AP00000885

AVERAGE LEVEL AND TYPE OF EXPOSURES TO VCM IN PVC MANUFACTURING PLANTS

Data Base May 1 - July 15, 1974

Duties	Operator Classification: Calvert City	Operator Classification: Pace	Average 8-Hr. TWA	Type of Exposure
General Supervisory	Supervisor	Supervisor	5	Intermittant
General Roving Duties	--NA--	Senior Operator	8	Intermittant
Reactor Charging,	3rd Floor Operator	Reactor Operator	22	Continuous
Dumping		Solutions Operator	19	Continuous
Reactor Cleaning	Utility	Utility	16	Intermittant, wear masks
Stripping, Transfer of Slurry	2nd Floor Operator	Recovery Operator	17	Continuous
Drying	Dryer	Finishing Operator	7	Intermittant
Bulk loading, Resin Transfer	Dryer	Bulk Loader	7	Intermittant
Bagging	Bagger	Bagger	14	Intermittant
Monomer Unloading, Utilities	Area 5 Operator	Artisan Operator	6	Intermittant
Maintenance	Maint. Mechanic	Mechanic	3	Intermittant
Warehouse Work	Material Handler	Bulk Loader	7	Intermittant
Analytical	Lab Technician	Lab Technician	1	Intermittant

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AN ECONOMIC IMPACT AND TECHNOLOGICAL FEASIBILITY STUDY FOR THE COMPOUNDERS, PROCESSORS AND FABRICATORS OF POLYVINYL CHLORIDE RESINS

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United States Department of Labor
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AP00000886

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SECTION I: INTRODUCTION AND SUMMARY

1.0 INTRODUCTION

On April 5, 1974, the Occupational Safety and Health Administration (OSHA) published a temporary emergency standard limiting the exposure to vinyl chloride in the work place to 50 parts per million. This standard is based on Section 6(c) of the Occupational Safety and Health Act which provides for such standards when it has been determined that workers are exposed to grave danger. Further, in keeping with the legislative intent of Section 6(b)(5) of the act, OSHA proceeded to develop a permanent standard dealing with vinyl chloride. This proposed standard was published in the Federal Register on May 10, 1974, and proposes a reduction in the permissible concentration of vinyl chloride in the work place to "no detectable level."

The proposed standard poses difficult issues for government and industry to consider. First, it is not clear that it is technologically feasible to comply with the proposed standard without a shutdown of the vinyl chloride industry. Second, it is not clear from existing experimental and other historical data that a "no detectable level" standard is justified. And third, it is quite clear that compliance with the proposed standard will require substantial capital investments and lead times.

This study was designed to investigate the technological feasibility of the proposed standard and to identify the economic impact and time frame associated with compliance with the proposed standard. Since the justification of the proposed standard is open to debate, the study examines some alternatives between the emergency temporary standard and the proposed permanent standard. The findings represent the combined efforts of OSHA, Foster D. Snell, Inc., a number of industry organizations involved in the production and fabrication of vinyl chloride and related products, and interested union and trade association representatives. They are presented in the profound interest of protecting the American worker against undue health hazards; providing industry with objective information from which to develop and promulgate the permanent standard for vinyl chloride.

There are two parts to this study each of which is submitted independently. Part I addresses the economic impact and technological feasibility of compliance with the emergency temporary standard, the proposed standard and alternative standards for the producers of vinyl chloride and polyvinyl chloride resins. Part I was prepared entirely by Foster D. Snell, Inc., a subsidiary of Booz, Allen & Hamilton, Inc. The report presents a summary of facts drawn from the vinyl chloride hearings, a survey of manufacturers of equipment which may be used to comply with the final standard. The report summarizes the facts and presents preliminary data on the general industry effect of compliance with the emergency temporary standard, an alternative standard, and the proposed standard ("no detectable level"). Part II addresses the economic impact and technological feasibility of compliance with the emergency temporary standard and the proposed standard for the compounders, processors and fabricators of polyvinyl chloride resins. Part II follows outlines and format similar to Part I. Each report is designed to stand alone.

1.1 SUMMARY

Section II discusses the background of the OSHA proposed permanent standard for vinyl chloride regulation, the supportive medical data, and on-going medical/epidemiological research. It is clear that due to the immediacy of the vinyl chloride situation, little research has been completed to support a "no detectable level" standard. The rodent research to date demonstrates that exposures as low as 50 ppm produce tumors. What has yet to be done is to determine the lowest level that will produce tumors in both test animals and in man himself.

Section III highlights the research methods and problems encountered in this study. Of particular importance is the overwhelming lack of data on the polyvinyl chloride compounders, processors and fabricators. However, using a variety of approaches, it is felt that enough information was collected to provide an accurate picture of the state of the industry today and how it could be economically and technologically impacted by the promulgation of a "no detectable level" standard.

Section IV outlines the structure and technology of the compounding, processing and fabricating operations. The key to understanding these layers is to realize the extent of the potential impact to the great number of firms and employees involved. These layers are highly interdependent and have a large proportion of vertically integrated firms who perform more than one operation with PVC. Operations involved include compounding the resin, processing it into semi-finished goods, then manufacturing finished goods.

Section V presents the research findings, focusing on five target areas. Market data discusses supply/demand and cost trends for the PVC resins, compounds, and finished products. The search for a feasible and available substitute for all of the different PVC resins has so far proven unsuccessful. The examination of the range of vinyl chloride residual monomer levels in the resins and compounds leads to the finding of very low worker exposure to VCM: over 90% of the industry is operating at 5 ppm or less.

Thus, the vast majority of the firms in these three industry layers could probably comply with a standard allowing some level of exposure as long as the monomer, polymer and copolymer producers upstream could continue operations.

SECTION II: BACKGROUND AND RESEARCH FOR THE PROPOSED STANDARD

2.0 INTRODUCTION

The procedure for the promulgation of a standard for protecting worker exposure to vinyl chloride is governed by strict regulations which establish a rigid schedule from the issue of an emergency temporary standard (ETS) to the promulgation of the final standard. In this situation, it is important to review the events leading up to the issue of the ETS and to examine in some detail the medical research on which any final standard is to be based. This section outlines in detail these two important topics.

2.1 BACKGROUND OF PROPOSED STANDARD

On January 22, 1974, the B.F. Goodrich Company notified the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA) of the deaths of several of their employees from angiosarcoma of the liver, a rare form of cancer. In an effort to determine whether or not these deaths were occupationally related, NIOSH, OSHA and the Kentucky Department of Labor held a joint inspection of the Goodrich plant and facilities. As a result of these actions, a fact-finding hearing aimed at uncovering the possible hazards involved with the manufacture and usage of vinyl chloride was hold on February 15, 1974.

Medical data presented at this hearing was directed toward determining the degree of carcinogenicity of vinyl chloride.

Experiments conducted by Professor Cesare Maltoni of Bologna, Italy, demonstrated that Sprague-Dawley rats exposed to levels from 10,000 ppm (parts per million) to 50 ppm developed malignant tumors, including angiosarcomas of the liver, at levels as low as 250 ppm. (Later results from this same experiment showed tumors at 50 ppm at that time.) An emergency temporary standard reducing vinyl chloride exposure to 50 ppm maximum was published in the Federal Register on April 5, 1974.

According to provisions in the Occupational Safety and Health Act of 1970, a permanent standard must be enacted within six months of the issuance of an emergency temporary standard, in this instance, by October 5, 1974. The proposed permanent standard regulating vinyl chloride exposure to a "no detectable level" was published in the Federal Register on May 10, 1974. To enable OSHA to promulgate the best possible standard by October, the public was invited to comment on the regulation. Public hearings were held on June 25-28 and July 8-11 to give industry, labor and other interested parties the opportunity to present their views and data regarding vinyl chloride to the Department of Labor.

2.2 MEDICAL RESEARCH ON VINYL CHLORIDE

Current evidence on the relationship between exposure to vinyl chloride monomer (VCM) and angiosarcoma of the liver encompasses three significant studies. They are:

(1) Results of experiments by Dr. Maltoni in which he exposed laboratory rats to different levels of VCM for a specified period of time[1];

(2) Experiments done by Bio-Test Labs in which they followed a protocol similar to Maltoni's and expanded their test animals to include hamsters and mice[2]; and,

(3) Work done by Gehring and others at Dow Chemical in which laboratory rats were exposed to selected levels of VCM for purposes of determining their bodily reactions, and the process and extent to which VCM is metabolized in their bodies[3].

There have been no experiments under controlled conditions in which human reactions to VCM have been studied. Human data now being used is the product of back-tracking and tracing the lives of the workers who contracted angiosarcoma of the liver. The work is inconclusive to date, indicating only that there is some relationship between exposure to VCM and the development of angiosarcoma of the liver. A so-called "dose/response ratio" however, linking length and level of exposure as a function of the probability of contracting the disease, does not exist.

Results of the experiments on rats, mice and hamsters indicate that contraction of angiosarcoma of the liver does seem to be related to level and length of exposure. They point to the existence of some dose/response ratio for laboratory animals, exposed to levels as low as 50 ppm, time weighted average, for 7 hours per day, 5 days per week, for 12 months.

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[1]Maltoni - Official Report of Proceedings, page 10.

[2]Bio-Test Lab - Exhibit No. 107 K.

[3]Gehring-Dow - P.J. Gehring, The Dow Chemical Company, Midland, Michigan. Exhibit 24 D.

Bio-Test and Maltoni have both reported the occurrence of angiosarcoma of the liver in test rats as early as 6 months after continuous exposure to 50 ppm was begun. These experiments are ongoing and have been further expanded to test the effect of exposure to levels below 50 ppm. Unfortunately, due to the requirements of long continuous exposure, large sample size and the necessity of having to allow the rats to die naturally before making an in-depth pathological examination, it appears that even preliminary findings at these new lower levels are at least 12 months away. This poses a difficult dilemna since: (1) it is generally acknowledged that the so-called "rat data" is the best evidence available; (2) both major studies undertaken have data for exposure to 50 ppm only; and (3) the proposed permanent standard has an allowable exposure level of "no detectable level."

The major pieces of bio-statistical evidence presented are:

(1) The Tabershaw-Cooper study which attempted to examine (a) the health of living workers who are or have been occupationally exposed to VCM, and (b) the medical history and cause of death of workers who had some exposure to VCM during their working lives;[4]

(2) The Mt. Sinai study of workers employed in vinyl chloride polymerizing plants for at least 5 years between 1946-1963[5];

(3) Additional work done by firms in the industry and other interested parties, all of which attempted to analyze the health of living workers and the causes of death of deceased workers[6].

No Dow!

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[4]Tabershaw - Cooper Study, Exhibit 20 J.

[5]Mt. Sinai - Exhibits 18 A-B-C.

[6]Testimony presented at the hearings by firms such as Tennecco and Goodrich, (exhibit 48c) and others, such as Dr. Peters (exhibits 22A & B).

In all of these studies, attempts were made to classify the worker sample according to average on the job exposure to VCM, job classification, and age. Incidences of all types of diseases in the groups examined (not just angiosarcoma of the liver) were compared to expected incidences of various diseases for the overall statistical group being examined.

Results varied depending upon such variables as: sample size; composition of the sample; success at contacting and receiving accurate information on all individuals included in the sample; and, the overall statistical group used for comparative purposes. All studies suggest that the actual incidence of angiosarcoma of the liver is well above the expected rate. However, no conclusive evidence was discovered regarding the incidence of other cancers or diseases.

