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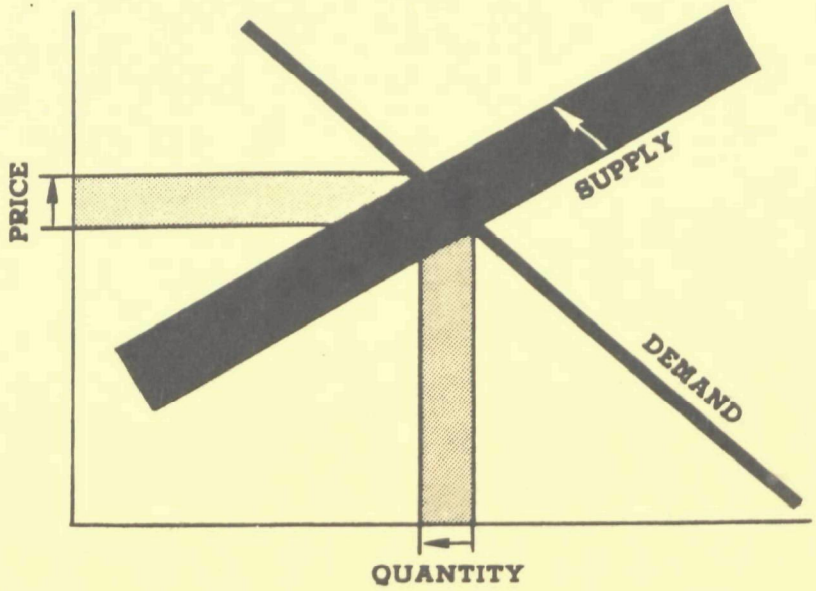
AUGUST 1973

ECONOMIC ANALYSIS OF PROPOSED EFFLUENT GUIDELINES

ORGANIC CHEMICALS INDUSTRY



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

ERRATA

In the report, "Economic Analysis of Proposed Effluent Guidelines - Organic Chemicals Industry," there is a misplaced decimal in Table 2, page 13, for the abatement cost per pound for ethylene dichloride (EDC). It reads 0.32 but should read 0.032¢/lb. This in turn reduces the cost of abatement as percent of sales price to 1.15% instead of 11.51% (Table 3), and the average weighted abatement cost for the seventeen products for which data was available from 4.23% to 3.86% of sales value. This is a reduction of about 10%, but as it only is applicable to half of the products in the industry, the error represents a 5% overstatement of the industry's minimum annual total cost, a range well within the limits of accuracy of this initial study. In any event, it does remove EDC from the list of potential serious problems.

The estimated new capital invested by the organic chemicals industry of $525 million in 1972 is low. The actual figure for 1971 (the most recent year published) was $939 million. We believe 1972 spending was at a comparable level, so that the annual capital cost estimated to be needed over the five years 1973-1977 to meet the suggested guidelines is equivalent to 61.5% of the total industry investment in 1972, not 110%. However, this still very major cost burden would have a serious effect on the industry's ability to expand.

TABLE 4 (Continued)

	Profitability Index 1)	Abatement Cost Index 2)	Economic Impact Index 3)
Small-Volume Intermediates & End-Product Organics			
Dyes & Organic Pigments	2		
Rubber Processing Chemicals	1		
Flavors & Fragrances	1		
Unformulated Pesticides	1		
Plasticizers	3		

1) 1 = Product had better than industry average profitability in 1972.
2 = Product had industry average profitability in 1972.
3 = Product had below industry average profitability in 1972.

2) Abatement cost as percent of sales cost based on Table 3.

1 = less than 1%
2 = 1 to 4%
3 = 4 to 8%
4 = 8 to 12%
5 = more than 12%

3) Abatement cost index X profitability index.

NOTICE OF ERROR

The above should be substituted for page 24.

Page 32 should be deleted.

EPA-230/1-73-019

ECONOMIC ANALYSIS OF PROPOSED EFFLUENT GUIDELINES – ORGANIC CHEMICAL INDUSTRY (MAJOR PRODUCTS)

August 1973

Contract No. 68-01-1541

Office of Planning and Evaluation
Environmental Protection Agency
Washington, D.C. 20460

This report has been reviewed by the Office of Planning and Evaluation, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

PREFACE

The attached document is a contractors' 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 promulgation 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 produce 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 Task Order No. 6, Contract 68-01-1541 by Arthur D. Little, Inc. Work was completed as of August 1973.

