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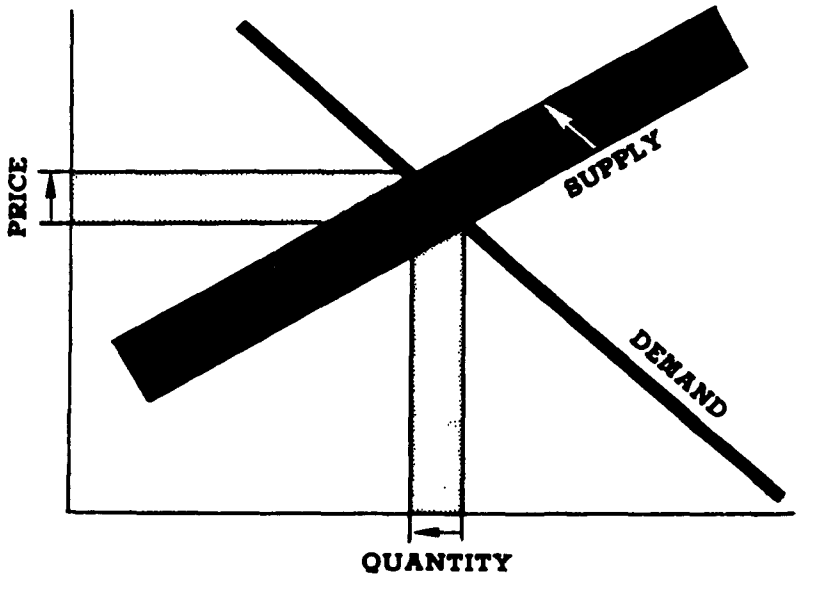
ECONOMIC ANALYSIS
OF
PROPOSED EFFLUENT GUIDELINES

THE PLASTICS AND SYNTHETICS INDUSTRY
PHASE II



U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Planning and Evaluation
Washington, D.C. 20460

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PREFACE

The attached document is a contractor's study prepared for the Office of Planning and Evaluation of the Environmental Protection Agency ("EPA"). The purpose of the study is to analyze the economic impact which could result from the application of alternative effluent limitation guidelines and standards of performance to be established under sections 304(b) and 306 of the Federal Water Pollution Control Act, as amended.

The study supplements the technical study ("EPA Development Document") supporting the issuance of proposed regulations under sections 304(b) and 306. The Development Document surveys existing and potential waste treatment control methods and technology within particular industrial source categories and supports proposal of certain effluent limitation guidelines and standards of performance based upon an analysis of the feasibility of these guidelines and standards in accordance with the requirements of sections 304(b) and 306 of the Act. Presented in the Development Document are the investment and operating costs associated with various alternative control and treatment technologies. The attached document supplements this analysis by estimating the broader economic effects which might result from the required application of various control methods and technologies. This study investigates the effect of alternative approaches in terms of product price increases, effects upon employment and the continued viability of affected plants, effects upon foreign trade and other competitive effects.

The study has been prepared with the supervision and review of the Office of Planning and Evaluation of EPA. This report was submitted in fulfillment of Contract No. 68-01-1541, Task Order No. 13 by Arthur D. Little, Inc. Work was completed as of September 1974.

This report is being released and circulated at approximately the same time as publication in the Federal Register of a notice of proposed rule making under sections 304(b) and 306 of the Act for the subject point source category. The study is not an official EPA publication. It will be considered along with the information contained in the Development Document and any comments received by EPA on either document before or during proposed rule making proceedings necessary to establish final regulations. Prior to final promulgation of regulations, the accompanying study shall have standing in any EPA proceeding or court proceeding only to the extent that it represents the views of the contractor who studied the subject industy. It cannot be cited, referenced, or represented in any respect in any such proceeding as a statement of EPA's views regarding the subject industy.

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I. INTRODUCTION

The purpose of this study is to determine the economic impact of the costs of pollution abatement requirements under the Federal Water Pollution Control Act Amendments of 1972 for each of four levels of treatment:

1) Best practicable control technology currently available – to be met by industrial discharges by 1977.

2) Best available technology economically achievable – to be met by industrial dischargers by 1983.

3) New source effluent standards – to be applied to all new facilities (that discharge directly to navigable waters) constructed after the promulgation of these guidelines.

4) New source pretreatment standards – to be applied to all facilities (that use municipal systems) constructed after promulgation of these guidelines.

The specific impacts to be considered are:

1) Price effects – including effects upon an industry's suppliers and consumers.

2) Profitability, growth, and capital availability effects.

3) Number, size, and location of plants that can be expected to close or curtail production.

4) Changes in employment.

5) Community impacts.

6) Balance of payments consequences.

7) Any other impacts.

II. EXECUTIVE SUMMARY

This Phase II study of the economic impact of water pollution control costs on the synthetics polymer industry is focused on the small volume specialty plastic materials which are generally made by two or more companies. With the exception of the unsaturated polyester resins, these materials are produced by major chemical companies which have both the technology and the capital available to install and operate water pollution control equipment. Again, with the exception of the unsaturated polyesters, the producers of these resins all produce other plastic materials, many of which are large volume, lower priced commodity type resins. Because of the specialized uses for these resins, they generally command higher prices and generate higher profits than do the larger volume commodity resins. With the exception again of the unsaturated polyester resins, the number of producers is limited to at most six. This prevents the very intense price competition characteristic of the large volume resins which are made by as many as 20 companies, and this in turn keeps profits at a higher level. With a few exceptions, there is little integration to end use products such as film or bottles. The exception is the unsaturated polyesters. Most of the resin producers, however, are integrated back to their raw materials. These resins are generally produced in plants which produce other resins. The location of the plants generally depends on the locations selected for the larger volume resins made at the same site, and there is a tendency for these plants to be located in the Southwest.

The production of these resins involves fairly sophisticated technology, again, with the exception of the unsaturated polyesters. These plants are generally quite well automated, and therefore are not labor intensive.

In general, prices in this industry are determined by the performance value of the material in competition with other plastics and non-plastic materials. A second factor in the price structure is the price sensitivity and in general, these products will not show conspicuously lower demand if the price were increased within reason. Three of the products, cellulose nitrate, ethyl cellulose and spandex fibers, have reached the peak of their demand and are declining in importance.

The characteristics of the unsaturated polyester resin industry segment are quite different. This industry consists of a large number of producers. The U.S. Tariff Commission lists some 70 producers, and this is not believed to be complete. These producers fall into two different categories; large resin and chemical companies, and small specialty resin and paint companies. Twenty-six of the companies are believed to represent 90% of the production, the remainder being spread over a number of small operations. The large companies have production capacities over a hundred million pounds, while some of the smaller individual operators produce less than a million pounds a year. The larger companies are integrated to some end products, and to some of the raw materials. The smaller companies are not integrated. The larger companies have a number of plants at various locations, primarily chosen close to the markets. The small companies generally have only one location. This segment of the industry is also characterized by the demand for a variety of grades and

types of resins, specifically formulated for a given end use. Large producers market a wide line of products whereas the smaller companies usually produce only one grade. The larger companies in the industry generally have modern up-to-date well-automated plants whereas the small companies have old relatively obsolete operations. It is estimated that 90% of the plants in this segment discharge to municipal sewers. The profits of the large producers are generally average for the plastics industry while profits for the smaller companies are below average.

Prices of these resins are generally determined by the performance of the polyester resin versus that of competing plastics and metals. In the case of some of the smaller companies, the price is determined largely by the level necessary to obtain the contract.

The assessment of the economic impact of the cost of meeting effluent guidelines is based primarily on whether the cost can be passed through as price increases to the consumer. If it can be passed on, there will be little or no effect on profitability, plant closures, employment effects, community effects, growth or balance of trade. In general, the price would rise slightly. A second consideration is whether the increase in price required to cover the cost of meeting the guidelines would affect the demand for the material. This is analyzed on the basis of the price/performance ratio of the plastic material versus that of substitute products such as glass, paper, metal and other plastics, recognizing that all of these may also face some increase in price in order to cover the cost of meeting their guidelines.

Impact

A review shown in Table 1, of the costs associated with pollution abatement control to be achieved by 1977, best practical control technology currently available (BPCTCA), and the cost associated with best available technology economically achievable (BATEA), to be achieved by 1983, shows a range of 0.1% of the current selling price to 10.7%.

Costs of this magnitude are insignificant compared to the increases in costs which are now and will result from increased raw material prices. We believe in all but two cases that the cost of meeting these controls can be added to the sales price so that there will be no effect on the profitability, growth, employment, production, the community or balance of trade. In general the producers have the capital and technology to achieve the standards set.

In two segments, saturated and unsaturated polyester resins, the costs of the initial investment to install treatment facilities to meet BPCTCA, BATEA and BADT guidelines will have some effect and may cause some companies to shut down. This added expense may also prevent some potential producers from entering these two industry segments. The cost of adding the necessary water pollution control equipment is only one factor in these situations. Added to this are the costs associated with gathering the necessary technical data and employing experts to assess the information and determine what treatment technology

Table 1

Cost Impact on Synthetic Polymers Production

	Capital Cost Per Plant ($1000)			Annualized Cost (¢/lb)*			Annualized Cost as % of Sales Prices*		
	BPT	BAT	BADT	BPT	BAT	BADT	BPT	BAT	BADT
Cellulose Nitrate	1113	2260	1113	0.4 - 0.85	0.5 - 1.8	0.45	0.8 - 1.7	1.0 - 3.6	0.9
Nitrile Barrier	82	161	82	0.06 - 0.36	0.06 - 0.78	0.18	0.1 - 0.6	0.1 - 1.3	0.3
Fluorocarbon	44-145	44-145	44-145	0.32 - 1.95	0.32 - 1.95	0.32	0.1 - 0.6	0.1 - 0.6	0.1
Ethylene Vinyl Acetate	26-47	53-101	26-47	0.03 - 0.30	0.06 - 0.93	0.03	0.2 - 2.0	0.4 - 6.2	0.2
Unsaturated Polyester	198	198	198	0.08 - 0.38	0.08 - 0.76	0.16	0.4 - 1.9	0.4 - 3.8	0.8
Saturated Polyester	49	77	49	0.07 - 2.03	0.21 - 4.48	0.14	0.1 - 2.9	0.3 - 6.4	0.2
Polypropylene Fiber	146	579	146	0.24 - 0.49	0.24 - 0.49	0.24	0.7 - 1.4	0.7 - 1.4	0.7
Methyl Methacrylate	155 - 1020	179-1176	155-1020	0.07 - 0.28	0.07 - 0.28	0.07	0.1 - 0.4	0.1 - 0.4	0.1
Alkyd Molding	198	198	198	0.08 - 0.38	0.08 - 0.76	0.16	0.4 - 1.9	0.4 - 3.8	0.8
Polyvinyl Butyral	1010	2759	1010	0.28 - 1.47	0.28 - 7.50	0.56	0.4 - 2.1	0.4 - 10.7	0.8
Polyvinyl Ether	29	58	29	0.20 - 0.70	0.20 - 1.80	0.30	0.2 - 0.7	0.2 - 1.8	0.3

*Including Capital Charges

Table 1 (continued)

Cost Impact on Synthetic Polymers Production

	Capital Cost Per Plant			Annualized Cost (¢/lb)*			Annualized Cost as % of Sales Prices *		
	BPT	BAT	BADT	BPT	BAT	BADT	BPT	BAT	BADT
Polyvinylidene Chloride	6-32	19-87	6-32	0.05 - 0.11	0.05 - 0.38	0.05	0.1 - 0.2	0.1 - 0.7	0.1
Silicones	1696-2480	4176-5965	1696-2480	0.60 - 1.20	1.70 - 3.50	0.70	0.6 - 1.2	1.7 - 3.5	0.7
Polyamides	60	172	60	0.13 - 1.17	0.26 - 3.25	0.26	0.1 - 0.9	0.2 - 2.5	0.2
Spandex	24	48	24	0.10 - 0.30	0.10 - 0.50	0.20	0.1 - 0.3	0.1 - 0.5	0.2
Ethyl Cellulose	360-530	750-1386	360-530	0.55 - 1.0	1.65 - 2.84	0.60	1.1 - 2.0	3.3 - 5.7	1.2

*Including Capital Charges

is needed. These costs will be a deterrent to some small producers. The effect will be heightened by the necessity to meet other federal standards such as air pollution, solid waste disposal, safety and noise control regulations. None of these factors would affect major resin producers. They may, however, affect the small – i.e., less than 50 employee – company.