There are some inherent limitations in studies of this type. Chief among them are:

(1) The complexity and length of time required to adequately do the study, including the previously stated problems of (a) tracing retirees and those who have changed employers, (b) examining the records of deceased employees included within the bounds of the study;

(2) The problem presented by occupational cancers, including angiosarcoma of the liver, which may have latency periods as long as 30 years. The only way known to adequately take this into account is very difficult, time consuming and expensive and requires repeated and thorough follow-ups on the exposed individuals included in the population study;

(3) The unavailability of accurate data on length and level of exposure for most workers undermines attempts at establishing level/length response ratios for human beings. Very real problems are found when one considers that these analyses are being undertaken years after a significant number of those in the sample were exposed

> and that this exposure occurred not in a controlled experimental situation, but rather in an ever-fluacting work environment where generally little or no regard was given to occupational exposure levels short of narcosis or some other less severe form of unpleasantness.

In short, as in the case of experimental animal data, results must be viewed with an eye towards their limitations; the search for immediate answers must not lead to improper conclusions. For this reason, statistical projections such as Schneiderman's must be seen for their limitations. His bio-statistical models for projected incidence of angiosarcoma of the liver in humans at various levels of exposure are premised on a human dose/response ratio analogous to that shown in the unfinished work of Maltoni and Bio-Test. His various extrapolations of the incidence of angiosarcoma of the liver in humans at levels below 50 ppm are based on two unproven hypotheses: (1) that rat reaction to VCM exposure is at least as severe as human reaction, and (2) below 50 ppm the posited risk curve is continuous with the curve above 50 ppm.

The medical evidence must be considered to be both inadequate and incomplete. Dr. Selikoff summed up OSHA's dilemna during his testimony at the public hearings when he said, "The question is--what do you do in the absence of knowledge?"[7] Current evidence seems suggestive. It points to general relationships, without being able to give specifics. It has raised the questions that must be examined and answered. What it does not do, however, is answer them.

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[7]Selikoff - Exhibits 18 A-B-C.

The Department of Labor finds itself in a position where it knows that some level of exposure at some length of time is hazardous to some workers. What is not known however is the precise nature of the interrelationship of these three variables.

2.3 ON-GOING STUDIES

The following is a list of on-going laboratory and epidemiological studies on vinyl chloride and the dates when each might be expected to produce some results.

(1) NIOSH

(a) Mortality among PVC workers compared to other occupational groups; to be completed by December 1974;

(b) Detailed industrial hygiene survey and special medical evaluation of at least three more PVC plants during the first and second quarters, fiscal year 1975;

(2) Bio-Test Laboratories

Continuing previous rodent studies at VC exposure levels below 50 ppm; to run for 18 months;

(3) Professor Ceasare Maltoni

Continuing previous rodent studies at exposure levels of 25, 10 and 1 ppm; to have initial results not later than two years from the present;

(4) Organization Resources Counselors, Inc.

Mortality study of workers from all five industry layers; to be completed by the end of 1974;

(5) Industry

(a) Various firms undertaking individual experiments on the physical responses of animals to vinyl chloride exposure; completion dates unknown;

(b) Various firms in the VCM and PVC producing industries undertaking medical surveillance of present and past employees; completion dates unknown.

SECTION III: METHODOLOGY

3.0 INTRODUCTION

A major difficulty with this study was in collecting the data necessary to gauge economic and technological impact. In this section, the structure and methodology of this report, as well as specific problem areas, are sketched in order to given the reader a feel for the report's thrust approach.

3.1 THE PROBLEM

Problems encountered in collecting information on the compounders, processors, and fabricators were formidable. Aside from the most rudimentary statistical statements on production, there is little reliable data available to answer the following fundamental questions:

(1) number of firms

(2) number of workers employed in the industry

(3) product flow in terms of raw materials, manufacturing processes, and end products

(4) worker exposure levels to vinyl chloride

(5) availability and adaptability of substitutes

(6) residual monomer levels in the resins and compounds used

(7) market history and forecast for PVC goods

(8) cost estimates for these layers to come into compliance with the "no detectable level" proposed standard in terms of

(a) corporate funds,
(b) new equipment,
(c) altered work practices,
(d) and diminished productivity.

3.2 RESEARCH APPROACH

In order to address these questions, extensive data collection was necessary. Sources utilized include:

(1) all private and governmental submissions to OSHA concerning the proposed vinyl chloride standard including pre and post hearing comments, hearing testimony and hearing exhibits;

(2) additional data submissions to the Department of Labor not included as part of the official record;

(3) OSHA compliance reports on inspection visits to PVC compounders, processors and fabricators;

(4) plant visits by OPER personnel;

(5) review of trade and technical literature relating to the three above-mentioned industry layers; and

(6) telephone interviews and personal contacts with representatives of various firms in the PVC industry.

An attempt to uncover further data by enlisting the assistance of the Industrial Union Department of the AFL-CIO proved fruitless.

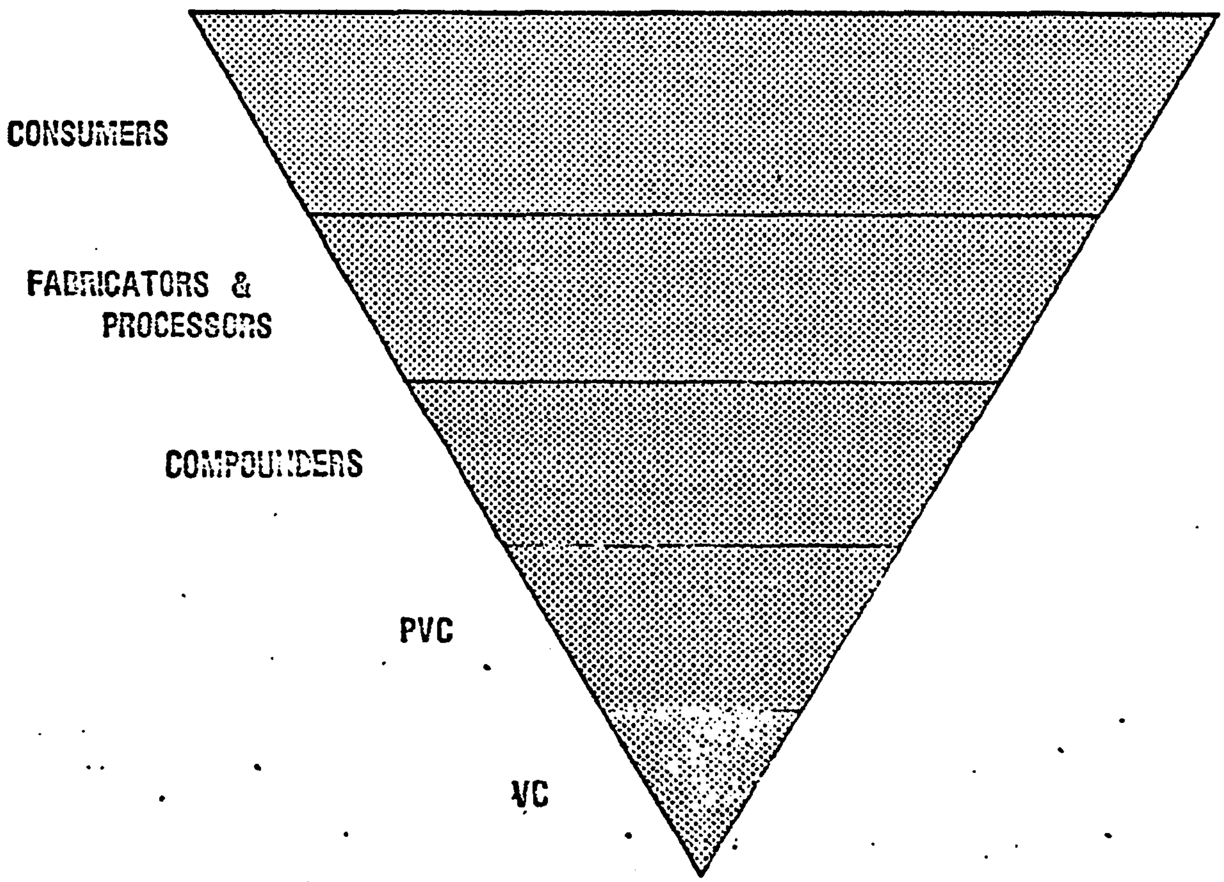
Characteristically, the information gathered consisted of much opinion and speculation with few hard facts. The reason for this, quite clearly, was vinyl chloride's sudden emergence as a serious occupational health hazard. Attempts had never been made to answer many of these questions because of the difficulties inherent in doing so. The industry was growing rapidly and parameters such as number of firms and employees were changing continuously. It appears that, although answers to many of these questions would have proven useful, the attitude prevalent among members of the compounding, processing and fabricating industries was that answering these questions was just "more bother that it was worth." Hence, it was not attempted.

Another factor which complicated data collection is the lack of attention paid to direct compliance issues by compounders, processors and fabricators. Because of the nature of their business and the low recorded exposure levels, many have assumed that their only real problem with the proposed standard is the potential loss of their resin supplies. The direct effects of the proposed regulation have not been adequately examined for impact. For this reason, Section 5.5 on the Cost of Compliance, for example, was particularly difficult to prepare. Industry estimates of the cost of particular requirements to compounder, processor and fabricator were just not done. Consequently, all of the work presented here represents final best estimates, based upon all the available information.

As in any report of this type, there is a certain inexactitude imposed upon it by the lack of definitive data and previous work done in the subject area.

INDUSTRY STRUCTURE
FOR COMPOUNDERS, PROCESSORS, FABRICATORS
OF POLYVINYL CHLORIDE RESINS
AND COMPOUNDS

ILLUSTRATION - 1



SECTION IV: INDUSTRY STRUCTURE AND TECHNOLOGY

4.0 INTRODUCTION

In order to fully comprehend the potential impact of any proposed standard, it is first necessary to understand the structure of the industry (s) affected. In the case of vinyl chloride/polyvinyl chloride, there are five such industry layers connected one to another by a series of inter-dependent relationships. They comprise what has come to be called the "vinyl chloride industry" .

The total industry can be envisioned as an inverted pyramid, divided into 5 industry process layers (see illustration 1).