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 has not been reviewed by EPA and is not an official EPA publication. The study 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 industry. It cannot be cited, referenced, or represented in any respect in any such proceeding as a statement of EPA's views regarding the subject industry.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

INTRODUCTION AND SUMMARY

This final report is submitted on a best efforts basis in compliance with Phase III of Contract No. 68-01-1541 with the Environmental Protection Agency on the "Economic Impact of Water Pollution Control on the Organic Chemical Industry." It must be emphasized that the estimates in this initial study must be considered as order-of-magnitude figures.

Using the Effluent Limitations Guidelines supplied to us by the EPA, we evaluated the 70 products or product classes developed during Phase I, which cover about 75% of the sales and volume of the organic chemical industry. Thirty-six of these products or product classes present potential water pollution problems. Of these, we could make a quantitative economic impact evaluation for only 17 products; lack of data prevented a similar study of the other products on the list. On the basis of data supplied by the EPA, which was compiled by Roy F. Weston, Inc.,[1] we first determined the cost of suggested best practicable control technology currently available (using the 95% treatment efficiency at the suggestion of the EPA) and compared that to the average selling price in 1972, the base year selected because it represents a more average year with regard to profits than most other recent years.

Costs of water pollution control, as a percent of sales value, ranged from a low of 0.4% to a high of 11.5%, for a weighted average value of about 4%, using best practicable technology at the most rigorous suggested guideline level of 95% removal. The cost differences among the several levels of removal efficiency are reported to be marginal. Using a profitability index developed during Phases I and II of this project, and combining it with an abatement cost index, we arrived at an economic impact index for those products for which specific abatement cost data was available. Of the 17 examined, 8 face a difficult problem because of either high abatement costs, a poor market picture, or a combination of both. These products, in roughly declining degree of concern, are: ethylene glycol, ethylene dichloride, caprolactam, methanol, acetic acid, acetone, phenol, and aniline.

It must be emphasized that in our belief other products or product classes face significant problems, even though we do not have the cost data to back up our belief. In our judgment these include (but may not be limited to) coal tar products, ethyl cellulose, dyes and organic pigments, and possibly some unformulated pesticides.

Insufficient data was supplied to us by the EPA to make a judgment of the economic impact of suggested best-technology economically achievable standards, new source effluent standards, or new source pretreatment standards. Costs for the first two standards were prepared only for a single size facility, and no cost data was developed for the new source pretreatment standards. All comments about the economic impact on the organic chemical industry are limited to the best practicable control technology currently available standards.

1. "Draft Development Document for Effluent Limitations Guidelines and Standards of Performance, Organic Chemical Industry," Prepared by Roy F. Weston, Inc., for the United States Environmental Protection Agency under Contract Number 68-01-1509, dated June 1973.

We have made a minimum and maximum estimate of the economic impact on the organic chemical industry. The minimum is based on the estimate that half of all organic chemicals had such minor pollution problems that the cost of meeting the suggested effluent guidelines would not exceed 1% of sales price. This estimate of half of all organics is based on categories given in the EPA Development Document and on those developed by this contractor of the raw effluent load of 70 products or product classes that represent about 75% of the industry's volume and sales. The other half would have an average cost of about 4% of sales. On the basis that the organic chemical industry's sales in 1972 equaled $8 billion, we estimate the total cost in complying with the guideline would reach $210 million annually. This cost would depress the organic chemical industry's after-tax profits by 9% of the 1972 base if two-thirds of the cost could be passed on to customers. Some of the costs probably could not be passed on to consumers, since the more efficient producers, we believe, would try to enhance their competitive position by not meeting all price increases of the producers that have higher manufacturing or higher pollution control costs. Prices would rise by 1.75% over the five years but growth in demand would not be influenced.

On the basis of capital costs needed to meet the suggested guidelines using the best practicable control technology currently available, we arrived at a maximum cost estimate. This estimate indicates that the industry would have to make a capital investment of $2.88 billion over the five-year period 1973-1977 to meet suggested standards. During this period, the average annual capital investment required would be $576 million, which is $50 million more than was spent by the industry for all purposes in 1972.

Amortization charges at an annual rate of 10.2% represented about half of total annual costs, so the industry's total cost is projected at $590 million annually when in full compliance. We believe that only half of this total could be passed on to customers, in part because of competitive pressure within the industry, but more because of the large price increases expected as a result of the rapidly rising costs of energy and feedstocks and the competition with products made by other industries. Consequently, the industry's net after-tax profit would be depressed by 37% of the 1972 base; prices would rise by 3.7% over the five years but this price increase would not significantly affect growth in demand. However, lack of sufficient capital to invest in increased production coupled with the closing of a significant number of small plants could be a serious hindrance to meeting the growth in demand.

