology is poorly defined and will need careful study to develop safe systems.

10. Change in coag system

Section D. Preventative Maintenance Programs

Equipment installed to prevent VCM loss to the atmosphere will be effective only if the plants carry-out sound presentative maintenance programs.

New equipment such as valves, instruments, seals, gasket materials, etc., may have to be developed to achieve very low emission levels.

Some of the technology developed in the various AEC programs may prove useful to the VCM/PVC industry.

APPENDIX 5

VCM Residual in PVC Resin

Type	Prior Level ppm (Jan-May)		Current Level ppm (June)	
	Avg	Range	Avg	Range
Bulk (pipe)	841	30-3050	134	9-782
Bulk (film)	726	10-2450	56	12-150
Suspension (General Purpose)	880	500-900	230	1-800
Modifying Resin	1137	450-1850	322	24-640
Plastisol	< 30		4	1-12

TYPICAL PVC OPERATOR MOVEMENTS

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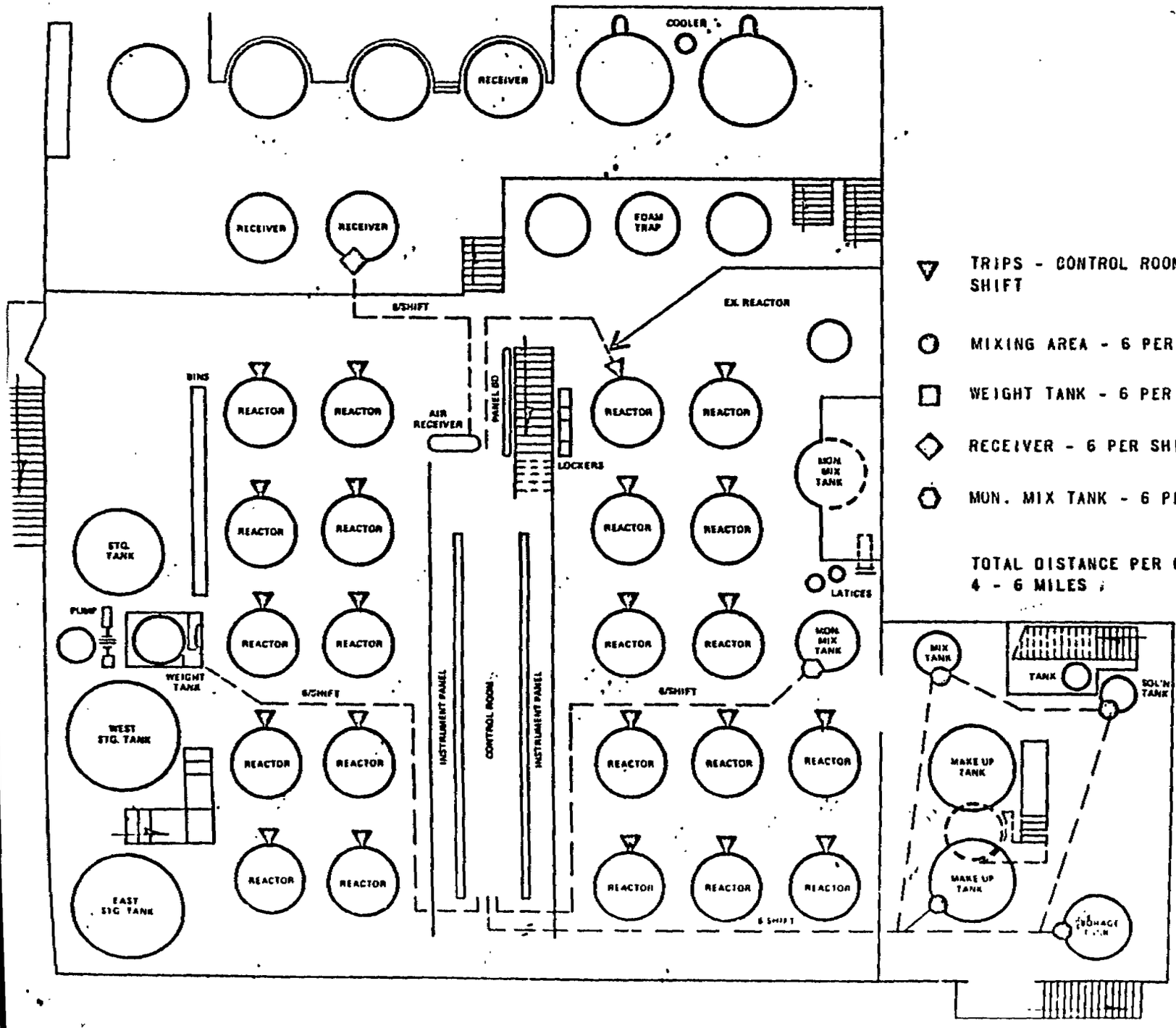