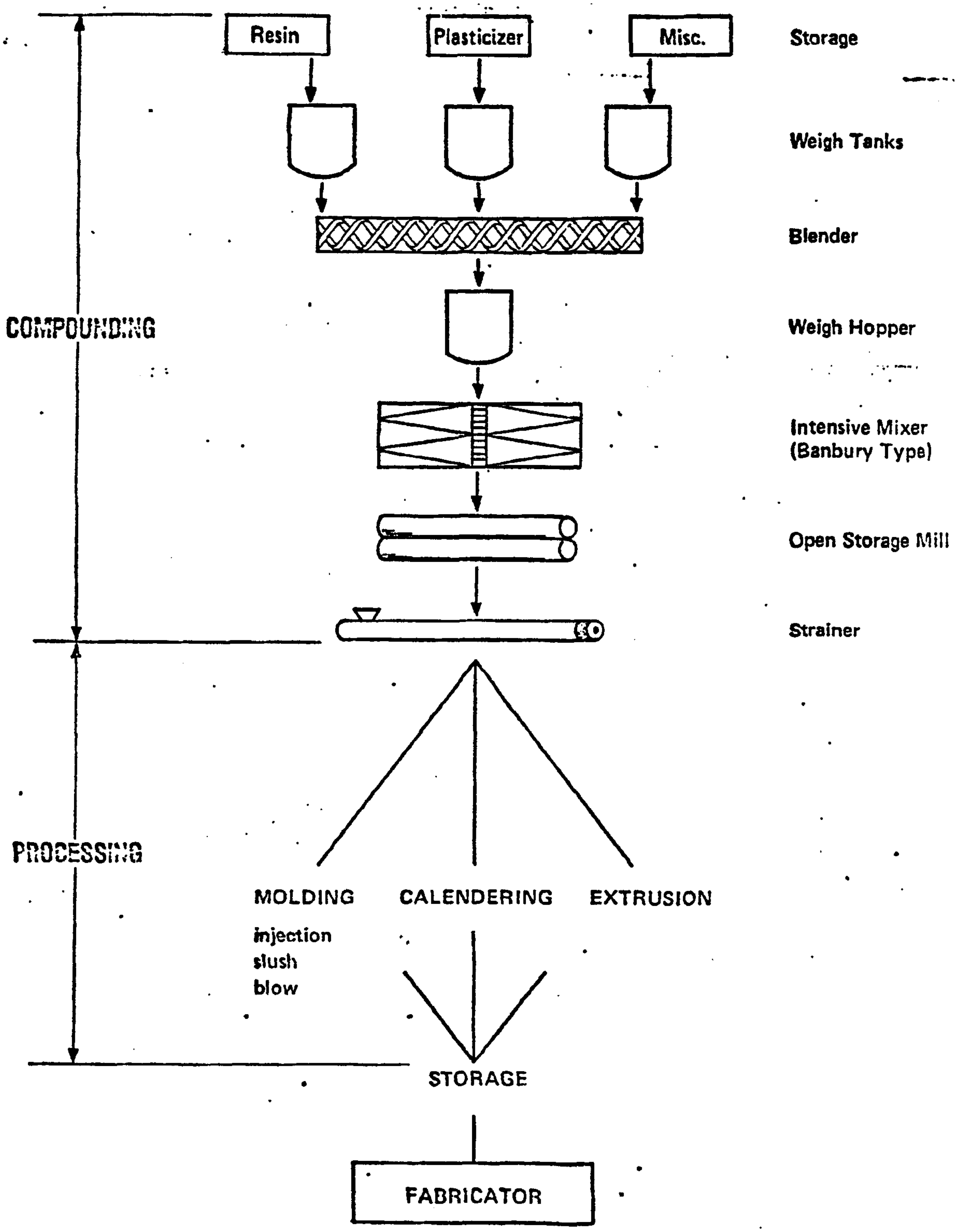
-vinyl chloride monomer (VCM) production
-polyvinyl chloride (PVC) production
-polyvinyl chloride compounding
-polyvinyl chloride processing
-polyvinyl chloride fabrication

As can be seen the entire structure rests on the VCM producing industry. Without liquified gas, polymerization(the manufacture of PVC resin) could not take place. The compounding, processing and fabricating industries, for their part are dependent on a steady supply of PVC resin to remain in business. There is a very real direct "ripple effect" on the compounders processors, and fabricators if VCM or PVC production is altered. In recent months, for example, shortages of petro-chemicals have constrained production of VCM, which has in turn, resulted in a reduction in the supply of PVC to the downstream industry layers. Reports have surfaced of individual processors and fabricators in serious trouble, even being forced out of business, due to the unavailability of their requisite resin.

At the outset of this study, it was determined that each industry layer would be impacted differently by the proposed standard and that they must be examined individually as well as in relation to each other. Part 1 of the report

FLOW DIAGRAM FOR COMPOUNDING AND PROCESSING OF VINYL CHLORIDE RESINS AND COMPOUNDS

ILLUSTRATION - 2



V.

deals with the structure and technology of the VCM and PVC producing industry layers. This section will do the same for the PVC compounding, fabricating, and processing industries. Specifically, it will describe each in terms of its size, employment, functions, and technology.

4.1 COMPOUNDERS

Below the VCM and PVC producing industry layers there are three others which could be impacted by the proposed standard. These are the PVC compounders, processors, and fabricators. As in most modern industries, a significant number of vertically integrated firms are to be found as well.

There are currently upwards of 200 compounding operations in this country. Due to lack of information and the fact that the great majority of these operations are integrated with others, the number of people employed in compounding is unknown. Estimates range to upwards of 1500 people. 7 per?

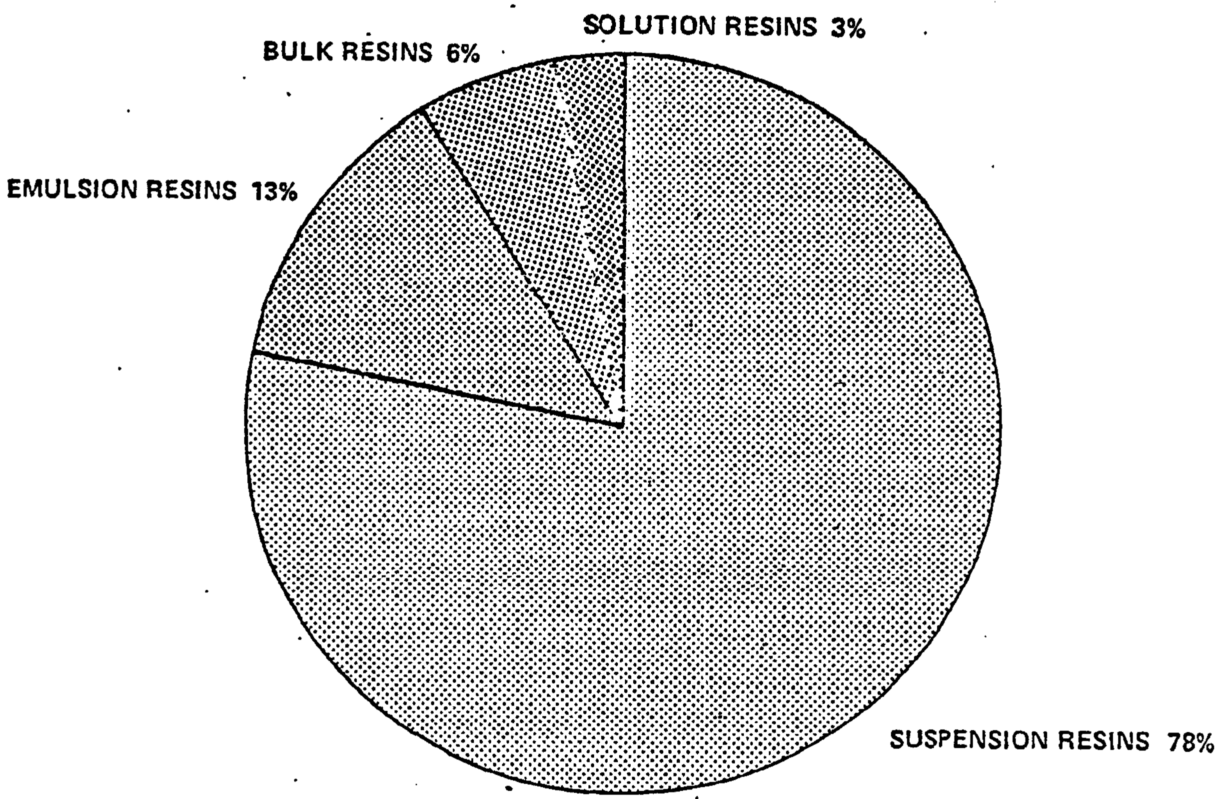
The essential operation in compounding is mixing. It involes the blending of additives with raw resin in order to give the new mixture desired qualities of color, strength, flexibility, stability, and heat resistance.

Within the compounder classification there are two types: those that compound only, independents, and those that perform more than one operation, vertically integrated compounders. Independents either produce compound for specific contract customers or sell it themselves to processors and processors/fabricators within the market for compound. There are currently an estimated 20-50 independents operating in the U.S. whose customers run the gamut of size and end use.

Vertically integrated compounders produce a precentage of their total production for the captive market of their firm's other operations. Integrateds vary widely according to size, with customers again ranging from so-called "ma and pa" operations all the way to major corporate giants. The total number of vertically integrated compounders may exceed 150.

TOTAL POLYVINYL CHLORIDE RESIN PRODUCTION BY METHOD (1972)

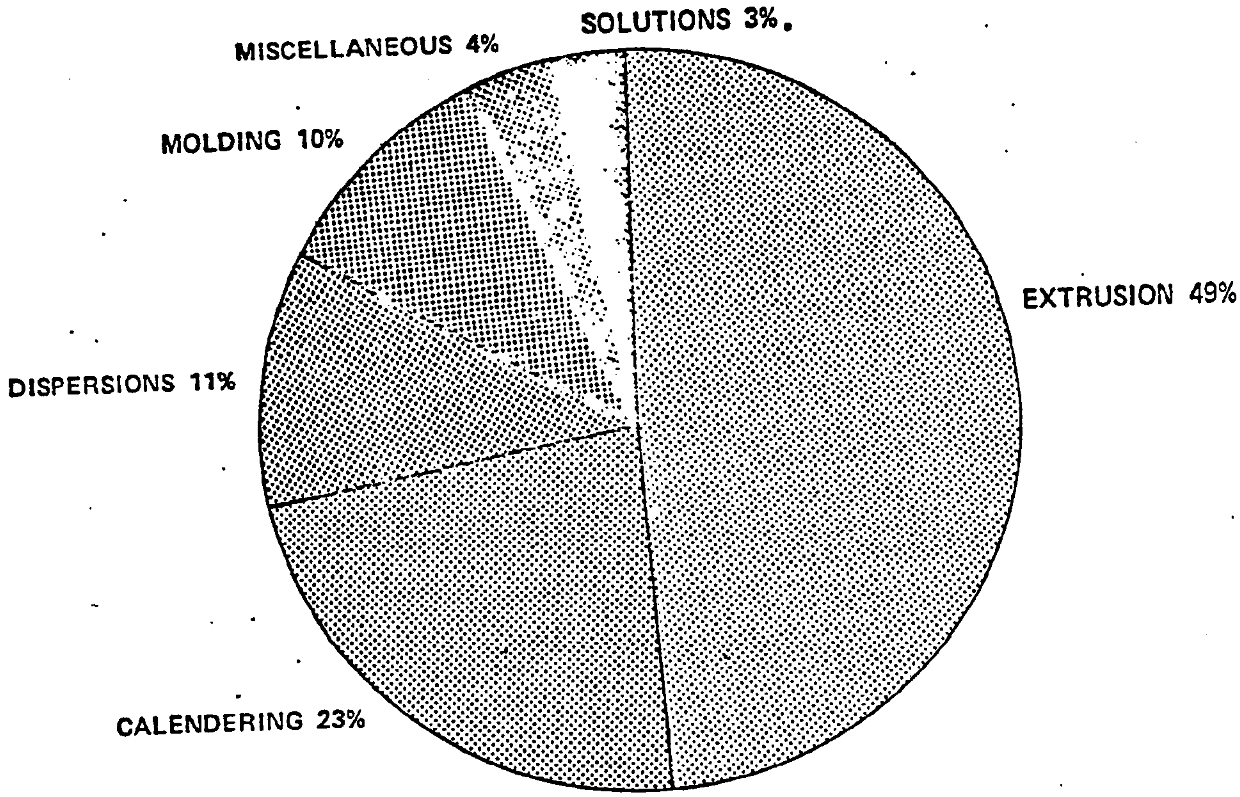
ILLUSTRATION - 3a



SOURCE:
CHEMICAL ECONOMICS HANDBOOK, STANFORD RESEARCH INSTITUTE

1972 CONSUMPTION OF POLYVINYL CHLORIDE RESINS BY PROCESS

ILLUSTRATION - 3b



SOURCE:
CHEMICAL ECONOMICS HANDBOOK, STANFORD RESEARCH INSTITUTE

4.2 PROCESSORS

For the purposes of this report, processors are defined as consumers of PVC raw resin and compound. Products turned out by processors range from semi-finished plastic sheet to a variety of finished plastic goods.

The best estimate currently available of the number of processors is between 3000-4000. This figure was arrived at after first determining through census data that there are approximately 24,000 establishments listed under Standard Industrial Classification of plastic, rubber and leather goods manufacturing (SIC 30 and 31).[1] Then, using an industry estimate that between 16% and 17% of all goods contain PVC, a figure of between 3800-4000 processors was derived.[2] Questioning of industry representatives on this subject has generally sustained this estimate. It is felt that this estimate, given present available information, is the best one available.