These two figures are the maximum and minimum limits of the economic impact on the industry. The truth lies between them and in our belief closer to the minimum than the maximum.

In any event, plants will be closed and the industry further concentrated in larger companies, since the most vulnerable companies will be those that are small, are marginally profitable and have plants in isolated locations. While quite a few such plants are expected to close, the unemployment should not be great, since it is those plants employing 20 or less that are must vulnerable.

The limitations of this study are obvious. Extrapolations to an industry level, based on a relatively small sample, can be very unreliable. The EPA must develop more detailed control cost data for the four levels of effluent standards before the range in estimates of economic impact can be narrowed to a reliable level. Particular attention is called to the practical necessity to limit this study to 70 products or product classes. Although these cover about 75% of the industry's sales, there is no reliable way to extrapolate the results to the 25% of the industry not covered. Because the fraction omitted is not large, the overall dislocation is not expected to be major. However, there are likely to be hardship cases in the unstudied sector of the industry and such companies will require special consideration. In any further study, therefore, not only must more detailed data be prepared on the 70 products or product classes, but also on the other quarter of the industry, which represents a very large number of small-volume products.

THE ORGANIC CHEMICAL INDUSTRY

Its Size

The organic chemical industry produces 80 to 90 million tons of chemicals each year. Thousands of compounds are made, ranging in production volume from a high of about 10 million tons of ethylene to very small quantities of reagent chemicals. However, 70 chemicals or classes of chemicals account for about three-fourths of the industry's sales, which in 1972 totaled an estimated $8 billion. Appendix A gives a more detailed statistical description of the organic chemical industry.

Companies and Plants

Nearly 500 companies are engaged in producing organic chemicals; however, the four largest producers account for a minimum of 36% and the first hundred for more than 92% of total shipments. Not only are there very large companies producing large volumes of chemicals, but also major companies in other industries such as petroleum, have significant chemical production. At the other end of the spectrum are many small companies operating small plants. There are about 27 plants employing more than one thousand, and about 220 plants with less than 10 employees. The large plants produce a wide variety of different chemicals and their effluent will generally be treated in a centralized water treatment plant. On the other hand, many of the smaller plants dump their effluent into public utility sewer systems.

Basic Organics

The products are primarily basic organic chemicals, which are generally petroleum based and to a much, and increasingly, lesser degree, coal based. These basic organics are generally produced in large-volume continuous process plants whose location is heavily oriented to their raw material (feedstock) source – natural gas fields, petroleum refineries or coke oven operations.

Large-Volume Intermediates

Because the basic chemicals are the raw material for upgraded intermediates, these intermediates are frequently made in the same plant to save freight cost, or by purchasers at adjacent plant sites that receive the basic organics by pipeline. Hence, the major portion of large-volume intermediates is also likely to be produced where their raw materials are found. Most large-volume intermediates are also produced via continuous processes and their unit value is likely to be at least double that of the basic organics.

Small-Volume Intermediates and Finished Products

While many of the large-volume intermediates are used directly in the production of finished chemicals – generally in the form of polymers such as resins, plastics, and synthetic fibers – a significant quantity goes into the production of the smaller-volume intermediates and finished products such as plasticizers, dyes and organic pigments, and pesticides. Typically, these products are likely to be located nearer the markets than the raw materials and their unit value may average more than 20 times that of the basic organics, although their physical volume is less than one-tenth that of the basics. Producers of small-volume intermediates and end products in many cases are producers of basic organics, but increasingly with upgrading the raw material costs become a less important part of total cost of the chemicals and other nonintegrated companies become more important. Continuous processes are used, but batch processes are likely to be more common and with this labor costs become a larger share of total cost.

Geographic Location

This general pattern of raw material or market orientation is evident in the geographic distribution of the organic chemical industry. About 35% of the industry, based on number of employees, is located in the Northeast, with much of it located in New Jersey, which accounts for about one-quarter of the industry's total employment. The South is responsible for nearly 45% of employment (and much larger percentage of tonnage) with Texas and Louisiana responsible for much of that. The Midwest accounts for less than 20% and the West has less than 5% of the organic chemical industry's employees. The Gulf Coast, principally Texas and Louisiana, is predominantly the source of basic organics – large-volume, low-cost and -priced, continuous processing – while the Northeast accounts for a major share of the upgraded products such as dyestuffs, flavor and fragrances, and other high-value, low-volume products.

