JUL 25 1974

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

Copies to

July 23, 1974

Mr. G. J. Henrich
Director of Safety and Loss Prevention
Chemicals Group
Olin Corporation
120 Long Ridge Rd.
Stamford, Connecticut 06904

Dear Mr. Henrich:

Thank you for your note of July 12th and copy of your company's statements at the recent OSHA hearings.

Enclosed is a copy of evidence which we presented.

Cordially yours,

Jean F. Malone

JEAN F. MALONE
Director of Plastic
Products Management

JFM/ez
Attachment

Statement of John L. Nelson
Vice President-Manufacturing, B.F.Goodrich Chemical Company
Prepar d For
Presentation At
Department of Labor Hearings On
Vinyl Chloride, Occupational Exposure Standard
July 8, 1974

I am John L. Nelson, vice president-manufacturing of B.F.Goodrich Chemical Company, a Division of The B.F.Goodrich Company. Our headquarters are at 6100 Oak Tree Boulevard, Cleveland, Ohio 44131.

I received a B.S. in Chemical Engineering from the University of Wisconsin in 1939. My experience in the chemical industry covers a period of thirty-five years, all of which has been with Goodrich, and most of which has been directly or indirectly connected with the production of vinyl chloride and polyvinyl chloride. I was located in our Louisville plant for nineteen years, during the last ten of which I served as plant manager.

Seated on this panel with me are all of the Goodrich representatives who participated in the presentation by The Society of the Plastics Industry, who will be available to answer questions on our testimony. They are:

- Mr. Anton Vittone
  President, B.F.Goodrich Chemical Company

- Mr. Philip J. Weaver
  Director of Industry Affairs, B.F.Goodrich Chemical Company

- Dr. Roger W. Strassburg
  Director of Environmental Affairs, The B.F.Goodrich Company

- Dr. Maurice N. Johnson
  Director of Environmental Health, The B.F.Goodrich Company

Also included on this panel is Dr. Condict Moore, Professor of Surgery and Director of the Cancer Center, University of Louisville School of Medicine. Dr. Moore will present a statement summarizing the program which the University is initiating pursuant to a grant from Goodrich.

The main purpose of my testimony will be to examine the question of technical feasibility in the light of our current engineering and scientific knowledge. In addition, I will discuss on-going research and development programs directed at the reduction of vinyl chloride losses from our manufacturing operations. Our goal is to reduce vinyl chloride exposure to the lowest feasible levels and to preserve the jobs dependent upon this widely used and versatile plastic material.

We will discuss these subjects in terms of our own extensive experience. Specifically, we will review:

1. Vinyl chloride exposure levels in Goodrich plants.

2. Our current programs to reduce exposure levels, including engineering, work practices, and training.

3. Our research and development programs to further reduce exposure levels in the future.

We will conclude with our position on certain aspects of the proposed permanent standard.

Goodrich is a major producer in the U.S. polyvinyl chloride (PVC) industry. We began commercial production of polyvinyl chloride resins and compounds in 1937. We currently operate five polyvinyl chloride plants - at Louisville, Kentucky; Avon Lake, Ohio; Long Beach, California; Henry, Illinois; and Pedricktown, New Jersey. We supply finished resins and compounds to about 2,200 domestic customer plants.

We also operate a vinyl chloride monomer plant at Calvert City, Kentucky. We buy, sell, produce, and use vinyl chloride, and our monomer and polymer capacity represents approximately 15-18% of the domestic capacity for these products. We employ about 1,500 workers in vinyl chloride, polyvinyl chloride, and compounding operations. (SEE EXHIBIT 1)

Review of Levels of Exposure to Vinyl Chloride

Over the years, our Company has sought to provide a safe working environment through two basic means - containment of known or potentially toxic materials during the manufacturing process, and protection of our employees through work practices, education and equipment.

Our efforts to provide a safe working environment have generally paralleled known scientific information or data relating to levels of exposure. This has resulted in decreasing levels of exposure with time.