The producers which will face the greatest difficulty will be the small manufacturer of unsaturated polyester resins (approximately two to three direct dischargers and seven plants in municipal systems.) These companies, faced with raw material shortages, costs to meet other federal standards, and increasing water pollution control costs might elect to shut down – certainly they will not expand. This situation represents only a very minor portion of the industry segment, and any dislocations would have only a minor impact on the entire industry but would be serious to the companies involved.

Production capacity and industry growth would not be seriously affected since the plants represent less than 1% of the industry capacity. Possibly 30 employees might be affected but this would not have any significant community effect. There would be no balance of trade effect since these producers do not export.

The other industry segment which might have a problem is the saturated thermoplastic polyesters. This new product is just getting started and the plants are small (25-50 MM lbs). As demand develops and larger plants are built the price will decline.

The extent of this price decline will determine the demand for the resin which will be based on its price/performance versus that of competitive materials, both plastic and non-plastic.

Table 1 shows that costs to meet BPCTCA are 0.1% – 2.9% of current sales price; the costs to meet BATEA are 0.3% – 6.4% and to meet BADT are 0.2%. As the price declines these percentages will increase and at the high end of the range of costs to meet BATEA these costs may become burdensome. Thus, one plant may be shut down in favor of building a new larger plant which would have lower pollution abatement costs per ton of product. There would be no effect on capacity, growth, employment or balance of trade.

III. METHODOLOGY

The economic analysis of proposed effluent limitations on the plastics industry is based on a consideration as to whether the cost of achieving these guidelines can be passed on to the consumer, and whether this increase in price would affect demand. If the added cost of meeting these guidelines cannot be passed on in the final selling price, then profitability would be lessened and if this is severe, plants would possibly shut down.

Another factor which we consider is whether the additional cost of meeting guidelines for water pollution control would increase the price so that the plastic material would no longer be competitive in the marketplace with substitute materials. Plastic materials compete in the marketplace on a price/performance basis with non-plastic materials, i.e., metal, glass and paper as well as other plastic materials. If the cost of meeting controls is high and is passed on to the consumer, this might reduce industry growth or perhaps cause a decline in demand, the latter of which could force plants to close. If such costs were not passed on in the final price, then profitability would be lessened to the point where no additional capacity would be installed and perhaps some plants would be shut down.

Where the costs of meeting guidelines can be passed on without affecting the growth of the industry, since other competing substitute materials are also going to have to pay increased costs for water pollution control, we conclude that there will be no plant closings and therefore no effect on the community, employment, production, or balance of trade.

Since these specialty plastics are not heavy polluters, we are assuming that the cost to meet the guidelines are certainly no greater than that of competing materials such as paper, glass, steel, aluminum and the large volume commodity plastics.

A second consideration is whether the companies producing the materials which must invest additional capital to install equipment for water pollution control have capital available for these expenditures. If this capital is not available, then some plants might choose to shut down.

With regard to balance of trade, the United States is generally the leader in specialty plastic materials so that there is little competition from foreign sources. Generally, prices abroad for these materials are higher than in the United States. We therefore conclude that generally there will be no effect on balance of trade unless the cost of meeting the guidelines should exceed the differential between the U.S. price and foreign prices. Generally speaking, exports of these materials is not a significant factor in total sales.

IV. INDIVIDUAL PRODUCT SEGMENTS

CELLULOSE NITRATE

A. INDUSTRY SEGMENTS

Cellulose Nitrate is made by only two companies, the Hercules Company with a plant at Parlin, New Jersey and the DuPont Company with a plant at Deepwater, New Jersey. Both companies manufacture their own chemical cellulose which is the major raw material. Cellulose nitrate is not used to any extent today as a plastic; it is still used in the production of lacquers. The product in the past has been made into sheet and rods; major applications were optical frames, shoe heels, piano and accordion keys, Ping-Pong balls, playing cards, market price tags, business machine cards and gambling dice. At one time there were a number of other producers including Monsanto and Cellanese. In all of the above applications other materials have replaced cellulose nitrate with the possible exception of dice. As a result almost all cellulose nitrate is now sold to paint companies for the production of lacquers.

Production of cellulose nitrate plastics other than coatings declined from 12 million pounds in 1940 to 1 million pounds in 1962 when statistics were discontinued. There is no future growth in cellulose nitrate plastic. Consumption of cellulosic resins for surface coatings was estimated to be 45 million pounds in the last reported year 1967.

Estimated end use is as follows:

Wood Furniture Finishes	27 million gallons
Cellophane Coatings	10 million gallons
Wood Finishes – Non-Furniture	6 million gallons
Paper Coatings	5 million gallons
Miscellaneous Finishes	5 million gallons
Modifiers	5 million gallons

All these cellulose nitrate finishes are lacquers and hence are based on solvent systems. Because of flammability hazards and air pollution considerations, solvent systems are being phased out in favor of aqueous or powdered coatings.

The cellulose nitrate plant of Hercules is at Parlin, New Jersey and it produces one other product. The DuPont plant at Deepwater produces resin primarily for lacquers. There is no water treatment plant at that facility; they pipe waste water to another plant where the wastes are treated along with the wastes from other organic chemical production. The total number of employees in these two plants is less than 100. We do not see any further growth for cellulose nitrate.

B. FINANCIAL PROFILES

The estimated annual profit before taxes for production of cellulose nitrate is shown below:

	¢/lb
Income	51
Cost	
Fixed Costs	10
Variable Costs	25
Sales G&A	5
Total	40
Net Return before tax[1]	11
% of Sales $	21.6%

The market salvage value of plant assets would only be the extent to which the specific pieces of equipment could be used for other purposes; i.e., pumps, kettles, filter presses, etc. The plants themselves are too old to be sold for further production of cellulose nitrate. The major constraint on financing additional capital assets is the lack of growth of the market rather than anything else.

C. METHODOLOGY

No change from general methodology.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Total Capital Cost Per Plant,$1000	1113	2260
Total Annual Cost,¢/lb	0.4 – 0.85	0.5 – 1.8
Annual Cost as % of Sales Price	0.8 – 1.7	1.0 – 3.6

E. IMPACT ANALYSIS

1. Price Effects

The additional cost to achieve BAT and BPT water pollution guidelines would not have any significant effect on the cellulose nitrate industry. Cellulose nitrate is only used where its properties dictate the application rather than by price. The small additional cost could be passed on to the consumer so that the price would be raised to accommodate these costs. Such a minor increase would not affect the market.

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1. Excludes freight, local and state taxes.

2. Profitability

40% of the waste from these plants is handled through plant waste treatment facilities and the other 60% is discharged to sewers Since we believe that the costs for meeting the guidelines can be passed on to the consumer, there would be no effect on the profitability of the industry.

3. Plant Closures and Production Effects

Since there would be no effect on profitability with the extra cost being passed on to the consumer, we see no plant closings or production effects.

4. Employment Effects

There would be no employment effects since there are no plant closings.

5. Community Effects

There would be no community effects.

6. Impact on Industry Growth

The increased costs would not affect the industry growth. The industry is declining because of the appearance of better and lower cost plastic materials. All previous molding uses are believed to have been discontinued and the only remaining segment, coatings, is declining.

7. Balance of Trade Effects

There would be no balance of trade effects.

F. LIMITS TO THE ANALYSIS

Assuming that the cost figures are accurate, we do not see that there are any questionable aspects to the impact analysis and no assumptions were made that were critical or would affect the accuracy of our judgment.

NITRILE BARRIER RESINS

INTRODUCTION

Nitrile Barrier resins are included in this study not because of their present significance (they are not yet made in commercial quantities and are not yet available for sale) but because of their potential significance in the future. These are the resins which have been test marketed as Coca Cola bottles, Pepsi Cola bottles and Seven-Up bottles. Obviously, if they should be accepted for soft drink bottles their consumption would quickly become significant. Since they are not yet being made commercially and in some cases even the raw materials have not yet been established, economic data on costs, profits, and type of plant are not available. The processes are proprietary.

The three materials classified as nitrile barrier resins are Barex made by Standard Oil of Ohio, Lopac made by Monsanto and NR-16 (an experimental designation) by DuPont. The NR-16 resin was developed jointly with American Can Company and is trade named Vicobar. These resins are lightweight, transparent, impact resistant and have a high acrylonitrile content. They can be formed into bottles which are clear, have excellent barrier properties, and can contain carbonated beverages. It is stated that they can be disposed of in normal waste channels without adversely affecting incinerator operations. They are generally approved for packaging foods and beverages. These materials will be competing with glass and other clear transparent plastics suitable for bottles such as PVC, methyl methacrylates and possibly aromatic polyesters. The reason for their potential significance is the market for soft drink bottles which could consume up to 4.4 billion pounds of this resin. These resins, of course, must compete with plastic coated glass bottles and other plastic bottles.

A. INDUSTRY SEGMENTS

At present these nitrile resins are only being made in developmental quantities for evaluation. There are several operating units. One is the DuPont Company, which is operating at a level of about 10 million pounds per year at Montague, Michigan and is presently increasing capacity to 30 million pounds per year. It is rumored that they are considering a 100 million pound a year plant. They state, however, that they do not have an operating plant, do not have a design basis, have made no decision on the process and have no plant data on the raw wastes or treatability of such wastes.

Vistron Company, a division of Standard Oil of Ohio, makes a product called Barex. It is presently being made in a pilot plant with a capacity of 12 million pounds per year operated by Ethyl Corporation at Baton Rouge, Louisiana. It is understood that Vistron is currently constructing a plant with a capacity of 20 million pounds a year at a cost of $9 million to be completed by 1975 in Ohio.

The third producer is Monsanto which produces Lopac resin. They are currently constructing a plant at Springfield, Massachusetts. Data on its capacity and process are not known. Monsanto is also constructing a plant to make nitrile barrier bottles in South Windsor, Connecticut and is considering two more bottle plants.

Probably no more than 50 people are currently employed in production. To date the composition of these specific resins is not known nor is it known whether the formulas are definitely established. One thing is common to all processes; they have at least a 60% acrylonitrile content. The other monomers which may be copolymerized with the acrylonitrile include methyl acrylate, methyl styrene, styrene, methyl acrylonitrile and butadiene.

Other companies who have been mentioned in the press as considering production of similar nitrile barrier resins include Borg-Warner, Dow, Rohm and Haas, Union Carbide, American Cyanamid and B.F. Goodrich.

Without knowing the specific raw materials or processes, it is not possible to discern whether there will be any difference in the effluent control costs by the different producers but we consider it unlikely.

B. FINANCIAL PROFILES

Since we do not know the process, size of the plant, raw materials or selling price, it is not possible to establish financial profiles. We estimate current profitability to be negative; but future profitability will be positive and approaching the industry average.

