Qeneral P6-1 (4)

B.F.Goodrich

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

6100 OAK TREE BOULEVARD · CLEVELAND, OHIO 44131 · PHONE 216-524-0200

INTERNATIONAL DEPARTMENT

VIA AIR MAIL

March 6, 1975

Subject: Vinyl Chloride

Included in this transmission are the following:

1) Articles related to VCM emission.

2) An Authorization to Manufacture prepared for Louisville plant for the purpose of changing recovery conditions in an effort to get PVC resin with less than 10 PPM of RVCM.

3) Report entitled "The Reaction of Potassium Permanganate with Vinyl Chloride Monomer". The Avon Lake plant is now experimenting with this procedure on a plant scale. The seal water from the recovery pumps is passed through a tank where dissolved VCM reacts with Potassium Permanganate before the water can go to sewer system.

4) A meeting report on Infrared Fourier Transform System for Monitoring Taxic Gases. This is for information purposes only and serves to illustrate that B.F. Goodrich is continually looking at new VCM detection equipment.

Best regards,

John E. Stroope

John E. Stroope

JES/kan

Attachments

2464 1001

Industry asks stay of standards on vinyl chloride

Associated Press

NEW YORK — The plastics industry has moved to stay new government standards regulating industrial workers' exposure to vinyl chloride.

The Society of the Plastics Industry, Inc., said yesterday it would ask the Supreme Court to review a recent federal appeals court decision upholding the new standards and ordering them into effect April 1.

Exposure to vinyl chloride has been linked to 21 cases of a rare, fatal liver cancer. The chemical is widely used in the manufacture of plastics.

New standards for exposure to the chemical were ordered last year by Secretary of Labor Peter Brennan, and the Occupational Safety and Health Administration published them on Oct. 4.

The standards establish an exposure level of only 1 part per million average over any eight-hour period and 5 parts per million average over any 15-minute period.

Workers who would be exposed to air with concentrations of vinyl chloride greater than those limits would be required to wear respirators.

In its motion before the 2nd U.S. Circuit Court of Appeals, the society asked that the interim exposure standard of 50 parts per million be continued pending disposition of the case by the Supreme Court.

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R.P.Kenney-A.~~[illegible]~~d-C.R.Flynn

JE

24641002

ICI to expand its US operations at Bayport

by Ann Taylor

ICI United States is studying several new chemicals manufacturing projects, following the acquisition of a 250-acre site in the Bayport industrial development complex near Houston, Tex. from an Exxon subsidiary. No specific details are available as none of the projects has been approved yet.

ICI United States is the US operating subsidiary of ICI America. Turnover for the last fiscal year (1 October 1973-30 September 1974) was \$300 million. ICI United States manufactures a variety of chemicals including specialities, pharmaceuticals, plastics, films, dyes and textile chemicals, agricultural chemicals, aerospace products and fibres—the latter via a joint venture with Celanese. There are seven company divisions.

Latest project—and ICI's largest single investment in the US—is the \$50 million Melinex polyester film plant at Hopewell, Va, which is believed to have capacity for about 22 000 tonnes/year. This unit started up at the beginning of 1972. Previously the UK market for Melinex had been supplied from ICI's Rozenburg, Netherlands, plant and from its Dumfries, UK, unit.

ICI made a major plunge into the US market with its acquisition of Atlas Chemical Industries in 1971 following a \$164 million bid. This company was merged with ICI America, whose headquarters is now at Wilmington, Del. There are plants in 10 states and corporate research laboratories in Wilmington.

The group's first step in the US came in the 1950s with the purchase of a 70% interest in Arnold Hoffman and Co, a New England manufacturer of textile chemicals and dyestuffs.

Other acquisitions included Stuart Pharmaceuticals, the Chemical Manufacturing Co which produces chemicals for use in polyurethane foams, and a stake in Rubicon Chemicals, and Katalco, a catalyst producer.

ICI America first started manufacturing at Bayonne, NJ in 1966 where operations include the production of Cereclor chlorinated paraffin waxes, Alloprene chlorinated rubber, polyurethane speciality chemicals and PTFE.

All the major European chemicals producers are building up their operations in the US. In ICI's case, the likely areas for expansion include specialities, products near to the consumer market and agrochemicals. ICI America has a biological research centre for agrochemicals in North Carolina.

Pharmaceuticals make a major contribution towards ICI United States profits, and further expansion is likely here, though probably not at Bayport.

UK oil imports drop by 10% in third quarter

Crude oil imports into the UK fell by 10% during the third quarter of 1974, confirming the trend towards energy conservation.

Imports in the third quarter totalled 25 million tons, against 28 million tons in the same period of 1973. According to *Energy Trends*, published by the Department of Energy, the cutback is due to the continuing high level of stocks and lower demand for oil products, with the exception of fuel oil. The constant demand for fuel oil is a result of the use of the product by power stations due to the coal shortage.

However, total energy consumption was only 0·5% less in October 1974, compared to October 1973, due to the increased use of natural gas.

Petrol consumption rose to the year's highest level in October, although for the first 10 months of the year, consumption fell by 4%. The effects of recent price increases and speed restrictions on demand have not yet been reflected in petrol consumption figures.

According to the Institute of Petroleum, oil consumption in the first nine months of 1974 dropped by 7·3%.

UK chemical job prospects encouraging

Job prospects for the New Year in UK chemical manufacturing firms are relatively encouraging, with more companies—nearly one in five—forecasting recruitment than cutbacks, according to a survey by Manpower, the worldwide service group.

In chemical manufacturing, 18·6% of companies anticipated an increase in labour requirements for this quarter, compared with 22·1% for the last quarter and 35·2% for the first quarter of 1974.

This compares with 10·1% of companies expecting a decrease for this quarter compared with 3·5% and 5·0% for the previous periods. 65·5% of companies saw no change while 5·4% did not know.

Looking at the regions, the survey says that at Darlington, Middlesbrough and Hartlepool, in the north-east, confidence in the region's long-term prospects associated with the development of the petrochemical industries and the easing of raw material shortages is tempered by cashflow problems and a continuing famine of skilled labour. Increases are forecast at Darlington in chemicals.

VCM cancer case at BPCI

A second case of angiosarcoma has been discovered in the UK PVC industry. The man, who was 37 years old, worked at the BP Chemicals site at Barry as an autoclave cleaner on the VCM plant, for just over 3 years, between 1966 and 1969. He died on 24 December.

There is apparently no doubt that this is a case of angiosarcoma, although the findings are still to be confirmed by a panel of government pathologists. What is different about the case, however, is the relatively short period of time that the man was exposed to VCM.

Of the 24 cases of angiosarcoma discovered in VCM workers throughout the world, all except this recent case involved workers who had been exposed to high concentrations over many years.

Although the level to which the latest victim was exposed over the three years was up to 500 ppm, this is still considerably below the levels of earlier years.

A spokesman for BP, however, stressed that there were unusual medical factors in the man's medical history that were being investigated, and which could have a bearing on the case.

The only previous case of angiosarcoma in a worker exposed to VCM in the UK involved an ICI pensioner aged 71.

BP's acknowledgement of this recent case of angiosarcoma came only a few days after the government working party, looking at the angiosarcoma/VCM question had agreed on the official exposure limit for the UK industry. This represents no change from the voluntary limits accepted by the UK PVC manufacturers, of a ceiling of 50 ppm, with a time weighted average of 25 ppm. It is understood that the working party was fully aware of the suspected BP case of angiosarcoma when deciding on its recommendations.

Meanwhile, in the US, a federal appeals court has ordered a stay on the implementation of the government regulations on workers exposure to VCM (CA, 11 October 1973 p 1).

The US plastics industry has asked for a stay on the grounds that the new standards were too vague, and were not based on substantial evidence. The new standards call for workers' exposure to be reduced to concentrations of VCM of 1 ppm over an eight hour shift. The present maximum level is 50 ppm.

The court granted a stay on the implementation of the new regulations until it had completed its review of the situation.

2464 1003

B.F. Goodrich Chemical Company

AUTHORIZATION TO MANUFACTURE

JES

				№ 6357	NEW PRODUCT
TO: P.H. Lawrence					CHANGED RECIPE
PLANT: Louisville, Kentucky					UNLIMITED PROD.
COMMODITY CODE NO: All 1100 gal. polys	TO BE LABELED	AMOUNT: *		EST. COST	NEW PROCESS: X
SUGGESTED SCHEDULE: February, 1975	SCHEDULE		EST. SAVINGS		NEW RAW MTLS.

WHY IS THIS PRODUCT TO BE MADE AND WHY DO IT NOW?

The current goal for RVCM in Geon pearl resins is 10 ppm or lower. To attain this goal without venting VCM to the atmosphere and assuming that stripping columns will not be generally available for Geon pearl resins made in the small reactors at Louisville, the RVCM must be removed in the blowdown tank. Work at other plants has indicated that RVCM can be lowered to satisfactory levels by stripping in the blowdown tank to 220°F. Current stripping temperatures at Louisville vary from 170°F in Bldg. 111 to 190°F in Bldg. 1.

* 10 charges then
100,000 lbs. then
250,000 lbs. then
750,000 lbs. then
unlimited

WHAT IS THE PRODUCT AND HOW IS IT TO BE MADE?

The products will be all pearl and G-90 series resins made in Bldg. 1, 15, and 111. Stripping to 220°F at various times to reduce RVCM in the finished resin to below 10 ppm without excessive venting to the atmosphere will be accomplished.

To Be Approved By	Production X		Development	
To Be Evaluated By	Production X	Dev.	Pol	Field Sales
Non-Standard Raw Materials To Be Furnished By				
Property Of	Production X		Development	
Attachments	Manufacturing Spec.		Product Spec.	Tech. Spec.
Technical Reports				

REQUESTED BY	DEPT: 5773, 5774, and 5775	R. Ballman S. Brown	DATE: 2/4/75

ROUTINGS AND APPROVALS

AUTHORITY			DATE
Manager	Development		
Manufacturing Processes			
Office—Vice-President-Production			
Sales Manager			
Manufacturing Plant—Technical		H. I. Barrett	2/6/75
Manufacturing Plant—Production		R A Wagner	2-7-75
Manufacturing Plant—Manager		[illegible]	2-10

BFG-15032

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2464 1004

BFG TECHNICAL DOCUMENT

B.F.GOODRICH CHEMICAL COMPANY TECHNICAL REPORT

TITLE

The Reaction of Potassium Permanganate with Vinyl Chloride Monomer

AUTHOR M. M. O'Mara, J. L. Dorsch, C. A. Daniels, R. F. Koebel

LOCATION ALTC

DATE December 30, 19

REQUESTED BY F. E. Krause

LOCATION ALTC

PROJECT NO. 3690

SUMMARY

We have previously reported that VCM in water will rapidly react with potassium permanganate ($KMnO_4$) to yield CO_2, HCl and formic acid at pH = 7 and that complete oxidation to CO_2, HCl occurs at pH = 10. An extension of this work has been directed toward obtaining a material balance (chloride ion) to further our understanding of this reaction.

VCM in pH = 7 and pH = 10 water was reacted with a solution of $KMnO_4$ in a variable volume polyethylene reaction vessel. The results of these experiments indicate a molar stoichiometry (VCM to $KMnO_4$) of 1.3 to 1.5 : 1. Material balance calculations (VCM-in; Cl^--out) could only account for 30 - 40% of the charged VCM.

At this point we are repeating this work using an improved gas chromatographic method of analysis for VCM and two independent methods of analysis for chloride ion in order to determine the cause of this low material balance.

This study will be carried out on a laboratory scale reaction and a process scale reaction (treatment of seal water).

Introduction

The purpose of this study was to study the oxidation of vinyl chloride monomer by potassium permanganate ($KMnO_4$) in solution. Specifically we set the following objectives:

(1) determine the rate of reaction,
(2) establish the reaction stoichiometry,
(3) identify the reaction products, and
(4) establish a material balance (VCM-in; chloride ion-out)

Since the rate of the reaction was very rapid (seconds) we decided not to spend any time on this particular objective. The reaction products at pH = 7 and pH = 10 have been established. A N.M.R. spectroscopic study has shown that at pH = 7, hydrogen chloride, formic acid, carbon dioxide, potassium ion and manganese dioxi are the reaction products. At the higher pH, formic acid is absent from the reaction products(1) due to its complete oxidation to carbon dioxide.

(1) C. A. Daniels, J. L. Dorsch, B.F.G.C.C. Technical Report, 12/12/74.

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[illegible] of this note is to summarize our studies pertaining to the [illegible]ing objectives: stoichiometry and material balance.

E[illegible]ntal

A gas chromatographic procedure was set up in order to follow the di[illegible]arance of VCM in water after reaction with $KMnO_4$. In this method, a s[illegible]ted solution of VCM in H_2O was prepared in a polyethylene bottle. The [illegible] of the bottle was reduced by 50% by squeezing the sides of the vessel. [illegible] was then capped with a septum. At no time was a vapor space per[illegible] above this solution. To carry out a reaction, a certain volume of an a[illegible] $KMnO_4$ solution was injected into the polyethylene bottle. This solut[illegible]s then chromatographed and the residual vinyl chloride remaining afte[illegible]ion was determined (volume corrections were made).

Standards

Chrom[illegible]hic standards were prepared by injecting various concentrations of V[illegible] into the chromatograph under the same conditions as used in the aque[illegible]sis. The μ mole VCM vs. counts calibration curve is shown in Figure [illegible] this calibration curve we determined the saturation concentratio[illegible] air at 23°C. and 14 lbs./in.^{2} of pressure to be 0.119 ± .002 weigh[illegible] [illegible]erens' data[2] at 30°C. and 14 lbs./in.^{2}, this value is about 0.17 wei[illegible] this may indicate an error in our g.c. procedure, I believe it re[illegible]nce in the methods of preparing a saturated solution of VCM. We [illegible] [illegible]erens' method which is the proper way of preparing a true saturated solution of a gas in a liquid. In our method we simply bubbled the gas into the solution for a period of time and assumed the solution to be near saturation. According to the above analysis, this saturation method was approximately 71% effective.

Reaction at pH = 7

In this experiment, our "saturated" VCM solution was analyzed prior to reaction. The $KMnO_4$ solution was then added to the VCM solution. Reaction was very rapid as evidenced by the immediate formation of the brown precipitate, MnO_2. After reaction, the solution was again analyzed for residual VCM. The reaction vessel was then opened and the solution was analyzed for chloride ion by ion potentiometry:

$$CHCl = CH_2 \xrightarrow[H_2O]{KMnO_4} HCl + CO_2 + \text{organics}^{(1)}$$

The results of this experiment are summarized in Table 1.

(2) A. R. Berens, Inter-Organizational Correspondence, "Solubility and Diffusion of VC in Water and PVC", 2/4/74.

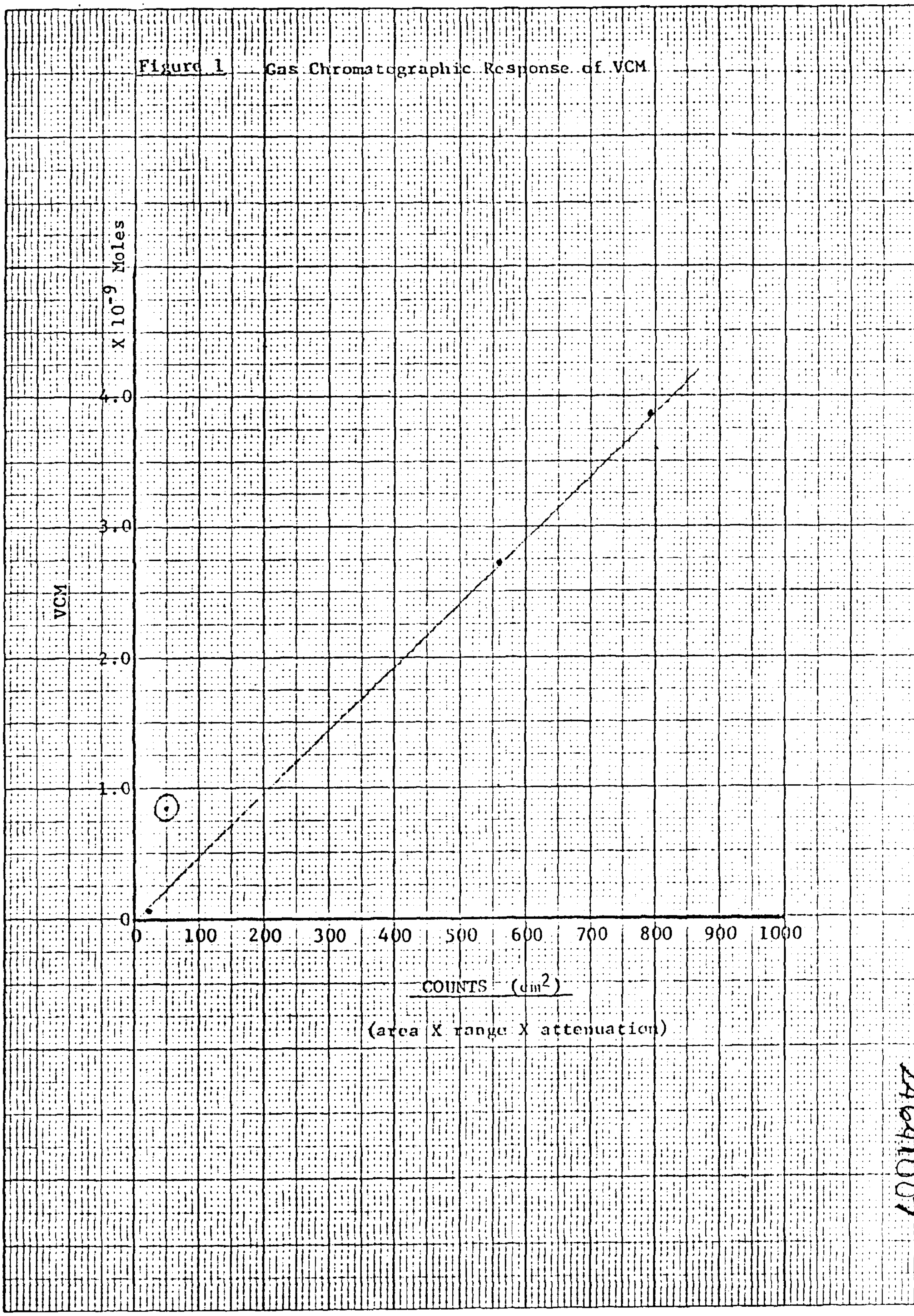

Figure 1 Gas Chromatographic Response of VCM

Table 1

Reaction of VCM with $KMnO_4$ in Solution at pH = 7

VCM solution: 0.117 wt. %

$KMnO_4$ solution: 0.0316 M

initial VCM aliquot (75cc): 0.00141 moles

$KMnO_4$ solution added (27.5cc): 0.000868 moles

final VCM in aliquot (102.5cc total): .000282 moles

moles VCM consumed: .00113

moles VCM: moles $KMnO_4$ = 1.30

Cl^- found (4.3×10^{-3} M): .00044 moles

chloride recovery = 38.9%

It is obvious that a material balance for chloride ion does not exist. At this point we do not know why this is so. We have examined the MnO_2 precipitate and have found no bound chloride. The NMR experiment[1] gives no evidence of a chlorinated hydrocarbon. E. Truscott has examined the aqueous solution, using atomic absorption spectroscopy, for a non-ionizing soluble manganese chloride complex. The aqueous solution contained 45 ppm of manganese which translates to 84×10^{-6} moles of Mn in the 102.5cc aliquot (Table 1). Although this is not a negligible quantity, it reflects the finite solubility of MnO_2 and soluble and ionizing manganese chloride species that may have formed. It is our belief that once these contributions are allowed for, any residual which might account for a non-ionizing species would be negligible.