The properties of vinyl chloride have been frequently and adequately described by other witnesses. I will review briefly the characteristics most important in PVC production. It has an intoxicating effect in concentrations of about 5000 ppm in air. The level of concentrations in air at which it can be detected by smell varies with individuals, but ranges between 250 and 4000 ppm. Our processes require handling of this material both as a gas and as a liquid. The gas will liquify at 6°F. at atmospheric pressure, or at about 45 psi at ambient temperatures. In our plants, operating pressures range from a vacuum to 160 psi. These pressures, coupled with the thousands of potential leak sources, make it extremely difficult to control exposure. Vinyl chloride is completely colorless, and odorless up to fairly high concentrations. Thus, at low levels it cannot be detected except with sensitive instruments.

There are four types of polyvinyl chloride processes which are used to convert vinyl chloride monomer to PVC: suspension, emulsion, mass, and solution. Goodrich uses the first three types with over three-quarters of its production being by the suspension process.

There are many variations within these types; solutions applicable to one type of process, product or plant are not necessarily applicable to other processes, products or plants.

The equipment used in the conversion of monomer to polymer in all three processes consists of multiple units of vessels, pumps, piping and valves, with thousands of potential sources of small fugitive or elusive leakage of vinyl chloride gas. The process is batch-type and, after each reacti n is completed, the vessel in which it is conducted requires varying kinds of purging, entering, cleaning, and preparation before the next batch can be started. These vessels, which we call polymerizers or reactors, have gone through an engineering evolution over the past thirty-five years.

During our first twenty years in the business, we used 1100-gallon reactors of stainless steel construction, which required entry and manual cleaning after every charge. This cleaning took about one hour, during which time workers cleaning vessels were exposed to vinyl chloride levels of an estimated 200-500 ppm. The worker would clean an average of five vessels every eight-hour work shift. We can only estimate early exposure levels, since the analytical sophistication to determine low levels of vinyl chloride in air has only been available in recent years. Our estimates were based on fragmentary data and interviews with employees to determine how often odor was evident, if and when they were aware of the intoxicating effect, and what level of explosimeter readings they might recall. While this method used to estimate exposure levels may seem crude by today's standards, our estimates are consistent with other similar testimony presented in this hearing.

Peak exposure levels ten and twenty years ago were one hundred times today's emergency standard, and probably averaged forty times today's average levels. My personal PVC experience goes back to when levels of exposure were of this magnitude.

Beginning in 1959, we experimented with glass-lined polymerizers and revisions to agitators and baffles to minimize buildup and cleaning time and did, as a result, reduce cleaning time to 20-30 minutes.

The next engineering breakthrough occurred in the late 1960's, with the Goodrich development of hydraulic reactor cleaning. This is a programmed high pressure water mechanism which is inserted into a polymerizer to remove buildup almost completely. This has greatly reduced human entry into polymerizers for manual cleaning. On some of our products, human entry has been reduced to as few as 3% of the batches. On some products, entry is still required after each batch. Over our total product mix, entry is required in about 10% of the batches.

Concurrent with the evolution of polymerizer design and mechanized cleaning, we installed additional equipment to improve the removal of vinyl chloride from the reactor prior to entry. With our current multi-step procedure, we have reduced vinyl chloride levels in open polymerizers down to the ambient level in the buildings today. The worker is further protected from vinyl chloride release from PVC resin buildup by use of an air line supplied respirator during the cleaning operation.

In the late 1950's, we began the development and installation of larger reactors. These steps reduced worker exposur , and also increased productivity and raw material efficiencies. Large polymerizers aut matically reduce the number of vessels, the amount of interconnecting piping, and reactor opening and cleaning operations. We now operate reactors in sizes of 1100, 1750, 2500, 3300, 4300, and 5300 gallons.

Some of our recent engineering and development effort has resulted in further scale-up of polymerizer size. By mid-1975, we will start up a new facility utilizing polymerizers of significantly larger size, which I will describe later on.

Some of our PVC workers in the Louisville plant had an additional exposure to high levels of vinyl chloride because of infrequent entry into what we term "cold rooms". Basically, these were large, insulated, multi-story refrigerated rooms which housed equipment for the distillation and storage of vinyl chloride.

Operator activity in these rooms took 10 to 15 minutes, once or twice a shift; but, during those periods, exposure levels were up to 3000 ppm. Today, entry is permitted only with an air supplied respirator.