Within the generic term, processing, there are five major types. Illustration 3 shows the distribution of PVC production by process. Note that extrusion alone accounts for almost one half of all PVC processed in this country. Illustration 4 shows the growth in use of the four major processes over time. Again, note the size and growth of extrusion.

Brief description of the processes are the following:

a) extrusion - PVC powders or pellets are heated and are forced through a shaping orifice (die), becoming one continously formed plastic piece.[3] Examples of goods produced by extrusion are pipe, electrical conduit, insulation and garden hose.

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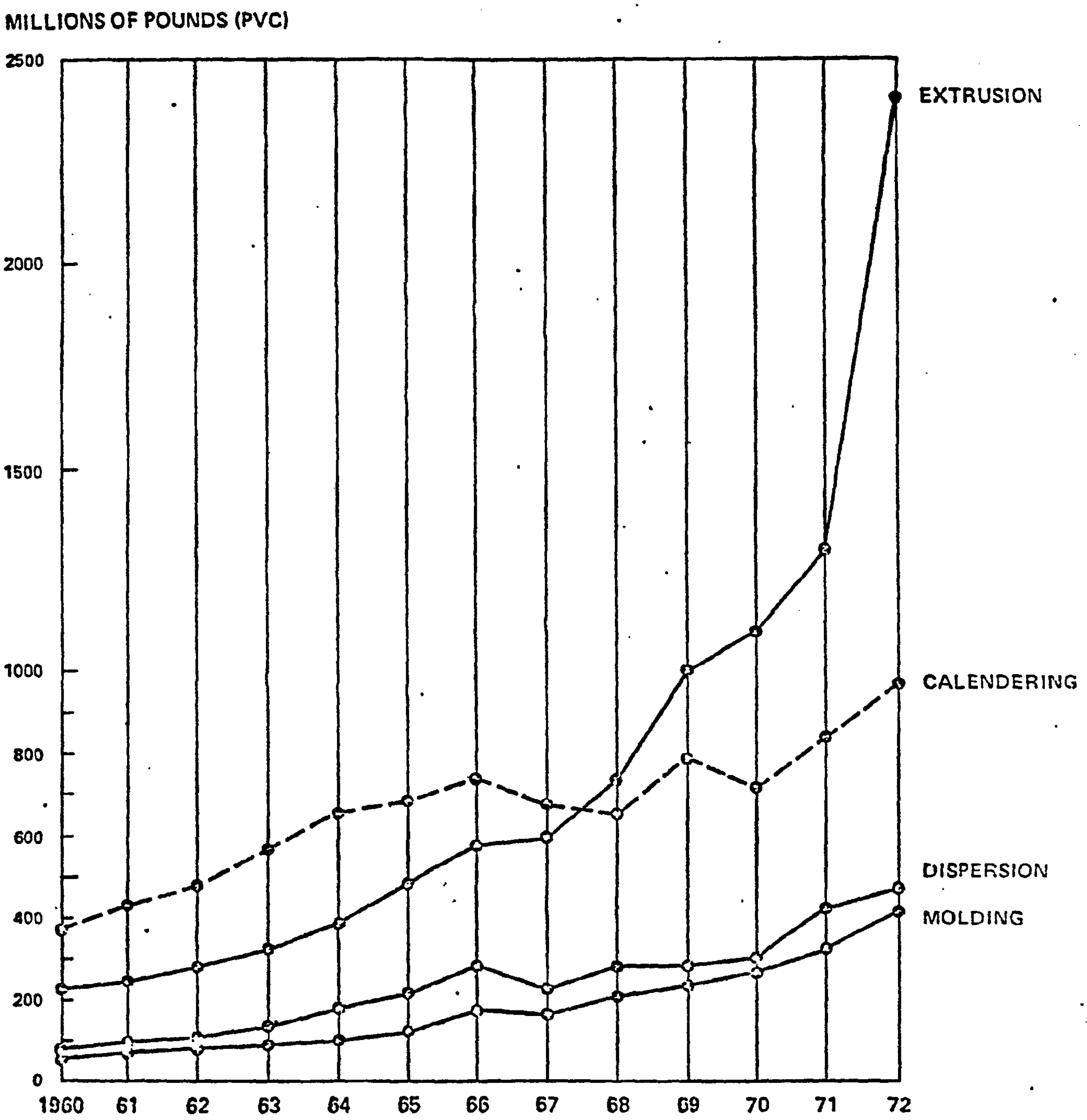
1 Standard Industrial Classification for the United States, SIC 30 and 31.

2 Information supplied by the B. F. Goodrich Company.

3 "Theory and Practices of Vinyl Chloride Compounding", Argus Chemical Company, Victor R. Struber, pg. 60.

POLYVINYL CHLORIDE CONSUMED BY PROCESS

ILLUSTRATION - 4



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b) calendering - PVC pellets or powdered compounds are fed directly onto the hot rollers of the calender.[4] As the mass is continously re-worked into plastic sheeting, it travels over and between a series of rollers. By the time the plastic reaches the finishing rollers, it may have traveled over 350 feet. Vinyl flooring and plastic film are examples of calendered products.

c) dispersion - This is a process in which finely divided compound is distributed uniformly throughout another material by equipment similar to an adapted paint mixer. The liquid mixture produced is then poured into a rotation molder for final shaping. Amoung the products made in this process are athletic balls, children's toys, boots and vinyl apparel.

d) injection molding - Granular or powder blends of compound are fed into screw-type molding machines. The rotation of the screw produces a uniform melt which is then injected into a mold at very high pressure.[5] The process is essentially a closed one from beginning to end. Major advantages to processors using injection molding come from the fact that the finished product requires no additional burring, the process leaves no scrap, and scores very high on quality control. Products made by injection include appliance and automobile parts, pipe fittings and telephone hand sets.

e) blow molding - Blow molding equipment is designed specifically for PVC resin. Most equipment is based either upon reciprocating in-line-screw-type injection[6] molding units or the continuous extrusion of plastic through a special tube-die.

4.3 FABRICATORS

This is the final level that could be affected by an OSHA regulation. Fabricators are the consumers of plastic sheet and extruded tubing for the production of marketable consumer goods. Industry estimates the number of fabricators to be 8000. With the restrictions imposed by our definition, this figure could drop to as low as 4000 firms.

The number of workers employed in both the fabricating and the processing segments of the industry ranges upwards of 320,000. This figure was derived by a method similar to that used in determining the number of processors: taking 16% to 17% of the total worker population of SIC codes 30 and 31.

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4 "Modern Plastics Encyclopedia" McGraw Hill, pg. 109.

5 Ibid.

6 Opsit, footnote #3, chapter 4.

Vinyl chloride exposure levels are lower at the fabrication sites than at the other four industry layers. Data form industry submissions and OSHA inspections (see Table 17) show that they are presently operating at levels below 5 ppm TWA, with more than 95% of the sample readings being below 15 ppm TLV.

SECTION V: FINDINGS

5.0 INTRODUCTION

Five major findings are presented here. They are divided into two groups:

(1) Demand/supply conditions for PVC, encompassing price, supply present uses, and possible substitutes.

(2) Areas directly related to problems of compliance, including discussion of the current situation with regard to occupational exposure and residual VCM levels as well as estimated costs of compliance with various provisions of the proposed standard.

5.1 MARKET FOR PVC

The current market for PVC shows a strong excess of demand over supply. This is primarily due to two factors:

(1) Growing demand for PVC resins on the part of industry;

(2) The current world shortage of petro-chemical feedstocks, a cornerstone of VCM (and thus PVC) production.

Estimates of this excess of demand range as high as 20-30% in some industries, with a good general average probably being in the neighborhood of 10%.

Specifically, growing demand has been a function of five forces:

(1) The widespread applicability of PVC resins;

(2) The falling price of PVC in the last thirteen years. A quick look at the price history of resin illustrates this point:[1]

Year	Average Value/lb.
1960	23.2
1965	17.3
1970	13.5
1973	13.0
1974	23.5

[1] Snell Preliminary Report, Exhibit III-11.

But, even though the average price has risen by a full 10¢ per pound in the last 12 months, we have not seen PVC priced out of markets. Indeed, demand seems to have risen with price, which indicates that consumers of resin still consider PVC processing and fabricating an economically viable endeavor, even at prices as much as 100% above a year ago.

(3) Until quite recently, buyers were able to obtain 100% of their PVC requirements without difficulty. Future prospects for price and supply seemed favorable, prompting more and more firms to get PVC into their operations.

(4) Before the recent concern for worker exposure to VC, PVC resin was an easily handled commodity. As a virtually non-flammable, non-volatile resin, it was easily transported and stored.

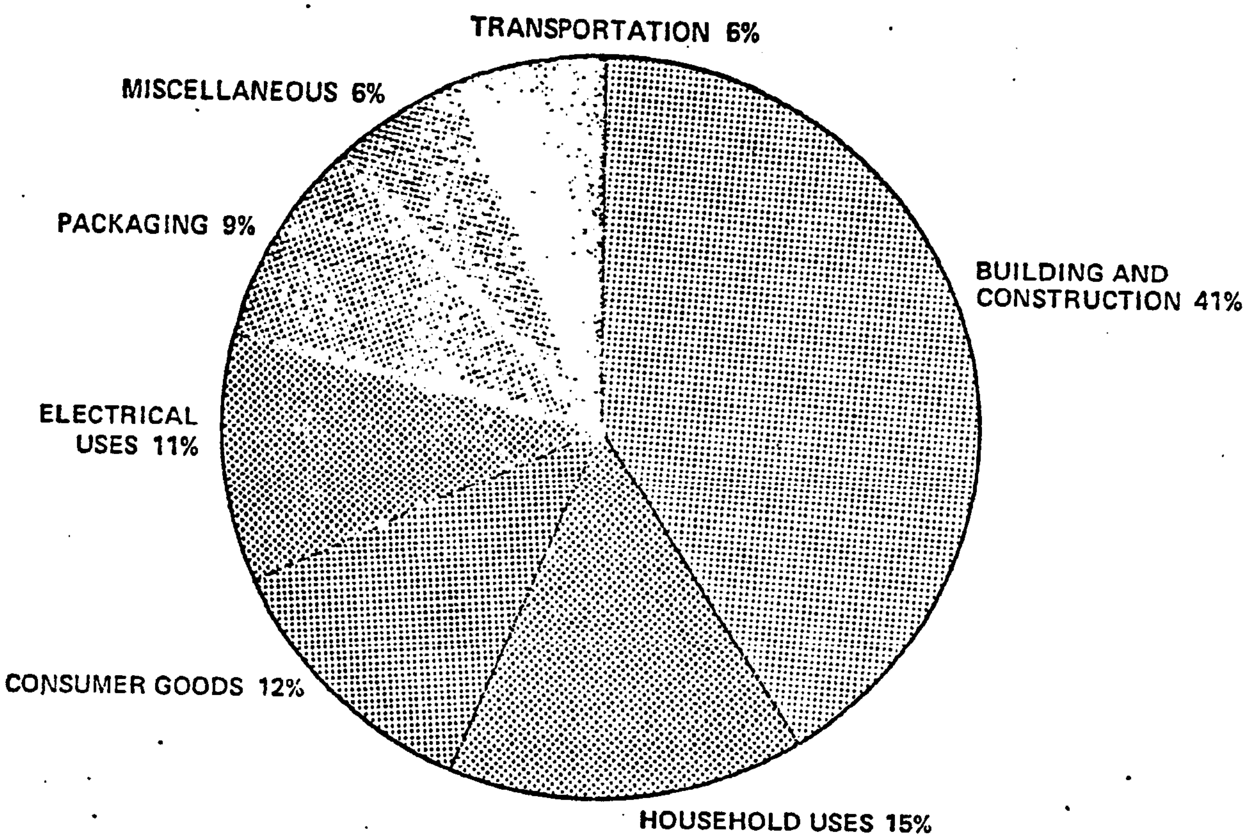
(5) Consumer demand for goods in which PVC was used has increased in recent years. Among these products are throwaway containers, bubble packaging, furniture and upholstery.