C. METHODOLOGY

Same as general methodology.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost Per Plant, $1000	82	161
Annual Cost, ¢/lb	0.06 – 0.36	0.06 – 0.78
Annual Cost as % of Sales Price	0.1 – 0.6	0.1 – 1.3

E. IMPACT ANALYSIS

1. Price Effects

The impact of present costs to reach both BPT, BAT, and BADT are not significant enough to affect the production or profitability of nitrile barrier resins. The price would be raised to take into account the cost of meeting the guidelines due to the anticipated demand

inelasticity of the product. These increases in price would be insignificant compared to anticipated increases caused by rising raw material prices. They will also be small in comparison to anticipated cost savings as larger plants are built.

2. Profitability

Under present circumstances with resin selling at 60¢ a pound, the added cost for water pollution can be passed on to the consumer and therefore there would be little effect on profitability. If, however, the nitrile barrier resins become suitable as bottles for carbonated beverages, the price will have to drop so that they will be competitive with glass and other resins. At these lower prices, the cost of meeting EPA guidelines might not be able to be fully passed on, which would reduce the profitability. Economies of scale of large plants which would then be built might offset this. Again, profitability would probably be more affected by the raw material costs than water abatement costs.

3. Plant Closures and Production

We do not expect any plant closures due to the cost of meeting BPT, BAT, and BADT guidelines.

4. Employment Effects

We do not anticipate any unemployment effects since no plant closures are expected.

5. Community Effects

Since there would be no employment effects there should be no community effects.

6. Impact on Growth

The major factor affecting the industry growth is going to be the performance qualifications of these resins versus glass bottles, polypropylene bottles and polyvinylchloride bottles. Since the cost of establishing new plants, BADT, represents only .03 of a percent of present selling price, there would not seem to be any restrictions on the construction of additional capacity. Our analysis shows that most of the barrier resin plants being built will have their own treatment facility or will have primary treatment, and 70% will be direct dischargers with the remaining 30% discharging to municipal sewers.

7. Balance of Trade

No effect.

F. LIMITS OF ANALYSIS

The major limit to the accuracy of our estimates is the fact that we do not know what the final nitrile barrier resins will be made of. Also we do not know what the future price will be. And finally, we do not know whether the properties of the resin will allow it to capture the large market from substitute materials. We are assuming that the resin will have moderate success which will allow construction of plants of 100 million pounds per year capacity by 1983. Further, we are assuming that the costs of pollution control will be comparable to those for competing materials.

FLUOROCARBON

INTRODUCTION

The six fluorocarbon resins listed below are considered together since they have several common properties. First, they all have similar effluent problems in dealing with fluorine. Secondly, they have a basically similar chemical nature. Thirdly, they are all high priced, small volume specialty resins produced by, at the most, three producers.

FLUOROCARBON RESIN PRODUCTION

Company	Resins	Trade Name	Capacity MM lb/yr
DuPont	Tetrafluoroethylene	Teflon	14
	Fluoronated ethylene propylene	Teflon FeP	
	Perfuoroalkoxy	Teflon PFA	2
	Ethylene Tetrafluoroethylene	Tefzel	
Allied	Chlorotrifluoroethylene	Plaskon CTFE	
	Ethylene Chlorotrifluoroethylene	Halon TFE	
	Tetrafluoroethylene	Halon TFE	3.5
ICI	Tetrafluoroethylene	Fluon	2.2
Pennwalt	Vinylidene fluoride	Kynar	2.2
3M Corp.	Chlorotrifluoroethylene	Kel F	2.3
		Total	26.2

Of the total produced, tetrafluoroethylene is believed to account for 75% of capacity and production. The fluorocarbon resins are noted for their lubricity, temperature resistance, chemical inertness, and weatherability. As a result, these products have found use in military vehicles, aerospace applications, automotive lubricants, non-stick pots and pans, electrical applications, and exterior coatings for buildings and equipment exposed to corrosive environments. They are available as granules, either filled or unfilled, powders, dispersions, elastomers, and as rods, tubes, and sheets.

A. INDUSTRY SEGMENTS

There are only five companies producing fluorocarbon resins as shown in the table above. All are major corporations having broad product lines, a high degree of diversification, excellent technology and strong financial backing. All but Pennwalt produce a variety

of other plastic materials. Allied and DuPont are integrated to the manufacture of ethylene and fluorine. All of these plants are modern, efficient, and have a high degree of technology. All of them are believed to be operating at an economic size level which is small because of the limited market for these products.

There are only five plants involved and the total number of employees in the industry is estimated to be less than 200.

All of these plants will be impacted about equally and we have contacted all the producers.

Prices of fluorocarbon resins range from $3.25 to $10.00 per pound depending on type. Tetrafluoroethylene, the largest volume produced, is $3.25 per pound. Considering the limited number of producers, the price of the fluorocarbons is determined not so much by competition between producers as competition with other materials, both plastic and rubber. For example, vinylidene fluoride, when used as a corrosion resistant coating for buildings, processing equipment, etc., compete with PVC, vinylidene chloride and silicate coatings. Tetrafluoroethylene competes with other plastics such as nylon and chlorinated tetrafluoroethylene. To some extent the producers also tend to follow the pricing lead of the major producer.

While there is continued slow growth for these materials we do not foresee that demand will reach a level where larger plants can be constructed which would allow a significant cost reduction. Therefore, major price changes in this segment of the industry will tend upward due to the increased costs of raw materials.

B. FINANCIAL PROFILE

Published data on profitability and cost structure for these materials is not available. Our best estimate of the industry averages is shown below:

Fluorocarbon Costs:	¢/lb
Income	325
Cost	
Fixed	85
Variable	135
Sales, G&A	25
Total	245
Return Before Tax[1]	80
% of $ Sales	24.6

1. Excludes freight, state and local taxes

We do not know of any significant deviation or variation between the producers regarding production cost or profitability. 3M may have somewhat higher raw material costs since it is not integrated to raw materials.

The market value of plant assets is probably about 10% of the original plant value since the only salvageable assets are the individual pieces of equipment. One tetrafluoroethylene plant was shut down last year because of market competition and was dismantled in this fashion.

C. METHODOLOGY

Same as general methodology.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost Per Plant,$1000	44 – 145	44 – 145
Annual Cost,¢/lb	0.32 – 1.95	0.32 – 1.95
Annual Cost as % of Sales Price	0.1 – 0.6	0.1 – 0.6

E. IMPACT ANALYSIS

1. Price Effects

Based on the average selling price of fluorocarbons, the cost to meet both BPT and BAT range from .1 percent to .6 percent of the selling price. The cost of pollution control for new plants is .10 of a percent. Since this would not affect demand, these prices will be passed along to the consumer and result in a consequent price rise.

2. Profitability

Due to the highly specialized and sophisticated uses for these expensive resins, there is no concern but that a cost of this order of magnitude can be passed along to the consumer and will have no effect on the profitability of the industry. In addition, all of the plants have some in-plant treatment, and all discharge to municipal sewers. This industry has already spent $180,000 on in-plant treatment, so that the effects of additional costs for the industry will only be another $180,000.

3-7 Plant Closures, Production, Employment, Community, Industry Growth and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any required increases can be passed on to the consumer, there will be no effect on plant closures, production, employment, communities, industry growth, or the balance of trade.

F. LIMITS OF ANALYSIS

We know of no critical assumptions which would affect our conclusions, and believe that our judgments are correct.

ETHYLENE VINYL ACETATE

INTRODUCTION

Ethylene vinyl acetate resins are essentially low-density polyethylene resins which have been copolymerized with 15% to 30% of vinyl acetate monomer in order to modify the properties. They should be considered as modified low-density polyethylenes. The major reasons for the modification is to change the crystallinity in order to improve the toughness of the polyethylene. These copolymers have found major application in films used to produce industrial sacks, i.e. 80 pound sacks used for the packaging of fertilizer, grain, chemicals, etc.

Technically, any of the 12 producers of low-density polyethylene can produce ethylene vinyl acetate copolymers and can utilize the same equipment. Therefore, reference should be made to the U.S. Environmental Protection Agency report on polyethylene entitled "Economic Analysis of Proposed Effluent Guidelines: The Plastics and Synthetics Industry (Phase I)".

A. INDUSTRY SEGMENTS

The producers of ethylene vinyl acetate resins are all essentially of the same size, nature and degree of integration. While almost any producer of low-density polyethylene could produce these resins, the major suppliers are believed to be:

Chemplex	Union Carbide
Dow	USI
DuPont	

Of these, DuPont has announced that it is withdrawing production of these resins in 1974. USI is probably the most vigorous in promoting the development of these products and indeed is integrated to manufacturing films as well as marketing resin. All of the companies are major sized corporations with sales over $100 million. All are integrated to the production of the basic raw material ethylene and all are major corporations highly diversified into other plastics.

It is our understanding that total production of ethylene vinyl acetate copolymer is about 3% of all low-density polyethylene resin or approximately 150 million pounds per year; this percentage is increasing. The total amount of vinyl acetate in the copolymer can vary between 15% and 30%. We believe that it averages about 17% and that this average content is also increasing. The difference in water pollution between low-density polyethylene and ethylene vinyl acetate resin is the recovery and purification of the unreacted vinyl acetate monomer.

The size, age, location, level of technology, level of integration and efficiency of these plants is similar to that for low-density polyethylene production. Only one

company, USI, has a separate line that produces just ethylene vinyl acetate copolymers. The others use equipment interchangeably with low-density polyethylene production. All others are of economic size which is now roughly 200-500 million pounds. Most plants were built within the last 10 years and operate at a high level of technology and efficiency. All of the producers are integrated to ethylene except USI and all are integrated to end products particularly film. It is not possible to identify the number of people employed in ethylene vinyl acetates production since there is no data on the percentage of each plant capacity used to produce the copolymer. We do not see any significant difference between the various producers of EVA.

B. FINANCIAL PROFILE

The financial performance of producing EVA versus low-density polyethylene depends mainly on the difference in the selling price between the copolymer and the homopolymer minus the additional cost of vinyl acetate monomer. Since there is no real data to determine the actual percentage of vinyl acetate in the product mix we can only base our figures on an estimate that on the average 17% vinyl acetate is added. These economics are shown below:

	Profitability Analysis ¢/lb
Income	16
Cost	
Fixed	3.5
Variable	8.1
Sales, G&A	1.4
Total	13.0
Return Before Tax[1]	3.0
% on Sales $	18.7

C. METHODOLOGY

Same as general methodology.

D. POLLUTION CONTROL COSTS

	BPT	**BAT**
Capital Cost per Plant, $1000	26-47	53-101
Annual Cost, ¢/lb	0.03 – 0.30	0.06 – 0.93
Annual Cost as a % of Sales Price	0.2 – 2.0	0.4 – 6.2

1. Excludes freight, state and local taxes.

E. IMPACT ANALYSIS

1. Price Effects

The costs of meeting BPT, BAT, and BADT are small in relationship to the selling price and insignificant in view of rising raw material costs. Prices will rise to accommodate the cost of meeting water pollution guidelines.

2. Profitability

All producers of ethylene vinyl acetate resins are understood to do primary treatment and 50% of them also do biological treatment. Thus, any impact on the industry's profitability will be less than that indicated by the costs required to meet standards. The industry is expected to spend $120,000 a year to meet 1977 standards, and $370,000 annually to meet 1983 standards. New plants will have to spend approximately $100,000 per year to meet 1977 requirements. Capital expenditures to date approximate $50,000 worth of installed equipment. As a result of the low percentage of total sales price required to meet standards and the substantial amount of already installed equipment, we do not see that the cost of meeting BPT and BAT will affect the profitability of the industry. These costs can be passed on to the consumer so that there should be no effect at all on profitability. The cost of water pollution control will be minimal compared to the overriding factor of the increased costs of ethylene due to the rising price of oil. In addition, data indicates that the costs of meeting water pollution guidelines for EVA is less than for both polyvinyl chloride and low-density polyethylene, its major competitors. We therefore see no effect on the profitability of producing EVA because of meeting EPA guidelines.