The background of the Goodrich Louisville, Kentucky angiosarcoma problem was covered by Mr. Vittone's statement at the OSHA fact-finding on February 15.

At that time, we reported three deaths from angiosarcoma of the liver among Louisville plant workers. Since then, we have reported to governmental agencies two additional deaths and two living cases of the disease, all at our Louisville plant.

After extensive and intensive epidemiological investigation of all of our monomer and PVC workers, no cases of angiosarcoma have been found in any other location.

Current Programs to Reduce Levels of Exposure

All PVC plants in our manufacturing system have achieved significant reductions in the level of vinyl chloride in the general work areas over recent months. This progress has been measured through the use of organic vapor analyzers, both portable and fixed, and based on literally hundreds of readings every day. The average of the readings has been reduced from about 35-40 ppm early this year to about 12-14 today. These readings range from 1-2 ppm to some excursions over 50 ppm. We are working hard to reduce the frequency of these excursions. During these excursions, or when there is a risk of such excursion, workers are required to wear air-supplied respiratory protection.

Included with this statement (EXHIBIT 2) is a summary of TWA exposure levels by job classification based on four-hour personnel monitoring techniques. This summary must be viewed as preliminary since the jobs have only been monitored for a period of two months. For example, we find considerable variation in TWA measurements ranging from below 5 ppm to 31 ppm on polymerizer charging operations.

Also included with this statement (EXHIBIT 3) is a six-months' history of area measurements of vinyl chloride levels by plants and by buildings showing the percentages of readings above 50 ppm and below 10 ppm.

This improvement is the result of aggressive and comprehensive programs carried out in each of our PVC plants and in our VCM plant to identify and correct leaks, initiate operating improvements and emphasize increased employee communications. Here are some of the more important parts of these programs.

Leak Reduction

Leak reduction has been the single greatest source of reduced vinyl chloride levels. The indispensable key to this progress was diligent monitoring on a 24-hour a day, seven days per week basis to record concentrations of monomer and track down the exact source of each leak. Early in January, personnel were assigned in each plant to do nothing but measure and record monomer concentrations and identify sources of the concentrations. Then, corrective action followed swiftly. OVA monitoring is still being done to locate sources of leaks.

Now, continuous recording fixed Bendix organic vapor analyzers are installed in all polymerization buildings in all plants. The Bendix instrument shows a higher reading if there is a significant leak anywhere in the area. The leak is tracked down with the portable OVA and repaired.

Operating Improvements

We have also made many operating improvements that have helped to reduce vinyl monomer concentrations in the work area. These include:

Vessels and pipelines containing monomer such as polymerizers, strainers, tank car unloading lines and Hamer blind installations, are being more thoroughly evacuated to recovery pumps before opening.

New procedures have been implemented for opening reactor manhole covers which reduce emission to the work area.

Regular vinyl monomer recovery operations have been improved and monomer efficiency raised.

Number of entries and time of each entry into polymerizer vessels for cleaning has been reduced.

Better manhole lid closure seals have been developed for polymerizers.

General ventilation has been greatly improved in many buildings. Localized ventilation has been installed at some repetitive trouble spots, such as pump seals.

Compressor and vacuum pump seal water have been put into closed systems.

Draining from foam traps have been put into closed systems.

Some ventilation and vent stacks have been put high above buildings so no monomer can be drawn back into the work area.

Tank car loading pipelines are vented and purged to flare before disconnecting.

Tank car sampling procedure is being refined for venting sample containers and purging to flare.

Employee Communications

Also important to the effectiveness of the overall program has been personnel motivation, awareness, training and dedication. Considerable time has been spent in every plant to develop 100% diligence in keeping concentrations of vinyl monomer in the work atmosphere low. Employee cooperation has been excellent.

Potential for Further Improvements

Further improvements can be expected from our work in the following areas:

A continuing investigation of better gaskets and seals.

Installation of special localized ventilation where determined necessary.

Better general push-pull, sweep-through ventilation is being installed where it does not already exist.

Education and motivation improvement of the people.

Further improvement of automatic systems to warn of excursions.