We examined this reaction at a higher pH to determine if an improvement in the material balance could be obtained. This experiment is summarized in Table 2 (duplicate). The first analysis in Table 2 gave a recovery identical to that in Table 1. The second analysis is somewhat lower. The stoichiometry of the reaction defined as moles of VCM consumed per mole of $KMnO_4$ was found to be 1.3 (pH = 7) and 1.5 (pH = 10). The theoretical value is 1.5.

Mention should be made of the high concentration of VCM in the pH = 10 solution. The solution was attained by using a commercial buffering solution and bubbling VCM into this solution. The concentration (.298 wt. %) was appreciably above that found in experiment #1 (Table 1) and that predicted from Berens' work. It should be noted that the ionic strength of the pH = 10 solution is much higher than neutral water. The solubility of VCM in a higher ionic strength solution should increase since VCM is a polar molecule.

Discussion

The reaction between VCM and $KMnO_4$ appears to be very straightforward. The NMR experiment (1) indicates that at pH = 10 only carbon dioxide, water and hydrogen chloride are formed from the VCM. Yet in our experiments we have only been able to account for only 30 - 40% of the chloride released in this reaction. Attempts at identifying another species [chlorinated hydrocarbon, a manganese chloride (non-ionizing)] which could account for this lack of material balance have failed. At this point we must assume that there is a major problem in one of the methods of analysis (g.c. or ion electrode). I believe that g.c. method is adequate. This analysis can be improved with the use of an internal standard. However, our VCM data seems to check with Berens' published data although our values were lower. (If we used Berens' data the material balance would be worse.) At this point we must assume that the ion electrode analysis is in error. Although our electrode standards were made up in neutral water (for pH = 7 experiments) and buffered water (for pH = 10 experiments) this analysis should be rechecked by another method.

2464.1009

Table 2

Reaction of VCM with $KMnO_4$ in Solution at pH = 10

Run A

VCM solution: 0.298%

$KMnO_4$ solution: 0.0316 M

initial VCM aliquot (50cc): .00239 moles
$KMnO_4$ solution added (70cc): .00221 moles
final VCM in aliquot (120cc): 0.0 moles

moles VCM consumed: .00239
Cl^- found (7.4×10^{-3} M): .00089 moles (in aliquot)

chloride recovery: 37.2%

Run B

initial VCM aliquot (50cc): .00233 moles
$KMnO_4$ solution added (50cc): .00158 moles
final VCM in aliquot (100cc): .000025 moles
moles VCM consumed: .00231
moles VCM : Mole $KMnO_4$: 1.46
Cl^- found (6.85×10^{-3} M): .000685

chloride recovery: 29.4%

There is another potential problem that also needs to be studied. During this work it occurred to us that some of the VCM in solution might be "disappearing" through a physical entrapment mechanism during the formation and precipitation of manganese dioxide. In this mechanism, VCM would be trapped in the manganese dioxide precipitate and would not be accounted for in either the chromatographic analysis or the chloride ion analysis. We have briefly explored this possibility and have determined that it does take place. The following VCM vs. time data applies to a reaction at pH = 10:

t (min.)	VCM, Moles X 10^4	Percent of Original
0	23.3	original
58	0.14	0.60
124	0.05	0.21
150	0.16	0.69
358	0.24	1.03
1500	0.25	1.07

It is seen that in the first two hours the original VCM concentration decreased by 99.8%. However as time proceeded the VCM concentration <u>increased</u> but not significantly. This increase must be due to VCM migration from MnO_2 into the solution. This reaction was repeated at pH = 4 with the following results:

t (min.)	VCM, Moles X 10^4	Percent of Original
0	16.1	original
70	0.04	0.25
95	0.07	0.43
1287	0.10	0.62

Again we see the same phenomenon. It should be stressed that this minor perturbation involves less than 1% of the charged VCM. We need to know if this is truly a minor effect or indicative of a much more serious problem.

Future Work

We are currently working with engineering to install a prototype unit in which process seal water will be treated with $KMnO_4$. We will use improved methods of chromatography (internal standard) and two methods of chloride analysis to establish a material balance.

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L. B. Crider	Avon Lake Technical Center	1/23/75

SUBJECT

MEETING REPORT: INFRARED FOURIER TRANSFORM SYSTEM FOR MONITORING TOXIC GASES

Introduction

In our search for new methods for monitoring toxic gases in a variety of work environments we have previously identified the Infrared Fourier Transform method as one that approaches an ideal concept in terms of being specific, rapid and having ppb detection capabilities. Applying this concept to RVCM monitoring involves the utilization of a variety of specialized technical skills, i.e., a good perception of the problem and the assemblying of the components for a system to meet a very specific need.

Our several prior discussions with the technical staff of the EOCOM Corp. revealed that they had the in-house technical capabilities and were, in fact, already in the process of putting together a system for the PVC industry. It was agreed that when this system was sufficiently advanced to make a presentation based on factual data (not a purely theoretical concept) that BFG would be interested in a detailed description of their system. This presentation was made by Dr. Tom Dunn (V. P. Marketing) and Mr. George Barr (Marketing Manager) at the ALTC on January 21.

The EOCOM Infrared Fourier Transform System

The description of the system by Dr. Dunn was essentially the same as presented to OSHA officials in Washington on January 17. Basically, the system includes the following components:

1. Sampling system - can include multiple sample points (up to 64) in locations up to 500 feet from the analyzer.

2. Analyzer section - Fourier Multiplex system with laser source, Michelson interferometer, 40 meter gas cell, detector and amplifier package.

3. Data System - A/D Converter, On-Line Computer (PDP-11), in-put/out-put teletype, magnetic tape storage and audio-visual alarms.

4. Software package - designed for the specific application.

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The application of this system (as described by EOCOM) to area monitoring is sufficiently developed to allow the calculation of an 8 hour TWA based on time-motion studies of employee work practices and high frequency analysis of the AVCM level in the work environment. A "typical PVC polymerization work area" was used to describe sampling locations and sampling frequencies to develop a "universe model" used in determining TWA's (hourly and shift) and also to provide leak searching capabilities.

The major advantages of the Fourier Transform infrared analyzer are the (1) high resolution (ability to discriminate among other interfering components), (2) high sensitivity . . . 50 ppb for VCM, and (3) high speed . . . 15 seconds/sample point. EOCOM claims less than 1% down time on the analyzer-data system.

Another distinct advantage of this system is that it can be readily used to moniter other organic contaminants in air, such as acrylonitrile benzene, vinylidene chloride and others.

Although OSHA was "impressed" with this concept there has been no commitment, in the form of a verbal or written assurance from OSHA, that the instructions to their compliance officer will include acceptance of this type of area monitoring in lieu of personal monitoring.

Assessment and Recommendations

The concept described in this presentation represents the most advanced technology for multi-component monitoring that we have identified to date. The cost of this system is $200 - 250,000. In making an analysis of how this system fits some of our current needs, the following are factors that need to be considered;

1. What specific work areas actually need (now or in the future) this type of monitoring capability, i.e., new plants, existing plants, specific buildings, or a plant envelop?

2. If the need exists, can the manufacturing location tolerate another new concept along with their present instrumental mix, i.e., does the plant have the technical where-with-all to run such a system?

3. Are the potential benefits worth the cost at the present time?

4. Is there a potential cost savings, i.e., will OSHA accept this type of area monitoring in lieu of personal monitoring?

2464L013

5. Does EOCOM's analysis of VCM monitoring really fit our long range needs, i.e., why dedicate a system like this to VCM when other monitoring requirements are already apparent.

6. Based on EOCOM's description we know it works in a confined area (building), but will it do equally well out-of-doors?

The only recommendation that can be made at the present time is that these questions (and others I'm sure) will need to be considered and reviewed by both R & D and Manufacturing. Also, in light of some of our new monitoring requirements (other than VCM) there is a need to re-evaluate and summarize our monitoring requirements at specific plant locations. We can then begin to assess our capabilities and needs to meet these requirements and also better assess how the Fourier Transform system may fit into this total picture.

Lin Crider
L. B. Crider

ch

Distribution

Attendees
L. B. Crider
H. E. Diem
M. E. Forsythe
J. A. Klupar
M. M. O'Mara
J. W. Ryan
L. W. Salzer
R. D. Scott
R. A. Yount
P. M. Zakriski
B. M. G. Zwicker

Others
B. A. DiLiddo-E. G. Schwaegerle
K. J. Kaminski
F. E. Krause
R. M. Kreager-A. L. Schultz
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A DIVISION OF THE B. F. GOODRICH COMPANY
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INTERNATIONAL DEPARTMENT

VIA AIR MAIL

February 6, 1975

VINYL CHLORIDE TRANSMITTAL

The court has ruled on the new OSHA Standard and upheld it in its entirety. The new effective date is April 1, 1975. Any further court action has not been decided as of this time. B.F. Goodrich has continued all preparations for implementing the new OSHA Standard during the time the court has had the case under study. Specific items in this transmittal are as follows:

1. Several newspaper and magazine articles relative to VCM exposure.

2. Results of RVCM values found in competitors' PVC resin.

3. A summary of VCl ambient vapor concentrations being monitored in the B.F. Goodrich plants.

4. A list of 50 raw materials used in manufacturing that could possibly come under review in the future. This data was compiled by J.A. Klupar to be used in the event any one of them might be questioned.

5. A summary of RVCM values determined in our various resin types. These will be reduced with the incorporation of new equipment being installed.

6. An article entitled "A Guide for Designing and Specifying Safe High Pressure Air Purification Systems". This is very important as the new OSHA Standard will require air line respirators which will require a good, clean source of air supply.

7. A sheet of VCM properties.

2464300I

8. A good article which gives a detailed approach to be taken by PVC industry in complying with new OSHA VCM Standard.

Yours very truly,

John E. Stroope

John E. Stroope

JES/kan

2464300Z

Federal court says new vinyl standards can be put into effect

By DENNIS POLITE
Louisville Times Staff Writer

The U.S. 2nd Circuit Court of Appeals in New York City says the federal government's proposed regulations for the vinyl-chloride industry can be put into effect April 1.

It rejected a challenge by the Society for the Plastics Industry, Inc., that the rules were too stringent, and were technologically infeasible.

"It is our conclusion that the challenged aspects of the vinyl-chloride standards are supported by substantial evidence in the record and the petitions for review must be denied," the court said.

The rules were originally to become effective Jan. 1. The plastics society went to court for the review, however, and the standards were temporarily stayed.

A spokesman for the society said today its next step in the matter has not been determined. He said the ruling was being given a legal review and the resulting course of action has not been set.

A spokesman for the federal Occupational Safety and Health Administration (OSHA), which issued the rules and which will monitor the industry, said it has not yet received a copy of the court ruling.

Court terms rules clear

The court said it found that the OSHA rules "are clear, definite and certain, and that they are entirely feasible since the goal . . . can be attained through the combination of technological means and respirators."

The rules call for workers in the vinyl-chloride industry to be exposed to no more than one part vinyl chloride per million parts of air by Jan. 1, 1976.

Exposure to levels higher than one part per million means the workers will have to wear respirators, which are optional this year, under the proposed rules.

Currently, the standard for vinyl chloride inside plants allow exposure up to 50 parts per million parts of air.

Vinyl chloride, a chemical used in the production of many plastics, has been linked to angiosarcoma, a rare cancer that often affects the liver.

About 22 vinyl-chloride worker deaths have been attributed to the cancer. Six of the workers were from the Louisville B. F. Goodrich Co. plant on Bells Lane.

A Goodrich spokesman said today it has not seen the court ruling. But he said its production of polyvinyl chloride (pvc), a product of vinyl chloride, does not depend on the ruling.

"We intend to maintain production under the new standard at all our PVC plants," he said. He said it would use respirators for workers.

The spokesman also said the firm has made numerous improvements in its processes and facilities since the danger of vinyl chloride became known last year. He said the firm also is testing new procedures for future use.

Although the court said the rules could become effective in 60 days, additional legal challenges by the industry could delay them further.

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JES

2464 3003

C.R.F.
J.B.S.
(8)

MESSAGE 7

VCM

16 JAN 75

TO: MR. J.W. ELDER

RE: VCM LIMITS IN UK

CC. J.L.Nelson · E.W.Harrington
A. Villaume Jr.
P.J. [illegible]
R.W. [illegible]
M.N. Johnson
R.P. Kenney - ~~[illegible]~~
R.D. Scott - [illegible]
E.G. [illegible] - [illegible]

RPK
LMP
ALH
JWE ✓

PLS ADVISE DR. ZWICKER I HAVE TALKED WITH ROBIN RAE IN B.P. INTERNATIONAL AT DEVONSHIRE HOUSE.

THE TRIPARTIT COMMITTEE DID MEET AND AGREED TO THE TEMPORARY STANDARD OF 25 PPM TWA WITH 15 MINUTE EXCURSIONS TO 50 PPM. THE COURT OF PRACTICE WILL ESTABLISH AS OFFICIAL IN MID-FEBRUARY. THE OFFICIAL RULING IS AT THE PRINTERS NOW AND RAE WILL SEE THAT I GET A COPY WHEN IT ISSUES. I WILL FORWARD COPY TO YOU UPON RECEIPT.

FURTHER, THE TRIPARTITE COMMITTEE WILL RECONSIDER THIS STANDARD IN APRIL TO SEE IF FURTHER MODIFICATION IS JUSTIFIED.

CONJECTURE IN UK INDUSTRY NOW IS THAT EVENTUALLY THE STANDARD WILL BE 10 PPM TWA BUT NO ONE IS PREDICTING WHEN EXACTLY. SOME SAY JANUARY 1, 1976 BUT IT IS ONLY CONJECTURE.

REGARDS
BENSON
JJH

2464300A

COURIER-JOURNAL Page B-5
January 28th, 1975

Traces of vinyl chloride are found outside Goodrich Bells Lane plant

By DENNIS POLITE
Louisville Times Staff Writer

The state Department of Labor has been sampling the air outside the B. F. Goodrich Co. plant on Bells Lane and has found traces of vinyl chloride in the air and at sewer outlets.

Dr. J. Bradford Block, medical consultant to the department, said readings of 3 and 4 parts of vinyl chloride per million parts of air occasionally have been found in the air near the plant. Most readings have been zero, he said.

Readings at sewer outlets outside the plant have ranged as high as 20 parts per million, Block said.

Block said the air sampling, done with Goodrich's cooperation, is to determine if any other workers in Rubbertown are being exposed to the chemical.

Vinyl chloride, a main ingredient for most plastics, is used by Goodrich in producing a plastic resin.

Vinyl chloride has also been linked to the rare cancer angiosarcoma; six former Goodrich workers have died of angiosarcoma of the liver, and three others have the disease.

Block said the readings, which have been taken for about a month, will continue in an effort to determine if a wind pattern carries the chemical to certain areas.

The U. S. Environmental Protection Agency (EPA) also is sampling the air to gather data for a clean-air law on vinyl chloride.

Block said the state's survey is not duplicating the EPA's effort.

There is no standard for vinyl chloride in the outside air. U.S. and state laws now allow workers inside plants to be exposed to up to 50 parts of vinyl chloride per million parts of air for an eight-hour period on the average.

A regulation lowering the exposure level to one part per million was to go into effect Jan. 1, but was halted by a federal court pending hearings on the rule.

Block said the state has never taken measurements outside the plant when readings have shown excessive levels inside. The outside readings, then, he said, reflect the normal level during normal operations.

Meanwhile, Goodrich has declined to comment about any facets of the vinyl-chloride matter.

It was just over a year ago that Goodrich first announced the potential danger of long-term exposure to vinyl chloride.

The company's no-comment posture was disclosed in response to a reporter's inquiry about the status of workers who have been furloughed from the plant because of liver problems and about other actions taken by the company.

A spokesman said a legal review is under way, and in view of the litigation involving the proposed standard there would be no comment "at this point."

The firm has given $500,000 to the University of Louisville School of Medicine to study the cancer problem.

UL said in a progress statement on the program that it has examined 700 of the 1,180 Goodrich workers. It did not release any findings.

Since the original Goodrich announcement in January 1974, [illegible] other cases of angiosarcoma have been uncovered among past or present vinyl-chloride workers.

According to a Goodrich spokesman, there are reports of four cases discovered recently in Canada.

Four cases were uncovered there last year, one of them a worker who was employed at a plant owned by Goodrich.

Little is known about the most recent cases, the Goodrich spokesman said, because of a Quebec law prohibiting disclosure by doctors of information concerning their patients.

A spokesman for the National Institute for Occupational Safety and Health said it had no information on any new cases. It has requested information if there are more cases, he said.

24643005

February 3, 1975

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RESPONSE TO QUESTIONS ON VCM DECISION

We have not seen the court's decision, and, therefore, have not had an opportunity to study the basis on which it was made. However, our plans for continued PVC production have not been contingent on a favorable ruling by the court on the petitions for review of the OHSA standard. We intend to maintain production under the new standard at all our PVC plants with the proper use of respiratory equipment.

The Company already has made numerous improvements in equipment, processes and work practices, including the use of respirators as required.

In addition, we are continuing our intensive research and development programs on new and improved technology. These programs have already provided promising results which are now undergoing further evaluation and in-plant testing for possible future use.

QUESTION

Does this mean that your plants can now meet the 1 and 5 ppm levels set in the standard?

ANSWER

Not without the use of respirators. The technology does not now exist to reach these low levels. This was confirmed in a study of technological feasibility conducted for OSHA by an independent engineering consultant firm, and our extensive work corroborates the findings of that study.

QUESTION

What are your exposure levels now?

ANSWER

Our plants are operating with average levels of 6 ppm. The frequency of excursions has been reduced to less than 2 percent of all readings at our PVC plants. (If asked) an excursion is defined as 50 ppm under the temporary standard, and will be 25 ppm under the 1975 provisions of the new standard.

In compliance with the standard, we have in place alarm systems which signal any levels above 25 ppm, and are installing alarms at lower levels. For the first year, wearing of respirators is optional with employees up to 25 ppm. We have most of the respiratory equipment required, and we have ordered additional equipment for delivery within the next 60 days.