3-7 Plant Closures, Production, Employment, Community, Industry Growth and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines had no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any required increases can be passed on to the consumer, there will be no effect on plant closings, employment, communities, industry growth, or the balance of trade.

F. LIMITS OF ANALYSIS

We believe that these analyses are correct based on our judgment of the growth of the industry. There are no critical assumptions which would affect the validity of our conclusions.

UNSATURATED POLYESTER RESINS

INTRODUCTION

Unsaturated polyester resins refers to the resins which are almost always reinforced with glass fiber and used in the production of sail boats, translucent corrugated architectural panels, automotive parts, motor boats, etc. This industry segment is the largest and most important of this study.

A. INDUSTRY SEGMENTS

The major producers are listed below:

Company	No. Plants
Owens Corning	2
Reichhold	7
Ashland	4
Glidden	5
W.R. Grace	5
Freeman	2
PPG	4
Koppers	2
Cook Paint and Varnish	5
Rohm & Haas	2
Atlas-ICI	1
	39

Producers who report their production range in size from companies producing less than 1 million pounds per year to major firms such as Reichhold Chemical and W.R. Grace which produce in excess of 100 million pounds per year. Some companies such as Ford Motor Company, Pioneer, and boat manufacturers produce primarily for captive use in cars, decorative laminates, and boats, respectively. Other firms such as Reichhold are primarily merchant producers selling a broad line of products. Since the equipment used to make polyester resin is the same as that used to make alkyd paint resins and most of the producers make both products, it is difficult to establish the exact capacity for either material. Present consumption by end use is shown below. Growth is expected to be 15% per year through 1978 with the most rapid growth in the transportation, appliances and construction segments.

End Uses	1973 MM lbs.
Aircraft & aerospace	28
Appliance & Equipment	82
Construction	220
Consumer goods	115
Corrosion resistant products	120
Electrical parts	108
Marine	385
Car and train	307
Other	85
	1450

Only one producer in the industry is using a continuous process. All others use a batch process and the minimum size economic plant is in the order of 25 million pounds per year requiring probably two to three kettles. Most of the major producers have multiple small plants located relatively near the markets with capacities of about 50 million pounds a year. As a result of this fragmentation it is unlikely that there will be further reductions in costs resulting from economies of scale in expanding to large plants.

The larger producers manufacture and market a variety of grades of resin, i.e. 12 base resins and 30 formulations tailored to their customer needs which vary in viscosity, molecular weight, etc. Some producers also provide specialty resins such as flame resistant grades which sell for a premium price. Most of the major producers are integrated to the manufacture of at least some of their raw materials namely, styrene monomer, glycols, and maleic or phthalic anhydride. However, raw materials are generally available in small quantities to all producers so that integration is not a necessity. A number of producers are also integrated to the manufacture of end products such as building panels, pipe, down spouts and gutters. Some producers of end products such as boats manufacture their own resin. Most of the major producers of polyester resins also produce a variety of other plastic materials particularly alkyds and other thermosetting resins.

In general, the resin producing plants are located near the marketplace since these resins do not require large-size plants. Reichhold Chemical, one of the largest manufacturers has, for example, located plants near the customers in such locations as Azusa, California; Detroit, Michigan; Elizabeth, New Jersey; Grand Junction, Tennessee; Houston, Texas; Jacksonville, Florida; San Francisco, California and Tacoma, Washington. We estimate the following geographical breakdown of production:

Midwest	50%
Northeast and Middle Atlantic	15%
South	25%
West	10%

Since the resins are relatively simple to make, a number of end users such as boat producers, corrugated panel producers, automobile companies, and furniture companies make their own resins. In addition, some of the producers of fiber glass reinforcement make their own resins.

The average age of the plants in the industry is impossible to estimate. There have been a number of recent expansions by the major producers in new plants. However, there are also some old alkyd resin kettles that have been in existence for 25 years which are now producing polyester resins. Since this is essentially a batch process the capacity depends on the number of kettles in a given plant and this varies from one to ten or more. All producers use the same technology which has not changed materially in the past 20 years. The one exception is the development of a continuous process by Reichhold Chemical Company which is believed to be used in one plant.

We estimate that there are approximately 80 plants producing these resins and 40 of them produce 90% of the resin. The major resin producers which have captive operations are

Owens Corning
Reichhold

The total number of employees in the industry is estimated to be 1200.

It is expected that the industry will grow from the 1973 level of 1.4 billion pounds per year to 2.8 billion pounds by 1978. Growth in 1974 will be limited by raw material shortages.

B. FINANCIAL PROFILE

It is extremely difficult to arrive at a meaningful, average financial profile for companies in this industry since they vary all the way from small companies operating obsolete alkyd resin kettles to large multi-national firms fully integrated to materials and end products. Furthermore, since the equipment is used interchangeably for other products, it is difficult to determine the operating profits for any given product at any given time. We are showing below, however, our best estimate of the financial profile for this industry including 1) a major merchant supplier and 2) a small custom producer.

PROFITABILITY ANALYSIS

Production Capacity	10 MM Lbs.	100 MM Lbs.
Income, ¢/lb	19	21
Cost, ¢/lb		
Fixed	11	10.0
Variable	4	3.0
Sales, G&A	2	3.5
Total	17	16.5
Return Before Tax[1]	2.0	4.5
% on Sales $	10%	21.4%

There is a very wide range of profitability from perhaps 10% to 25% return on sales before tax depending on the size of the company, the degree of integration, the product mix and the overhead cost.

The salvage value of the assets is small, perhaps 10% of the original value of the equipment. Generally the equipment can be used to produce other resins.

C. METHODOLOGY

The best way to assess the economic impact of water pollution control costs is to relate the value of polyester resins to the value of competing materials and determine whether these costs can be passed through to the consumer. If they can there will be no impact.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant, $1000	198	198
Annual Cost, ¢/lb	0.08 – 0.38	0.08 – 0.76
Annual Cost as a % of Sales Price	0.4 – 1.9	0.4 – 3.8

1. Excludes freight, state and local taxes.

E. IMPACT ANALYSIS

1. Price Effects

Prices in this industry are determined primarily by strong price competition amongst producers. Since there are a wide variety of formulations it is readily possible for one producer to reduce his costs and therefore use price to obtain a specific customer contract. Another factor influencing the price structure of the industry is competition from other substitute materials particularly in automotive parts where reinforced polyesters must compete with steel, other plastics and aluminum which are equally suitable. As it is true with many other industries, the major price effect of the future is going to be due to the rapidly increasing cost of raw materials particularly styrene, which, for example, has doubled in price in the last nine months. This price increase far obscures the .4 cent per pound cost to meet 1977 pollution controls. For example, due to the shortage of styrene, prices of the resins have increased by 50% in the last three months to approximately 30¢ a pound.

This industry sends 90% of its waste to municipal sewers so that only 10% of the waste load is regulated by effluent limitations. The BPT and BAT costs can readily be passed on to the consumer by the larger producers. We therefore expect that there may be minor increases in prices due to meeting effluent guidelines with major price increases due to the increased price of raw materials.

2. Profitability

The major financial effect will be on the profitability of smaller companies if they have to invest substantial capital to install pollution control equipment. They will also need technical assistance in installing and providing for water pollution control. These companies will have to compete on a price basis with the companies which already have these capabilities and much of the installed equipment. This will be compounded by a probable necessity for their meeting other federal standards such as air pollution, safety and noise. The cumulative effect of these regulations may severely reduce their profitability and strain their capital resources. Today many of these companies discharge to municipal sewers. The larger companies should be able to pass on the costs of pollution control.

3. Production Effects

Production of these resins is now controlled by the availability of raw materials. Many companies have recently cut back on production because of the lack of raw materials. While it is possible that some small companies not discharging to municipal sewers will shut down operations rather than pay for water pollution control, this productive capacity would be more than offset by expansions of the major producers if they could get sufficient styrene monomer and other raw materials. If there are plant closings

the major reason will be the lack of available raw materials rather than the costs of water pollution abatement. The major effect of water pollution control costs would be that some small companies might close down rather than install the necessary treatment equipment. Annual operating costs to meet 1977 and 1983 standards will be 0.4% of the sales price for a small plant; hence only a few, perhaps 10 plants, might close. These would be those plants too small to afford the investment. Since only 10% of the waste load is discharged directly it is estimated that two to three plant closures would occur as a result of effluent limitations and approximately seven plants could potentially close if pretreatment standards require capital and annual expenditures similar to BPT.

4. Employment Effects

We estimate that perhaps 10 small plants; i.e. 5 mm lbs/year capacity, might choose to cease operations. The employment effect from such plant closings would approximate 100 people. However, only about twenty to thirty employees would be affected by direct discharge effluent limitations.

5. Community Effects

Plant closings would generally be in medium sized cities in New England and the Midwest. The overall effect on the community would be negligible due to the small size of the companies closing down. Dislocated employees would undoubtedly be absorbed in the local work force. There would be no secondary effects.

6. Impact on Industry Growth

A new polyester resin plant coming on stream and meeting BADT levels will have a cost of .15¢ per pound. This might prevent small producers from entering this industry; however, it would not affect industry growth since large present producers would expand and build new plants. We believe that the costs for meeting new plant standards will be able to be passed on to the consumer and, therefore, industry growth will not be affected. Industry growth will be affected over the next several years due to a shortage of raw materials, however.

7. Balance of Trade Effects

We do not see that the small additional costs for water pollution control of the unsaturated polyesters would have any effect on the balance of trade.

F. LIMITS OF ANALYSIS

We know of no critical assumptions which have been made that would affect the accuracy of this analysis. Estimates as to the number of plants which might close could vary by ± 20%. The only assumption which has been made is that 90% of the waste is discharged to municipal sewers. If this were incorrect, there might be additional problems since some additional small plants not on municipal sewers might have difficulty in meeting the standards.

SATURATED POLYESTER RESINS

A. INDUSTRY SEGMENTS

Saturated polyester resins as distinct from unsaturated polyester resins are a series of relatively new engineering thermoplastic molding resins, which are sold in limited quantities (15 million pounds per year) for injection molding of parts requiring high temperature resistance, excellent dimensional stability and excellent electrical properties. They have unsurpassed chemical resistance and are very easily fabricated. These resins compete with materials such as nylon, phenolics, and polyacetals. They sell in the price range of 65¢ to 95¢ per pound.

There are only three producers, General Electric which manufactures Valox, Celanese which manufactures Celenex, and Eastman Chemical Products which makes Tennite.

All of the plants are new, i.e. built in 1971. The Tennessee Eastman plant is at Kingsport, Tennessee. The General Electric plant is at Pittsfield, Massachusetts and the Celanese plant is at Belvidere, New Jersey. Total employees are estimated to number 25.

There are two basic types of resins: PET (polyethylene terephthalate) and PTMT (tetramethylene phthalate). A variety of grades are offered including flame resistant grades in both natural and colors. The product is similar to polyester fibers and can be made in the same equipment. Both Celanese and Tennessee Eastman make polyester fibers.

A 20% per year growth is expected with predictions of 100 million pounds per year by 1980.