Installation of magnetic level indicators on our fleet of tank cars to replace dip-tubes which release monomer in the tank car loader work place. This will require eighteen to twenty-four months to complete.

I mentioned earlier that we are constructing a new PVC facility at our Louisville plant, which will start up about mid-1975. This installation is a part of our continuing program to improve our PVC resin manufacturing system. Preliminary engineering of this plant was started in late 1972, funds were appropriated in July-1973, and field construction work began early this year. It will employ large polymerizers, computer control, outdoor design and the latest technology. We expect vinyl chloride exposure levels to be lower than those currently existing in our PVC plants, but actual exposure levels will not be known until the fall of 1975.

We estimate that for the same capacity, a plant utilizing large reactors will have about 87% fewer potential fugitive leak sources compared with our smaller poly plants.

Although this new facility incorporates our latest technology, we fully expect to make additional improvements resulting from our on-going research and development work. It is expected that some of these improvements will take up to 24 months after the completion of the developmental effort.

Research and Development

Goodrich is doing everything it can with current technology, as rapidly as possible, to reduce vinyl chloride exposure levels. Further improvements and reductions in levels will come from the engineering changes and work practices we outlined previously. Improvements beyond these can only be achieved through future technological breakthroughs. In the past five months, we have redirected and greatly accelerated our research and development efforts. We have 135 scientists and technicians at our Research and Development facilities and in our plants working on process and product improvements directed at lower vinyl chloride losses and reduced exposure. Our goal is to approach negligible losses of vinyl chloride from all sourc s.

About a quarter of the research and development effort is involved with analytical techniques and equipment, analyst training, and developmental analyses directed at worker exposure and residual monomer content of resins. During 1973, this effort resulted in selection of direct reading portable and sequential continuous monitoring equipment which have been essential tools in our efforts to reduce vinyl chloride levels in work areas of our production plants. Current effort is being directed toward more precise and rapid measurement of worker exposure.

About half of this research and development effort concerns fundamental process improvements to reduce losses inherent in our present processes. To our knowledge, there is no PVC production plant in the world operating in a completely closed polymerizer mode because of the buildup problem in reactors. Our programs toward this end include investigations of the fundamental mechanisms leading to resin adherence to polymerizer surfaces and a wide variety of methods aimed at eliminating adherence, chemically and/or mechanically. It is difficult to estimate how soon, if ever, we might achieve our goals in a practical way.

The balance of our research and development program includes reduction of monomer losses beyond the polymerization area. This is the development of a process by which the vinyl chloride monomer is removed from the PVC resin slurry before drying, thus increasing the recovery of vinyl chloride monomer.

This would also result in lower residual vinyl chloride in our finished resins when proven in production plant installations. We can foresee completion of this work and installation of facilities in two to four years for the majority of our resins.

Finally, in order to reach levels below .01% residual vinyl chloride in some PVC resins, we see the necessity for some basic changes in our manufacturing technology and the structure of PVC particles. This will take time to complete the small-scale work and scale up to production facilities.

Goodrich Position

Goodrich believes it prudent to reduce levels of exposure to vinyl chloride, but opposes the proposed permanent standard for vinyl chl ride. Achievement of no-detectable level of VCM exposure is not technically feasible. Neither is it feasible nor safe to require VCM and PVC workers to wear respiratory protection for full eight-hour work shifts. Thus, if the proposed standard is adopted, Goodrich would have no alternative but to shut down its monomer and PVC resin operations.

Goodrich generally supports the position outlined by witnesses for The Society of the Plastics Industry.

Exposure Levels

More specifically, we endorse the SPI proposal on the stepwise reduction of vinyl chloride levels in PVC work areas and in vinyl chloride monomer work areas.

Further, Goodrich is committed to reach these levels of exposure in the shortest practical time. As evidence of our commitment, before OSHA issued the proposed permanent standard, we set an internal goal of achieving a 25 ppm ceiling and 10 ppm TWA as soon as possible.

Monitoring

The standard should require sequential monitoring of work areas in both monomer and polymer plants with proper alarms to signal the need for respiratory protection. This should be backed up with adequate personnel monitoring to validate the area monitoring system.