2464 3006

ECN technology

PVC processing equipment meets new VCM regulations

ICI Plastics Division and T. K. Fielder Ltd. of the UK have jointly developed an aspirator system for the removal of vinyl chloride monomer from working areas in PVC dry blending operations, which is commercially available.

Known as the *Exorsta* system, the new equipment is expected to help the plastics processing industry in meeting the OSHA 1 ppm standard on vinyl chloride exposure. It also substantially reduces the VCM content of processed PVC resin, from around 1 000 ppm in the uncompounded condition to between 5-10 ppm after mixing and compounding.

In the process, VCM is removed during the dry blending operation through a sophisticated system of venting and air stripping during the PVC blending and cooling cycles.

Nearly all the VCM which is generated in the headspace of mixer and cooler vessels is exhausted away from the working area throughout the cycle. The operation of the system is integrated into the automatic filling, mixing and discharge cycles in such a way to minimize dust carry-over and loss of production output.

The system is described as readily adaptable to all existing commercial dry-blending equipment and the price of the new units range from \$3 000 to \$6 000, depending on the size and complexity of the compounding operation.

In order to exploit the US and Canadian markets, the equipment is being marketed in North America by the Werner and Pfleiderer Corporation from its Waldwick, New Jersey, USA Laboratories.

VCM Level Questioned

Speaking during the presentation of the 1974 third quarter financial results, Mr. C. A. Cash, president and chief executive officer of the Diamond-Shamrock Corporation commented on the new OSHA standards for VCM.

He said that Diamond-Shamrock will comply with the new US Labour Department standard for VCM exposure of Ippm in the company's PVC operations. However, he seriously questioned the wisdom of such a rigid standard, which "creates a real and immediate threat to employee's safety because of the awkward and limiting equipment required to be worn on the job."

Additionally, Cash stated that Diamond-Shamrock supports the US Society of Plastics Industry in its efforts to have an impartial court review all of the evidence presented to the US Labour Department on what Diamond-Shamrock considers to be an "overly restrictive standard."

ICI, Mitsubishi link on desalination

MITSUBISHI Chemical Industries and ICI Australia have agreed to jointly develop a new desalination process to the commercial stage using technology independently developed by both companies. The new process is intended to be used for the development of water resources and for the recycling of water.

A joint production and sales company is expected to be set up in Japan sometime after the middle of next year, according to Japanese reports, and it is hoped to start production of equipment at the end of the year.

ICI Australia and the Australian governmental research organization, the Commonwealth Scientific and Industrial Research Organization (CSIRO), have already jointly developed a water desalination process, *ECN*, November 15, 1974.

In the joint ICI-Mitsubishi project, the ICI-CSIRO process will be combined with Mitsubishi's ion-exchange resin desalination technology to evolve a low-cost water purification system.

Phillips develops aromatics extraction

DEVELOPMENT work on aromatics extraction by the Phillips Petroleum Company has shown that extra active distillation in conventional distillation columns can be operated without problems when two liquid phases are on the distillation trays, according to a Phillips Petroleum statement.

The discovery permits highly selective solvents to be used for aromatics extraction which were previously rejected because of their limited solubility. Using this new approach, Phillips has demonstrated the recovery of chemical grade benzene, toluene and xylene from reformate and pyrolysis gasoline aromatic concentrates. An economic comparison with existing commercial processes has shown a 15 per cent capital cost saving and a reduction of 8 per cent in energy requirements, the company stated to *ECN*.

EEC sets sulphur levels for gas-oil

THE EEC Economic and Social Committee has recently adopted in a plenary session a proposed directive concerning the harmonization of legislation in EEC member states on the sulphur content of certain liquid fuels.

Aim of the proposed directive is to eliminate the divergencies which exist between the legislative, regulatory, and administrative provisions of the EEC member states concerning the maximum sulphur content of liquid fuels.

Two types of gas-oil (A and B) are defined in the proposed directive, for which different sulphur content targets have been set. These are 0·5 per cent as from October 1, 1975, and 0·3 per cent as from October 1, 1980, for the A category, and 0·8 per cent and 0·5 per cent respectively for category B.

Gas-oil for which a greater degree of tolerance is provided is intended for use in areas where the level of atmospheric pollution by SO_2 is sufficiently low.

Monsanto UK plant receives safety award

THE Ruabon plant of Monsanto Limited has been presented with the Gold Safety Performance Citation of the British Safety Council after an evaluation of the site's safety organisation that probed 14 main areas of effort and performance.

Monsanto Ruabon, situated in Clwyd, produces industrial and speciality chemicals and has achieved a very low accident rate in relation to the industrial average as a result of its concerted efforts to improve safety.

EEC publishes mercury and cadmium data

THE EEC Commission has just published a 700-page book containing all the papers presented at the symposium on "Problems raised by the contamination of man and his environment by mercury and cadmium," held in Luxembourg from July 3 to 5, earlier this year.

This publication contains detailed information concerning the presence of mercury and cadmium in the environment, the analysis techniques used in making measurements, the ecological consequences of mercury and cadmium pollution, the significance of these two pollutants for man, and their effects on public health.

The volume, in English, is on sale at the Publications Office of the European Communities (PO Box 1003, Luxembourg).

2464007

newsdesk

Norsk Hydro may soon restart PVC production

NORSK HYDRO may be able to restart PVC production in the very near future following a relatively favourable report by the special commission investigating health risks at its PVC plants.

The commission, consisting of three doctors nominated by the Government health authorities, trade unions, and the Norwegian employers' federation, stated that Hydro will be medically justified in restarting production provided it invested in more secure production methods.

Specific recommendations include the installation of closed production systems, new polymerization vessels to replace some of the older plant on site, and the introduction of more efficient ventilation equipment. Norsk Hydro replies that alterations made before and during the shutdown ought to meet the safety requirements listed in the report. It expects to restart production with the newer one-third of its autoclaves. Long-term, the commission recommended entirely new polymerization plants, a feature of Hydro's plans to double capacity in any case but one which will take at least 2-3 years to achieve.

Although production could be under way again within a few days, the company now has to convince its workers that the medical risks are negligible.

Meetings between the company and its employees are expected to take up the next five days or possibly up to a week. But first reactions from the workers are reported to be unfavourable and the restarting of production could prove expensive in terms of wage rises.

Apart from the genuine concern on health, one of the chief reasons for the shutdown in the first place was the demand for substantially increased wages and generous time off for people employed on what was then seen as a hazardous process.

The restarting of PVC production in the near future will come at an opportune moment for Norsk Hydro. Its PVC stocks are understood to be very nearly depleted after a lengthy period of supplying customers without its own production. It admits the situation would be much worse were it not for the large volumes of material now available on the open market.

● Meanwhile in the UK, a former BP Chemicals employee has died of angiosarcoma of the liver, the rare form of cancer linked with exposure to vinyl chloride. His death, the first in the UK recorded as due to angiosarcoma, brings the number of confirmed VCM-related fatalities to 25 worldwide, although a former ICI worker's death is also suspected of being caused by the disease.

The BP case, however, involves the shortest ever exposure to VCM—the man was employed for only three years eight months in cleaning polymerization vessels. Previous cases related to exposures of eleven years or more.

Government-appointed pathologists are to examine samples of the man's liver to see if there could be any other contributory factors in view of the comparatively brief exposure period.

BP Chemicals meanwhile is increasing spending on new equipment from £1m. to £2m. at the Barry polymerization plants where the man was employed. The other major UK producer, ICI, is also considering the construction of new PVC facilities, partly in order to replace its ageing Hillhouse plant which is rumoured to be incapable of meeting even the 50ppm interim standard.

Italian group in Occidental share deal

UNCONFIRMED REPORTS from New York maintain that Ghaith Pharaon, the Saudi business man who acquired 1 million shares in Occidental Petroleum, was acting for an Italo-Saudi group who now own 4m. Occidental shares—7·5-8 per cent of the equity and the largest single shareholding.

The Italian partner owning 3m. shares was strongly rumoured to be Capitalfin investment group, owned equally by ENI, Banca Nazionale del Lavoro, Montedison, and the two Fiat-Agnelli holding companies, IFI and SAI. But the company has now denied its involvement.

However, a Montedison spokesman said that Fingest Internazionale, Montedison's leading offshore investment group, "could not exclude the possibility that it had bought Occidental shares on the market." Such purchases would merely be of a trading nature and not strategic, he indicated. Fingest is a prominent operator on the world's money, commodity, and stock markets.

Under Securities and Exchange Commission (SEC) regulations, the holding involved in the alleged Italo-Saudi deal would have to be notified. Quoted by the *Wall Street Journal*, Pharaon said he had bought 700-800 000 Oxy shares on behalf of himself and a European group last April.

Dr Armand Hammer's statement to the SEC that "a prominent Arab" had bought 1m. Oxy shares and its apparent conflict with Pharaon's statement will be one of the aspects of the SEC inquiry into Oxy share dealings now under way.

Monsanto confident of strong 1975 first half

MONSANTO's president, John Hanley, is predicting a 'reasonably strong performance' for his company in the first half of 1975. A number of key Monsanto product areas, such as herbicides, phosphate products and Fisher Controls, he pointed out, are not directly related to the industrial economy.

The group's range of products has already meant that the slow-down in demand—shortly after mid-year in Europe and at the end of the third quarter in the USA—did not translate into as significant decline in third quarter earnings as would have been the case in earlier years. The continuing softness in automotive production, housing starts and consumer durable expenditure in the final quarter had, however, begun to affect an increasing number of products such as plastics, rubber chemicals and polybutyral sheet.

Mr. Hanley agreed that a recovery will begin at the mid-year, followed by a period of moderate growth.

Monsanto's capital expenditure in 1975 will be $500-600 million (m.) against $300m. in 1974.

Overall, 1974 profits are expected to be in the region of $323m.-$328m.

Montedison hints at renewed dividend

SIGNOR CORSI, managing director of Montedison, has hinted in the Italian weekly *Panorama* that the company should be able to pay a dividend this year—its first since 1969.

Chemicals and fibres, however, were not the main causes for Montedison's improvement: Sig. Corsi pointed to large-scale borrowing of low interest rate money in 1971/2 and speculation in foreign exchange and commodity markets as the principal factors.

The Montedison subsidiary, Gemina, had bought silver at $3·50/ounce, he said, and sold it at $4.80/ounce, but this speculation was not as successful as the foreign exchange operations. The cost of money to Montedison at present is about 10·41 per cent and this compares with about 7·07 per cent last year.

German pharmaceuticals continue steady progress

GERMANY's pharmaceutical industry consolidated its leading position last year in spite of increasing difficulties.

According to the *Bundesverband der Pharmazeutischen Industrie* exports in the first half of 1974 totalled DM1 800 million (m), a 23 per cent increase on 1973. Germany is the world's largest exporter of pharmaceuticals, selling 36 per cent of production overseas.

2464308

A 14 THE COURIER-JOURNAL, TUESDAY, JANUARY 21, 1975

UL gets $300,000 to study liver cancer

University of Louisville trustees announced yesterday the receipt of a $300,000 grant from the B. F. Goodrich Co. to be used in research into angiosarcoma, a rare liver cancer that has been linked to vinyl chloride.

The liver cancer has killed six workers at the Goodrich plant on Bells Lane. Three other local Goodrich workers also have angiosarcoma.

Vinyl chloride, a gas liquefied under pressure, is processed to produce polyvinyl chloride, a plastic used in such products as phonograph records and vinyl tops.

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State to probe deaths of chemical workers

By DENNIS POLITE
Louisville Times Staff Writer

The state Department of Labor's medical consultation team will soon launch a study into the causes of death among former workers at six Louisville-area chemical firms.

The survey will attempt to determine if workers now at the companies are being exposed to chemicals that may be harmful, such as vinyl chloride, linked to cancer deaths.

Dr. J. Bradford Block, medical consultant to the department, said the study was planned after the discovery that vinyl chloride was the likely cause of liver cancer among workers at the B. F. Goodrich Co. plant here.

Block said Goodrich was not among the plants to be surveyed. The plants will not be identified, Block said.

In addition to the Goodrich vinyl chloride discovery, Block said another finding by the labor department prompted the study.

He said an investigation into the causes of death among workers at a local chemical plant found that of approximately 200 deaths, all but 12 were due to cancer or heart attacks. He said that was more than would normally be expected.

The survey will cover plants which employ a total of about 3,500 workers.

Block said the focus on possible job-related cancer causers was sharpened by the vinyl chloride discovery at Goodrich.

Last January, Goodrich said it suspected that long-term exposure to vinyl chloride may have caused the liver cancer deaths of three of its workers.

Later investigations by company and federal job-safety officials have pushed the number of rare liver cancer deaths among former Goodrich workers to six. Another three workers have the cancer, called angiosarcoma.

Block said the survey will begin within a month.

The state is also going to look into the chlorprene situation at the E. I. du Pont de Nemours plant in Louisville, Block said.

Last month, Du Pont told its employes and customers that Russian research had turned up a possible link between lung cancer and worker exposure to the chemical, which is used to make synthetic rubber.

The federal National Institute for Occupational Safety and Health said this week that it will look into the situation.

Affects companies using chemicals

Registration rule draws 20 firms

A state Occupational Safety and Health Administration (OSHA) regulation requiring firms using 14 known cancer-linked chemicals has drawn only 20 registrants thus far.

State labor officials had said they expected about 50 firms to register under the regulation, which became effective last July 1.

The regulation was added to the state's OSHA code after the discovery that exposure to vinyl chloride was the likely cause of liver cancer among some workers at the B. F. Goodrich Co. plant here. However, the regulation had been proposed prior to the Goodrich situation.

Dr. J. Bradford Block, medical consultant to the state labor department, said of the 20 firms which have registered, 14 listed vinyl chloride as the cancer-linked chemical they use.

Block said a lot of firms are apparently unaware of the requirement to register. He said one firm registered only last week.

Block said the state will not penalize firms which register later, if it takes the initiative to register.

However, he said, OSHA regulations call for penalties if the firm is inspected by an OSHA team and found to be using a chemical which is among the 14 but not registered with the state.

"We've had real good cooperation with the firms," Block said. "It's just a matter of them being aware."

He said each time there is something said publicly about the regulation more firms register.

Block said a federal regulation calling for the registration of the same chemicals has been ruled unenforceable. He said the ruling was based on the fact the regulations don't have separate medical data for each chemical.

Block said the state's stand

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J E Shrope

RECEIVED
The B. F. Goodrich
Chemical Co.
JAN 27 1975
INTERNATIONAL
5394

What the law means to you Jerome H. Heckman*

Legal Exchange

Readers' inquiries are solicited for this department, which is a forum for the discussion of legal questions of broad interest to the plastics industry. Inquiries will be used as the basis for general comment. The comments are in no way meant to serve as a substitute for expert legal advice. Names will be withheld on request.

We have been swamped with questions regarding application of specific provisions in the OSHA Vinyl Chloride Standard adopted on October 4, 1974. The questions below are among those asked most frequently. At the time of this writing, intensive appellate procedures were under way to attempt to have the entire Standard declared unlawful and invalid. Likewise, proceedings looking towards the staying of the effective date of the Standard were in process. Thus, while the responses to the questions are based on the assumption that the Standard will become effective January 1, 1975, it is our hope that it will not go into effect as written, that a Stay may have been granted by the time this column appears, and that the entire matter will be remanded to the Department of Labor for complete reconsideration.

An interpretation is needed concerning the Standard for Exposure to Vinyl Chloride (29 C.F.R. 1910.93q) promulgated by the Occupational Safety and Health Administration (OSHA) on October 4. The question relates to the need for warning signs required by subparagraph (1) of the Standard. If a processor-fabricator facility is below the "permissible limit" as defined, is the facility still deemed to be a regulated area? Is it required to post the area with the sign "Cancer Suspect Agent Area—Authorized Personnel Only"?

No. "Regulated areas" are discussed in subparagraph (e) of the Standard. This subparagraph states that (1) a regulated area shall be established where: (i) vinyl chloride or polyvinyl chloride is manufactured, reacted, repackaged, stored, handled or used: and (ii) vinyl chloride concentrations are in excess of the *permissible exposure* limit (1 p.p.m., 8 hour TWA, and 5 p.p.m. maximum for any 15-min. period). If the facility is below the permissible exposure limit, then no regulated area need be set up and consequently the signs are not required. (If monitoring shows less than 0.05 p.p.m. employee exposure to VCM, virtually no further action is required under the Standard; this "action level" concept is not to be confused with the "permissible exposure limit" concept.)

Although the question is limited to "processor-fabricators," the answer is equally applicable to all operations falling within the scope of this Standard.

Paragraph (1) (3) requires that "containers of... other waste contaminated with vinyl chloride shall be legibly labeled: Contaminated with Vinyl Chloride—Cancer Suspect Agent." Are such labels required on PVC scrap within a facility in inventory for further processing?

The purpose of the labels required by this subparagraph would be to warn employees that waste material is or may be contaminated with vinyl chloride so that a hazard might be posed to those who handle it without taking proper precautions. The provision in the Standard is aimed primarily at dealing with waste from polymerization reactors where the possibility of entrapment of relatively large quantities of vinyl chloride exists, or other waste generated in VC or PVC producing facilities, where contamination with vinyl chloride can be expected to occur. On the other hand, scrap produced in processors' or fabricators' plants by trimming of processed material poses little or no problem in this regard since such scrap can properly be considered to be a fabricated material which is outside the scope of the Standard. In other words, the type of scrap generated in the plant of a processor-fabricator that has already been through the mass melting stage need not carry the label while it is in inventory awaiting further processing. To the contrary, compounded material which has not been through a fabrication process (for example, excess compound remaining after a run has been completed), when stored in "in-plant" containers does require labeling, but such labeling should be in accordance with subparagraph (1) (4) which applies to containers of polyvinyl chloride. Labeling should read:

"Polyvinyl Chloride Contains Vinyl Chloride
Vinyl Chloride is a Cancer-Suspect Agent"

It should also be noted that we have confirmed this interpretation of the requirements of the Standard informally with the appropriate OSHA officials.

Shipments of polyvinyl chloride resin received from a manufacturer will no doubt bear the required labeling. If bulk shipments are received, are labels required on any polyvinyl chloride container within a facility?

The intent of the Standard is to warn employees of the possible hazard that exists in handling polyvinyl chloride which has not previously been subjected to mass melting and which may be expected to release vinyl chloride when it is mass melted. Consequently, if bulk shipments of polyvinyl chloride resins are received, and if the PVC is placed in containers within a facility which employees are intended to handle, those containers should carry the labeling required by subparagraph (1) (4) of the Standard.

Bulk shipments contained in silos and transported within a plant by pneumatic tubes so that there is no employee contact with the material do not pose the same employee exposure as might be posed by drums or bags of the same polyvinyl chloride that would have to be opened and emptied by hand. It is in these latter cases that the containers require hazard labeling. Consequently, if the bulk shipments are stored within a facility in containers that require opening and emptying by employees who might thereby be exposed to residual VC vapor, it is only these containers that will require the cautionary labeling.—END

*Keller and Heckman, 1150 17th St. N.W., Washington, D.C. 20036. Mr. Heckman is general counsel of SPI, the International Non-Woven and Disposables Assn., and other trade groups and private companies.