B. FINANCIAL PROFILE

It is very difficult to establish the financial profile for these resins since they are only being made in limited quantity and/or are being made in facilities used for polyester textile fibers. The economics of a commercially sized plant which will be built as demand grows, will be significantly different. Our estimate of future profitability is shown below:

	¢/lb
Income	68
Cost	
Fixed	9
Variable	35
Sales, G&A	10.5
Total	54.5
Return before tax[1]	13.5
% on sales $	20

C. METHODOLOGY

The only method of assessing the economic impact of water pollution abatement costs is the extent to which these costs can be passed on to the final consumer. Since these materials are relatively high priced engineering materials whose price will be declining, the assessment will have to be based on estimated future prices and estimates of the materials which these engineering plastics will replace.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant, $1000	49	77
Annual Cost, ¢/lb	0.07 – 2.03	0.21 – 4.48
Annual Cost as a % of Sales Price	0.1 – 2.9	0.3 – 6.4

E. IMPACT ANALYSIS

1. Price Effects

The price of polyesters today, 68¢/lb. is an introductory price and probably does not cover the full cost of production and development. As larger scale plants are built and sales increase in volume, it is expected that the price would come down. The level to which this price will drop depends on the performance value of the polyester versus competing materials, including metal, polypropylene and other engineering plastics. The price will be maintained at whatever level is required to market the products in sufficient volume to operate the plants close to capacity. We believe that the polyesters will compete primarily with other engineering resins such as polyacetal and nylon and that the cost of meeting water pollution standards will be passed on to the consumer since the

1. Excludes freight, state and local taxes.

increase is small in relationship to the value of the product; therefore, prices will rise to reflect these costs. It will, however, be only a small percentage 0.1% to 3.0%. A rise of this nature will be obscured by considerably higher price increases due to the increased cost of raw materials. The cost for water pollution control in new plants is only .02 of a % of selling price, and this would be added to the sales price.

2. Profitability

The financial effects of water pollution control on the profitability would be negligible for companies who are able to meet BPT and BAT and who are operating on low volume water supplies, since these costs could be readily passed on to the consumer. There is believed to be one present plant operating on a high volume water flow. If it has to meet 1977 and 1983 standards it would be at a disadvantage and its profitability would be reduced since it could only pass on as much of the cost as the lower cost producers. The effect on profitability of new entrants and new plants, which is indeed the future of this industry, would also be negligible since the costs are quite low. The present and potential producers, General Electric, Tennessee Eastman, Goodyear and Celanese all have ample capital reserves.

3. Plant Closures and Production Effects

There would be no effect on present production because of the cost of water pollution. There is the possibility that the costs of water pollution in the one high-cost plant might cause this plant to be shut down in favor of building a new plant since the cost of new plant construction is only .02 of a percent of sales price for water pollution controls, whereas modifying the one existing plant to meet BAT by 1983 would be 6.4%. We foresee that the old plant will not shut down until the new plant is substituted; thus, on a overall basis, total production would not be affected. We expect that production will expand as the market expands and as the price/performance ratio of the materials improves versus competitive materials. Since we believe this product will expand in use and that there is capital available, and since the cost of water pollution control in new plants is low, these costs can be passed on. There will be expansions and growth in the industry to 100 million pounds.

4. Employment Effects

We believe that this industry is going to expand, that more and more people will be employed, and if an obsolete plant is shut down, the employees will be readily absorbed into the new plant which will have considerably larger capacity.

5. Community Effects

Since this industry is expanding and employing more people, and the dislocated employees will be reemployed in another plant within the industry there will be no community effects.

6. Impact on Industry Growth

This industry is expected to grow depending on the price/performance ratio of this material versus competitive products. We do not see that the cost of meeting guideline standards would affect this growth. Growth will depend on the relative value of these materials which will be more dependent on raw material costs than on costs for water pollution controls.

7. Balance of Trade Effects

There will be no balance of trade effects since exports are expected to increase regardless of price rises affected by effluent abatement costs.

F. LIMITS OF ANALYSIS

We believe that the accuracy of our estimates are ± 15%. There were no critical assumptions which would be sufficiently sensitive to overrule our basic conclusions and there are no questions remaining to be answered.

POLYPROPYLENE FIBERS

A. INDUSTRY SEGMENTS

Polypropylene fibers are defined as multi-filament and staple fibers used in textile applications and exclude slit film, fibrelated film and mono filaments. Capacity for multi-filament and staple is estimated at 205 million pounds per year. The principal market for multi-filament is in the manufacture of indoor/outdoor carpets. Shown below is our estimate of the demand for polypropylene fiber.

	1973	1976
Multi-filament	**MM Lbs.**	**MM Lbs.**
Carpets	55	65
Upholstery	30	35
Other		5
Staple		
Nonwoven Carpets	40	45
Carpet Backing	13	20
Other	2	10
Total	140	180

All three of the major producers of polypropylene fibers are large well financed diversified corporations. The table below shows their estimated capacity.

		Capacity
Company		**MM lbs/yr.**
Hercules Co.	Covington, Kentucky Oxford, Georgia	115
Phillips Fiber	Spartanburg, South Carolina	45
Standard Oil of California	Dayton, Tennessee	45
		205

Of the three companies, Hercules and Phillips are both integrated to the manufacture of polypropylene resins. Standard Oil of California purchases resin. Hercules is the major producer of polypropylene and Phillips is a major producer of other polyolefin resins. Phillips is also integrated to the manufacture of other fabricated forms such as film and bottles. Standard Oil of California is only concerned with the production of polypropylene multi-filaments. All of the plants are under 10 years of age. All producers use essentially the same technology and we do not know any difference in efficiency between these operations. The only difference between the producers is the fact that Standard Oil of California does not make its own resin. The number of employees in this industry is estimated to be 1,000.

B. FINANCIAL PROFILES

Shown below is our estimate of the profit of polypropylene fiber production:

	Profitability Analysis ¢/lb
Income	35
Cost	
Fixed	12
Variable	11
Sales, G&A	4
Total	27
Return Before Tax[1]	8
% Return on Sales $	23

This is an estimated average of the three producers. There could be a different profit for Hercules and Phillips depending on the price which they pay themselves for their captive polypropylene resin. Since Standard Oil of California has propane available it need not worry about the availability of propylene which is made from propane raw material sources. We do not see that there are any financial constraints on additional expansions in this industry since all of the producers have ample capital available.

C. METHODOLOGY

This is the same as the general methodology. The impact depends on whether the industry can pass costs through as price increases to consumers which in turn depends on the price/performance of the material versus that of competitive materials.

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1. Excludes freight, state, and local taxes.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant,$1000	146	579
Annual Cost,¢/lb	0.24 – 0.49	0.24 – 0.49
Annual Cost as a % of Sales Price	0.7 – 1.4	0.7 – 1.4

E. IMPACT ANALYSIS

1. Price Effects

Since there are only three producers of polypropylene fiber, prices are not determined by competition between producers, but by competition and end uses between polypropylene fiber and other substitute fibers such as polyesters and nylon. We do expect that there will be an increase in the price of polypropylene fiber over the next several years due to sharply increasing prices of the raw material propylene which comes from natural gas and which is now and is expected to continue to be in short supply. The cost to control water pollution for polypropylene fibers through 1977 and 1983 amounts to only 0.7% to 1.4% of present selling price, while the cost for a new plant is only 0.07 percent of the selling price. These factors are insignificant in comparison to the cost increases of raw materials and can undoubtedly be passed along to the consumer, thus raising the price slightly. Further, all present producers of polypropylene discharge to municipal sewers and, therefore, do not come under the effluent standards. We, therefore, project only a minor increase in prices due to the costs of water pollution control. Such a minor increase would not affect the competitive position of polypropylene fibers versus that of competitive materials since these materials face similar price increases due to water pollution controls.

2. Profitability

The profitability of producing polypropylene fibers should not be affected in any way since any minor increase in costs can be passed on to the consumer. There will be no effect on capital availability since all of the producers of polypropylene fibers have almost unlimited capital available.

3.-7. Plant Closures, Production, Employment, Community, Industry Growth, and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any

required increases can be passed on to the consumer, there will be no effect on plant closings, employment, communities, industry growth or the balance of trade.

F. LIMITS TO THE ANALYSIS

We believe the accuracy of our judgment is high. We do not believe that there are any critical assumptions which would affect the overall validity of our conclusions, and there are no questions remaining to be answered.

METHYLMETHACRYLATE RESINS

A. INDUSTRY SEGMENTS

Methylmethacrylate resins were originally produced in sheet form during World War II and trade named Plexiglass and Lucite. These clear, transparent sheets were used as canopies on military aircraft. These resins are now familiar in their use as illuminated signs at gas stations and other outdoor displays, ornamental decorative objects such as cigarette lighters and the ubiquitous automobile tail light lenses. The product is made in two forms: (1) a clear transparent sheet and (2) a molding powder. Major new growth is anticipated for these materials due to the laws requiring unbreakable glazing in storm doors, etc.; thus, methacrylate sheeting is replacing glass in these applications. Another new application for methacrylate resins which could increase demand by 50% over the next seven years is the development of methacrylate bath tubs and wash basins. These are already used extensively in mobile homes and are finding increased use in residential homes.

Shown below is the estimated production capacity of the methacrylates including integrated production of the monomer:

Company		Capacity MM lbs.		
		Monomer	Cast Sheet	Molding Resin
Rohm and Hass	Bristol, Pa.			
	Deer Park, Texas	520	130	45
DuPont	Parkersburg, W.Va.	120	0	35
American Cyanamid	Wallingford, Ct.			
	Sanborn, Maine	100	25	13
Swedlow	Florence, Ky.			
	Garden Grove, Cal.	0	70	0
Others		0	15	7
Total		740	240	100

It can be noted that three of the producers, Rohm and Haas, DuPont and Cyanamid are major chemical firms producing a variety of other chemicals and plastics. Swedlow which has two plants, one on the west coast and one in Kentucky, produces only methacrylate resins. All producers, with the exception of DuPont, are integrated to the production of the cast sheet. DuPont has recently licensed a process from Japan to make cast sheet and will build a production unit at Memphis to do this. The technology in the manufacture of molding resins has not changed substantially over the past 10 years and is not expected to. There has been, however, a major change in the manufacture of cast sheet since Swedlow developed a continuous casting process. Rohm and Haas has also

developed a continuous casting process and DuPont has licensed one from Japan. Continuous casting is less expensive than cell casting. These continuous casting plants are 0-5 years of age. The cell casting units are considerably older, being perhaps 25 years old.

The only segment of the industry which would be affected differently by water abatement costs are the approximately 3 small companies included in the "other" category which account for a total of 22 million pounds.

B. FINANCIAL PROFILE

Shown below is the estimated profitability of producing methylmethacrylate sheet and compound.

	Profitability Analysis ¢/lb
Income	70
Cost	
Fixed	10
Variable	43
Sales, G&A	7
Total	60
Return Before Tax[1]	10
% Return on Sales	14.3

Costs will be similar for all producers with the exception that American Cyanamid, which only has a cell casting line, will have somewhat higher costs for sheet and DuPont will have to pay a royalty to Mitsubishi for its license. Swedlow's costs may be higher since they must purchase monomer.

Prices of the methacrylate molding compounds are determined by the price sensitivity effect and the prices of competing materials. The price sensitivity effect is small; namely, lowered prices are not going to materially increase demand. Competition from other resins, i.e., polycarbonates in tail light lenses is a big factor. In general, these prices will remain stable except for any increase in raw material cost. In the cast sheet segment the price of methacrylate sheet will be determined by its performance value versus safety glass, polycarbonates, and other plastic glazing materials. Its use in sanitary ware such as wash basins and bath tubs will also be based on its performance against that of competing materials such as melamine resins and enameled iron. The price in general will be held at the highest level which will allow it to improve its market share in each of these applications. The price of cell cast sheet will be determined by competition with the continuous cast sheet and will be held at a slight premium due to its somewhat better properties. The continuous cast sheet will maintain a price/performance value relative to extruded sheet since the continuous cast sheet has better properties than the extruded sheet. Prices are expected to increase as basic feedstocks rise in cost.