- TRIPS - CONTROL ROOM TO REACTORS - 80 PER SHIFT
- MIXING AREA - 6 PER SHIFT
- WEIGHT TANK - 6 PER SHIFT
- RECEIVER - 6 PER SHIFT
- MON. MIX TANK - 6 PER SHIFT

TOTAL DISTANCE PER OPERATOR PER SHIFT
4 - 6 MILES

May 23, 1974

Mr. J.M. Gilmore
Plant Manager

Subject: Vinyl Chloride Levels at Niagara Falls Plant from 1946 to Early 1974

Introduction

Vinyl chloride exposure data was gathered from various sources (see references) from actual instrument readings within the plant during various periods, generally from the late 60's, and from interviews of twenty-four (24) workers(6) during the week of May 20, 1974. Those selected for interview represented men with long service at the plant (15 years to 28 years) and in operating building exposure (13 year to 27½ years). Selection for interview was also based upon judgement that fairly reliable information could be obtained from the individual.

Additional helpful information was also obtained during the interviews and is included.

Summary

Interview Data

Period covered	1946 - 1972
No. Men	24

(1) Calculated TWA ppm VCM:

Bldg.	TWA
C-1 (thru 1966)	496
C-2 (thru 1967)	141
E-1	502
E-2	154
F	7.8
Overall (weighted)	256.8

(2) Of those that worked in Bldgs. the following information was obtained:

(a) During cleaning of E Bldg. reactors 95.7% smelled VCM; about 1/3 less than 10% of the time and about 1/3 more than 50% of the time.

(b) While cleaning about 50% became dizzy a few times.

(c) All interviewed became dizzy from breathing VCM at one time or another; about 40-50% frequently in C-1, E-2 & E-1; seldom or never in F; most, a few times or less in C-2.

(d) Only one (1) man claimed he was made unconcious by breathing VCM and none were ever hospitalized.

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(e) None were ever given oxygen form breathing VCM.

(f) None ever used a respirator or self contained air mask performing their normal duties.

(g) None ever took a shower as a result of contacting VCM with their clothing. However, all took a shower at the end of each shift.

(h) Most men ate food in every building during their employment period.

(3) VCM levels from instrument measurements (ppm):

(See details in tables included and sample calculations).

Year	Area		See Reference and Table
1967-1968	Inside E-2 reactors	325 normal max.	(4)
1968	E Bldg. Compressor Areas	380-564 TWA	(3)
1969	E Bldg. Compressor Areas	458-592 TWA	(3)

Interview Levels for Reference

Bldg.	Calc. 1946-1972	Calc. TWA 1973	Calc. TWA 1974 (to 2-17) (1&2)
E-1	502	48.4	25.1
E-2	154	26.3	17.4
F-1	7.8	125.1	92.7
F-3	-	4.4	43.8
K	-	175.5	16.7
C-1	496	48.8	63.8
C-2	141	3.5	8.3
Overall (weighted)	258.8	53.2	32.3

(4) A listing of equipment and process improvements completed in 1974 is included.

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Conclusions

1. Overall plant TWA level of VCM has improved considerably since the early years of operation from a calculated overall high of about 260 ppm to about 32 ppm in early 1974.
2. Highest TWA was calculated from interview data (to 1972) for E-1 (502 ppm) and C-1 (496 ppm). Early 1974 E-1 TWA from instrument data was calculated as 25 ppm, demonstrating tremendous improvement.
3. E-2 level dropped from 154 ppm TWA to 17 ppm in early 1974; again tremendous improvement.
4. F-1 level remains fairly high at 93 ppm TWA; interview level of 7.8 TWA (1946-1972) appears low.
5. Personnel interviewed were most cooperative, interested and convinced that VCM levels are greatly improved now. They sincerely believe that both management and labor have the same goals.