Respiratory Protection

We support the SPI recommendation that OSHA give management the necessary flexibility to select and utilize the most appropriate respiratory equipment for the protection of workers. This could include the use of half-face air-purifying type protection.

Impervious Clothing

We urge OSHA to reconsider the requirements covering the use of impervious clothing. Others have previously testified that such clothing presents a serious restraint on worker mobility. It also exposes the wearer to severe heat stress, particularly when worn in confined areas and where physical effort is required on the work assignment.

There may be some occasions where high exposure levels can occur. In those instances, suits impervious to water should be adequate. But for most jobs in vinyl chloride monomer and polyvinyl chloride plants, including r actor cleaning, where exposure is at low levels, regular work type clothes (coveralls or pants and shirts with full length sl eves) should be adequate.

Vinyl Chloride Level in PVC

Goodrich supports the SPI proposal that appropriate labeling of PVC containers be required when vinyl chloride levels in PVC exceeds 0.1%, effective October 5, 1974 and, further, that the requirement for labeling be changed to 0.01% effective October 5, 1977.

Labeling

We support the SPI position that the language to be used on signs at regulated areas emphasize the precautionary steps to be taken, rather than "scare" language emphasizing the nature of the substance.

Similarly, we support the SPI concept of product labeling, both monomer and polymer, and agree that such labeling should be designed to provide information to those who need it, rather than a basis upon which to panic because of a potential disease characterization.

As part of our overall effort, on May 1, 1974, Goodrich made a grant to the University of Louisville Medical School Cancer Center. This was the result of Goodrich's desire to bring continuing comprehensive medical advice and consultation to the situation and to support a broad scientific inquiry into the problem.

At this time, I present Dr. Condict Moore, Professor of Surgery at the University of Louisville School of Medicine, who will summarize the program which the University is initiating pursuant to a grant from Goodrich. Dr. Moore's statement is attached.

IN SUMMARY, then, Goodrich's position is as follows:

1. We are committed to reduce vinyl chloride exposure to the lowest level that is feasible through a combination of engineering changes, work practices, the part-time use of respiratory equipment, and technological development.

2. A no-detectable level of VCM in its monomer and polymer plants is not technically feasible.

3. Full-time use of respiratory protection by PVC and VCM workers is not feasible.

4. We will be forced to shut down our PVC and VCM operations if the proposed permanent standard is adopted.

5. We have embarked on a multi-million dollar research and development program to generate new technology which might make possible further reduction in levels of vinyl chloride exposure.

6. We oppose the permanent standard as proposed by OSHA, and generally endorse the position taken by witnesses for the SPI.

7. We will support and cooperate with programs to obtain medical and toxicological data that are needed.

EXHIBIT 1

PLANT START-UP DATA AND ENROLLMENT

Plant and Location	Type of Product	Start-up Date	Current PVC or Monomer Enrollment
Avon Lake, Ohio	PVC	1953	481
Henry, Illinois	PVC	1965	76
Long Beach, Cal.	PVC	1960	100
Louisville, Ky.	PVC*	1942	465
Pedricktown, N. J.	PVC	1970	118
Calvert City, Ky.	Monomer	1950	250
Total			1,490

*Also vinyl chloride monomer until 1968

EXHIBIT 2

PERSONNEL MONITORING DATA

A limited amount of data have been taken during May and June, 1974. The data for various operations have been categorized to show the number of values in several ranges of vinyl chloride concentration. All data are time weighted averages over a four-hour period absorbed on carbon tubes and tested by gas chromatography. This data does not, in all cases, represent actual worker exposure since every worker wears respiratory equipment when the work atmosphere is greater than 25 ppm or where operations and experience show there is a risk of exceeding 25 ppm.