1. Excludes freight, state and local taxes.

C. METHODOLOGY

The economic impact of the costs of pollution controls will be based on the extent to which these costs can be passed along to the consumer without losing a share of the market to competitive materials.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant, $1000	155 - 1020	179 - 1176
Annual Cost, ¢/lb	0.07 - 0.28	0.07 - 0.28
Annual Cost as a % of Sales Prices	0.1 – 0.4	0.1 – 0.4

E. IMPACT ANALYSIS

1. Price Effects

There is a problem in dealing with methylmethacrylate resins since 240 million pounds are sold as a cast sheet in a finished fabricated form, whereas another 100 million pounds are sold as resin at a significantly lower price. This resin then is injection molded into automobile tail lights, etc. The cost of the finished sheet is 70¢/lb and the resin is 45¢/lb. As a result the cost of water pollution control as a percent of the sales price varies considerably. In any event the cost, as shown above, is small. These required price increases are all relatively insignificant.

Due to the increasing price/performance value of these materials we believe that the costs to meet BPT, BAT and BADT water pollution abatement will be passed on to the consumer and the prices will rise accordingly. We see no secondary effects as a result of these price increases.

2. Profitability

The profitability of this industry should not be affected by this minor increase in cost since we believe it can be passed on to the consumer. There would be no problem with capital availability since the producers, Rohm and Haas, DuPont, American Cyanamid, and Swedlow, have ample capital reserves.

3.-7. Plant Closures, Production, Employment, Community, Industry Growth, and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any

required increases can be passed on to the consumer, there will be no effect on plant closings, employment, communities, industry growth, or the balance of trade.

F. LIMITS TO THE ANALYSIS

We believe the accuracy of our judgment is high. We do not believe that there are any critical assumptions which would affect the overall validity of our conclusions, and there are no questions remaining to be answered.

ALKYD MOLDING RESINS

A. INDUSTRY SEGMENTS

Alkyd molding resins are chemically similar to unsaturated polyester resins and the alkyd resins used for paint. They are generally available in the form of dry powder, paste, and rope and usually contain fillers including glass and clay. The alkyd resin itself can be made by any company which makes polyester resin or alkyd paint resin and thus capacity figures are not meaningful. Much of the alkyd resin is sold to compounders who add fillers, colors, catalysts and reinforcement and then sell their proprietary compound to the end users such as aircraft companies, automotive companies, electrical appliance companies, etc. Major uses for these resins are in automotive parts because of their high temperature resistance, excellent electrical properties and excellent dimensional stability. Other applications include appliances, television sets, etc. The compounder who adds fillers, such as glass fiber and clay, to prepare a proprietary compound does not generate any liquid waste. These resins have been in use since 1950 but consumption is believed to be less than 75 MM pounds. Growth is expected to be modest, 5-7% per year.

It is difficult to prepare a list of alkyd molding resin producers since some listings include people that are primarily paint resin producers and others who are primarily compounders. Shown below is our estimate of the major producers.

Allied Chemical, Morristown, N.J.
Durez, Tonawanda, N.Y.
Plastics Engineering Company, Sheboygan, Wis.
Koppers, Pittsburgh, Pa.
Celanese, Louisville, Ky.
Freeman Chemical, Port Washington, Wis.
Resyn Corporation, Enden, N.J.
Arco Chemical, Philadelphia, Pa.

There is no significant difference in the firms that produce these resins. Some of the firms are integrated to the manufacture of raw materials, such as Allied and Koppers, and most of them formulate molding compounds. There are a large number of different formulations as indicated by the fact that the price varies from 35¢ to 55¢ depending upon the specific formulation.

The technology to make these resins has not changed much over the past 10 years except in formulations for specific end uses. The plants are relatively old compared to the plastics industry since they are using older alkyd and polyester equipment.

No producer makes these resins in more than one plant. There are a number of smaller plants that could make these resins and no new producers are anticipated.

We have taken into account all the major producers of these resins and do not see that any one producer would be affected differently than any other.

B. FINANCIAL PROFILE

It is very difficult to determine the financial profiles for these resins including profit before tax and cash flow since production costs are similar to those for polyesters whereas the price is dependent on the specific nature of the proprietary compound manufactured. Thus, the profitability may even vary for each batch of resin made by any one of the producers. Because of the technical service required and the costs associated with developing proprietary compounds there is a considerable increase over the actual production cost of the resin at the mill. Those companies which have highly proprietary compounds may sell them for 55¢ per pound. Other companies which are producing fairly standard resins may only receive 35¢. Margins are estimated to range from 25% to 10% on sales before tax. The salvage value of the assets is the same for all producers and is only that of the value of the resin kettle. These can generally be sold as used equipment for perhaps 10% to 20% of the original dollar investment depending on their condition. The estimated cost structure is shown below:

	¢/lb
Income	39
Cost	
Fixed	17.0
Variable	9.0
Sales, G&A	4.5
Total	30.5
Return before tax[1]	8.5
% Return on Sales	22%

Prices in this industry are dependent upon the performance of the alkyd molding compound versus that of competitive plastics materials such as phenolics, polyesters, and the new engineering thermoplastics. Price is not affected by supply versus demand because supply can be readily increased at any time that the demand should grow. The market volume is not sufficiently large to encourage intense competition. This is a specialty product whose price is determined by its specific performance value in a given application. We do not see that there will be any major price change in the near future since the technology is fairly well understood and the raw materials are standard. Prices may go up some as a result of the increased cost of raw materials such as styrene monomer.

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1. Excludes freight, state and local taxes.

C. METHODOLOGY

Same as the general methodology; the impact depends on the ability to pass costs through as increased prices to consumer, which in turn depends on the price/performance of the product versus that of competitive materials.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant,$1000	198	198
Annual Cost,¢/lb	0.08 – 0.38	0.08 – 0.76
Annual Cost as a % of Sales Prices	0.4 – 1.9	0.4 – 3.8

E. IMPACT ANALYSIS

1. Price Effects

The cost for water pollution control for alkyd molding resins is the same as for unsaturated polyesters. However, since the alkyd molding resins sell for a higher price per pound the percent increase in selling price is less.

The alkyd resins are used only where their particular performance is required. The cost of water pollution control as a percent of sales is not significant for BPCTCA, BATEA or BADT. We do not believe that there are going to be any new plants. Since this is a relatively low percent increase, we believe that these costs can be passed on to the consumer with a resultant price increase, and there would be no secondary effects of these price increases.

2. Profitability

Since price increases can be passed on to the end user, there would be no effect on profitability. In addition,there would be no problem with capital availability since the major chemical companies have ample financial resources.

3-7. Plant Closures, Production, Employment, Community, Industry Growth, and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any required increases can be passed on to the consumer, there will be no effect on plant closings, employment, communities, industry growth or the balance of trade.

F. LIMITS TO THE ANALYSIS

We believe our analysis is accurate by ± 15%. We do not believe there are any critical assumptions which would affect the validity of our conclusions and there are no questions remaining to be answered.

POLYVINYL BUTYRAL

A. INDUSTRY SEGMENTS

Eighty percent of the market for polyvinyl butyral is for the safety inner layer in automobile glass; the remainder is for coatings and export. This product was developed about 40 years ago and at one time was used in all windows of automobiles. In the 1950's the automotive manufacturers shifted to tempered glass for side windows and rear windows for most cars. In all cars, however, polyvinyl butyral is used as the safety ply in the front windshield. In 1966 the PVB ply was increased in thickness to 0.76 millimeter.

There are at present only two producers of polyvinyl butyral sheet, Monsanto and DuPont. Up until December of 1973 it was also made by Union Carbide.

Polyvinyl butyral is made from polyvinyl alcohol and both producers are integrated to this intermediate raw material, polyvinyl alcohol. Further, both producers are integrated to the manufacture of the sheet which is then sold to the major manufacturers of automobile windshield glass, namely Pittsburgh Plate Glass and Libbey-Owens-Ford. There are three plants: Monsanto has a plant at Indian Orchard, Massachusetts which is 30 years old and a newer plant at Trenton, Michigan which is 16 years old. The DuPont plant is at Fayetteville, North Carolina and is about 20 years old. The Trenton, Michigan plant of Monsanto produces only polyvinyl butyral; the Indian Orchard plant produces a complex of thermo-setting and thermoplastic resins.

The capacity of these plants is not readily discernible since they can be easily expanded as the demand by the automotive industry increases. It is a batch process and the basic raw material is polyvinyl alcohol and its precursor polyvinyl acetate. The technology differs somewhat between the two plants since it is possible to produce by-product materials such as ethyl acetate or to recycle the polyvinyl alcohol. It is doubtful that this technology is going to change. It is also very doubtful that any new producers will enter the market. Both producers would probably be equally impacted by the cost of water pollution control.

B. FINANCIAL PROFILES

No figures have ever been released on the cost of production or profitability of producing polyvinyl butyral since they are interwoven with the cost of production of the polyvinyl acetate, polyvinyl alcohol, polyvinyl formal and other derivatives that can be made in the same plant. Our best estimate is shown below:

	¢/lb
Income	72
Cost	
Fixed	10
Variable	40
Sales G&A	7.5
Total	57.5
Return before tax[1]	14.5
% Return on Sales	20.0

We believe that the production costs to both producers, although using somewhat different processes, are quite similar.

Prices in this industry are determined by competitive materials. The only competitor is tempered glass which is lower priced but not as effective. It has been approved for use in side and rear windows but not for front windows. Improvements in the performance of tempered or coated glass could force a reduction in the price of polyvinyl butyral. At the higher end of the scale polycarbonate sheet, which is about four times as expensive as tempered glass, grew 38% last year in use in safety glass. It is being used in security areas such as armored cars, bulletproof cars, and areas where theft or other security problems are high. A third product has now been made available. This is a polyester windshield produced by the Sieracin Corporation which is optional on certain high priced models. It can be electrically heated, is shatterproof, and was used in aircraft in competition with methacrylates many years ago.

We do not foresee that there will be any significant changes in the prices of polyvinyl butyral as a result of water pollution abatement costs. However, the basic intermediate, vinyl acetate, is based on ethylene which is expected to increase sharply in cost due to the "energy crisis."

C. METHODOLOGY

The economic impact of water pollution costs will be assessed on the basis of whether these costs can be passed on to the ultimate consumer.

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1. Excludes freight, state and local taxes.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant, $1000	1010	2759
Annual Cost, ¢/lb	0.28 – 1.47	0.28 – 7.50
Annual Cost as a % of Sales Price	0.4 – 2.1	0.4 – 10.7

There are only two producers of polyvinyl butyral, 30% of production capacity is currently handled by in-plant water treatment facilities, and 70% is handled by municipal sewers. All plants have primary treatment. Twenty-five percent of the effluent is treated at the plant by biological treatment, and the remaining 75% is sent to municipal sewers. To date, it is estimated that the industry has spent roughly $110,000 to meet water pollution control costs.

E. IMPACT ANALYSIS

1. Price Effects

Since polyvinyl butyral is the only approved safety interlayer for automobile windshields and, thus, demand is inelastic, we believe that the price will be increased to take care of the relatively minor costs needed for water pollution control. There will probably be significant price increases due to rising raw material costs.

2. Profitability

Financial effects will also be minimal since the profitability will remain the same as long as the costs are passed on to the consumer; namely the automotive manufacturer and ultimately the automobile buyer. There will be no problem of capital availability since both producers are major U.S. corporations.

3-7. Plant Closures, Production, Employment, Community, Industry Growth, and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any required increases can be passed on to the consumer, there will be no effect on plant, closings, employment, communities, industry growth or the balance of trade.

F. LIMITS TO THE ANALYSIS

We believe that our judgments are accurate based on current information. The only critical assumption is that no new improved safety glass inner layer with a better price/performance ratio will become available before 1983. However, the chance that the cost to meet guidelines would increase the possibility of this seems small.