VCl Ambient Vapor Concentrations

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WEEKLY SUMMARY

VCl Ambient Vapor Concentrations

DATE: 12/20/74 through 1/17/75

		AVERAGE					% READINGS > 10 PPM				
		Prev. Month	12/20 12/27	12/27 1/3	1/3 1/10	1/10 1/17	Prev. Month	12/20 12/27	12/27 1/3	1/3 1/10	1/10 1/17
AVON LAKE GEN. CHEM.	451-1	6.0	--- DATA NOT AVAILABLE ---	--- DATA NOT AVAILABLE ---	5.3	--- DATA NOT AVAILABLE ---	---	--- DATA NOT AVAILABLE ---	--- DATA NOT AVAILABLE ---	8.7	--- DATA NOT AVAILABLE ---
	-2	9.7			7.3		---			17.7	
	-3	7.3			7.0		---			24.0	
	Avg.	7.7			6.5		---			16.8	
	461-1	10.4			0.7		---			0.7	
	-2	8.0			2.0		---			4.7	
	-3	13.1			6.0		---			15.3	
	Avg.	10.5			2.9		---			6.9	
	464-1	5.0			4.0		---			3.3	
	-2	3.2			2.0		---			2.7	
	-3	7.1			12.0		---			45.7	
	Avg.	5.1			6.0		---			17.2	
	463-1	1.0			.017	.033	---			0.0	0.0
	-2	2.1			.129	.131	---			0.0	0.0
	Avg.	1.6			.073	.082	---			0.0	0.0
	PLANT AVG.	6.2			3.9		---			10.2	
HENRY	Pzn-1	4.8	3.0	3.0	5.0	6.0	---	4.3	4.7	5.9	12.1
	-2	5.5	3.0	3.0	5.0	4.0	---	3.7	6.2	6.3	6.9
	-3	5.5	4.0	4.0	4.0	5.0	---	5.8	4.7	5.7	8.7
	PLANT AVG.	5.3	3.3	3.3	4.7	5.0	---	4.6	5.2	6.0	9.2
LONG BEACH	Pzn-1	4.3	--- PLANT SHUTDOWN ---	--- PLANT SHUTDOWN ---	0.9	3.4	---	--- PLANT SHUTDOWN ---	--- PLANT SHUTDOWN ---	0.3	3.0
	-2	4.2			0.9	3.5	---			1.0	2.8
	Roof	4.1			0.8	3.3	---			0.0	4.2
	PLANT AVG.	4.2			0.9	3.4	---			0.4	3.3

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WEEKLY SUMMARY

VCl Ambient Vapor Concentrations

		AVERAGE					% READINGS > 10 PPM				
		Prev. Month	12/20 12/27	12/27 1/3	1/3 1/10	1/10 1/17	Prev. Month	12/20 12/27	12/27 1/3	1/3 1/10	1/10 1/17
LOUISVILLE	1-1	3.8	3.0	2.0	5.0	2.0	---	7.5	1.7	10.5	3.3
	-2	3.3	4.0	1.0	4.0	1.0	---	6.7	3.5	8.3	0.9
	-3	4.5	5.0	5.0	5.0	3.0	---	8.3	11.9	11.4	4.5
	Avg.	3.9	4.0	2.7	4.7	2.0	---	7.5	5.7	10.1	2.9
	15-1	4.0	7.0	7.0	4.0	2.0	---	11.7	15.4	3.6	1.8
	-2	4.3	6.0	4.0	2.0	2.0	---	11.3	4.5	1.5	1.5
	-3	4.5	5.0	6.0	3.0	2.0	---	12.8	9.1	3.6	1.2
	Avg.	4.3	6.0	5.7	3.0	2.0	---	11.9	9.7	2.9	1.5
	111-1	3.5	2.0	2.0	4.0	3.0	---	3.3	0.7	4.2	3.0
	-2	3.5	4.0	2.0	3.0	4.0	---	8.0	1.0	3.6	4.8
	-3	5.0	4.0	3.0	5.0	5.0	---	5.2	4.9	8.5	7.0
	Avg.	4.0	3.3	2.3	4.0	4.0	---	5.5	2.2	5.4	4.9
	115-2	12.5	17.0	24.0	15.0	9.0	---	57.5	50.5	59.3	21.4
	Avg.	12.5	17.0	24.0	15.0	9.0	---	57.5	50.5	59.3	21.4
	121-1	3.0	8.0	1.0	2.0	3.0	---	20.0	1.8	4.2	3.6
	-2	2.8	3.0	2.0	3.0	2.0	---	8.8	4.2	8.0	3.6
	-3	3.3	2.0	1.0	2.0	2.0	---	5.4	0.0	5.1	2.7
	Avg.	3.0	4.3	1.3	2.3	2.3	---	11.4	2.0	5.8	3.3
	PLANT AVG.	5.5	6.9	7.2	5.8	3.9	---	18.8	14.0	16.7	6.8
PEDRICKTOWN	512-1	5.0	4.4	4.7	3.4	2.7	---	5.2	--- COMPUTER DOWN ---	3.1	3.8
	-2	6.4	5.3	5.0	8.5	2.9	---	10.5		15.8	3.9
	Avg.	5.7	4.9	4.9	6.0	2.8	---	7.9		9.5	3.9
	513-2	2.5	4.0	3.9	4.2	2.5	---	7.7		7.3	2.1
	-3	9.9	3.9	3.5	5.1	6.0	---	7.0		5.8	13.6
	Avg.	6.2	4.0	3.7	4.7	4.3	---	7.4		6.6	7.9
	PLANT AVG.	6.0	4.5	4.3	5.4	3.6	---	7.7		8.1	5.9

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BFG RESTRICTED

WEEKLY SUMMARY

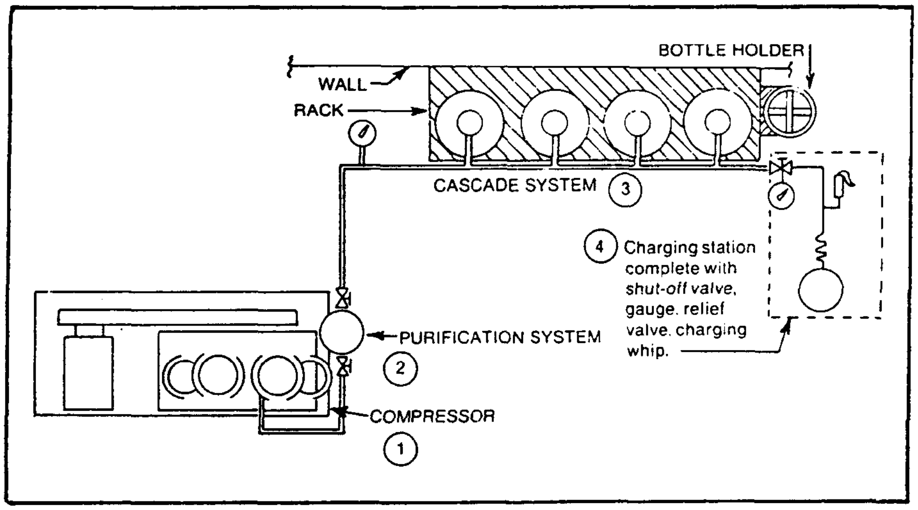
Ambient Organic Vapor Concentrations

CALVERT CITY	AVERAGE					% READING >10 PPM			
Week Ending	Prev. Month	12/30-1/5	1/6-1/12			Prev. Month	12/30-1/5	1/6-1/12	
Control Room	1	1	1			0	0	0	
Chromatograph Houses	6	4	4			20	10	16	
Caustic Scrubber Area	2	2	2			6	2	5	
Quench Areas	2	6	3			8	17	5	
VCM Column Areas	3	1	2			8	3	2	
Refrigeration Machine	2	2	1			3	2	0	
Tank Farm Areas	1	1	1			0	0	0	
Loading Rack Areas	1	1	1			0	0	0	

cc: CLWoods
GEEvens
JRRender
JJSchonaerts
RASpurlock
GDSchaaf
HWaltemate

A Guide For Designing and Specifying Safe High Pressure Air Purification Systems

FIRST QUESTIONS FOR THE PURCHASER



1. WHAT SHOULD I BUY?

The purchaser must determine first whether he wishes to buy an entire breathing air process system or to buy one or more of its components.

The illustration (above) provides a schematic.diagram of such a system, identifying each of its four basic components: compressor, purification system, cascade system, and charging station.

This specific system is an electrically-powered unit. It can be powered with either a gasoline or a diesel engine. It can be used either as a stationary or a mobile unit.

2. WHERE SHOULD I LOCATE THE EQUIPMENT?

After deciding what types of equipment to buy, the purchaser should decide where he is going to locate the equipment. This should be done before the specification for purchase is prepared, so that the constraints of space may be taken into consideration.

The place where the equipment is located within a fire station should be clean, dry, well ventilated, and cool. The compressor should be protected from ingesting undesirable odors and carbon monoxide from internal combustion engines, such as those which power the fire trucks.

3. WHO WILL INSTALL THE EQUIPMENT?

The purchaser should then decide whether he is going to install the equipment or have it installed by the person he buys it from.

If the installation is going to be performed by the dealer, determine his qualifications to perform the installation. The surest way to do this is to determine where he has made other installations, to visit the fire companies where these installations have been made, and to find out whether the people at those fire companies are satisfied with the work that has been done.

Once the purchaser has answered these three questions, he can then proceed to deciding what SPECIFIC equipment to buy.

SPECIFYING THE EQUIPMENT

Available Electric Power

I. THE COMPRESSOR

When buying a compressor, *the first thing to be considered is the electric power available* into the building and into the area where the compressor will be located, how many volts in what phases and cycles are available. If the compressor requires more power than is readily available, extra costs, delays in installation, and/or modifications of the compressor would occur. Such costs and delays have been known to run to as much as $5,000 and one and one-half years.

Horsepower

The second thing to consider is the horsepower, which determines the cubic feet per minute of air the compressor can deliver. A 1 horsepower compressor will deliver 1 cubic foot per minute of air at 3000 PSIG. A 15 horsepower compressor will deliver 15 cubic feet per minute of air at 3000 PSIG. High pressure, air-cooled compressors are available in 2.5, 3, 3.5, 4, 5, 6, 7, 7.5, 8, 10, 15, and 20 horsepower and will deliver pressures ranging from 3000 to 5000 PSIG.

Size

The third thing to consider is the size of the machine you need.

If yours is a paid department with a mask unit or mask service to fill bottles and repair the self-contained breathing apparatus, this decision can be based on the anticipated air usage of the department, based on past experience and projections of future use.

If yours is a volunteer department, the size of the machine should not be determined by the amount of air you are using but on the amount of time it takes to fill your cascade system. After a big fire, a lot of self-contained breathing apparatus must be filled from your cascade system. A typical 4 horsepower compressor will fill a large receiver that is empty in 1 hour. It will take 4 hours to fill 4 large, empty receivers. A 15 horsepower compressor, delivering 15 cubic feet of air a minute, will fill the same four receivers in 1 hour, 15 minutes. Using the smaller compressor, a volunteer department may have to spend most of the night replenishing its cascade system after a late night fire.

Whether yours is a paid or a volunteer department, it should be remembered that, if you have been buying your air or obtaining it from outside the department, you will find upon having your own air available that your use of air will double. This increase will come from the additional use of your self-contained breathing apparatus in training programs.

CAUTION: It is not recommended that cascade bottles, or receivers, be depleted to zero PSIG. Normally, they should be depleted to no less than 300 or 400 PSIG.

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desicant, and particularly on the Hopcalite, and to keep moist atmospheric air from saturating the Hopcalite, rendering it ineffective.

Special Considerations In Preparing the Specification for the Purification System.

There are several other things to keep in mind in preparing the specification for your purification system. They are:

Have the supplier spell out for you approximately how many cubic feet of air he expects the system to process between cartridge changes.

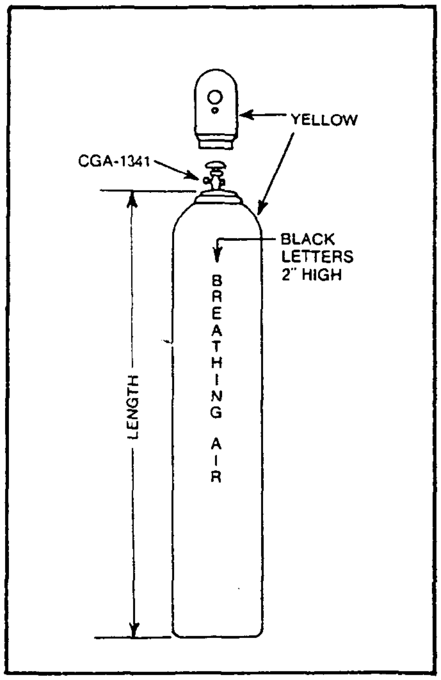
Have him spell out the quality of air he intends to supply. In your specification, you should spell out the air quality standard you wish the system to meet. This may be the NFPA standard, the CGA standard, or the OSHA standard. Even if you do not fall under OSHA laws at the present time, it may be wise to use OSHA standards, which are increasingly influencing air-quality policies. It doesn't cost a great deal more to have the purification system designed to meet these standards.

Refer to a specific vendor model number in your specification. If the supplier responds to your inquiry with that model number, you will be assured of getting the piece of equipment you want. However, if he offers an alternate model number, make sure that, as part of his response, he has included a statement as to how much air this alternate will process between cartridge changes. *Be sure he defines precisely what he is offering you if he suggests an alternate to your specification.*

Note on cartridge life: If you have a purification system rated at 3000 PSIG, the system should be operated at between 2800 and 3000 PSIG, and let the effluent or processed air flow into the cascade bottles. Do not let the pressure in the cascade bottles equalize to around 500 PSIG. Open the valves on the purification system to equalize that pressure, turn the compressor on, and start pumping from that pressure to 3000 PSIG. You aren't going to fill the bottles as fast, but you are going to substantially increase the life of the cartridges.

III. THE CASCADE SYSTEM

The Cascade Bottles



PART NO.	DOT 3AA	NOMINAL DIMENSIONS INS.			
		I.D.	O.D.	WALL	LGTH.
119	2400	8¾	9 11/64	.270	55
120	3600	8½	9.25	.375	51

PART NO.	DOT 3AA	APPROX. WT. #	MIN. CAP. CU. FT.	CPR. PRESS	PROOF PRESS
119	2400	137	300	2400	4000
120	3600	185	360	3600	6000

The cascade bottle is also a pressure receiver. *You can purchase high-pressure receivers or you can purchase high-pressure bottles for a cascade system,* as shown above.

These bottles come in any size you may want. Most inquiries are for DOT 3AA2400 or DOT 3AA3600 bottles. The 3600 PSIG bottle costs approximately 25 percent more than the 2400 PSIG bottle, and is the more economical and frequently purchased bottle. The 3600 bottle holds 360 cubic feet of air at 3600 PSIG. The 2400 bottle holds 300 cubic feet of air at 2400 PSIG. With higher pressure self-contained breathing apparatus coming into existence today, most systems are being designed at 3500 PSIG. They use the higher pressure bottle as the receiver.

The bottles should be painted yellow, the CGA color indentification for "breathing air."

You should specify the bottles by DOT number.

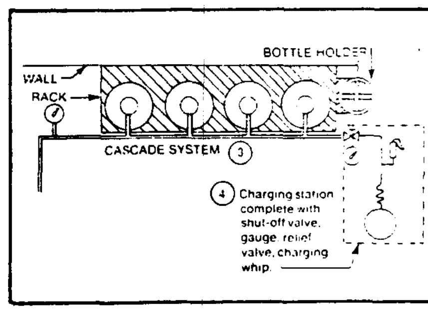
It is best to purchase the bottle to Department of Transportation specifications.

Make sure you get a test report showing the serial number of each bottle you buy. There have been occasions when a fire department was sold used bottles without being informed that the bottles were not new ones.

When receiving a bottle from a manufacturer, turn it upside down, clean the bottom surface, prime it, and paint it. Then repaint the whole bottle. Sometimes, the bottoms of the bottles haven't been painted; or the paint is gone by the time it is received by the fire department. Painting it upon receipt will help keep the bottle from rusting.

When receiving a bottle from a manufacturer, remove the valve, inspect the inside of the bottle for contaminants, and reinstall the valve. Then, draw a vacuum on the bottle and pressurize it with processed air.

Cascade Racks



Cascade bottles should be fastened securely to a wall, by means of a rack, as illustrated above. If these bottles are allowed to sit loose, and should a bottle fall, breaking the valve, the bottle will act like a balloon that has just had the air released from it.

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It is not good practice to allow everyone in the fire department to operate the breathing air process system. Three criteria may be used to select those who will operate the system:

- Demonstration of responsibility.
- Demonstration of an interest in the equipment.
- Availability for filling self-contained breathing apparatus bottles on a routine basis.

The people selected should participate in the training program.

The training program should consist of the following:

- General familarization with the equipment and how it works.
- Familiarization with the hazards involved in producing, handling, and storing high pressure air.
- Learning the step-by-step procedure.

With regard this procedure, the specification should contain a requirement that a written operating procedure be supplied with the equipment. Test reports on the cascade bottles should also be specified. After the equipment has been installed, a complete log should be kept on the compressor running time and on service to the equipment.

A NOTE ON OPERATING COSTS

The system described should cost the fire department less than one-fifth of a cent per cubic foot of air, including costs of electricity, insurance, and amortization of the equipment over a ten-year period. This cost may be compared with the cost of purchasing air from an outside source in making a purchasing decision.

It should also be remembered that when air is purchased from outside, the fire department is subject to the normal working day of the local air supplier. The presence in the department of a system removes this constraint.

SUMMARY

Three basic things should be remembered by fire department personnel in buying breathing air process systems.

1. When receiving and examining bids, *look at each bid as it pertains to every detail of the specification.* If two bidders appear to meet the specification and one is considerably lower than the other in price, find out the reason. Make sure that it is understood who will install the system and what specific services will be performed by the seller. Have these services included in the purchase contract.

2. *Be sure that all the equipment is clean and oil-free.* When a valve is opened, allowing air to flow quickly into the line, if that line is contaminated, a dieseling effect can take place due to the high heat build-up when the pressure is released into the tubing. This can result in a dangerous explosion.

3. *Put the responsibility on the supplier to give you what you want, but be sure your specification is clear enough for him to know exactly what you want.*

Chemical Names:
Vinyl chloride, vinyl chloride monomer, chloroethylene; chloroethene
Chemical Formula: CH_2CHCl
Molecular Weight: 62.5
Description:

At ordinary temperatures and pressures, vinyl chloride is a colorless gas with a mild, sweet odor. But as supplied in tank cars and trucks under pressure, it is a liquid. Vinyl chloride is highly volatile and its vapor is extremely flammable.