J.F. Bickley
Manager Quality Control

JFB:ch

D.H. Francis
M. Trowbridge
S.H. Kernaghan
J. Pollock
R.H. Evans

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PERSONNEL INTERVIEWED

NAME	NO. YRS. SERVICE	NO. YRS. PRODUCTION &/OR MAINTENANCE
A. C. Malbone	28	14
J. S. Miller	27½	27½
A. A. Reed	27½	27½
R. S. Hare	27½	27½
G. F. Toner	26½	26½
H. B. Prerk	25	17
W. A. Julian	25	25
P. A. Himes	25	20
R. Buckley	24½	24½
J. M. Lederhouse	23½	23½
R. A. Rinker	23	23
J. R. Marsicano	22½	22½
R. L. Richardson	22½	22½
H. F. Selfridge	22	22
F. L. Cummings	22	22
D. L. St. John	21½	21½
C. E. Ludwick	20½	20½
C. M. Aparicio	20	13
W. J. Kupfer	18½	18½
R. B. Rafferty	16½	16½
R. D. Boyer	16½	16½
J. L. DeLong	16	16
D. R. Crooks	15½	15½
R. L. Shively	15	15

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(6)

RESULTS OF PERSONAL INTERVIEWS WITH WORKERS
DURING THE PERIOD 1946 – 1972

1. Men Interviewed: Worked in Bldg.	No. of Men	Estimated General Building Level of VCM Vapor (ppm) Excludes inside E-1 & E-2 Reactors: 0-100	100-400	400-500	500-1000	1000	2. Estimated Hours per Shift Per Man Exposure At Odor Detecting Level or Higher*: <10	10'-1 Hr.	1 Hr.-4 Hrs.	4 Hrs.-7 Hrs.	Calc. TWA
Total	24										
C-1	No. 17		1		6	10		6		11	496
	% 70.8		5.9		35.3	58.8		35.3		64.7	
C-2	No. 13		7	1	5		2	1	10		141
	% 54.2		53.8	7.7	38.5		15.4	7.7	76.9		
	No. 24		3	1	11	9		4	5	15	502
	% 100.0		12.5	4.2	45.8	37.5		16.7	20.8	62.5	
E-2	No. 22		14	3	5			4	11	7	154
	% 91.7		63.6	13.7	22.7			18.2	50.0	31.8	
F	No. 24	24					3	14	7		7.8
	% 100.0	100.0					12.5	58.3	29.2		
Overall:											258.8

Notes: 1. K Bldg. is included with E Bldgs. since E Bldg. operators generally bleed VCM transfer pumps.

2. Normal odor detection level was estimated at 400-500 ppm VCM because of lengthy time period operator worked in areas where he was exposed to VCM.

3. Exposure time in F Bldg. relates only to slurry and latex holding tanks and Oliver filters.

4. Operators, maintenance men and men cleaning equipment included in above table.

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RESULTS OF PERSONAL INTERVIEWS WITH WORKERS FOR PERIOD 1946 - 1972

1 When cleaning E-1 or E-2 Bldg. Reactors (inside) after use of air movers:

3. Did you ever smell VCM? (1 man did not clean reactors)

	No	Yes
No.	1	22
%	4.3	95.7

If yes, approximately what % of the time:

	<10%	10-20%	20-30%	50%	50-80%	100%
No.	8		5	2	7	
%	36.4		22.7	9.1	31.8	

4. Did you ever become dizzy inside of an E Bldg. reactor while cleaning it?

	No	Yes
No.	11	12
%	47.8	52.2

If yes, approximately how many times:

	Few	Moderate No. (30-50%)	Frequently
No.	11	1	0
%	91.7	8.3	0

5. Other than during cleaning of reactors did you ever become dizzy from breathing VCM?

	No	Yes
No.	0	24
%	0	100

When you became dizzy from breathing VCM what building was it in and how frequently?