OPERATION -- PVC POLYMERIZATION

	PPM VCl Ranges				
	0-5	6-10	11-20	21-35	Over 35
Charge Operator	22	5	5	2	0
Recovery Operator	12	8	1	3	1
Hydraulic Reactor Cleaner Operator	6	2	2	0	2
Poly Cleaner	3	3	2	1	1

OPERATION -- MONOMER PRODUCTION

	PPM VCl Ranges				
	0-5	6-10	11-20	21-35	Over 35
Furnace Operator	2	1	1	0	0
VCl Purification Operator	7	0	0	0	0
Tank Farm Operator	0	2	1	2	0

EXHIBIT 3

VCL MONITORING DATA

Area Measurements Using Portable and Fixed Instrumentation, Measuring Total Hydrocarbons by the Flame Ionization Method

PLANT: AVON LAKE, OHIO

Building	Product	Month	% Readings Above 50 PPM	% Readings Under 10 PPM
451	Dispersion Resin	January	3.5	8.7
		February	3.9	14.4
		March	2.6	23.4
		April	4.9	42.9
		May	2.7	65.2
		June	4.7	72.5
461	Suspension Resin	January	4.7	24.1
		February	3.3	37.9
		March	2.5	21.7
		April	3.4	14.6
		May	2.2	59.3
		June	4.9	57.8
464	Suspension Resin	January	5.1	11.1
		February	3.1	10.3
		March	1.1	34.8
		April	0.0	58.9
		May	2.8	71.2
		June	2.8	82.5
463	PVC Latex	January	0.0	70.9
		February	0.2	91.7
		March	0.0	97.5
		April	0.7	97.6
		May	0.4	86.3
		June	1.9	82.3

EXHIBIT 3 - Cont'd.

VCL MONITORING DATA

Area Measurements Using Portable and Fixed Instrumentation,
Measuring Total Hydrocarbons by the Flame Ionization Method

PLANT: HENRY, ILLINOIS

Building	Product	Month	% Readings Above 50 PPM	% Readings Under 10 PPM
731	Suspension and Dispersion Resins	January	33.0	20.3
		February	10.0	17.4
		March	2.0	27.9
		April	4.8	69.1
		May	2.3	82.0
		June	2.9	79.1

PLANT: LONG BEACH, CALIFORNIA

Building	Product	Month	% Readings Above 50 PPM	% Readings Under 10 PPM
812	Suspension Resin	January	2.6	Data not analyzed
		February	1.8	" " "
		March	2.4	" " "
		April	2.2	" " "
		May	0.5	" " "
		June	1.3	84.4

EXHIBIT 3 - Cont'd.

VCL MONITORING DATA

Area Measurements Using Portable and Fixed Instrumentation, Measuring Total Hydrocarbons by the Flame Ionization Method

PLANT: LOUISVILLE, KENTUCKY

Building	Product	Month	% Readings Above 50 PPM	% Readings Under 10 PPM
121	Dispersion Resin and Latex	January	10.9	0.2
		February	3.2	5.9
		March	0.6	40.8
		April	1.7	62.0
		May	1.0	86.2
		June	0.9	88.3
111	Suspension Resin	January	9.1	0.2
		February	2.0	5.9
		March	1.5	36.0
		April	1.8	71.0
		May	1.7	90.2
		June	1.5	90.5
1	Suspension Resin	January	3.0	0.4
		February	0.6	7.8
		March	1.3	21.0
		April	1.3	73.8
		May	1.2	90.9
		June	1.1	91.2
15	Copolymers Solution Resin	January	6.4	0.7
		February	2.2	5.1
		March	1.2	29.4
		April	2.2	64.7
		May	4.6	62.9
		June	1.7	78.6
115	VCl Recovery Purification	January	- Data Not Taken -	
		February	3.0	0.5
		March	5.0	9.3
		April	1.9	34.7
		May	5.4	33.3
		June	0.8	25.2

EXHIBIT 3 - Cont'd.

VCL MONITORING DATA

Area Measurements Using Portable and Fixed Instrumentation, Measuring Total Hydrocarbons by the Flame Ionization Method

PLANT: PEDRICKTOWN, NEW JERSEY

Building	Product	Month	% Readings Above 50 PPM	% Readings Under 10 PPM
512	Mass Polymerization	January	5.1	35.7
		February	2.0	46.5
		March	1.1	69.3
		April	0.6	76.2
		May	1.4	79.3
		June	0.6	80.7
513	Suspension and Dispersion Resins	January	3.8	39.1
		February	2.4	66.0
		March	1.0	81.3
		April	0.7	78.8
		May	1.2	75.2
		June	0.5	75.9