Boiling Point, °C	-13.8
°F	+7.0
Freezing Point, °C	-153.7
°F	-245
Flash Point, open cup, °C	-78
°F	-108.4
Explosive Limits, volume % in air at 25°C (77°F)	3.6 to 33
Autoignition Temperature, °C	472
°F	882
Critical Temperature, °C	158.4
°F	317
Critical Pressure, psia	775
Vapor Density, air = 1	2.15
Solubility, water in monomer at 25°C (77°F), weight %	0.11

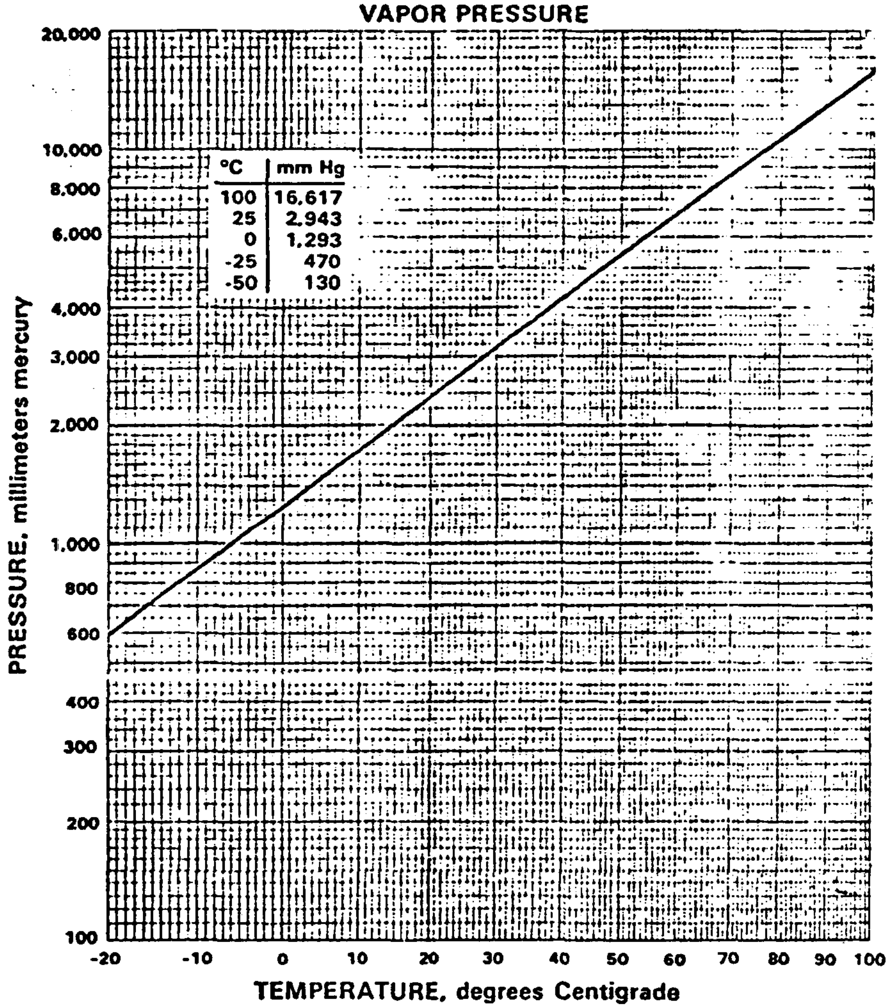
Solubility

Vinyl chloride is relatively insoluble in water but soluble in most organic solvents.

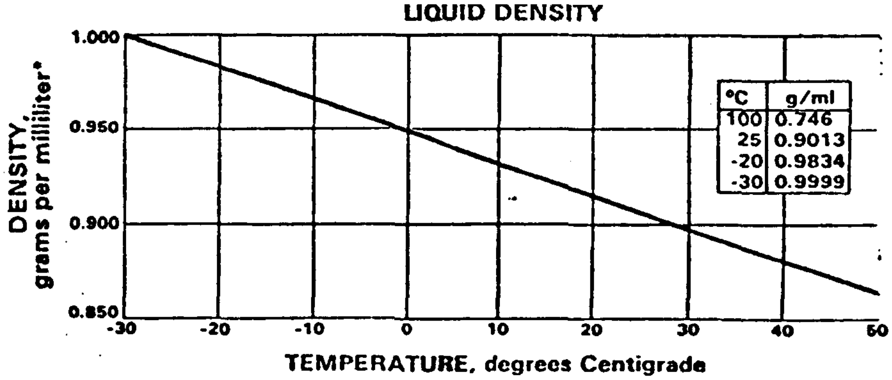
Reactivity

Vinyl chloride polymerizes exothermically in the presence of light, air, oxygen or catalysts. Heat alone will not initiate polymerization. Vinyl chloride is thermally stable to quite high temperatures. Although peroxide formation due to air exposure is a slow reaction, certain peroxide products are shock-sensitive.
Vinyl chloride is noncorrosive to metals when dry at normal ambient temperatures, but water at elevated temperatures accelerates corrosion.
The double bond behaves as in other unsaturated compounds. The chlorine atom is relatively inactive and is more stable than in saturated or allylic compounds.

VAPOR PRESSURE



LIQUID DENSITY



*To convert to pounds per gallon, multiply grams per milliliter by 8.345.

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lazards

Fire and explosion

Vinyl chloride vapor is extremely flammable. Its explosive limits are between 3.6 and 33% by volume in air. Sufficient ventilation and the elimination of ignition sources are mandatory in areas where vapor concentrations may reach a flammable level. When a tank car is unloaded, both the car tank and the unloading pump should be electrically grounded. An explosion hazard exists when persons unloading a shipment draw samples or vent vapor to atmosphere.

The major products of combustion include toxic and corrosive hydrogen chloride as well as carbon monoxide, and less than 10 ppm of phosgene. Only in the very near vicinity of a vinyl chloride monomer fire could detectable amounts of phosgene be present. The main sources of danger to personnel result from carbon monoxide and from the extensive formation of hydrogen chloride gas. However, the pungent odor of hydrogen chloride acts as a warning to clear the area or to obtain the ...essary breathing apparatus before ...empting any fire control measures.

Carbon dioxide or dry chemical agents extinguish small fires effectively, but no extinguisher is known for large fires. Streams of water cannot extinguish a liquid vinyl chloride fire because the monomer does not mix with water and will float on top. Water may be sprayed to cool equipment, however. If the source of the vinyl chloride monomer leak has not been closed off, do not attempt to extinguish a large fire because hot metal can reignite an unburned vapor cloud. No one without proper protective respiratory equipment should enter an area where there has been a fire until the area has been adequately ventilated.

Chemical reactions

Contamination of uninhibited vinyl chloride monomer may catalyze polymerization, which is highly exothermic, or cause decomposition, which liberates toxic hydrogen chloride gas. The high purity of vinyl chloride must be maintained in shipment, transfer and storage.

Exposure to oxygen, air or sunlight can also catalyze polymerization.

Peroxides may also form but not so readily as with many other monomers.

Toxicity

Uninhibited vinyl chloride monomer is not absorbed through the skin, but the liquid may cause frostbite because it evaporates so fast. If an inhibitor is included, it may cause local skin burns. Most vinyl chloride monomer shipped today is uninhibited.

Workmen should wear eye protection and protective clothing to prevent skin contact. If vinyl chloride gets on clothing or shoes, they should be removed immediately. If vinyl chloride contacts the skin, wash immediately with soap and water. If vinyl chloride contacts the eyes, the eyes should be washed immediately and thoroughly with water for at least 15 minutes. Get medical attention.

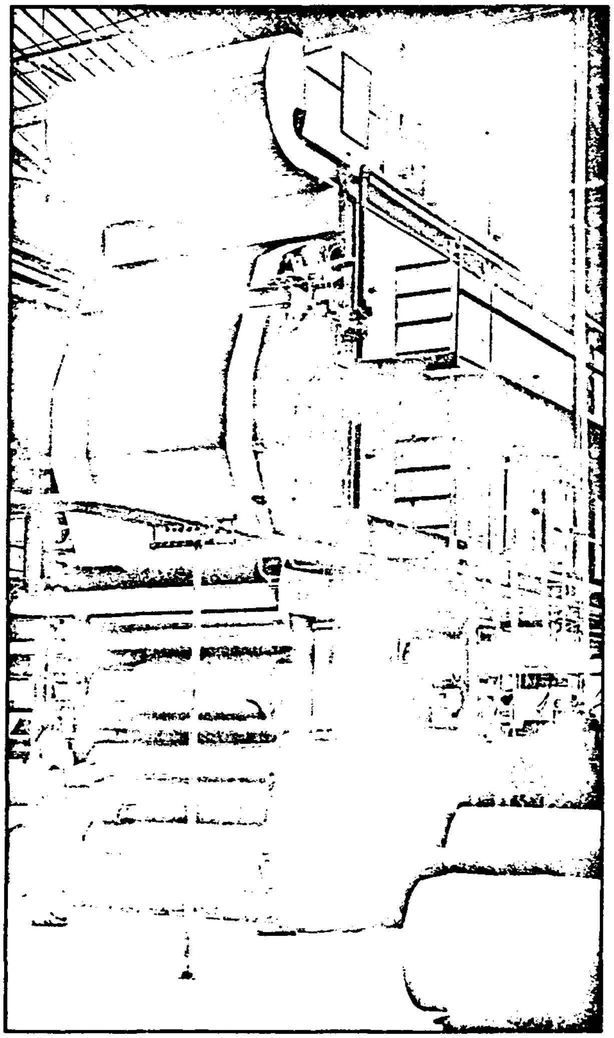
Vinyl chloride vapor concentrations in work areas should not exceed 200 ppm as a time-weighted average atmospheric concentration for an 8-hour day to avoid adverse effects on workmen. Its odor is pleasant and the sense of smell cannot be relied upon as a warning. High vapor concentrations can cause lung irritation, dizziness and anesthesia. Chronic overexposure may injure the liver. In all cases of overexposure, immediately remove the affected individual to fresh air and obtain medical attention.

More information

More information on fire, explosion, reactivity and toxicity hazards, as well as emergency procedures, appears in Chemical Safety Data Sheet SD-56, "Vinyl Chloride," published in 1972 by the Manufacturing Chemists Association, 1825 Connecticut Avenue, N.W., Washington, D.C. 20009.

Living with VCM
How PVC Processors Can Cope

It may take some effort. And expense. But you should be able to protect your workers, comply with the new OSHA regulation and *stay in business. This comprehensive report is intended to help guide you through the provisions of the new rule and suggest approaches to meeting its requirements in your individual plant situation. By Matthew H. Naitove, Associate Editor*



General Tire & Rubber Co.

As this issue reaches you, the countdown will have already begun toward the Jan. 1 deadline of the most critical challenge yet to face the plastics industry. Hardly anyone involved in manufacturing or handling vinyl chloride monomer (abbreviated VC or VCM) or the PVC resin made from it is now unfamiliar with the dramatic chain of events which has led to the present crisis atmosphere. Some of the major links in that chain were:

- The announcement late last January by B.F. Goodrich Chemical Co. of the discovery of three deaths between 1968 and 1973 of long-time workers in a Louisville, Ky., PVC polymerization plant owing to a very rare cancer, angiosarcoma of the liver. (Subsequent intensive search in the U.S. and Europe revealed a total of over two dozen cases of this disease among monomer and polymer production and PVC fabrication workers.)
- Publication in the Federal Register on April 5 of an OSHA Emergency Temporary Standard limiting employee exposure in VCM and PVC production and processing plants to a 50 parts-per-million ceiling, one-tenth the prior limit. The standard also required regular workplace monitoring of airborne VCM by no later than April 22.
- First public reports in June of two angiosarcoma deaths associated with PVC processing and another two such deaths of persons living a few miles from PVC processing operations in Connecticut.
- OSHA hearings in June and July which produced voluminous testimony from representatives of industry, labor, medical science and others on possible health hazards from VCM and industry's ability to minimize these hazards.
- Announcement last Oct. 1 of the permanent OSHA standard on VCM, effective Jan. 1, the major thrust of which is to limit exposure to 1ppm averaged over 8 hrs and to maximum excursions of 5 ppm averaged over 15 min.

Where are we now? OSHA's Jan. 1 deadline leaves a scant matter of weeks before the effective date of a standard that some monomer producers and most PVC makers say is impossible to meet with any known technology short of putting men into respirators—an alternative fraught with its own large difficulties.

As for the PVC processor, whose only possible exposure is from the relatively small amounts of residual monomer trapped in the resin, the burden of the standard on him is assumed by its authors to be relatively light. In fact, the industry consensus seems to be that most, if not all, processors should be able to keep the majority of worker exposures within allowable limits by instituting certain engineering changes—mainly, increased ventilation—or work-practice modifications at reasonable cost. Most experts agree that the major problem for the processor under the new standard may be its ultimate effects on resin availability and cost. (See also p. 25.)

SPI and about 10 chemical firms have gone to court in hopes of having the standard sent back to OSHA for revision, and have appealed to OSHA for a stay in making the rule effective. Whatever the chances of some relief being granted, either by the end of this month or later, tighter restrictions on VCM are here to stay, and the PVC processor would be well advised to understand the new rule and know in advance what is required of him for compliance.

This is advisable both to minimize a health risk whose full extent is still only guessed at and because of the new and closer look OSHA is taking at processing operations. While the plastics industry has not until recently been considered a prime target for compliance inspections, an OSHA standards official in Washington says that firms

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manufacturing VCM and PVC "can plan to get to know an OSHA inspector in the near future." And the word from the compliance section is ditto for PVC fabricators. While in one sense the standard may be said to be aimed mainly at monomer and polymer production, where workers are subject to greater potential exposures, OSHA also has its eye on processors, who employ the great bulk of those potentially exposed—an estimated 350,000 vs. some 6500 workers in VCM and PVC chemical operations. So be prepared.

Recognizing the urgent need of many of those affected for guidance and advice, this article will try to provide answers to frequent questions on how the standard applies to the PVC processor, how he determines whether he has a VCM problem in his plant and what to do about it if he has. The information presented here has been gleaned from interviews with Government officials, health researchers, major PVC suppliers and their customers, makers of analytical equipment and independent testing laboratories. In viewing what's still a fast-changing situation, this article tries to pinpoint, where possible, what's presently known and, in other cases, tries at least to warn where the question marks remain.

The people in the know Before turning to specifics, here are some general remarks about two important sources of information regarding VCM—OSHA itself and your resin supplier.

First and most important, no PVC processor should be without a copy of the actual standard. Reprints from the Federal Register should be available free from your regional or area OSHA office; or else you can write to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. (request Part II of the Federal Register of Oct. 4, 1974). Reprints of the OSHA standard cost $.75 per copy.

Two additional documents should be issued by OSHA before Jan. 1. One is the Program Directive, which instructs regional and area personnel in how to conduct compliance inspections; it is intended to bring as much uniformity as possible to nationwide enforcement of the standard. The other is a Sampling Data Sheet intended to instruct field personnel in a uniform method of sampling for VCM in air. This will likewise be of interest to the PVC processor because it indicates how an inspector will judge compliance. Both documents will be publicly available from regional and area offices.

If you want direct answers to individual questions about the standard or its application to a given work situation, a recommended starting point is the Div. of Occupational Health Programming, Washington, D.C.

And for down-to-earth advice on what to do in your own plant, your PVC resin supplier is probably your best bet. Not only has he been living with the problem longer and thus has experience in monomer detection and air analysis, but he's likely to have his own processing facility as well and so be intimately acquainted with your problem. Resin suppliers have been keeping their customers informed through letters, bulletins and other means and; in many cases, have done actual monitoring in customer facilities.

First, know the law The initial statement regarding scope of the new VCM standard (29 CFR Part 1910, Section 1910.93q) reads in part: "This section applies to the manufacture, reaction, packaging, repackaging, storage, handling or use of vinyl chloride or polyvinyl chloride [homopolymer and copolymers], but does not apply to the handling or use of fabricated products made of polyvinyl chloride."

"Fabricated product" is said to mean product "which does not require further processing at temperatures, and for times, sufficient to cause mass melting of the polyvinyl chloride resulting in the release of vinyl chloride."

While OSHA apparently neither has closely defined "mass melting" nor intends to do so, it feels that the limits of what is covered are pretty clear. According to Grover Wrenn, chief of the Div. of Health Standards Development, the standard is specifically not intended to regulate certain processes that involve only partial heating of a fabricated material, such as thermoforming, heat-sealing, embossing, shrink-film or blister packaging.

Opinion in Washington seems to be that scrap is exempt "fabricated product"—at least until it's subjected to further melt processing. Coverage of the standard in this area still looks questionable, though not if virgin is re-extruded or molded together with the scrap. But even if scrap is reprocessed alone, it would be prudent to monitor for VCM, though technical experience to date indicates that little or no vinyl chloride monomer release is likely from this source.

Another basic principle of the standard is that it aims at regulating individual worker exposures, not absolute concentrations in air. That is, it is primarily concerned with amounts of VCM actually in the worker's breathing zone (defined, "without regard to the use of respirators") and not those in nonwork areas, such as inside a storage silo or just adjacent to an injection machine nozzle. Furthermore, the regulation applies on an individual-by-individual basis. One worker may be exempted from its provisions while another at a different job or location in the same plant may not.

What's more, the standard provides an extra incentive to achieve low VCM levels by promulgating the key concept of an "action level," set at a 0.5-ppm time-weighted average. (TWA is a measure of what levels an employee was exposed to for how long in various work stations.) "The purpose of the action level," according to the preamble, "is to minimize the impact of the standard on the employers who have attained exposure levels well below the permissible limit. Thus . . . employers may, in effect, be exempted from some provisions of the standard." Or, as one industry observer puts it, "The complexity of life increases geometrically above 0.5 ppm."

Table 1—EMPLOYER REQUIREMENTS[a]

	Exposure Level, ppm		
	≤ 0.5	$>0.5 \leq 1.0$	>1.0
Monitoring Program	None	Quarterly	Monthly
Medical Surveillance	No	Yes	Yes
Medical Records	No	Yes	Yes
Regulated Areas	No	No	Yes
Roster of Authorized Persons Entering Regulated Areas	No	No	Yes
Respirators	No	No	Yes
Warning Labels on Storage Containers	Yes	Yes	Yes
Training	Yes	Yes	Yes

[a]Data supplied by Diamond Shamrock Chemical Corp.