		No. Men	Never	Seldom	Few Times	Frecuently
Total		24				
C-1	No.	17	2	2	3	10
	%	70.8	11.8	11.8	17.6	58.8
C-2	No.	13	4	4	5	0
	%	54.2	30.8	30.8	38.4	0
E-1	No.	24	0	4	7	13
	%	100.0	0	16.6	29.2	54.2
E-2	No.	22	3	5	5	9
	%	91.7	14.6	22.7	22.7	40.0
F	No.	24	11	13	0	0
	%	100.0	45.8	54.2	0	0

6. Were you ever unconcious from breathing VCM?

	No	Yes
No.	23	1
%	95.8	4.2

7. Have you ever been given oxygen as a result of breathing VCM?

	No	Yes
No.	24	
%	100.0	

8. Did you ever use a respirator in perfomance of your normal duties?

	No	Yes
No.	24	
%	100.0	

9. Did you ever use a self contained air mask (Scott air pack or equivalent) in performance of your normal duties?

	No	Yes
No.	24	
%	100.0	

10. Have you ever been hospitalized as a result of breathing VCM?

	No	Yes
No.	24	
%	100.0	

11. If your clothing was contacted with VCM liquid, did you then take a shower?

	No	Yes
No.	24	
%	100.0	

12. Did you take a shower at the end of each shift?

	No	Yes
No.		24
%		100.0

13. Did you eat food in buildings listed if you worked there?

		No	Yes
C-1	No.	2	15
	%	11.8	88.2
C-2	No.	2	11
	%	15.4	84.6
E-1	No.	3	21
	%	12.5	87.5
E-2	No.	2	20
	%	9.1	90.9
F	No.	8	16
	%	33.3	66.7

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VINYL CHLORIDE LEVELS IN 1967-1968 INSIDE E-2 REACTORS (4)

Meter Type: Davis-Vapotester (readings in ppm)

Date	Reactor No.	Remarks	Rdg.
10-25-67	7	Aired 1 hr. but not during rdg.	Bottom 325 max. Bottom 225 avg.
10-25-67	5	Aired 25 minutes	Bottom 250 max. Bottom 150 avg.
8-30-67	6	Aired 20 minutes	Bottom 300 max. Top baffles 240
10-8-68	5	20 minutes after airing	150
10-8-68	4	Aired twice	60
10-8-68	2	Aired 22 minutes	60
10-8-68	6	Aired 20 minutes	240-300
10-8-68	1	Aired 25 minutes	300
10-9-68	3	Aired 20 minutes	270
10-9-68	5	Aired 30 minutes	180
10-9-68	6	Aired 20 minutes	540 (not typical max.)
10-9-68	6	After 30 minutes	180

Normal airing time is 20 minutes

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(3)

VINYL CHLORIDE LEVELS IN 1968 and 1969

Meter Type: MSA Halogenated Hydrocarbon Detector Tube
(readings in ppm)

Building	Year	Dates	No.of Rdgs.	% at each level: Zero	50	0-100	101-250	251-500	501-1000	>625	1000	Ca T
E-1	1968	4/17-11/29	33	3.0	3.0	30.3	24.2	9.1	15.2	-	21.2	3
E-1	1969	1/29	7	0.0	-	42.9	-	-	-	57.1	-	5
E-2	1968	4/17-11/29	25	0.0	-	16.0	24.0	8.0	16.0	-	36.0	5
E-2	1969	1/6-1/7	15	20.0	20.0	40.0	13.3	6.7	-	40.0	-	4

*Using Davis Vapotester one retest was repeated and reading was >3000 ppm.

[illegible]a covers areas at and around Vinyl Chloride Compressors.

Nine(9) tests were made using a Davis Vapotester February and March of 1969 on the Worthington Compressors in E-1 with readings running from 0.036% VC (360ppm) to 3.6% VC (36,000 ppm).