POLYVINYL ETHERS

A. INDUSTRY SEGMENTS

The vinyl ethers presently made include: vinyl ethyl ether made by Union Carbide, vinyl methyl ether made by GAF Corporation and a vinyl methylmaleic anhydride copolymer also made by GAF. Other ethers have been made in experimental quantities but these are the only ones of commercial significance. They are offered in both solution and powdered form so that in total there are about six different grades.

These are not true plastic materials in that their applications are in the manufacture of hair spray, can coatings, warp sizing of textiles and pressure sensitive adhesives. GAF operates two plants, both at Calvert City. The Union Carbide plant is at South Charleston, West Virginia. All three are parts of larger chemical producing operations.

There is no published information on the capacity to produce these particular resins and the information is held confidential. We believe, however, that the total market is about 3-5 million pounds and we estimate that the dollar sales in total is in the order of $3.75 million. Plants are not operating at capacity and because of limited growth we do not expect new producers or new plants. Both producers are integrated to the manufacture of some of their raw materials. There is no integration to end products.

The plants are approximately 15 years old. We do not foresee any changes in technology which would change the nature of the production process. We would estimate that less than 100 employees are employed in total. We see no reason to distinguish between the two producers with regard to the impact of water abatement costs.

B. FINANCIAL PROFILES

No information is available on the profitability or cash flow of these three resins. Our estimate is that the total profit before tax on all three of them is in the order of $1.0 million. Our estimate of costs are shown below. We have no reason to believe that the profitability of one producer differs materially from that of the others. The major constraint on additional plant construction is the size of the market. There are no financial constraints.

	¢/lb
Income	100
Cost	
Fixed	25
Variable	50
Total	75
Return before tax[1]	25
% Return on Sales	25

1. Excludes freight, state and local taxes.

Prices in this industry are determined by the value of the product in its end use. These resins are only used in highly specialized applications where there is little competition. Under these circumstances prices can probably be maintained at a profitable level. We do not think prices will change unless some new technology is developed and that is considered quite unlikely. New competing plastics with lower prices might force a reduction in prices.

C. METHODOLOGY

The economic impact of the cost of water abatement controls will be determined by whether the cost can be passed along to the consumer, which we think is likely. These products are based on raw materials which are likely to increase in cost.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant, $1000	29	58
Annual Cost, ¢/lb	0.20 – 0.70	0.20 – 1.80
Annual Cost as % of Sales Price	0.2 – 0.70	0.20 – 1.80

At present, polyvinyl ether wastes are treated as follows: 70% is handled in primary industrial treatment and 30% is discharged to municipal sewers. The total annual cost to the industry to meet 1977 standards has been estimated at $30,000; to meet 1983 standards, it will be $70,000 per year.

E. IMPACT ANALYSIS

1. Price Effects

We believe that since the costs to meet water pollution guidelines are a minor percent of the selling price, these costs will be passed on to the consumer. Thus, the price of the resin will rise to include the costs for water abatement control in 1977 and 1983. These increases will also cover the costs to new plants. We do not see that there will be any secondary effects as a result of these price increases.

2. Profitability

Since we believe that the costs for water pollution abatement can be passed on to the consumer, there will be no effect on profitability. Further, since the cost to provide such water abatement is low, we do not see that there will be any effect on capital availability.

3-7. Plant Closures, Production, Employment, Community, Industry Growth, and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any required increases can be passed on to the consumer, there will be no effect on plant closings, employment, communities, industry growth or the balance of trade.

F. LIMITS TO THE ANALYSIS

We believe that our analysis is correct by ± 15%. We have made no assumptions that would be critical to our conclusions, and there are no questions remaining to be answered.

POLYVINYLIDENE CHLORIDE

A. INDUSTRY SEGMENTS

Polyvinylidene chloride resin, trade named Saran by Dow, is manufactured in two forms, as a latex which is used for coatings on paper and other plastic films and as a solid material which is extruded into film commonly used for wrapping turkey, cheese, etc.

Dow and Vulcan are the sole producers of the monomer and Dow is the sole producer of the solid polyvinylidene chloride. Dewey and Almy produces latex from purchased monomer at Owensboro, Kentucky. DuPont is believed to make latex for captive use. Latices are offered in different solids concentration and molecular weights for different uses.

The Dow plant at Midland, Michigan is estimated to be at least 20 years of age, whereas the latex plant of Dewey and Almy is about 12 years of age. We estimate that production is in the order of 50 million pounds per year. The total number of employees involved would be less than 100. We do not see that the producers would be affected differently by the impact of water abatement control costs. Growth is estimated to be 10% per year over the next five years.

B. FINANCIAL PROFILES

No data has ever been released on the profitability of producing vinylidene chloride latex. We estimate a profit of 30% of the sales as shown below. The salvage value of the assets would be that of the equipment such as kettles and reactors which are used. This equipment can be used in the manufacture of other types of resins. Dow would probably have higher profits then Dewey and Almy since it markets both the solid and latex and is integrated back to the monomer. There are no financial constraints on additional plant expansions; the major restriction being the limited growth of the market which is estimated to be about 12% per year.

	¢/lb
Income	54
Cost	
Fixed	8
Variable	30
Total	38
Return before tax[1]	16
% Return on Sales	30

1. Excludes freight, state and local taxes.

Prices in this industry are determined by the competitive value of the product, i.e., the price/performance ratio of vinylidene chloride versus other packaging materials and other plastic coatings. Vinylidene chloride latices are high priced and, hence, are used only where they are required for their excellent barrier properties. They are not price sensitive and, thus, lower prices would probably not increase the size of the market significantly. We do not see that there will be significant price changes other than those caused by increases in feedstock raw materials, i.e., ethylene due to increased crude oil prices.

C. METHODOLOGY

The impact of increased costs for water abatement control will be assessed on the basis of whether these increased costs can be passed on to the final consumer without loss of market share.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant, $1000	6 – 32	17 – 87
Annual Cost, ¢/lb	0.05 – 0.11	0.05 – 0.38
Annual Cost as a % of Sales Price	0.1 – 0.2	0.1 – 0.7

There are only three independent producers and one captive producer, all of which are major corporations. All producers have primary treatment, and 50% of these have biological treatment. There is no discharge to municipal sewers. The annual cost to meet 1977 guidelines is only $10,000; for the industry to meet 1983 guidelines, the industry will spend $40,000/year, and no new plants are expected.

E. IMPACT ANALYSIS

1. Price Effects

Any additional costs for water pollution abatement will be passed on to the consumer since no other materials are available at similar prices. Therefore, there will be a minor increase in price to offset the additional expenses needed.

2-7. Profitability, Plant Closures, Production, Employment, Community, Industry Growth, and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any required increases can be passed on to the consumer, there will be no effect on profitability, plant closings, employment, communities, industry growth or the balance of trade.

F. LIMITS TO THE ANALYSIS

The estimated accuracy of our analysis is ± 15%. We have made no critical assumptions which could affect our conclusions and there are no questions remaining to be answered.

SILICONE RESINS

A. INDUSTRY SEGMENTS

Silicone materials fall into four categories: resins, fluids, specialties, and elastomers. This study is concerned only with the resins and fluids. The elastomers are used for seals and gaskets, cosmetic surgery, and medical applications. The fluids include greases, water resistant coatings, emulsifying agents, defoaming agents, and automobile and furniture polishes. The specialties include hand lotions, release agents, anticoagulants and water repellents. There are also five new silicone glycols used as powder surface modifiers, emulsifiers and wetting agents.

There are five plants producing these products as listed below:

Stauffer: Adrian, Michigan
General Electric: Waterford, New York
Union Carbide: Sistersville, West Virginia
Dow Corning: Carrollton, Kentucky and Midland, Michigan

All of the producers of silicones are diversified into other plastic and chemical products.

The total capacity of the industry is estimated at 150 million pounds and it is broken down as follows:

Elastomers	45 million pounds
Resins	20 million pounds
Fluids	60 million pounds
Specialties	15 million pounds
Other	10 million pounds

The industry is believed to be running at about 85% of capacity. The plants range from 20 years old to 10 years old.

All producers utilize nearly the same technology and all are integrated to the intermediate raw material chlorosilane. All of the companies produce end product such as greases, rubbers, resins and fluids. We estimate that the number of employees involved in the manufacture of these resins is less than 100.

B. FINANCIAL PROFILES

It is not possible to estimate the profitability of silicone resin production since the producers make both elastomers, resins, fluids, and specialties and prices range from $9 to $1/lb. Any average profit figure would have to cover products ranging from medical

inplants to rubber gaskets used in automobiles. There is no way to separate the profitability of the resin segment from the overall operations. Our best estimate is that return on sales before tax is in the order of 20%. Fixed costs are high, perhaps as high as 30% of total costs, due to the extensive technical service and product development effort required.

There are no financial constraints on further expansion. Expansion will be dictated by demand. We do not see that there is any significant difference between the profitability of the various producers although their product mix does vary on a year-to-year basis.

The major factor that determines the price of the silicone resins is its price sensitivity and this effect is small. In most applications, silicones are used where no other products are available and, therefore, a price reduction would not materially increase demand. This tends to keep prices stable and at a high level. The constraints on higher prices are the availability of competitive materials once the price reaches a high enough level. We do not foresee any likely price changes other than those caused by inflation.

C. METHODOLOGY

The economic impact of water pollution control costs will be determined by the extent to which these costs can be passed on to the consumer through price increases.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant, $1000	1696 - 2480	4176 - 5965
Annual Cost, ¢/lb	0.60 – 1.20	1.70 – 3.50
Annual Cost as a % of Sales Price	0.6 – 1.2	1.7 – 3.5

It should be recognized that all of the present producers have their own treatment plants rather than depending upon municipal sewage treatment. All producers provide primary treatment and 20% of the producers provide biological treatment of their wastes within their own plant complex. The data we have been provided states that the total annual costs to handle silicone wastes in 1977 will be $1,560,000 and the annual cost to meet 1983 guidelines will be $5.21 million dollars. Offsetting this, however, is the fact that the industry already spends $390,000/year for present pollution control systems.

E. IMPACT ANALYSIS

1. Price Effects

We believe that in light of the unique price/performance position of silicone resins the costs of meeting BPCTCA, BATEA and BADT guidelines can be passed along to the consumers. We, therefore, expect that prices will rise proportionate to the costs of water pollution abatement. We suggest that costs for raw materials and inflation will grossly exceed these costs. We see no secondary effects because of the price increases.

2-7. Profitability, Plant Closures, Production, Employment, Community, Industry Growth, and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any required increases can be passed on to the consumer, there will be no effect on profitability, plant closings, employment, communities, industry growth or the balance of trade.

F. LIMITS TO THE ANALYSIS

The accuracy of our analysis is ± 15%. We do not know of any critical assumptions that have been made which would alter our overall conclusions, and there are no questions remaining to be answered.

POLYAMIDES

A. INDUSTRY SEGMENTS

The polyamides considered in this report are those other than nylon 6 and 66. This includes nylon 6-10, nylon 11 and nylon 12. A listing of producers is shown below:

		Sales/Price
Nylon 6-10	– DuPont, Richmond, Virginia Monsanto, Pensacola, Florida	$1.20
Nylon 11	– Rilsan Corporation, Glen Rock, N.J.	$1.54
Nylon 12	– Rilsan Corporation, Glen Rock, N.J.	$1.60

Monsanto reports that their specialty nylons are produced at irregular intervals on one or two of their 20 autoclaves. They operate for about one day at a time and the waste is insignificant compared with the water waste generated from production of nylon 6 and 66 at the same plant. Rilsan Corporation, a French Company, has a plant at Glen Rock, New Jersey which produces nylon 11 and 12. They state that manufacturing data is classified as confidential and cannot be made available. Our best estimate is that their total production is in the order of 5 million pounds a year. These resins are used for powder coating, a technique common in Europe but only just getting started in this country. They obtain their monomers from their plant in Europe. An examination of their facility indicates that the plant has zero discharge. The total number of people employed in this industry segment is less than 100.