Turning now from general principles to specific duties of employers in processing plants, the new OSHA regulation calls for the following actions in specified situations:

- Monitoring is required at least to determine initial exposure levels. (*Monitoring* done before Jan. 1 reportedly will be accepted.) Since moni-

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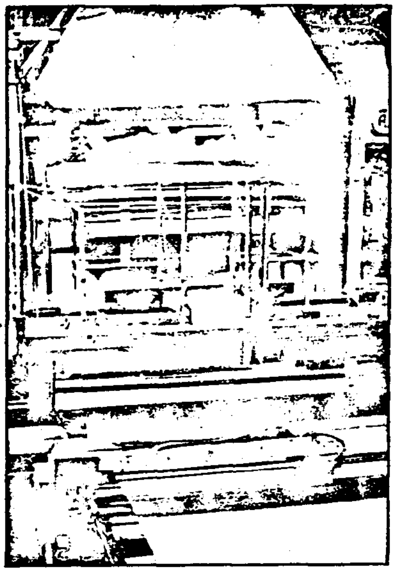


Local exhaust hoods over calender rolls and other process equipment are a major means of lowering VCM exposures.

toring need not be continued for any employee whose exposure is found to be at or below the action level ("unless changes have been made in production, process, control, type of resin, etc."), just what constitutes sufficient initial monitoring remains an important question of interpretation, at least until the Program Directive comes out. Though this point is interpreted by some to mean only one 8-hr TWA determination per worker for a clean bill of health, this may not necessarily be so. Said one OSHA standards official, "Speaking as an industrial hygienist, I'm not sure I would accept a single run-through. At least the points where highest exposures might be expected should be repeated."

At any rate, in cases where above-action-level exposures are found, monitoring must be continued at least quarterly when below the permissible limit and at least monthly when above the limit, until two successive readings no less than five working days apart confirm exposures below the action level.

- Regulated areas must be established in processing plants wherever PVC is "stored, handled or used" and exposures exceed permissible limits. This means restricting access to "authorized persons" and keeping daily rosters of those entering the regulated areas. Such areas, which need not be physically walled in, might consist of the work space around a piece of processing equipment, as long as requirements for access control and keeping of rosters are met.

- Respiratory protection must be supplied if exposures exceed 1- and 5-ppm limits. Though the employer must provide respirators for all who are thus exposed, until Dec. 31, 1975, employees may choose to forego such protection as long as exposures don't exceed 25 ppm (defined as a 15-min ceiling). Anyone choosing not to wear a respirator "shall be informed at least quarterly of the hazards of vinyl chloride and the purpose, proper use, and limitations of respiratory devices."

- Provisions for employee training about the hazards of VCM apply to all PVC processors, regardless of exposure levels at their plants. Compliance officials offer no precise definition for any such a program; it could employ lectures, slides, demonstrations, pamphlets, etc. Where respirators are used, proper instruction in use and maintenance is required as per Section 1910.134 of OSHA regulations. Some review of the training program must be given annually.

- Medical surveillance of anyone exposed over the action level involves a specified yearly examination (or equivalent, as determined by a physician), provided at no cost to the worker. An OSHA-sponsored study by Foster D. Snell, Inc., Florham Park, N.J., estimates cost of such surveillance at $140-160/employee, requiring a minimum of 1½ hrs of his time. It may be discontinued, as with monitoring, after exposures have been reduced below the action level. (A firm offering package medical programs specially tailored to this standard is Health Evaluation Programs, Inc., Park Ridge, Ill.)

- Containers of PVC resin—including bags, boxes, loaded railcars, trucks and silos—and regulated areas must display specified signs or labels warning of a "cancer-suspect agent."

- All records of monitoring, medical exams and rosters of persons entering regulated areas must be maintained for at least 30 years.

- Within a month after establishing a regulated area, reports must be submitted to your OSHA area director, citing plant location and number of employees in the regulated area. Each employee exposed to more than permissible levels (whether wearing a respirator or not) must be informed in writing within 10 days of monitoring results.

A simplified roster of employer duties related to VCM levels is presented in Table 1, opposite.

Next, find out if you have a problem With regard to monitoring—the first step toward compliance—industry observers note that a large proportion of processors are already behindhand in this area. Not only have a good many PVC processors ignored the vinyl chloride monitoring requirement of the emergency temporary standard which has been in effect since April, but some have even indicated they will wait until the last minute before confronting the situation.

Of course, other processors have more than met their obligations. For instance, one custom molder, Ball Plastics Div., Ball Corp., Evansville, Ind., had been monitoring for the presence of organic vapors for several years before it recently began testing for VCM in particular. And several firms, particularly the larger ones, say they intend to continue monitoring regularly even though they find no VCM exposures in their plants amounting to the action level.

By and large, those who have monitored found they had little to fear. Interviews with companies in practically all areas of PVC processing—including extrusion, calendering, injection, blow and rotational molding—indicate many processors will find they have been operating with virtually undetectable levels all along. This is confirmed by the experience of two independent laboratories, DeBell & Richardson Testing Institute and Gollob Analytical Services, which monitored for vinyl chloride in a total of about 50 PVC processing operations and found few major exposure problems that didn't seem correctable with improved ventilation.

This is not to say that common problem areas don't exist or that you ought not anticipate such and pay special attention to these aspects of your operation. Experience has shown what common sense would predict: that highest exposures are generally associated with materials handling and storage and occur around hot-processing equipment, particularly in the case of intensive mixing units. Moreover, the chances of encountering unacceptable VCM levels can be related to whether one handles raw resin or compound, powder or pellets, plasticized or unplasticized material as discussed below.

Wherever resin is stored is a place to watch. According to Diamond Shamrock studies, area monitoring of trucks loaded with resin showed levels above 15 ppm, air space in a bulk railcar after four days' storage measured over 40 ppm and the inside of a silo, 1 ft above the resin surface, had more than 120 ppm. Granted that these were spot samples of areas where employees either don't work at all or for only short times, you nonetheless should be alert to possible exposures of workers unloading a truck, sampling a railcar, maintaining a silo dust filter, and opening up bags or boxes of material.

According to Gollob sources, poorly ventilated warehouses can contain a few ppm, with some sites going as high as 25 ppm. The contribution to a worker's TWA would depend, of course, on the amount of time he spent near the stored resin.

Processing at elevated temperatures also tends to liberate residual monomer from the resin. Most experiments show that by far the greatest amounts are released during dryblending, and that relatively little is given off during subsequent extrusion, molding, etc. For example, investigators reportedly have found insignificant VCM levels right over extruder dies. And the Diamond Shamrock data showed exposures to operators of extruders, injection and blow molding machines to be rarely above permissible or action levels, while monitoring of mixing operations indicated the need for much greater care to avoid unacceptable levels.

By this reasoning, processors handling compounds are expected to encounter less airborne monomer by an order of magnitude, especially if the compound has been produced by high-intensity mixing. Rigid pellets, according to some sources, may release more VCM than powder compounds, depending on how each was manufactured. Finally, flexible compounds, whether powder or pellets, reportedly should give lower exposures than rigids, as the plasticizer is said to displace the monomer during compounding.

Monitoring technique: no simple matter Probably no aspect of the VCM standard has aroused more intense discussion than the monitoring technology itself. Considerable research and innovation in analytical techniques have been fostered by the attention to this issue during the past year, and new equipment offerings have greatly expanded the choices available.

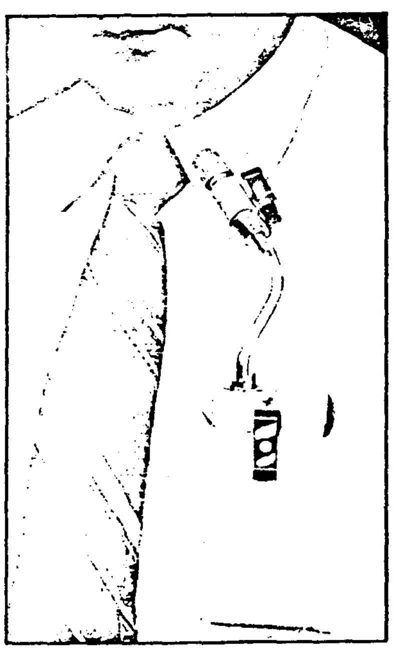
However, one of the biggest questions remains. What will satisfy OSHA? The standard requires only that "individual employee exposure levels be determined"; in fact, OSHA officials say they mean to allow employers a certain amount of freedom as to exact method of compliance so long as that intent be fulfilled. (The Program Directive should supply more information regarding criteria.)

The standard's preamble expressly permits both area and personal (or "personnel") monitoring. Area monitoring of a specific plant location is said to offer the advantage of convenience; personnel monitoring of actual breathing zones gives more direct determination of the time-weighted averages, in which the regulation is expressed.

For instance, a 1-ppm TWA could result from breathing exactly 1 ppm for 8 hrs, or 2 ppm for 4 hrs, or 4 ppm for 2 hrs; or it could mean, for example, breathing 1.5 ppm for 4 hrs, followed by 0.5 ppm for another 4 hrs.

Some sources believe that area monitoring can give accurate determinations of TWA's without having the worker carry a personal monitoring device around with him for long periods. One way this might be done is by area-monitoring all work stations and then calculating by computer the amount of time each worker spent in each location.

Another approach to figuring TWA might be to combine area and personal monitoring. That is, once personal monitoring had established exposure below the action level, area monitoring could watchdog the operation to warn if exposure changed. Besides allowing immediate warning of high-level excursions, as personal monitoring does not, area monitoring has been determined by some company health officers to be far more economical over the long term with regard to manpower requirements.



Personal monitoring pumps with charcoal tubes are the most common tool for determining worker exposures. (Courtesy, Anatole J. Sipin Co.)

What will OSHA use? The VCM standard makes reference to only one specific monitoring and analysis method, described by the National Institute for Occupational Safety and Health in the *NIOSH Manual of Analytical Methods*. This method will be used by OSHA inspectors and is also the most widely employed in the industry to date. A copy of the procedure, "Vinyl Chloride in Air" (P&CAM #178), can be obtained from the NIOSH Office of Technical Publications in Cincinnati.

The basic monitoring tool for this method is a personal sampling pump, a battery-powered device of the size and shape of a transistor radio, with a flexible tube attached (see photo, below). The pump draws air in the flexible tube and through a glass tube containing activated coconut-shell charcoal used to adsorb any VCM present. Pumps weigh from as little as 10 oz up to about 2 lbs and may be carried in a shirt pocket or clipped to a belt. The end of the flexible tube is clipped someplace like the shirt collar to give a representative sampling of the breathing zone.

To analyze monitoring results, the glass tube is removed from the pump, the charcoal emptied from the tube and shaken together with carbon disulfide solvent to desorb the VCM. Then a sample of the CS_2/VCM solution is run through a gas chromatograph, which separates the VCM from other chemicals present, to a flame ionization detector, which indicates how much VCM is present. From the sample one can calculate the total amount of VCM adsorbed by the charcoal from a known volume of air (pump flow rate having been accurately calibrated) during a measured time period —thus obtaining a TWA.

Though the NIOSH charcoal-tube method is only suggested and not required, it has raised numerous questions and objections. One concerns the length of the sampling period deemed sufficient to establish an 8-hr TWA. Must one sample continuously for 8 hrs for each worker, or would several shorter sampling periods suffice?

Industry opinion on this point ranges from those who feel an 8-hr sampling gives the only definitive answer to advocates of periods as short as 15 min, the latter stipulating of course that samples be made during times of expected peak exposure.

The NIOSH manual recommends a

pump flow rate of 50 cc/min, with total volume sampled not to exceed 5 liters for the standard charcoal tube. This recommendation is made in order to avoid overloading the tube's adsorbent capacity, which would result in false readings. At this flow rate, and with the normal range of sampling volume reportedly 1-5 liters, tubes must be changed every 20-100 min (1 liter equalling 1000 cc). Thus, for practicality, a DeBell & Richardson consultant recommends monitoring each worker for at least ½ hr every 2 hrs, or 4 samples/shift, even though full 8-hr monitoring might be theoretically preferable.

But this same source says that innovations in pump design now permit "a whole new philosophy of personal monitoring." Now that lower operating ranges of pumps have recently dropped from 50 to as low as 5 cc/min, a worker reportedly can use a single tube throughout an entire shift. The consultant therefore recommends using a pump with a suitable operating range, for instance 10-50 cc/min, permitting full 8-hr monitoring with a few tubes at low flow rates; he also suggests taking a few short-time samples at the higher rate during periods of expected peak exposure to satisfy the 5-ppm 15-min ceiling. Here, high flow rates would be better for maximum accuracy since they concentrate as much VCM as possible on the charcoal.

Another stumbling block in interpreting the monitoring provisions has been the requirement that whatever measurement used shall have a minimum accuracy, "with a confidence level of 95%," of ±50% at 0.25-0.5 ppm, ±35% at 0.5-1.0 ppm and ±25% over 1 ppm.

The detection method offered in the NIOSH manual currently reads, "Precision: Unknown." but fuller evaluation by NIOSH is reportedly due by Jan. 1. OSHA says it will accept this method as meeting its accuracy requirements—which the agency considers to be quite loose—and the unofficial word is that it will prove more accurate than called for.

In any case, most observers agree that the NIOSH method isn't for amateurs. Among the various sources of error, or "interferences," to which the method is reportedly subject are batch-to-batch variations in charcoal, affecting its adsorptive and desorptive efficiency. High humidity is also said to be particularly bad for accuracy. Inexact pump calibration is another source of error, as is contamination of the carbon disulfide (itself a highly

Table 2—VCM MONITORING AND ANALYSIS SERVICES[a]

Aetna Life & Casualty Co., Hartford, Conn.
Airco Industrial Gases, Murray Hill, N.J.
Anderson-Nichols, Boston
Boehringer Laboratories, Wynnewood, Pa.
Chrometrics Laboratories, Inc., Park Ridge, Ill.
George D. Clayton & Associates, Southfield, Mich.
Crobaugh Labs. Cleveland
DeBell & Richardson Testing Institute, Enfield, Conn.
Denver Research Institute, University of Denver, Denver
Diamond Shamrock Corp., Environmental Laboratories, Painesville, Ohio
Gollob Analytical Service, Inc., Berkeley Heights, N.J.
Gulf Research & Development Co., Pittsburgh
LFE Corp., Environmental Analysis Laboratories, Richmond, Calif.
National Loss Control Service Corp., Long Grove, Ill.
Pollution Control Science, Inc., Miamisburg, Ohio
Charles M. Shapiro & Son, Brooklyn, N.Y.
Ten Ech Environmental Consultants, South Bend, Ind.
University of Cincinnati Medical Center, Kettering Laboratory, Cincinnati
U.S. Testing Co., Hoboken, N.J.

[a]Partial listing.

toxic chemical), besides numerous possible testing discrepancies on the part of the laboratory analyst.

A number of modifications of the NIOSH method have appeared recently. Scientists at Western Electric's Research Center in Princeton, N.J., developed a new type of sampling tube containing porous polymer adsorbent in place of charcoal. Together with thermal desorption of the VCM, instead of carbon disulfide extraction, the method is said to be one or two orders of magnitude more sensitive and is believed to be more accurate than charcoal tubes; also, the new tubes are reusable. Western Electric also uses a mass spectrometer, reportedly giving the most precise identification of VCM presence of any instrument, though it costs in the neighborhood of $100,000, is expensive to operate and requires highly trained personnel. The company is said to be planning to license the new technology and an "improved" area-monitoring method in the near future.

Still another method which has attracted considerable attention is the use of plastic bags instead of sampling tubes for personal monitoring. Now that some pumps are available which can be operated in both a pressure and a suction mode, they can be used to fill a bag with air samples.

Bags of aluminized Mylar, Tedlar, Teflon and saran are said to have proved acceptable. They reportedly come in 1-7 liter sizes and may be clipped to a belt or carried in a small knapsack. A 2-liter bag measures about 8 x 16 x 2 in. thick when inflated. The bags require a septum for withdrawing a sample with a gas syringe or a valve which can be directly coupled to the gas chromatograph inlet port.

Bag sampling is attractive for its simplicity. Because air is merely collected and then analyzed directly, there are fewer opportunities for error, and whatever gc reading is obtained is an actual TWA for the contents of the bag. Some knowledgeable sources vouch for bag sampling as inherently more accurate than adsorbent tube methods.

Should you buy equipment? Regardless of all the above considerations, probably the main objection to the NIOSH method, from the point of view of a great many processors, is that gas chromatographs are sophisticated instruments, generally costing several thousand dollars and at least requiring supervision by a trained analytical chemist. Numerous smaller, simpler, less expensive versions of these and other types of instruments are being advertised. Their manufacturers claim to supply them fully calibrated for push-button operation by relatively untrained personnel.

But experienced technical personnel at PVC resin companies tend to be skeptical of such claims, reasoning that analyzing for any gas in the range of ½ ppm involves considerable uncertainties and that in the case of VCM, the stakes are too high to permit a casual approach.

Thus resin suppliers are generally cautioning their customers against hastily jumping into large equipment purchases. They feel most processors won't be involved in monitoring over a long term. In fact, many fabricators may find that they only need perform initial monitoring and very little thereafter. Most others should be able to get below the action level and stay there.

Consequently, resin suppliers recommend that most processors begin by consulting an independent analytical laboratory (see Table 2, above). These groups provide various services, including complete monitoring and analysis, processing of samples taken by the customer himself and equipment rental. A spot-check indicates that fees commonly run $10-30/sample, depending on number and type of samples, volume discounts being generally offered.

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Individual needs will of course differ. Smaller processors have already shown some preference for outside consultants, while larger operations, particularly those associated with a resin producer or other technical-backup source, have installed sophisticated equipment systems. General Tire & Rubber Co., for instance, has a $10,000 gas chromatograph in each of its 12 PVC processing plants (used for a variety of purposes) and a mass spectrometer at its Akron research center.

A shopper's guide If you are considering equipment purchases, you'll quickly find there's a bewildering array of instruments now being advertised to the plastics industry—and they cover every level of price and sophistication.

The following brief overview of some of the basic approaches to vinyl chloride detection and measurement provides an indication of costs and representative suppliers (see also Table 3, *right*):

Table 3—VCM MONITORING and ANALYSIS EQUIPMENT SUPPLIERS[a]

A.E.D., Inc., Chicago
Alltech Associates, Arlington Heights, Ill.
Analytical Instrument Development, Inc., Avondale, Pa.
Applied Automation, Inc., Bartlesville, Okla.
Arcas, Inc., Houston
Bacharach Instrument Co., Pittsburgh
Baseline Industries, Inc., Lyons, Colo.
Beckman Instruments, Inc., Process Instruments Div., Fullerton, Calif.
Beckman Instruments, Inc., Scientific Instruments Div., Irvine, Calif.
Bendix Corp., Environmental Science Div., Baltimore
Bendix Corp., Process Instrument Div., Ronceverte, W. Va.
E. D. Bullard Co., Sausalito, Calif.
Byron Instruments, Inc., Raleigh, N.C.
Calibrated Instruments, Inc., Ardsley, N.Y.
Carle Instruments, Fullerton, Calif.
Century Systems Corp., Arkansas City, Kans.
Devco Engineering Inc., Fairfield, N.J.
Empire Technology Inc., Clifton Park-Elnora, N.Y.
Environmental Compliance Corp., Pittsburgh
Environmental Measurement Systems, div. of Western Marine Electronics, Seattle
Eocom Corp., Irvine, Calif.
Gow-Mac Instrument Co., Madison, N.J.
Hewlett-Packard, Avondale, Pa.
Honeywell Inc., Process Analyzer Center, Houston.
Ion Track Instruments, Inc., Waltham, Mass.
Matheson Gas Products, E. Rutherford, N.J.
Microchemical Specialties Co., Berkeley, Calif.
MDA Scientific, Inc., Park Ridge, Ill.
Mine Safety Appliances Co., Pittsburgh
National Environmental Instruments, Warwick, R.I.
Perkin-Elmer Corp., Norwalk, Conn.
Anatole J. Sipin Co., N.Y.C.
SKC Inc., Pittsburgh
TC Systems, Inc., Houston
Varian Associates, Palo Alto, Calif.
Wilks Scientific Corp., S. Norwalk, Conn.