The supply problem caused by the scarcity of petro-chemical feedstocks gives the appearance of developing into a chronic one. There are few, if any, substitutes for the hydrocarbons used in the VCM production. The short term and intermediate prospects for the industry are to adapt itself to the current supply situation while the oil industry searches for new sources of petro-chemicals.

As can be seen in diagram 5, there are five major end uses for PVC; building and construction, household uses, consumer goods, electrical uses and packaging. Diagrams 6 through 10 break these five down further according to product use.

END USE OF POLYVINYL CHLORIDE RESINS (1972)

ILLUSTRATION - 5

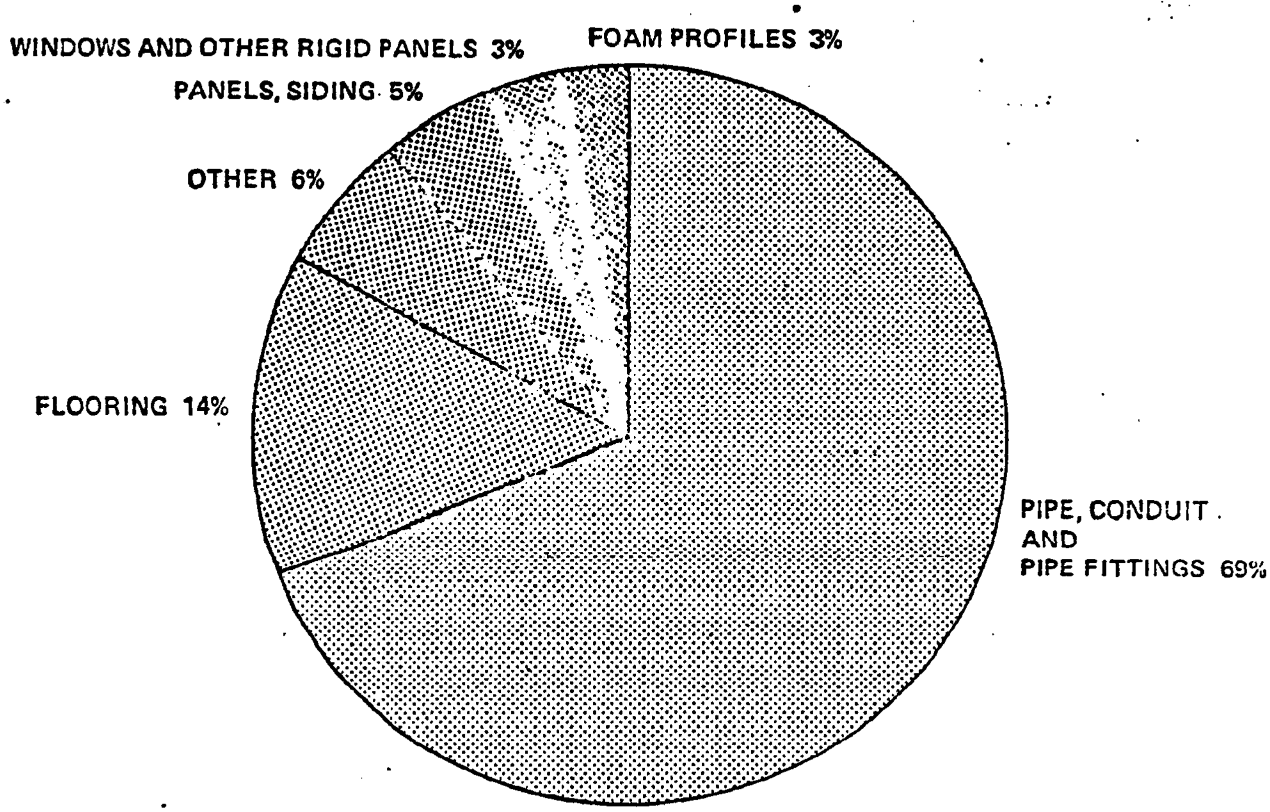


SOURCE:
CHEMICAL ECONOMICS HANDBOOK, STANFORD RESEARCH INSTITUTE

POLYVINYL PRODUCTS IN BUILDING & CONSTRUCTION INDUSTRY

(41% OF TOTAL RESINS)

ILLUSTRATION - 6

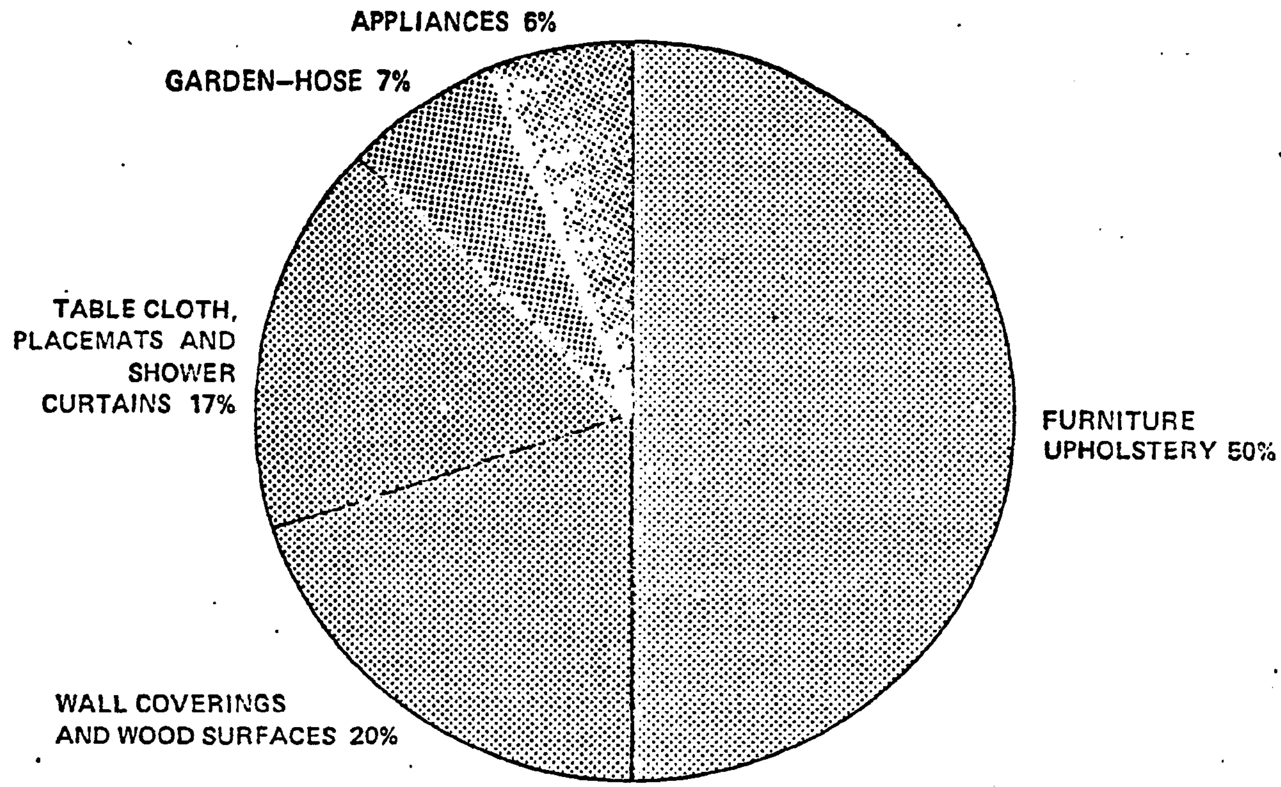


SOURCE:
CHEMICAL ECONOMICS HANDBOOK, STANFORD RESEARCH INSTITUTE

POLYVINYL PRODUCTS IN HOUSEHOLD USES

(15% OF TOTAL RESINS)

ILLUSTRATION - 7

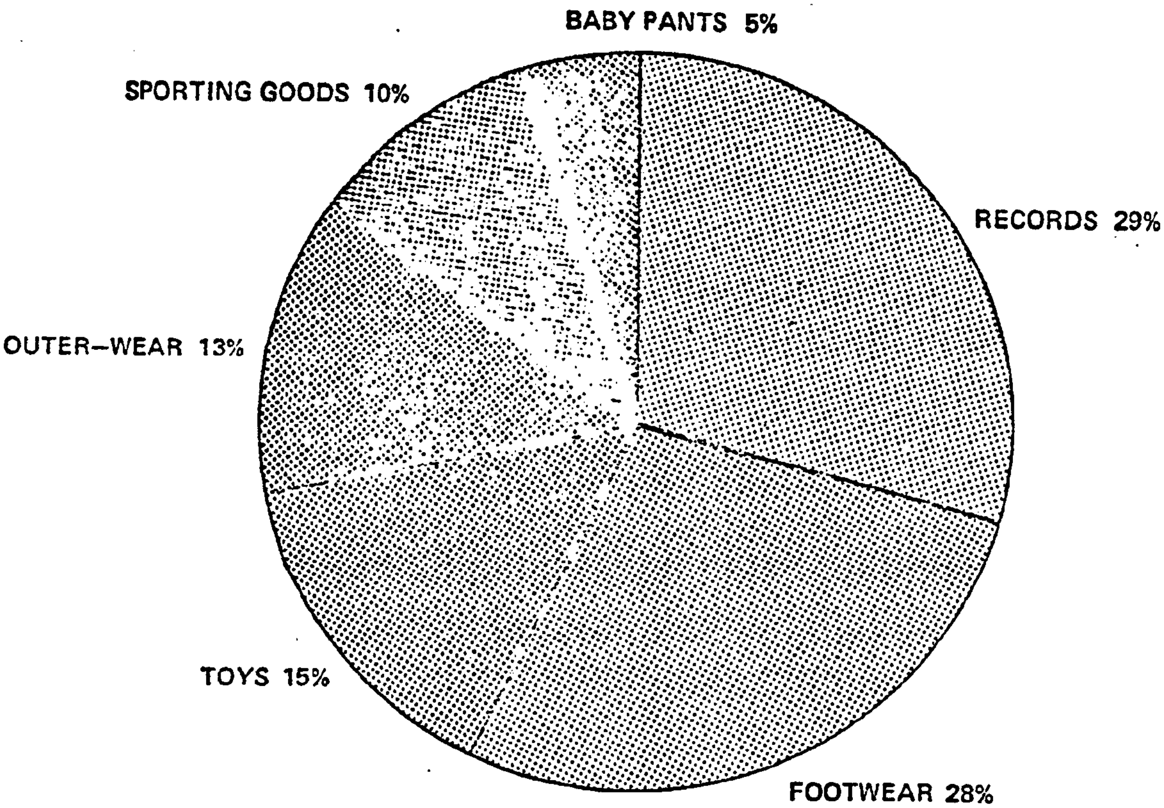


SOURCE:
CHEMICAL ECONOMICS HANDBOOK, STANFORD RESEARCH INSTITUTE

POLYVINYL PRODUCTS IN CONSUMER GOODS

(12% OF TOTAL RESINS)