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VINYL CHLORIDE LEVELS IN 1973 (1-7-73 through 12-23-73)

Meter Type: Johnson & Williams (readings in ppm)

Building	No.of Rdgs.	Max.	Min.	% at each level								Calc TWA
				Zero	1-10	11-50	51-100	101-200	201-500	501-1000	1000	
E-1	582	3000	0	73.5	1.2	7.9	7.1	5.0	2.4	1.7	1.2	48.
E-2	597	2800	0	84.1	1.0	4.8	1.8	1.7	2.4	0.7	0.5	26.
F-1	222	2454	0	47.[illegible]	3.2	14.0	12.6	6.3	11.8	3.6	[illegible]	125.
F-3	73	200	0	93.2	-	4.0	1.4	1.4	-	-	-	4
K	85	2240	0	50.6	1.2	5.9	14.1	8.2	3.5	10.6	5.9	275
C-1 (Pump)	77	2800	0	79.2	1.3	6.5	2.6	2.6	5.2	1.3	1.3	46
C-2 (Compressor)	73	200	0	91.8	2.7	4.1	-	1.4	-	-	-	3
										Overall (weighted)		53
Total	1709											

- ta covers various points in entire building.

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VINYL CHLORIDE LEVELS IN 1974 (1-15-74 through 2-17-74) (1)

Meter Type: Johnson & Williams (readings in ppm)

Building	No. of Pdgs.	Max.	Min.	% at each level								Ca T
				Zero	1-10	11-50	51-100	101-200	201-500	501-1000	1000	
E-1	63	504	0	79.4	-	7.9	7.9	3.2	-	1.6	-	2
E-2	80	168	0	78.8	-	5.0	11.2	5.0	-	-	-	1
F-1	27	840	0	51.9	7.4	14.8	3.7	11.1	3.7	7.4	-	9
F-3	8	300	0	87.5	-	-	-	-	12.5	-	-	1
K	9	100	0	77.8	-	-	22.2	-	-	-	-	1
C-1 (Pump)	9	300	0	66.7	-	-	11.1	11.1	11.1	-	-	6
C-2 (Compressor)	9	60	0	88.9	-	-	11.1	-	-	-	-	
										Overall (weighted)		
Total	205											

Data covers various points in entire building.

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71301

SAMPLE CALCULATIONS

Vinyl Chloride Levels from Interviews

For C-1 Bldg.

No. Men Avg. estimated ppm VCM x $\frac{\%}{100}$ of men exposed x hrs. exposed.

No. Men	Avg. estimated ppm VCM		$\frac{\%}{100}$ of men exposed		hrs. exposed.	
1	250	x	0.059	x	5.5	= 81.1
6	750	x	0.353	x	0.6	= 158.9
10	1000	x	0.588	x	5.5	= 3,234.0
16 Total						3,474

$$\frac{3,474 \text{ ppm - man - hrs.}}{7 \text{ hrs. total exposure}} = 496 \text{ ppm TWA per man}$$

Overall TWA

Bldg. TWA x $\frac{\%}{100}$ of total men worked in Bldg.

Bldg. TWA		$\frac{\%}{100}$		
496	x	0.708	=	351.168
141	x	0.542	=	76.422
502	x	1.000	=	502.000
154	x	0.917	=	141.218
7.8	x	1.000	=	7.8
Total		4.167		1,078.608

$$\frac{1,078.608}{4.167} = 258.8 \text{ TWA overall weighted}$$

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SAMPLE CALCULATIONS

Vinyl Chloride Levels in 1974

For E-1 Bldg.

Use midpoint for each ppm range, i.e. range is 51-100 then use 75 ppm avg.

%/100	x	avg. ppm	=	10.
0.794	x	0	=	0
0.079	x	30	=	2.37
0.079	x	75	=	5.925
0.032	x	150	=	4.8
0.016	x	750	=	12.00
Total 1.000				25.095

$$TWA = \frac{25.095}{1.0} \neq 25.1$$

Overall TWA

	%Bldg TWA	x	No. Rdgs.	=	No.
E-1	25.1	x	63	=	1581.3
E-2	17.4	x	80	=	1392.0
F-1	92.7	x	27	=	2502.9
F-3	43.8	x	8	=	350.4
K	16.7	x	9	=	150.3
C-1	63.8	x	9	=	574.2
C-2	8.3	x	9	=	74.7
Total			205		6625.8

$$\frac{6625.8}{\text{no. rdgs.}} = \frac{6625.8}{205} = 32.3$$

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ITEMS COMPLETED IN 1974 TO LOWER VCM LEVELS