[a]Partial listing.

• *Personal monitoring pumps.* These, already discussed above, are offered for $300-350 by such firms as Sipin, SKC, Bendix, Mine Safety Appliances and Calibrated Instruments. Charcoal tubes, at 40¢ apiece, are available from SKC and other pump suppliers as well as various distributors. Sampling bags may be obtained from Alltech Associates, Calibrated Instruments and other pump suppliers. They cost as much as $6 each but are reportedly reusable.

• *Gas chromatography.* Equipment here encompasses a wide variety of types, from laboratory analytical models for analyzing personal monitoring samples to on-line process monitors for continuous sequential sampling of one to 30 remote locations, as well as units that combine both capabilities. Prices also range all over the map, with large, sophisticated lab models selling for $5000-10,000 or more and simplified, portable units costing around $1000-$5000. Suppliers include Perkin-Elmer, Hewlett-Packard, Varian, Beckman, Bendix, Gow-Mac, Baseline Industries, Century Systems, Arcas, Applied Automation, and Analytical Instrument Development.

• *Infrared absorption analysis.* This technology has been attracting considerable attention as an alternative to gas chromatography for both personal and area monitoring. Units range from battery-powered portable types (under $3000) to computerized multipoint monitoring systems ($10,000 and over). Two firms which have shown particular interest in VCM detection are Wilks Scientific and Eocom.

• *Colorimetric methods.* These appear to be another promising alternative. MDA Scientific has developed several models that employ a chemically impregnated paper tape which changes color as VCM is drawn into the sampling port. An optical sensor then measures concentration according to depth of color change. System reportedly offers extremely simple operation and sensitivity to 0.01 ppm. Continuous area-monitoring unit with paper-tape cassette costs $2900 with chart recorder; spot-sampling model is $500. MDA is also developing a personal monitor to be worn by workers ($650 plus $950 for the tape reader); device will give both TWA and continuous profile of worker exposure. For a simplified colorimetric approach to manual spot sampling, Bendix supplies glass tubes containing a reactive absorbent medium said to be highly specific to VCM. Sample from a hand pump is injected into a tube, with length of stain produced indicating concentration. Method reportedly can measure 0.5 ppm with ±5-10% accuracy. (Cost is $85-90 for 10 tubes and sampling pump.)

• *Total hydrocarbon or organic vapor analyzers.* This approach to area monitoring, as the term suggests, isn't specific to VCM and so is more suitable for showing where VCM doesn't exist than where it does. Suppliers such as Bendix, Bacharach and Century Systems provide units from portable direct-reading types to stationary, remote multipoint monitors. Prices range from around $600 to over $6000.

Various other analytical approaches to portable and stationary area-monitoring are available. Examples include a detection system based on the differing physiochemical adsorptive forces of different compounds, supplied by Environmental Measurement Systems; an electron-capture detector system from Ion Track Instruments; systems from Devco Engineering based on identifying VCM by its dielectric constant, and an electrolytic-cell gas sensor from Bullard. (Prices vary with the unit.)

But whichever way you decide to monitor, keep the OSHA inspector and the method he's using in mind. As a major PVC supplier puts it, "We want to be damn sure our results match up with his."

What about respirators? Another equipment question which has been causing some confusion is that of respirators. While it's hoped and expected that very few workers in processing plants will ever need to wear one, at least one informed source doubts whether all purchasers of uncompounded resin will be able in the short term to get below permissible VCM limits in certain plant areas, such as mixing rooms. Furthermore, a senior OSHA official says that sampling of incoming railcars might well be classified as a "hazardous operation"—defined, in part, as a situation in which accidental overexposures might reasonably occur—and thus require respiratory protection.

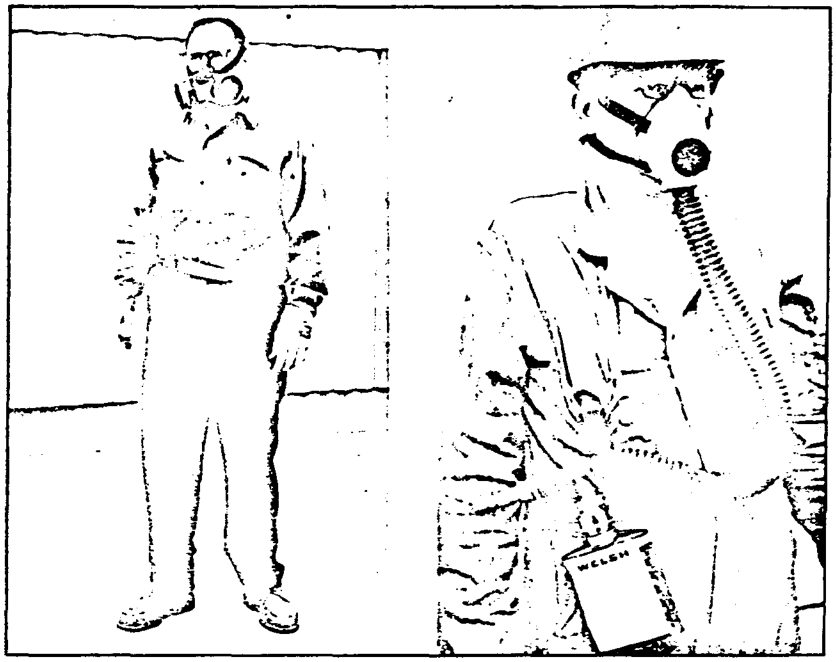
One major question concerns what

type of respirator is legal and practical to use. The standard lists specific types of respirators as permissible in certain maximum VCM ambient concentrations; the equipment for the higher levels is generally more expensive. Basic types include:

- *Air-purifying masks*, which filter ambient air through cartridges or canisters containing adsorbent media. Cartridge types reportedly run $10-12, canisters about $50 and "powered" (blower-equipped) types around $200. Replacement cartridges are $3-6 and cans $10-15. Cartidge masks are permitted for up to 10 ppm and canisters for up to 25 ppm, probably as much as would be found in a processing plant.
- Air-supplied masks, which are fed through a hose from an outside source. Masks themselves cost $80-85; the least expensive method of supplying air would be to connect with the plant's compressed-air system and add a low-pressure purifier (about $1000). As issued, the standard permits air-line respirators without auxiliary supply in up to 100 ppm; but the list omits what's said to be actually the most common respirator type. The list is being amended so that, for not over 1000 ppm, OSHA reportedly will permit a Type C supplied-air, continuous-flow respirator with full or half mask, helmet or hood, which costs approximately $60-80.
- Self-contained compressed-air bottles, which, depending on type, can be used in all environments. For a 15-min supply, these units start at $350-400. Combination air-line types with self-contained auxiliary supply would run $200. However, to refill compressed-air tanks requires a high-pressure purifier/compressor/cascade system costing $5000-$6000.

If any respirator is used at all, clearly the most desirable for the processor in terms of cost and convenience of use are the air-purifying types. Unfortunately, to date no such respirators have been approved by NIOSH, as required by the standard. NIOSH reportedly only just completed testing protocols to begin evaluations and possible certifications of respirators this month. One important question still left hanging is whether NIOSH will insist on end-of-service-life indicators (the first of which is only recently rumored to have been developed) or will go along with OSHA's acceptance of "administrative controls" to make sure cartridges and canisters are replaced sufficiently often.

But even if all approvals are made immediately, it will be impossible to



Cartridge (l.) and canister (r.) type air-purifying respirators are least expensive and easiest to use, but must await NIOSH approval.

supply the industry with the required number of respirators by Jan. 1, according to an SPI petition for a delay of the standard. Some 25,000 respirators are reportedly already on order for VCM and PVC manufacturers alone, and SPI says today's supply is only 26% of current demand; with expeditious NIOSH approvals, supply would still be only 78% of demand.

But should lack of available respirators be the only factor keeping you from compliance, OSHA sources in Washington say application for a variance is always a possible avenue of relief.

Tips on engineering controls When asked what difficulty processors will have in lowering VCM levels in their plants, most informed sources replied that in the long run, getting rid of VCM would not properly be the processor's problem at all. Since his only exposure to VCM can be from unreacted monomer in the resin (PVC does not degrade to VCM), the most evident solution is for the resin supplier to remove as much of it as possible.

There is indeed a strong push by all resin suppliers to accomplish just that. Today's resins reportedly may contain anywhere from less than 1 ppm to over 1500 ppm of VCM, depending on method of manufacture, grade, particle structure and other factors. The initial goal, industry wide, seems to be to get averages below 50 ppm; some suppliers say they can achieve this consistently in certain grades or from certain production facilities. Tenneco Chemicals even claims it has been able, on a pilot-plant basis, to produce resin with "no detectable" VCM remaining.

Meanwhile, the next best answer for the processor is said to be to remove as much VCM as possible, under controlled conditions, during the compounding process. Such an effort would leave that much less monomer to cause problems downstream. Substantial improvements in VCM removal reportedly have been shown possible with a new technology developed jointly by ICI's Plastics Div. and T. K. Fielder Ltd. in England, with the technology now made available in the U.S. and Canada through Werner & Pfleiderer Corp., Waldwick, N.J.

The system centers on the dryblending cycle, where most VCM is normally generated, and further enhances this effect while insuring that the VCM so produced is safely exhausted from the work area. In this way, it not only makes the resin more free of monomer for subsequent processing, but reportely also tends to yield lower VCM levels in the mixer work area.

Filtered air is continuously aspirated through the mixer headspace while small amounts of low-pressure air are also injected at or near the bottom of the mixer bowl. This air then flows through the material, stripping away additional VCM from the mix. Monomer-laden air is drawn from the mixer through a cyclone separator, where large particles are collected in a removable dust bin; it then moves on to a cloth filter to trap additional fines before passing through a turboblower and being exhausted from the work area. (See diagram.)

With this Exorsta system, much more monomer reportedly can be removed, at lower temperatures than would otherwise be necessary. Company data show that residual VCM in finished dryblend can be halved by increasing mixing temperature from 250 F to 265 F, though even better results can be obtained at the lower temperature by adding headspace aspiration alone. With air stripping as well, monomer removal at 250 F is increased more than fourfold again. Thus the system is said to readily produce dryblends with only 5-10 ppm residual VCM vs. more than 100 ppm by conventional dry-blending techniques.

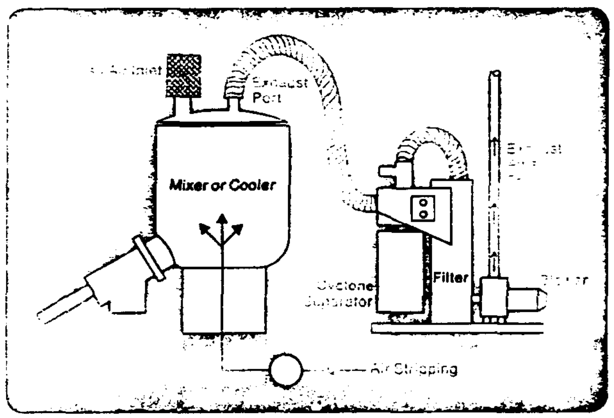
Werner & Pfleiderer supplies complete Exorsta systems, including engineering, training and installation services as well. The Exorsta system is a self-contained design with cyclone separator, filter and exhaust mechanisms and is said to be readily adaptable to retrofitting all existing dryblend units. It costs $3000-6000 installed, depending on size and type of mixing equipment.

Considerable work is being done in monomer-extraction techniques. Process Control Corp., Atlanta, reports it also has been retrofitting mixer units with its own aspiration systems. And Werner & Pfleiderer is developing technology for using vented twin-screw compounding extruders to remove even more monomer. A goal which it hopes to accomplish soon is to produce compound with as little as 1 ppm residual VCM.

Among other techniques for minimizing VCM exposures in processing plants, automated bulk materials handling is certainly a step in the right direction, as it eliminates exposure from opening bags or boxes or from stored material in warehouses. But remember that what happens in a pneumatic feed line is reportedly something like *air stripping in a mixer; that is,* there will be plenty of entrained monomer and possible leaks are a factor to consider.

For this reason, Process Control Corp. engineers have been recommending vacuum rather than pressure systems. Pressure and friction reportedly can make feed lines quite hot (180-200 F) while vacuum lines are cooler (100-120 F) and thus cause less monomer to be released. What's more, Process Control's vacuum-conveying systems feature closed-loop designs that both exhaust monomer outside the plant and reportedly avoid particle-size classification problems said to be common in closed-loop pressure systems.

Process Control is working on other materials-handling approaches to minimize worker exposures in mixing areas. Here part of the problem is said to be that usually only major compound ingredients (such as resin and plasticizer) are metered automatically to the mixer while from six to 13 "microingredients" (additives which together add up to no more than 10% of the total) are added by hand. The company recommends instead that these microingredients be masterbatched together with enough resin to dilute the whole to a sizeable volume from which portions could be automatically dosed. Getting the operator away from the mixer as much as possible is thus a simple answer to reducing his exposure.



New system removes as much VCM as possible during dryblending, so less can escape downstream. (Courtesy, Werner & Pfleiderer Corp.)

But of all engineering controls applied to the VCM problem, ventilation is probably the most widespread and versatile. Moving large volumes of air to ventilate entire work areas is the most expensive and least efficient approach; in addition, winter weather will require that incoming air be heated, at considerable extra expense.

Locating exhaust hoods near processing equipment is by far the preferred approach, and many processors attribute their lack of exposure problems to doing this. In many cases, local ventilation had already been installed to remove plasticizer vapors and other fumes. (One plant even went to the novel length of entirely enclosing a calendering line.)

Proper ventilation is also advisable in warehouses where PVC resin is stored. Cost and airflow requirements can possibly be minimized by keeping all PVC segregated in one corner, perhaps in an actual enclosure, with local exhausting provided. Alternatively, in a warehouse with relatively good overall air movement, you might scatter the PVC in smaller lots so that lesser local VCM concentrations could accumulate. Amount of ventilation needed in a warehouse will partly depend on storage temperature, more monomer being liberated at higher temperatures. How long the resin is stored is also relevant; VCM emissions from bagged resin reportedly decline rapidly to negligible levels after a few weeks (though this is not necessarily true for pelletized PVC materials).

Some processors are spending several thousand dollars on ventilation in order to get below the action level. As this is a technically complex subject in itself, you may well want to consult a professional engineer before making such an investment.

Dr. Maurice Oberg of LFE Environmental Analysis Laboratories presented some of the complexities involved at a recent SPE meeting in N.Y.C. For example, distance of an exhaust hood from the VCM source is an important factor, with airflow requirements increasing proportionally to the square of that distance. Hood configuration is likewise important, since 25% less airflow reportedly can provide the same amount of control if the hood is flanged or if it's placed flush against a wall or other surface. One example Oberg cited was a hood over an extruder die, the hood flange contacting the die at roughly a 45° angle. Such an arrangement reportedly would provide efficient fume removal and avoid dripping condensed plasticizer, for instance, on the extrudate. A flexible metal duct would permit the hood to be moved for access to the die.

The above considerations, as well as shape of hood, fan blade configuration and duct geometry, are only some of the factors involved in designing the most efficient system for your money. (A professional manual on the subject is "Industrial Ventilation," published by the American Conference of Governmental Industrial Hygienists Committee on Industrial Ventilation, Lansing, Mich.) □□

TO		
W. M. Smith	Cleveland	
FROM		
D. Y. Lewis	Avon Lake General Chemical	12/26/74

SUBJECT

Following is the data you requested:

Sample Identification	RVCM (ppm)	Porosity	I. V.	Sonic Sifter
American Chem ACC-102 Tulgon, Ariz.	106.07	0.125	0.902	40 - 0.07 60 - 0.32 80 - 4.17 100 - 12.60 140 - 53.25 200 - 22.04 pan - 7.54 $\bar{x}$ - 122.0 s - 30.6
American Chem ACC102 320-1274 Carson, Calif.	0.40	0.140	0.921	40 - 0.08 60 - 1.66 80 - 16.02 100 - 24.05 140 - 44.70 200 - 10.48 pan - 3.00 $\bar{x}$ - 143.5 s - 30.12
Airco Products 1230P Resin	259.35	0.170	0.866	40 - 0.33 60 - 20.90 80 - 36.16 100 - 20.75 140 - 19.42 200 - 1.85 pan - 0.60 $\bar{x}$ - 191.6 s - 32.0
Goodyear	278.13	0.185	0.876	40 - 0.08 60 - 0.33 80 - 3.00 100 - 8.08 140 - 73.70 200 - 13.41 pan - 1.40 $\bar{x}$ - 124.2 s - 19.2

2464B029

Sample Identification	RVCM (ppm)	Porosity	I. V.	Sonic Sifter
Hooker	0.33	0.220	0.908	40 - 0.09
				60 - 0.19
				80 - 0.71
				100 - 4.36
				140 - 84.97
				200 - 9.07
				pan - 0.61
				$\bar{x}$ - 124.4
				s - 14.10
PVC Compound Bld. UPE-27B Bin 3507 (apparent density - .623 gms/cc)	22.73			
Conoco 5385 12-3-74 J M Pueblo, Colo	17.77			
Diamond Shamrock 12-4-74 Car ACFX 54620	33.81			

D. Y. Lewis

D. Y. Lewis

/dl

cc: F. V. Zemanek ◄ COPY FOR

2464 3030

W.M. Smith — Cleveland

F.V. Zemanek ◄ COPY FOR ◄ ALGC — 12/11/74

Competitive Resin Data

Six (6) competitive resin samples have been sent to the M.S. Lab for RVCM, Sonic Sifter Screens, Porosity and Inherent Viscosity. The ALGC laboratory personnel ran the I.V. and RVCM analyses. Following is the identification and data:

Borden Pipe Resin

RVCM	=	43.5 ppm
Porosity	=	0.215
I.V.	=	0.963*
S.S.- 40	=	.14
60	=	.50
80	=	5.95
100	=	17.11
140	=	58.42
200	=	15.47
pan	=	2.41
$\bar{X}$	=	130.35
S	=	24.98

Firestone FPC9326 L-B4892 (11-27-74)

RVCM	=	349.35 ppm
Porosity	=	0.180
I.V.	=	0.963
S.S.- 40	=	.06
60	=	2.49
80	=	23.03
100	=	23.86
140	=	41.34
200	=	7.57
pan	=	1.64
$\bar{X}$	=	149.54
S	=	28.53

Air Products PVC 1230P(12-3-74)

RVCM	=	735.99 ppm
Porosity	=	0.130
I.V.	=	0.884
S.S.- 40	=	.22
60	=	1.67
80	=	10.30
100	=	20.57
140	=	45.50
200	=	13.54
pan	=	8.20
$\bar{X}$	=	136.16
S	=	39.56

Hooker B-303 L-57-4-32-13

RVCM	=	20.25 ppm
Porosity	=	0.180
I.V.	=	0.909
S.S.- 40	=	.06
60	=	.14
80	=	.90
100	=	2.04
140	=	82.80
200	=	13.89
pan	=	.16
$\bar{X}$	=	111.50
S	=	12.53

(continued)

TO: W.M. Smith

Competitive Resin Data

Hooker Rucon B-303 L-57-433-13 Butner Plant ACFX57135		Conoco PTLX-41656 Resin Type 1843 Bulk 5385	
RVCM =	217.65 ppm	RVCM =	265.37 ppm
Porosity =	0.200	Porosity =	0.215
I.V. =	0.911	I.V. =	0.917
S.S.- 40 =	.04	S.S.- 40 =	.06
60 =	.08	60 =	2.29
80 =	1.53	80 =	16.38
100 =	4.17	100 =	20.69
140 =	73.93	140 =	44.85
200 =	19.92	200 =	13.01
pan =	.33	pan =	2.72
$\overline{X}$ =	115.62	$\overline{X}$ =	140.09
S =	14.61	S =	31.30

* Note: After 24 hours of sample time preparation (heat and agitation), a good portion of the sample appeared to remain insoluble. The I.V. was run on the solution as it was.