B. FINANCIAL PROFILE

There is no way to isolate the costs and profits of producing nylon 6-12 from the other nylons produced in the same plants at Richmond and Pensacola. There is no data on raw material costs or production costs at Rilsan's plant at Glen Rock, New Jersey and the plant is not operating on a commercial scale. There are so many factors, i.e., consumer acceptance, price/performance, affecting the future profitability of these experimental resins that the cost of water abatement is not significant.

C. METHODOLOGY

The methodology is the same as for the other resins, i.e., the impact depends upon whether the costs can be passed to the consumer through price increases and, thus, the firm's profitability is not affected.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant,$1000	60	172
Annual Cost,¢/lb	0.13 – 1.17	0.26 – 3.25
Annual Cost as a % of Sales Price	0.1 – 0.9	0.2 – 2.5

We have been informed that at present 100% of the producers treat their own waste and do not discharge to municipal sewers. All producers provide primary treatment, and 60% provide biological treatment. The annual cost to meet 1977 guidelines will be $80,000 for the industry and to meet 1983 levels, $220 000. The industry already spends $40.000/year.

E. IMPACT ANALYSIS

1. Price Effects

Our analysis of industry pricing practice shows that the insignificant cost for water pollution control could be readily added to the price, and prices will rise accordingly. We see no secondary effects as a result of these price increases.

Since the demand for these products is based on their performance in various end uses, they are not sensitive to minor increments in price. There will, however, be major price increases due to raw material shortages. Since the corporations involved in manufacturing these products have ample financial reserves, we see no problem with capital availability.

2-7. Profitability, Plant Closures, Production, Employment, Community, Industry Growth, and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any required increases can be passed on to the consumer, there will be no effect on profitability, plant closings, employment, communities, industry growth or the balance of trade.

F. LIMITATIONS OF THE ANALYSIS

We believe our judgments are accurate. We have made no assumptions which are critical to the sensitivity of our conclusions, and there are no questions remaining to be answered.

SPANDEX FIBERS

A. INDUSTRY SEGMENTS

Spandex is a polyurethane synthetic fiber manufactured in the United States by three companies, DuPont at Williamsburg, Virginia, Globe Manufacturing Company at Fall River, Massachusetts and Gastonia, North Carolina and Ameliotex Incorporated, at Rocky Hill, New Jersey. No production figures are available. We believe that DuPont which is integrated to raw materials manufactures 75% to 80% of the total produced, which is between 15-20 million pounds per year. This product is an elasticized synthetic yarn which replaced rubber thread. At one point there were four or five additional producers, all of which have discontinued production because of the limited market. The market is now saturated and shows little signs of growth. The raw materials are similar to those for other polyurethane plastics. There is only one grade although it is made available in different deniers. DuPont, of course, is a major producer of other synthetic fibers. Globe Manufacturing and Ameliotex only produce Spandex fibers for their own use.

The process of manufacturing these fibers is proprietary and we are not certain that Globe and Ameliotex use the same process as DuPont. There would, however, appear to be little difference in water pollution between the different producers.

The product was developed for use in bathing suits, foundation garments, support hose, etc. It was originally estimated that these fibers would be used for suits and dresses; however, these markets have been taken over by knitted fabrics. The only possibility of significant growth in this industry would be due to a change in women's fashions. However, since there is excess capacity today, we do not visualize additional plants being constructed even with increased demand.

We believe these plants are approximately 10 years of age. We do not believe that there has been any change in technology in recent years nor do we expect any future change. We estimate that there are less than 100 people employed in the total industry. We do think there might be differences in the significance of pollution control costs between DuPont which is by far the major producer and the two smaller producers, who probably have higher production costs.

B. FINANCIAL PROFILES

There is no available data on the profitability of producing Spandex fiber. Our estimate of the profitability is shown below:

	¢/lb
Income	100
Cost	
Fixed	25
Variable	60
Total	85
Return before tax[1]	15
% Return on Sales	15

We expect that DuPont makes a considerably better profit than the two small independent producers. There is little or no salvage value for the assets because the equipment is highly specialized and cannot be used for the production of other fibers.

The major factor affecting the price of Spandex fiber is the relationship between supply and demand. Supply has generally exceeded demand which tends to keep the price down. Serious competition from other products, the only one of which is rubber thread, is unlikely since Spandex is a superior material. We do not expect any significant price changes other than necessary to cover raw material and pollution abatement costs.

C. METHODOLOGY

The economic impact of water pollution controls will depend on the extent to which these costs can be passed through to the customer.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant,$1000	24	48
Annual Cost,¢/lb	0.10 – 0.30	0.10 – 0.50
Annual Cost as a % of Sales Price	0.1 – 0.3	0.1 – 0.5

There are only three producers of Spandex fibers and 90% of the waste is controlled by in-plant water treatment; 10% of the waste is handled by municipal sewerage. All wastes have primary treatment. Sixty percent have industrial biological treatment. The estimated annual cost to the industry to meet 1977 standards is only $40,000, and $80,000 after 1983. It is estimated that the industry already spends $20,000/year.

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1. Excludes freight, state and local taxes.

E. IMPACT ANALYSIS

1. Price Effects

We believe that the costs to meet effluent guidelines will be added to the price of the fiber. These price increases will have minimal effect considering that Spandex fibers are used where they are definitely required. There is no competing material and, therefore, the price increase will have no effect on demand.

2-7. Profitability, Plant Closures, Production, Employment, Community, Industry Growth, and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, and any required increases can be passed on to the consumer, there will be no effect on profitability, plant closings, employment, communities, industry growth or the balance of trade.

F. LIMITS TO THE ANALYSIS

We know of no critical assumptions which would affect our overall conclusions, and there are no questions remaining to be answered.

ETHYL CELLULOSE

A. INDUSTRY SEGMENTS

Ethyl cellulose, the only cellulosic except cellulose nitrate used as a plastic, was originally produced during World War II and was used because of its toughness at low temperatures. The major applications were flashlight cases and chess pieces. The material is now available as pellets for molding and extrusion and as a transparent sheet. This resin has good electrical properties and excellent toughness. At present there are two producers, Dow at Midland, Michigan, and Hercules at Hopewell, Virginia, where other cellulose derivatives are also produced. The water wastes are combined with those from other cellulose-based products and the costs will be difficult to allocate between these products.

No figures have ever been released on the size of plants or production capacity. Our estimate is that less than 5 million pounds per year are produced and that the plants employ less than 25 people. We do not believe that water pollution costs will have a material effect on the future of this limited industry. We foresee no growth for the product and cannot visualize that there would be any new producers. Discontinuance of production at either Dow or Hercules would have no significant effect on either company.

B. FINANCIAL PROFILES

No data is available on costs. Our best estimate is that producers earn a 25% pre-tax return on sales excluding costs for freight and local taxes.

C. METHODOLOGY

The impact will be based on the ability to pass pollution control costs on to the consumer through price increases and, thus, the effect on the plant's profitability.

D. POLLUTION CONTROL COSTS

	BPT	BAT
Capital Cost per Plant, $1000	360 – 530	750 – 1386
Annual Cost ¢/lb	0.55 – 1.0	1.65 – 2.84
Annual Cost as a % of Sales Price	1.1 – 2.0	3.3 – 5.7

The costs for water pollution abatement for ethyl cellulose has been combined with the manufacture of other cellulose derivatives since they cannot be separated. All plants have primary treatment and all plants treat their own wastes; thus they do not discharge to municipal sewers. It is estimated that the industry already spends approximately $540,000/year for pollution control.

E. IMPACT ANALYSIS

1. Price Effects

The costs to meet 1977 and 1983 pollution controls will be added to the price of the ethyl cellulose resin with a resultant minor price increase. This price increase is achievable due to the inelasticity of demand.

2-7. Profitability, Plant Closures, Production, Employment, Community, Industry Growth, and Balance of Trade Effects

Since the impact of the cost of meeting the guidelines has no important effect on prices, these costs are insignificant in view of rapidly rising raw material costs, and any required increases can be passed on to the consumer, there will be no effect on profitability, plant closings, employment, communities, industry growth or the balance of trade.

F. LIMITS TO THE ANALYSIS

These estimates are believed to be accurate. We know of no assumptions which would affect the validity of our conclusions and there are no questions remaining to be answered.

OTHER RESINS

Although not a part of this contract and not the subject of current study by Arthur D. Little, Inc., we have been asked to comment on the economic impact of the costs of meeting the guidelines for epoxy resins, urea and melamine resins, and phenolic resins, since these guidelines are currently being reproposed. Our comments are included below.

UREA AND MELAMINE RESINS

The new costs of meeting guidelines for melamine and urea resins, are higher than previously estimated for BPT standards, and somewhat lower for BAT standards. Further, they are still a relatively small percentage of the selling price, i.e., 0.3 – 0.4% to meet BPT and 0.7 – 0.8% to meet BAT standards.

The cost of pollution control for 1977 standards is small. The costs to meet 1983 levels are not significant for the larger plants using standard amounts of water. Small plants using high amounts of water would have some problem, especially those plants making urea resins whose profit margins are minimal. There are a number of captive urea resin plants used to make resin for particle board and adhesive which might also find it difficult to install new capacity considering the investment required and the overall cost. Under these circumstances it might be cheaper for those producers to buy resin rather than manufacture their own.

EPOXY RESINS

The cost to meet the revised guideline standards for epoxy resins are higher than the previously proposed BPT standards and about the same for the BAT standards. In both cases, these costs are a relatively small percentage of the selling price, i.e., 0.2 – 0.8% to meet BPT and 0.7 – 2.3% to meet BAT standards. We,therefore,do not see that there will be any significant impact on the industry as a result of these annual costs.

The investments necessary in a high water usage plant to meet BAT standards ($1.4 million) might cause some problems. Older plants might shut down in favor of construction of newer plants depending upon the degree of obsolescence of the older units. There are plants whose age and high water use might cause a problem. There are about 20 compounders and a large number of captive producers and most discharge to sewers.

PHENOLICS

The costs to meet water effluent guideline standards for phenolics are high. They do present a problem and the impact on the industry may well be significant, since the cost is very high for an industry which has relatively modest profit margins (6 to 10 percent of selling price). It is our understanding that the costs to meet these guidelines are still under review at the time of printing of this document. Until final cost figures are available, estimates of the potential impact cannot be made. An addendum analysis of this segment will be conducted in the near future to assess these potential impacts.

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15. Supplementary Notes

16. Abstracts

We expect little economic impact from the imposition of proposed effluent guidelines on the manufacture of the specialty resins with the exception of unsaturated polyester resins and thermoplastic polyester resins. The small producers of unsaturated polyester resins will face some difficulty and might close. This would affect less than 1% of the industry capacity. Costs of meeting guideline standards might slow the growth of saturated polyester resins. Phenolic resins will likely be affected depending on final costs yet to be developed.

17. Key Words and Document Analysis. 17a. Descriptors

Cellulose Nitrate
Nitrile Barrier Resins
Fluorocarbons
Ethylene Vinyl Acetate
Unsaturated Polyester Resins
Saturated Polyester Resins
Polypropylene Fibers
Methylmethacrylate
Alkyd Molding Resins
Polyvinyl Butyral
Polyvinyl Ethers
Polyvinylidene Chloride
Silicone Resins
Polyamides
Spandex Fibers
Ethyl Cellulose
Other Resins

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

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