ILLUSTRATION - 8

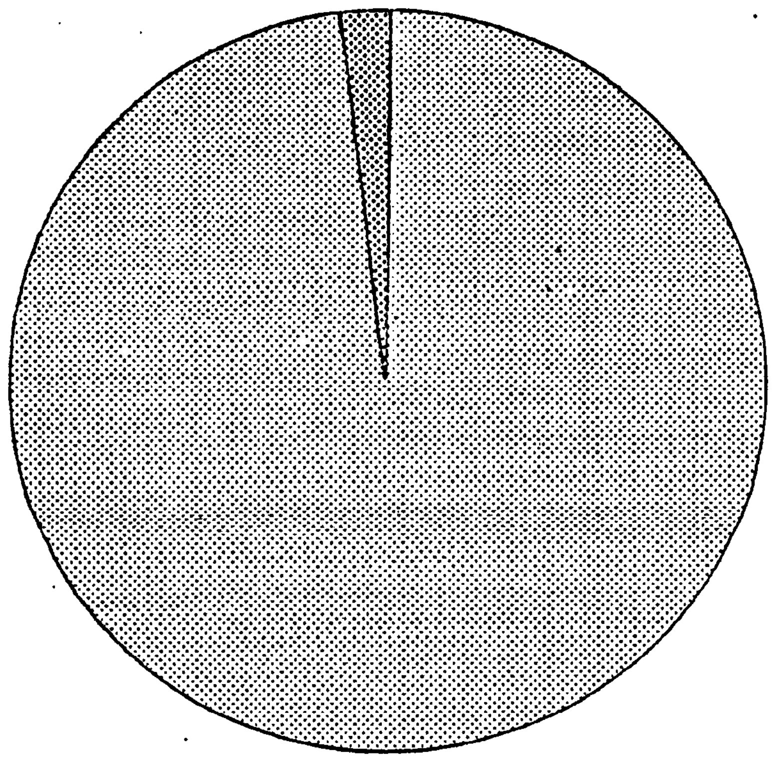


SOURCE:
CHEMICAL ECONOMICS HANDBOOK, STANFORD RESEARCH INSTITUTE

POLYVINYL PRODUCTS IN ELECTRICAL USES

(11% OF TOTAL RESINS)

ILLUSTRATION - 9

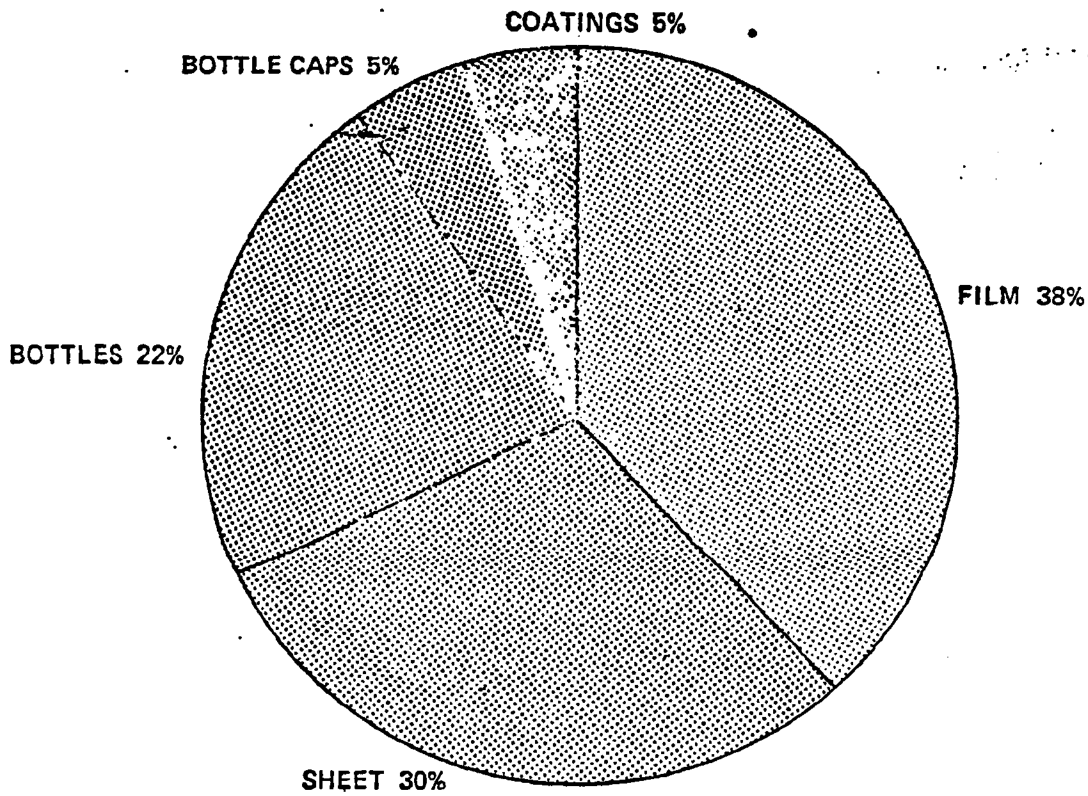


SOURCE:
CHEMICAL ECONOMICS HANDBOOK, STANFORD RESEARCH INSTITUTE

POLYVINYL PRODUCTS IN PACKAGING INDUSTRY

(9% OF TOTAL RESINS)

ILLUSTRATION - 10



SOURCE:
CHEMICAL ECONOMICS HANDBOOK, STANFORD RESEARCH INSTITUTE

5.2 POSSIBLE SUBSTITUTES

In looking into the subject of alternatives to PVC resin, major substitutes were evaluated for their adaptability, availability and cost. Findings tended to dismiss the major known substitutes as not economically viable.

If one defines substitutes as being both technologically feasible and economically viable from the point of view of an individual PVC processor or fabricator, there are few, if any, good substitutes presently available. The major reasons for this conclusion are:

(1) Difficulties imposed by adaptability of the substitute into the firm's production process;

(2) Inadequate supplies of the material available in the relatively short run;

(3) Prices for the substitutes which are considerably higher than current PVC price levels.

In the area of adaptability, there are few substitutes that could be used in a PVC processor or fabricator's plant without major retooling and very substantial capital outlays. Indeed, one group of substitutes, comprised of wood, steel, aluminum, cement and rubber are products with qualities unrelated to plastics and thus must outright be dismissed as infeasible by firms currently producing plastic goods.

Thermoplastics, the other major group of substitutes, made up of ethylene, polyethelene, melamine and ABS, are also not particularly feasible. Although retooling by some PVC processors could be a possibility, it would be very costly. In addition, these four, being thermoplastics like PVC, suffer from the same supply constraints PVC does due to shortages of the requisite petro-chemical feedstocks.

The other major drawback to alternative thermoplastics is price. Although they could conceivably be substituted for PVC in the production of some building and construction, home furnishings and packaging uses, costs for the raw materials would range from double for ABS and polyester, to almost four times PVC, for melamine.

5.3 EXPOSURE OF WORKERS

Levels of worker exposure to vinyl chloride are generally "low" in the compounding, processing, and fabricating industry layers. Analysis of monitoring data supplied to OSHA through the public hearings shows that:

86% of all readings were under 1 ppm

92% of all readings were under 2 ppm

96% of all readings were under 5 ppm

98% of all readings were under 10 ppm

(See Table 11 for more detailed results)

These figures were checked against readings taken during official OSHA inspections of PVC compounding, processing, and fabricating operations. Results of this cross-checking tended to corroborate the evidence supplied at the hearings and from other sources.

EXPOSURE LEVELS OF VINYL CHLORIDE IN BREATHING ZONE FOR WORKERS, FOR COMPOUNDERS, PROCESSORS & FABRICATORS*

ILLUSTRATION - 11

Company	No. of samples	Exposure in Parts per Million (as a Cumulative Percent of Total Samples)**								
		≤1	≤ 2	≤3	≤4	≤5	≤10	≤15	≤20	≤25
Diamond Shamrock	137	81.3%	88.0%	89.6%	91.8%	92.6%	97.0%	98.5%	100.0%	–
Robintech	202	81.7	89.0	90.6	91.6	92.6	95.5	96.0	100.0	–
B.F. Goodrich	139	95.7	97.1	97.1	97.1	97.1	99.3	100.0	–	–
Sperry Rubber & Plastics	8	100.0	–	–	–	–	–	–	–	–
Johns-Manville	195	91.8	95.4	95.9	96.4	96.4	99.0	99.5	100.0	–
Harvey Hubbell (Kerite Corp.)	7	100.0	–	–	–	–	–	–	–	–
Pandell Bradford	35	94.3	97.1	100.0	–	–	–	–	–	–
Steere Enterprises	45	86.7	88.9	88.9	93.3	95.6	95.6	100.0	–	–
Diamond Shamrock (Painesville)	15	86.7	93.3	100.0	–	–	–	–	–	–
Uniroyal (Mishawaka)	30	40.0	60.0	76.7	83.3	86.7	90.0	96.7	96.7	96.7
Firestone (Film & Sheet)	19	94.7	94.7	94.7	100.0	–	–	–	–	–
A. Schulman	26	92.3	96.2	96.2	100.0	–	–	–	–	–
Goodyear Tire & Rubber Co.	14	50.0	100.0	–	–	–	–	–	–	–

*Data were derived from Vinyl Chloride Hearings' Exhibits.

** Various personal sampling devices and air bags.

ILLUSTRATION - 12

EXPOSURE LEVELS OF VINYL CHLORIDE IN BREATHING ZONES FOR WORKERS FOR COMPOUNDERS, PROCESSORS & FABRICATORS (from OSHA inspections)

COMPANY	SAMPLES	NO DETECTABLE	1 ppm	2 ppm	3 ppm	4 ppm	5 ppm	10 ppm	15 ppm	20 ppm	25 ppm
H.O. Canfield of IN.	10	90%	90%	90%	100%	-	-	-	-	-	-
Custom Trim Products	8	88	100	-	-	-	-	-	-	-	-
RSG Sloan Mfg.	8	100	-	-	-	-	-	-	-	-	-
C.M. Paula Co.	7	14	14	100	-	-	-	-	-	-	-
Royal Plastics Inc.	4	75	100	-	-	-	-	-	-	-	-
Endura Plastic Inc.	4	100	-	-	-	-	-	-	-	-	-
Sandrew Inc.	4	100	-	-	-	-	-	-	-	-	-
Weber Enterprise	1	0	0	100	-	-	-	-	-	-	-
General Cable Co.	2	100	-	-	-	-	-	-	-	-	-
Jet Stream Plastic	4	0	0	0	0	0	0	100	-	-	-
General Tire & Rubber	2	0	0	100	-	-	-	-	-	-	-
Cement, Rubber, Asbestos	2	0	0	100	-	-	-	-	-	-	-
Amsco Chemical	6	0	50	67	67	67	83	100	-	-	-
Mecklandburg	2	0	0	100	-	-	-	-	-	-	-
Modern Pipe	2	0	0	100	-	-	-	-	-	-	-
DeWitt Shoe	2	0	50	50	100	-	-	-	-	-	-
Swann Rubber	4	0	75	75	75	75	100	-	-	-	-

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ILLUSTRATION - 12, continued

COMPANY	SAMPLES	NO DETECTABLE	1 ppm	2 ppm	3 ppm	4 ppm	5 ppm	10 ppm	15 ppm	20 ppm	25 ppm
Mi-Ice Runner Lures	4	50%	75%	75%	75%	75%	100%	-	-	-	-
Matheson Gas	5	100	-	-	-	-	-	-	-	-	-
Gifford Hill Co. (Resin Extrusion)	4	50	50	50	50	50	50	50	50	50	100
Gifford Hill Co. (PVC resin mix)	5	0	0	* THE RANGE OF THE SAMPLES WERE 31 ppm - 104 ppm *					0	0	0
Phoenix Cable	1	0	0	100	-	-	-	-	-	-	-
Western Electric	7	0	57	100	-	-	-	-	-	-	-
Quality Plastics Co.	4	100	-	-	-	-	-	-	-	-	-
Continental Industries	2	100	-	-	-	-	-	-	-	-	-
Nebraska Plastic Inc.	2	0	100	-	-	-	-	-	-	-	-
J.F. McElwain	10	0	0	70	100	-	-	-	-	-	-
Tug Portland	2	0	100	-	-	-	-	-	-	-	-
State Wire & Cable	2	100	-	-	-	-	-	-	-	-	-
Packaging Systems	15	0	0	93	100	-	-	-	-	-	-
Majestic Extruders	3	67	100	-	-	-	-	-	-	-	-
Pulse Plastics Products	5	80	100	-	-	-	-	-	-	-	-