1. Run E-1 wall fans continuously.
2. Run E-2 wall fans continuously.
3. New E-1 water charging procedure adopted.
4. Vented E-2 air movers to outside.
5. New E-2 reactors charging (Diznic) procedures adopted.
6. E-2 Selectro ventilation installed.
7. Purchased four (4) Century meters for testing VCM level and for leaks.
8. E-1 Selectro ventilation installed.
9. Capped off E-2 reactor air mover discharge manifolds.
10. Exhaust duct connected to H-7 Seal Water Tank.
11. Installed exhausts for E-2 Worthington seals.
12. Sealed E-2 sump from Isol back up into building.
13. Installed lines from Ribbon Cooler to Welex so lids can be opened from Welex floor.
14. Rinse water from E-1 reactors being drawn into #7 receiver rather than being rinsed to sewer.
15. Rinse water from E-2 reactors drawn into empty receiver or transferred to "F" rather than to sewer.
16. 20,000 gallon tank ventilation revised (3 fans).
17. Cleaned up E-1 and E-2 wall fan louvres.
18. New ventilation system for Welex installed.
19. Larger ventilation line for 3rd floor Ribbon Cooler installed.
20. Installed air purge (closed system) in Welex discharge line.
21. New D-145F lunch room erected.
22. New D-145H lunch room erected.
23. 6" Bird centrifuge effluent piping from P-1 & P-2 installed to sump. Sump covered.
24. Ventilated E-1 Worthington compressor.

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25. New ventilation system on 10,000 gallon tanks.

26. C-1 pump seal ventilated.

27. C-1 Worthington compressor ventilated.

28. Issued respirators to personnel.

29. Covers installed over Triwalls for cleanings.

30. E-2 6" quick opening doors ventilated while rinsing.

31. New bags in 145H Pangborn dust collector installed.

32. Ventilated E-2 H-4 vacuum pump seal water effluent.

33. Ventilated E-2 H-7 vacuum pump seal water effluent.

34. Ventilated E-1 Worthington compressor seals.

35. E-2 KD pot drains piped to outside.

36. E-2 empty reactor KD pots drained outside.

37. E-1 Nash vacuum pump seal H_2O repiped to outside.

38. E-1 degassing Nash & KD pots extended away from building.

39. Installed numerous air line drops and masks. (E-1, E-2, C-1, K, F, Welex, Ribbon blender).

40. Ventilated #3 P&S Holding tank.

41. Ventilated #2 P&S Holding tank.

42. Repipe Reslurry Bird centrifuge effluent to the outside.

43. Ventilated E-2 VCM Filter.

44. Ventilated E-2 VCM Charge pumps.

45. Supplied long rubber gloves for E-1 & E-2 operators to wear when rinsing reactors.

46. Ventilated sample points under # 1 & 2 receivers in E-2.

47. Ventilated sample point for "M" resins in E-1.

48. Bought 24 type C masks and installed numerous air line drops around the plant operating areas to comply with OSHA.

49. Ventilated # 1 P&S Holding tank.

50. Ventilated # 1 P&S Coagulator agitator seal.

51. Ventilated # 2 P&S Coagulator agitator seal.

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52. Ventilated # 3 P&S Coagulator agitator seal.

53. Bottom ventilated E-2 3,500 gallon reactors.

54. Bought personnel monitoring equipment.

55. On 4-8-74 1 man/shift assigned to take Century meter enviromental readings and leak detection.

56. Based on Century tests, requiring operators to wear air line masks at VCM car hook-up.

57. Six (6) additional ventilation fans installed in E-1 but not all wired yet.

58. Five (5) additional ventilation fans installed in E-2 but not all wired yet.

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REFERENCES

(1) & (2) Supervisional test log from J. Pollock, Personnel Manager, files.

(3) VC Leakage data by K. Greenwald & R. D. Heffler, Lab Technicians, also from S. H. Karnaghan, Technical Superintendant, files.

(4) Summary of notes supplied by M. Trowbridge, General Foreman, Vinyl Production from his files.

(5) Items completed in 1974 to lower VCM levels supplied by M. Trowbridge, General Foreman, Vinyl Production from his files.

(6) Personal interview results with plant workers by J.F. Hlickley, Quality Control Manager, during week of May 20, 1974.