Bill, if we can be of more help give me a call.

Vic

F.V. Zemanek

FVZ/bjs

cc: J.M. Whitney

2464303Z

SUBSTANCE	ACGIH 1974 TLV ppm	ACGIH 1974 TLV mg/m3	OSHA STANDARD 1910.93 T W A ppm	OSHA STANDARD 1910.93 T W A mg/m3	Acceptable Peaks ppm	Acceptable Peaks Minutes	Odor Threshol ppm
cetic Acid	10	25	10	25			1
Acetone	1000	2400	1000	2400			100
Acetonitrile	40	70	40	70			
Acrylamide-Skin	--	0.3	--	0.3			
Acrylic Acid							
Acrylonitrile-Skin	20	45	20	45			21
Allyl Chloride	1	3	1	3			0.5
Ammonia	25	18	50	35			47
Aniline	5	19	5	19			1
Benzene	p10	p30	10(C25)		50	10/8 hr.	5
1,3-Butadiene	1000	2200	1000	2200			
Butane	p600	p1450					
Butyl Acrylate							
Carbon Disulfide	20	60	20(C30)		100	30/8 hr.	0.2
Carbon Tetrachloride-Skin	10	65	10(C25)		200	5/4 hr.	100
Chlorine	1	3	1	3			0.3
Chloroform	25	120	C50	240			
Cyclohexylamine-Skin	10	40					
1,2-Dichloroethane	50	200	50(C100)		200	5/3 hr.	12
Dicyclopentadiene							
Di-iso Butylene							
Diphenyl	0.2	1	0.2	1			
Diphenylamine	--	10					
Epichlorohydrin	5	19	5	19			
Ethyl Acetate	400	1400	400	1400			
Ethyl Acrylate-Skin	25	100	25	100			0.000
thylene Oxide	50	90	50	90			700
thylidene Norbornene	C5	C25					
Formaldehyde	C2	C3	3(C5)		10	30/8 hr.	1
Hexane	p100	p360	500	1800			
Isobutylene							
Isoprene							
Isopropyl Acetate	250	950	250	950			
Isopropyl Alcohol-Skin	400	980	400	980			
Mercury	0.001	0.01		C0.1			
Methyl Acrylate-Skin	10	35	10	35			20
Methyl Alcohol-Skin	200	260	200	260			100
M.B. Isocyanate (MDI)	C0.02	C0.2	C0.02	C0.2			
Methylene Chloride	p100	p360	500(C1000)		2000	5/2 hr.	214
Morpholine-Skin	20	70	20	70			
p-Nitroaniline-Skin	1	6	1	6			
Phenol-Skin	5	19	5	19			0.05
Phosphoric Acid	--	1	--	1			
Phosphorus Trichloride	0.5	3	0.5	3			
Styrene	100	420	100(C200)		600	5/3 hr.	0.1-0.
Toluene	100	375	200(C300)		500	10/8 hr.	2-4
Trichloroethylene	100	535	100(C200)		300	5/2 hr.	21
Vinyl Acetate	10	30					
Vinyl Chloride	Pending		1		5	15/8 hr.	250-500
Vinylidene Chloride	10	40					500-100

ppm - Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 mm Hg.
p - Proposed for 1975.
- Ceiling - Should not be exceeded, unless acceptable peak is permitted.
Skin - Potential contribution to overall exposure by the cutaneous route including mucous membranes and eye, either by airborne, or more particularly, by direct contact.

JAK:cj
1/2/75

2464303 3

PHYSICAL PROPERTIES

SUBSTANCE	MW	Formula	MP °F	BP °F	Vapor Density Air=1	Specific Gravity H2O=1
Acetic Acid	60.0	CH3COOH	61	245	2.1	1.05
Acetone	58.0	CH3COCH3	-137	134	2.0	0.79
Acetonitrile	41.0	CH3CN	-42	176	1.4	0.79
Acrylamide-Skin	71.1	CH2=CHCONH2	184	-	2.5	1.12
Acrylic Acid	72.0	CH2=CHCOOH	54	288	2.5	1.05
Acrylonitrile-Skin	53.0	CH2CHCN	-117	171	1.8	0.81
Allyl Chloride	76.5	CH2=CHCH2Cl	-213	113	2.6	0.94
Ammonia	17.0	NH3	-108	-28	0.6	0.77
Aniline	93.6	C6H5NH2	21	364	3.2	1.02
Benzene	78.1	C6H6	41	176	2.7	0.88
1,3-Butadiene	54.1	CH2=CHCH=CH2	-164	23	1.9	0.62
Butane	58.1	CH3(CH2)2CH3	-211	33	2.0	0.60
Butyl Acrylate	128.1	CH2=CHCOOC4H9	-84	-	4.4	0.89
Carbon Disulfide	76.1	CS2	-169	115	2.6	1.26
Carbon Tetrachloride-Skin	153.8	CCl-4	-9	171	5.3	1.58
Chlorine	70.9	Cl-2	-150	-30	2.5	1.47
Chloroform	119.4	CHCl-3	-83	142	4.1	1.49
Cyclohexylamine-Skin	99.2	C6H-11-NH2	-0.4	275	3.4	0.87
1,2-Dichloroethane	99.0	CH2ClCH2Cl	-32	182	3.4	1.26
Dicyclopentadiene	132.1	C-10-H-12	91	338	4.6	0.93
Di-iso Butylene	112.2	C8H-16	-150	216	4.0	0.72
Diphenyl	154.2	C6H5C6H5	158	492	5.3	0.99
Diphenylamine	169.2	(C6H5)2NH	127	575	5.8	1.16
Epichlorohydrin	92.5	CHClOCHCH3	-54	243	3.3	1.18
Ethyl Acetate	88.1	CH3COOC2H5	-119	171	3.0	0.90
Ethyl Acrylate-Skin	100.0	CH2=CHCOOC2H5	-98	212	3.5	0.92
Ethylene Oxide	44.0	CH2-OCH2	-168	51	1.5	0.87
Ethylidene Norbornene	120.2	C9H-12	-112	298	4.0	0.90
Formaldehyde	30.0	HCOH	-134	-3	1.1	0.82
Hexane	86.2	CH3(CH2)4CH3	-141	156	3.0	0.66
Isobutylene	56.1	(CH3)2CCH2	-220	20	1.9	0.60
Isoprene	68.1	CH2=C(CH3)CH=CH2	-233	93	2.4	0.68
Isopropyl Acetate	102.0	CH3COOC3H7	-99	191	3.5	0.87
Isopropyl Alcohol-Skin	60.0	C3H7-OH	-122	181	2.1	0.79
Mercury	200.6	Hg	-38	674	-	13.6
Methyl Acrylate-Skin	86.0	CH2=CHCOOCH3	-103	176	3.0	0.95
Methyl Alcohol-Skin	32.0	CH3-OH	-144	147	1.1	0.79
M.B. Isocyanate (MDI)	360.3	N2-O-2-C-15-H-10	99	-	-	1.19
Methylene Chloride	84.9	CH2Cl-2	-143	104	2.9	1.3
Morpholine-Skin	87.2	O(CH2CH2)2NH	18	262	3.0	1.0
p-Nitroaniline-Skin	138.1	C6H6N2-O-2	295	545	-	1.44
Phenol-Skin	94.1	C6H5-OH	104	358	3.2	1.1
Phosphoric Acid	98.0	H3PO4	108	-	-	1.86
Phosphorus Trichloride	137.4	PCl-3	-169	167	4.8	1.59
Styrene	104.1	C6H5CH=CH2	-23	295	3.6	0.91
Toluene	92.1	C6H5CH3	-139	231	3.1	0.87
Trichloroethylene	131.4	CHCl=CCl-2	-99	188	4.5	1.46
Vinyl Acetate	86.1	CH3COOCH=CH2	-148	163	3.0	0.94
Vinyl Chloride	62.5	CH2=CHCl	-245	7	2.2	0.91
Vinylidene Chloride	97.0	CH2=CCl-2	-188	99	3.4	1.3

2464 3034

JAK:cj
1/2/75

SUBSTANCE	Flash Point CC, °F	Ignition Temp °F	Flammable Limits By Volume % LEL	% UEL	NFPA 704M System Health	Fire	Reaction
Acetic Acid	109	869	5.4	16.0	2	2	1
Acetone	0	869	2.6	12.8	1	3	0
Acetonitrile	42oc	975	4.4	16.0	2	3	1
Acrylamide-Skin					3		
Acrylic Acid	130oc	Polym.	--	--	3	2	2
Acrylonitrile-Skin	32oc	898	3.0	17.0	4	3	2
Allyl Chloride	-25	905	2.9	11.1	3	3	1
Ammonia	-	1204	16	25	3	1	0
Aniline	158	1139	1.3	--	3	2	0
Benzene	12	1040	1.3	7.1	2	3	0
1,3-Butadiene	< 20	788	2.0	12.0	2	4	2
Butane	-76	761	1.9	8.5	1	4	0
Butyl Acrylate	120oc	559	1.5	9.9	2	2	2
Carbon Disuifide	-22	194	1.3	50.0	2	3	0
Carbon Tetrachloride-Skin	None	--	None	--	3	0	0
Chlorine	-	--	--	--	3	0	0
Chloroform	None	--	None	--	2	0	0
Cyclohexylamine-Skin	90oc	560	--	--	2	3	0
1,2-Dichloroethane	56	775	6.2	16	2	3	0
Dicyclopentadiene	90oc	--			1	3	1
Di-iso Butylene	20						
Diphenyl	235	1004	0.6	5.8	2	1	0
Diphenylamine	307	1175			3	1	0
Epichlorohydrin	105oc				3	2	1
Ethyl Acetate	24	800	2.2	11.0	1	3	0
Ethyl Acrylate-Skin	60oc		1.8		2	3	2
Ethylene Oxide	<0	804	3.6	100.0	2	4	3
Ethylidene Norbornene							
Formaldehyde	-	806	7.0	73	2	4	0
Hexane	-7	437	1.1	7.5	1	3	0
Isobutylene	-	869	1.8	9.6	1	4	0
Isoprene	-65	428	2	9	2	4	2
Isopnopyl Acetate	40	860	1.8	8	1	3	0
Isopropyl Alcohol-Skin	53	750	2	12	1	3	0
Mercury	-	--	--	--			
Methyl Acrylate-Skin	270oc		2.8	25	2	3	2
Methyl Alcohol-Skin	52	725	6.7	36	1	3	0
M.B. Isocyanate (MDI)							
Methylene Chloride	-	1139	15.5	66	2	0	0
Morpholine-Skin	100oc	590			2	3	0
p-Nitroaniline-Skin	390				3	1	3
Phenol-Skin	175	1319			3	2	0
Phosphoric Acid	-	--	--	--	2	0	0
Phosphorus Trichloride	-	--	--	--	3	0	2
Styrene	90	914	1.1	6.1	2	3	2
Toluene	40	896	1.2	7.1	2	3	0
Trichloroethylene	-	788	12.5	90	1	1	0
Vinyl Acetate	18	800	2.6	13.4	2	3	2
Vinyl Chloride	-108	882	3.6	33.0	3	4	1
Vinylidene Chloride	0	1058	7.3	16.0	2	4	2

oc - Open Cup

JAK:cj
1/2/75

2464303S

NFPA, 704M SYSTEM: A numerical system for the identification of the Fire Hazards of Materials developed by the National Fire Protection Association. The numbers given in the three columns have been taken from NFPA publications and other sources. For full definitions of the various degrees of hazard (0 to 4 in each category), see NFPA No. 704M-1969. Abbreviated definitions are as follows:

HEALTH

4 Can cause death or major injury despite medical treatment.
3 Can cause serious injury despite medical treatment.
2 Can cause injury. Requires prompt treatment.
1 Can cause irritation if not treated.
0 No hazard.

FIRE

4 Very flammable gases or very volatile flammable liquids.
3 Can be ignited at all normal temperatures.
2 Ignites if moderately heated.
1 Ignites after considerable preheating.
0 Will not burn.

REACTIVITY (Stability)

4 Readily detonates or explodes.
3 Can detonate or explode but requires strong initiating force or heating under confinement.
2 Normally unstable but will not detonate.
1 Normally stable. Unstable at high temp. and pressure. Reacts with water.
0 Normally stable. Not reactive with water.

JAK:cj
1/2/75

2464/3036

SUBSTANCE	LD50 - Oral Rat - mg/Kg	TCLo - Inhalation Human - ppm	LCLo - Inhalation Rat - ppm	LD50 - Skin Rabbit - mg/Kg
Acetic Acid	3310			
Acetone		500		
Acetonitrile	200		8000/4H	
Acrylamide-Skin	170			
Acrylic Acid	350		6000/5H	280
Acrylonitrile-Skin	93		500/4H	280
Allyl Chloride			2000/4H	2200
Ammonia		20	2000/4H	
Aniline	440		250/4H	820
Benzene	3400	210		
1,3-Butadiene				
Butane				
Butyl Acrylate	3730			2000
Carbon Disulfide				
Carbon Tetrachloride-Skin		20	4000/4H	
Chlorine		15		
Chloroform	300	10/1Y	8000/4H	
Cyclohexylamine-Skin	710		8000/4H	320
1,2-Dichloroethane	680	4000	1000/4H	3890
Dicyclopentadiene	410		500/4H	
Di-iso Butylene				
Diphenyl	2180			2500
Diphenylamine				
Epichlorohydrin	90		250/4H	
Ethyl Acetate				
Ethyl Acrylate-Skin	830		2000/4H	1950
Ethylene Oxide	330			
Ethylidene Norbornene	2830	6/30M		
Formaldehyde	800	13.8	250/4H	
Hexane				
Isobutylene				
Isoprene				
Isopropyl Acetate	3000	200		
Isopropyl Alcohol-Skin				
Mercury		169 $\mu g/m^3$		
Methyl Acrylate-Skin	300		1000/4H	
Methyl Alcohol-Skin		300		
M.B. Isocyanate (MDI)		0.13/30M		
Methylene Chloride		500/8H		
Morpholine-Skin	1050			500
p-Nitroaniline-Skin	3249			
Phenol-Skin	414			
Phosphoric Acid	1530	100 mg/m^3		
Phosphorus Trichloride				
Styrene	4920	376		
Toluene	3000	200	100	
Trichloroethylene	4920	110/8H	8000/4H	
Vinyl Acetate	2920		4000/4H	2320
Vinyl Chloride		20	250/4H/260DI	
Vinylidene Chloride				

LD50 - lethal dose 50 percent kill
TCLo - lowest published toxic concentration
LCLo - lowest published lethal concentration

M - Minute
H - Hour
Y - Year

DI - Day Intermittent

JAK:cj
1/2/75

24643037

SYNONYMS

SUBSTANCE

Acetic Acid	Ethanoic Acid	Vinegar Acid
Acetone	Dimethyl Ketone	2-propanone
Acetonitrile	Cyano methane	
Acrylamide-Skin	Acrylic Amide	
Acrylic Acid	Propenoic Acid	
Acrylonitrile-Skin	Propene nitrile	
Allyl Chloride	3-Chloropropene	
Ammonia	-	
Aniline	Aminobenzene	
Benzene	Benzol	
1,3-Butadiene	Biethylene	Bivinyl
Butane	-	
Butyl Acrylate	Butylester 2-propenoic acid	
Carbon Disulfide	Carbon Bisulfide	
Carbon Tetrachloride-Skin	Tetrachloro methane	
Chlorine	-	
Chloroform	Trichloro methane	
Cyclohexylamine-Skin	Aminocyclohexane	
1,2-Dichloroethane	Ethylene Dichloride	EDC
Dicyclopentadiene	3a,4,7,7a-Tetrahydro-4,7-Methanoindene	
Di-iso Butylene	2,4,4-Trimethyl pentene-1/2,4,4-Trimethyl pentene-2	
Diphenyl	Phenyl benzene	
Diphenylamine	Anilino benzene	
Epichlorohydrin	1-Chloro-2,3-Epoxy Propane	Chloro-1,2-Propylene Oxide
Ethyl Acetate	Acetic Acid, Ethyl Ester	
Ethyl Acrylate-Skin	Acrylic Acid, Ethyl Ester	Ethyl Propenoate
Ethylene Oxide	Oxirane	1,2-Epoxy ethane
Ethylidene Norbornene	5-Ethylidene-2-Norbornene	ENB
Formaldehyde	Formalin	Methanal
Hexane	-	
Isobutylene	2-methylpropene	
Isoprene	3-methyl-1,3-butadiene	
Isopropyl Acetate	Acetic Acid, Isopropyl Ester	
Isopropyl Alcohol-Skin	Isopropanol	
Mercury	Quick Silver	
Methyl Acrylate-Skin	Acrylic Acid, Methyl Ester	
Methyl Alcohol-Skin	Methanol	
M.B. Isocyanate (MDI)	p,p'-Diphenyl methane Diisocyanate	
Methylene Chloride	Dichloro methane	
Morpholine-Skin	Tetrahydro-2H-1,4-Oxazine	
p-Nitroaniline-Skin	1-amino-4-nitro benzene	
Phenol-Skin	Carbolic Acid	
Phosphoric Acid	Ortho-phosphoric acid	
Phosphorus Trichloride	Phosphorus Chloride	
Styrene	Vinyl benzene	
Toluene	Methyl benzene	
Trichloroethylene	TCE	
Vinyl Acetate	Acetic Acid Vinyl Ester	
Vinyl Chloride	Chloro ethane	
Vinylidene Chloride	1,1-Dichloro ethylene	

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