ILLUSTRATION - 12, continued

COMPANY	SAMPLES	NO DETECTABLE	1 ppm	2 ppm	3 ppm	4 ppm	5 ppm	10 ppm	15 ppm	20 ppm	25 ppm
Mercury Plastics	1	100'	-	-	-	-	-	-	-	-	-
Modern Miltex Corp.	5	0	0	40	40	40	40	80	100	-	-
Rues Div. of Hooker Chemical Company	5	0	20	40	80	80	100	-	-	-	-
Atlantic Wire & Cable	5	0	0	80	80	80	80	80	100	-	-
Interstate Mfg. Co.	3	0	0	67	100	-	-	-	-	-	-

<u>TOTALS</u>

COMPANY	SAMPLES	NO DETECTABLE	1 ppm	2 ppm	3 ppm	4 ppm	5 ppm	10 ppm	15 ppm	20 ppm	25 ppm	More
37	160	60	22	48	10	1	2	7	2	0	3	5
Percent in each range		37.50	13.75	30.00	6.25	.625	1.25	4.375	1.25	0.00	1.875	3.12
CUMULATIVE PERCENTAGES		37.50	51.25	81.25	87.50	88.125	89.375	93.75	95.00	95.00	96.875	

Of the three industry layers in question, the compounders have the most exposure. Processing has less exposure by virtue of the fact that it subjects PVC compounds, which still contain some small amounts of residual VCM to heat pressure. Fabricating, the fashioning of a finished product from an intermediate one made through processing, is the most removed from possible worker exposure to VCM.

Some reasons for the feasibly higher exposure levels at the compounding layer are:

(1) Compounders work with raw resin which still has much of the original residual VCM entrapped within it. This is especially true today due to the high market demand for PVC. Raw resin spends very little time in inventory between the time it is produced and the time it is compounded. The result is that the release of residual monomer, which naturally takes place over time, is limited.

(2) The mixing and blending operations accelerate the release of residual VCM by heating the resin. Even though venting is done above the mixers and mixer operators do not normally get near the top of an operating vessel, there is an inevitable release of residual into the ambient air of the workplace.

It can be argued, however, that processors, fabricators, and processors/fabricators really do not have an exposure problem at all. Referring back to our monitoring data, 81% of all readings from both the hearings and OSHA inspections taken at these layers indicate exposure levels of one ppm (TLV) or less. The evidence becomes even stronger if allowable exposure becomes defined as an eight hour time weighted average (TWA) which allows for excursions above one ppm and gives a better picture of the true exposure level.

EXPOSURE LEVELS FROM PUBLIC HEARINGS

ILLUSTRATION - 13

EXPOSURE LEVELS	# of FIRMS*	% of FIRMS	CUMULATIVE %
No Detectable	(Not Available)		
1 ppm	2	14	-
2 ppm	2	14	29
3 ppm	2	14	43
4 ppm	2	14	57
5 ppm	-	-	57
10 ppm	-	-	57
15 ppm	2	14	71
20 ppm	3	21	93
25 ppm	-	-	93
Over 25 ppm	1	7	100

* Number of firms with 100% of all available samples (from breathing zones) below or equal to the listed exposure levels.

EXPOSURE LEVELS FROM OSHA INSPECTIONS

ILLUSTRATION - 14

EXPOSURE LEVELS	# of FIRMS*	% of FIRMS	CUMULATIVE %
No Detectable	9	24	-
1 ppm	6	16	41
2 ppm	8	22	63
3 ppm	5	13	76
4 ppm	-	-	76
5 ppm	3	8	84
10 ppm	2	5	89
15 ppm	2	5	94
20 ppm	-	-	94
25 ppm	1	3	97
Over 25 ppm	1	3	100

* Number of firms with 100 % of all available samples (from breathing zones) below or equal to the listed exposure levels.

EXPECTED VALUE OF EXPOSURE LEVELS*
(Information from Public Hearings)
ILLUSTRATION - 15

	(A) # of Samples at Each Level	(B) Exposure Level (ppm)	(A X B)
	766	1	766
	53	2	106
	13	3	39
	13	4	52
	7	5	35
	21	10	210
	8	15	120
	10	20	200
	0	25	0
TOTAL 1	891		1528/891 = 1.7 ppm
	1	100 (est.)	100
TOTAL 2	892		1628/892 = 1.8 ppm

* The average of all possible samples gives the Expected Value (EV). As the sample size continues to increase, the difference between the Time Weighted Average (TWA) and the EV approach zero. Thus, the two terms become more nearly interchangeable. The current operating levels were estimated using the above procedure.

EXPECTED VALUE OF EXPOSURE LEVEL*
(Data supplied by OSHA inspections)

ILLUSTRATION - 16

	(A) # of Samples at Each Level	(B) Exposure Level (ppm)	(A X B)
	60	0	0
	22	1	22
	48	2	96
	10	3	30
	1	4	4
	2	5	10
	7	10	70
	2	15	30
	0	20	0
	3	25	75
TOTAL 1	155		337/155 = 2.7 ppm
	5	67.5 (avg.)	337.5
TOTAL 2	160		674.5/160 = 4.2 ppm

* The average of all possible samples gives the Expected Value (EV). As the sample size continues to increase, the difference between the Time Weighted Average (TWA) and the EV approach zero. Thus, the two terms become more nearly interchangeable. The current operating levels were estimated using the above procedure.

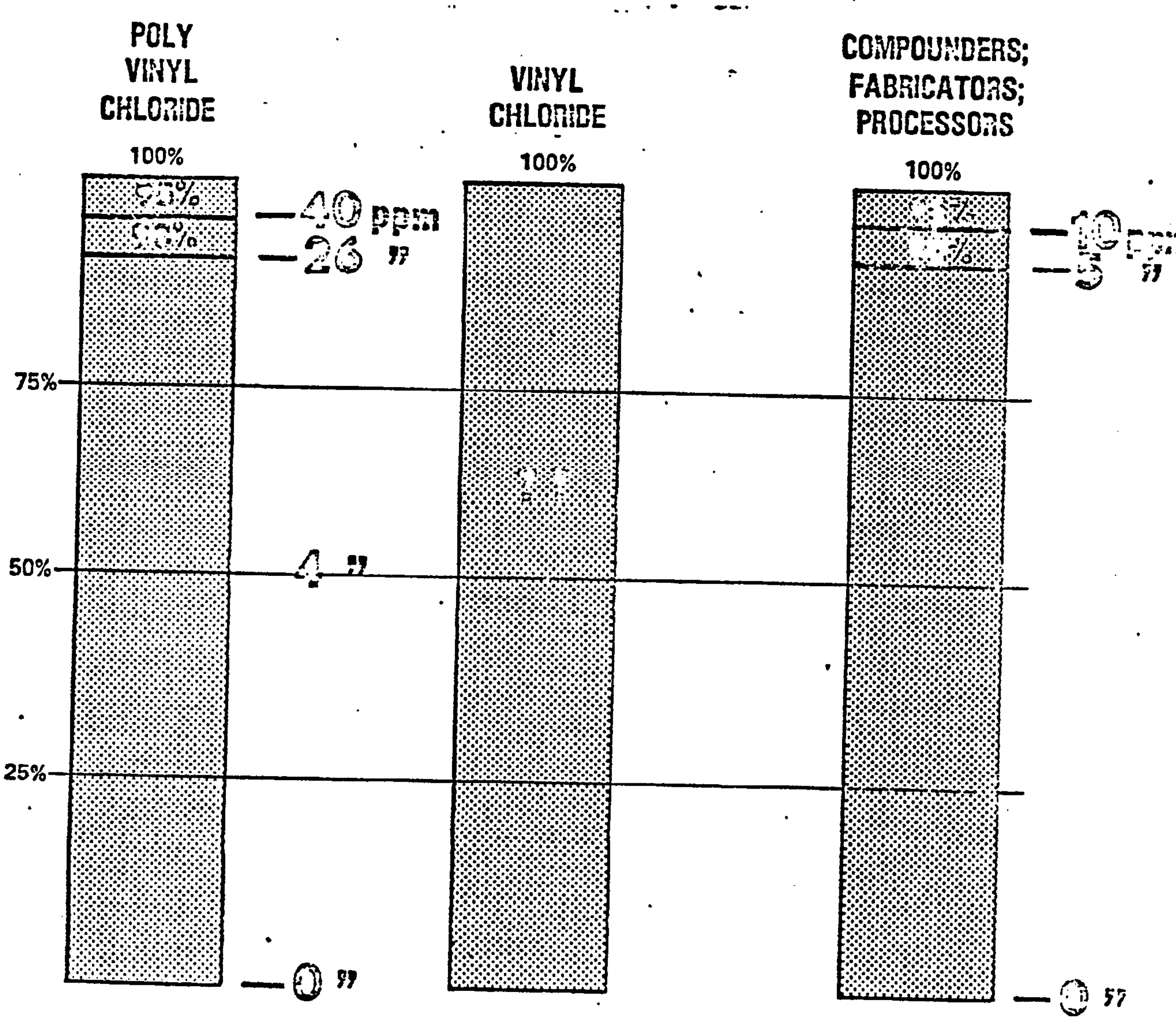
PERCENTAGE OF SAMPLES AT SELECTED EXPOSURE LEVELS

ILLUSTRATION - 17

LEVELS OF EXPOSURE (ppm)	O.S.H.A. INSPECTIONS (percent)	PUBLIC HEARING DATA (percent)
No Detectable	38	N/A
1	51	86
2	81	92
3	87	93
4	88	95
5	89	96
10	93	98
15	95	99
20	95	100 (approx.)
25	97	-
Over 25	100 (approx.)	-

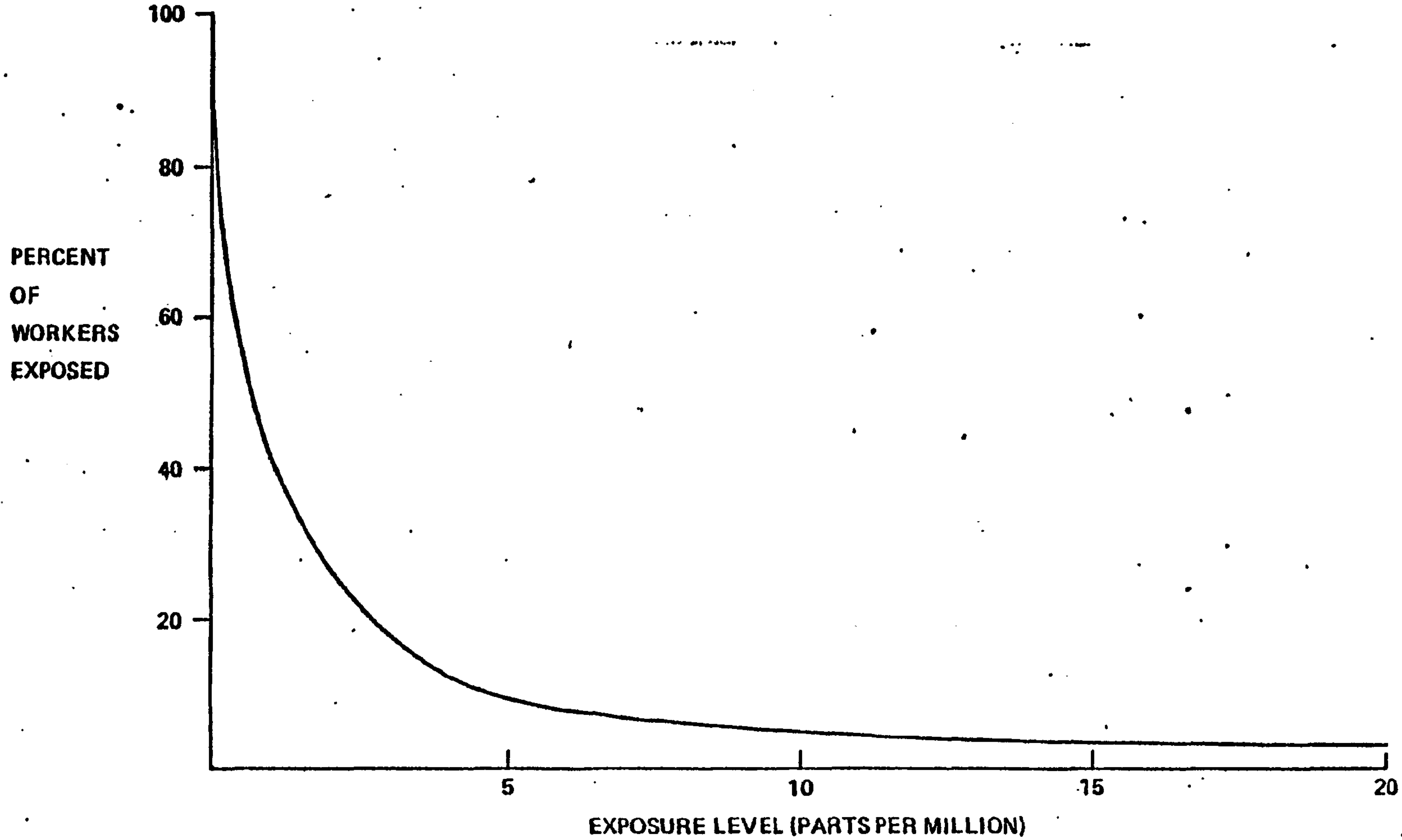
PERCENTAGE OF WORKERS AT SELECTED EXPOSURE LEVELS BY INDUSTRY LAYER

ILLUSTRATION - 18



SUMMARY OF AVAILABLE DATA FOR WORKER EXPOSURE TO VINYL CHLORIDE IN COMPOUNDING, PROCESSING AND FABRICATING OPERATIONS

ILLUSTRATION - 19



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Compounders and vertically integrated compounder/processors and compounder/processor/fabricators have more VCM in their workplaces, but still minimal amounts. According to our figures, 86% have one ppm or less. A review of hearing testimony reveals that most compounders claim to be already operating at or near the proposed standard's level of one ppm. Repeatedly, it is stated that if the form of measurement is changed to a time weighted average, few if any changes would be required for full compliance. Further, it seems reasonable to assume that if PVC producers are successful in the next few years in their efforts to reduce the level of residual monomer found in the resins, the whole issue of VCM exposure at the compounding, processing, and fabricating levels would no longer effectively exist.

5.4 RESIDUAL VCM IN PVC RESINS USED BY COMPOUNDING, PROCESSORS AND FABRICATORS

The residual monomer level in the PVC resins and compounds is the sole source of worker exposure to vinyl chloride in the compounding, processing and fabricating firms. Different resins have different residual levels, due to particle size and polymerization process. Compounds typically have levels lower than those in the resins because of further heat treatment and processing. The PVC producing industry is currently trying to reduce the residual levels in order to decrease the already low levels found downstream in the industry.

The long term solution holding the greatest promise for reducing exposure levels at the compounding, processing and fabricating industry layers is to eliminate residual VCM in the PVC resins.

Estimates of residual levels in resins currently range from 10-20 ppm (.001% by weight) up to 7,000 ppm (.7% by weight).[2] High residual resins (above 100 ppm) are normally the product of the most widely used of the four processes, suspension. Typical average mid-1974 VCM residual levels for suspension resins are the following:

General Purpose	50 ppm
Pipe Grade	150 ppm
Copolymers	1000-7000 ppm[3]

A weighted average of the overall residual level for suspension resins is 500 ppm.

Overall residual level averages for the other major processes are:

Bulk	20 ppm
Dispersion	10 ppm
Solution	1.5 ppm[4]

It should be noted that residual levels for individual resins produced by any of the four major processes may vary with the overall average by a factor of three or more.

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[2] *Ibid*, Exhibit III-17.

[3] *Ibid*.

[4] *Ibid*.

Estimating residual monomer levels by total production, shows:

57% of total 1973 production less than 100 ppm

32% of total 1973 production between 100-500 ppm

11% of total 1973 production greater than 500 ppm

The major factors determining residual level are size and weight of the resin particle. These two, in turn, are related to end use. Normally, the heavier the particle, the greater the amount of residual. Two other factors affecting residual level are the temperature and length of time which the resin is subjected to during stripping. Residual levels for compounds tend to be several orders of magnitude lower than the PVC resins. The reason for this is because much of the residual has been lost through natural leakage and the additional stages of heat and pressure that the resin has been subjected to during the compounding process.

PVC producers are currently experimenting with methods of improving the stripping operation, the process within the manufacture of PVC in which the newly polymerized resin is heated and put under a vacuum. The purpose of this step is to draw off as much of the unreacted monomer as possible and reuse it during the next polymerization, thus decreasing the residual level with the process itself.

Manufacturers are faced with several serious problems in trying to improve the efficiency of their stripping operations. Three major ones are:

(1) The primary technical difficulty in improving the stripping operation is due to the fact that PVC resins tend to deteriorate if subjected to too much heat for too long a time period.

(2) There are no real economic incentives to further refine operations; PVC producing firms face a sizeable net loss in any investments in improved stripping techniques.

(3) The economics of the situation seem to be such that it is significantly cheaper for the firms to discharge the additional amount of monomer rather than to try and recapture and reuse it. The problem then becomes one of how and where to discharge the VCM.

The long-run outlook, however, has some hopeful signs. Indications are that some of the residual levels reported earlier have already been reduced from previous levels by utilization of already available technology and operating procedures. In addition, producers of pipe grade suspension resins (approximately 27% of total resin production) are reported hopeful of being able to further reduce residual levels to less than 100 ppm.

Optimism over swift solutions must be tempered by reality. Although levels can be reduced, it will take time. It must be remembered that there are in excess of 20 resins now being produced in this country. Because of qualitative differences between resins, panaceas will not be forthcoming.

In sum, compounders, processors and fabricators buy their worker exposure to vinyl chloride by purchasing resins and compounds containing various amounts of residual monomer. As the resin is compounded, processed and fabricated, more of the trapped monomer is freed. This release occurs through natural leakage, heat treatment, and pressure applied to the resin or compound. Thus, as one follows the resin through to the final stage, processing or fabricating workers are exposed to lower and lower levels of monomer. If the polymerizers could eliminate the residual monomer in their resins, downstream exposure would cease to be an issue.

5.5 COST OF COMPLIANCE

Under the proposed permanent standard, compounders, processors and fabricators would be required to comply with all of the same provisions of the standard as VCM and PVC producers. Major requirements unrelated to exposure level in the workplace would include:

(1) The monitoring of VCM levels throughout the workplace;

(2) Medical surveillance of employees;

(3) Recordkeeping of VCM monitoring and medical data;

(4) Providing personal protective equipment, including respirators and impervious clothing, for all "covered workers;"

(5) Installation of shower changing rooms and altered work practices to allow for the clothing change and shower provisions;

(6) Providing for medical examinations as soon as possible after a worker has been exposed to an "unacceptable" level of VCM;

(7) Posting signs and labels informing people in regulated areas of the potential presence of harmful concentrations of VCM in the ambient workplace air.

In addition, engineering changes and altered work practices may have to be instituted by many firms in order to reduce occupational exposure levels to "no detectable." These would be considered as provisions for compliance related to exposure level.

The following are representative costs of compliance for particular provisions of the proposed standard for compounders, processors and fabricators. Their inclusion in the proposed standard is directly related to the regulated area provision of the proposed standard, which states that a "regulated area shall be established where (ii) polyvinyl chloride capable of releasing detectable levels of vinyl chloride is manufactured, reacted, released, repackaged, stored or used."[5]

All of these figures were taken from compliance cost estimates done by Foster D. Snell, Inc., for the VCM and PVC producing industries. The rationale for using them is that under the proposed permanent standard, all five of the major industry layers are faced with the same requirements.

[5] Occupational Safety and Health Standard on Vinyl Chloride, 29 CFR Part 1910.93g 15(d)(1)(11).

(1) Medical Surveillance[6], (per man) — including a complete physical examination, X-rays, blood count and tests designed to uncover liver disfunction — $160

(2) Monitoring of Exposure Levels[7] (per plant)

(a) Area Monitoring

(1) 10-point sequential monitoring system, including gas chromatograph	$12,000
(2) installation of system	15,000
(3) Operations and maintenance	30,000
	$57,000

(b) Personal Monitoring*

(1) 6, Sipin pumps, charcoal tubes, etc.	$ 2,000
(2) operations and maintenance	25,000
(3) gas chromatograph for analysis of samples	3,500
(4) personnel needed to sample and analyze	15,000
	$45,500

(3) Personal Protective Equipment[8] (per man)

(a) Respirators

(1) air supplied	$90
(2) back pack	$600
(3) gas mask	$60
(4) dust filter	$10

(b) Clothing

(1) throwaway suit	$9
(2) pressurized suit	$300

(4) Recordkeeping	?
(5) Signs and Labeling	?
(6) Showers and Changing Rooms	?
(7) Altered Work Practices	?
(8) Loss in Productivity	?

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* The cost of contracting out of these tasks would run below these because it would not include some start-up costs.

Estimates for all of the above are not able to be made at this time. Although it would certainly be useful to be able to include these costs, particularly numbers 7 and 8, it is felt that they quite simply cannot be accurately estimated. In view of this, leaving them unanswered seems more constructive than answering them with possibly mistaken or erroneous information.

As alluded to in Section III, cost impact information at the compounder, processor and fabricator level is just not readily available. These industry layers seem to feel that they ought to be treated separately by any regulation and thus have not themselves examined the possible direct impact resulting from the proposed standard. The standard itself is viewed as having been written with the VCM and PVC producers in mind.

Unfortunately, there also exist no good estimates of engineering costs related to compliance with the proposed standard. Again, since almost all compounders, processors and fabricators are currently operating at exposure levels well below both the Emergency Temporary Standard and the VCM and PVC producers, and since it is generally believed that the permanent

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[6] Snell Preliminary Report, Appendix F.

[7] Ibid.

[8] Ibid.

standard will be less stringent than the proposed standard, possible engineering changes and the costs associated with them have not in most cases, been planned for. These three industry layers have adopted a "wait and see" attitude towards the whole question of control of vinyl chloride exposure. Most firms are doing nothing, with the possible exception of some personal monitoring. The are waiting to learn what they will be required to do.

Aside from the obvious difficulty this creates in trying to estimate cost impact, this situation may also produce real logistical problems once a permanent standard has been promulgated. The Department of Labor may be faced with 8,000 or more compounders, processors and fabricators all straining simultaneously to secure the same limited supply of equipment and technical expertise. The industries that provide these services and equipment will most certainly not be able to meet this sudden surge in demand, thus creating shortages and long lead times. This would be especially critical if deadlines are written into the permanent standard.

The upshot of this discussion is that a comprehensive picture of cost impact has not been able to be presented. Due to the scarcity of information necessary for making such estimates, the question of direct economic effect on the compounder, processor and fabricator level, is still an open one.