Appendix B shows the location of those organic chemicals plants that face a significant water pollution abatement cost to meet proposed standards based on best practicable control technology currently available. The plant locations oriented to raw material are clearly indicated for basic and large-volume intermediate organic chemicals, as is the market orientation of most small-volume intermediates and finished products.

Industry Growth and Profits

Dollar sales of the organic chemical industry have grown at an annual rate of about 7-1/2% over the last 15 years, but in actual volume of production growth has been closer to 8-1/2% per year because the unit prices of organic chemicals, on average, have actually declined in current dollars by nearly 15% over that 15-year period, 1958-1972. (Many categories of organics have declined by much more.) Although productivity improvements have helped maintain the unit labor costs in the industry, increases in raw materials, energy, and plant construction and erection costs have not permitted costs to be reduced by a

corresponding 15%. The difference has come out of profits and the industry's profitability has definitely been squeezed over the 15 years, with periodic upturns in profits generally the result of better utilization of production capacity, as is the case in 1972 and so far in 1973.

Competition between chemical and petroleum companies, many of whom over-expanded in the sixties and had poor marketing programs, competition with foreign imports in some cases, and finally, competition with nonchemical substitutes, contributed to the general decline in prices and the industry's profits.

THE IMPACT OF WATER POLLUTION CONTROL ON THE ORGANIC CHEMICAL INDUSTRY

In an industry as diverse and complex as the organic chemical industry one cannot generalize beyond saying that all members of the industry will be affected. The degree of the economic impact will vary considerably among companies, plants, and products. In an effort to differentiate among products and product classes, we have developed a grouping of products and product classes that account for about 75% of the organic chemical industry's total sales. Table 1 lists this grouping and the raw effluent load categorization.

The Cost of Water Pollution Abatement

Data submitted in the EPA Development Document have been used to calculate the cost of meeting the proposed guidelines for specific chemicals that may have serious impact potential. Of the 70 products or product classes reviewed, about half exhibit a potentially severe impact because of their raw effluent load. In Table 2 we have compiled a list which includes all of the chemicals in categories C&D of the EPA Development Document plus five we believe may present a potential problem even though they are not in categories C&D. Of this list of 36 products, the Document includes survey data for 22.

We have been able to apply the Development Document results to the calculation of the cost of pollution abatement for 17 products. Of the other five surveyed, three yield results not considered reliable because of the degree of extrapolation required (tetraethyl lead, bisphenol, and phthalate plasticizers), one on which we take exception to Document data (coal tar in which problems related to tar acid and tar base refining were not considered), and one where the data is not specific enough to make the calculations (dyes and pigments).

Cost Based on Best Practicable Control Technology Currently Available. For this analysis we have used, as reported, estimates given in the EPA Development Document of treatment plant investment and operating costs, and of effluent hydraulic load. With regard to cost for best practicable control, the data appear to be reasonable. In the second instance we have no way to judge the reasonableness of the hydraulic load but note that it is stated to be the result of a field survey.

Estimates of the pollution abatement costs are included in the EPA Development Document for each product category, as a function of the waste treatment plant hydraulic load. At the instruction of EPA, we used the data for categories B-1 and C-1. These estimates were based on 95% treatment efficiency, and costs are marginally higher than for less efficient waste treatment. Costs given in the EPA Document include both a depreciation charge (20% of investment per year) and an "amortization" charge equal to full capital recovery in five years with interest at 7% on the unpaid principal. For our cost calculation we deleted these charges and substituted an "amortization" charge equal to capital recovery in 20 years with interest at 8%. This charge is equivalent to 10.2% of investment per year.

TABLE 1

POTENTIAL WATER POLLUTION PROBLEMS DUE TO RAW EFFLUENT LOAD IN THE ORGANIC CHEMICAL INDUSTRY

	Develop Document Category[1)]
A. Basic Organic Chemicals	
1. Coal Derived Basics	
2) Coal tar acids	C
2) Coal tar crudes	C
2) Coal tar distillates	C
2) Naphtha solvents	C
2) Naphthalene	C
2) Anthracene	C
2) Creosote	C
2) Cresols	C
2) Cresylic	C
2) Acid	C
2) Pitch	C
2) Tar	C
2) Benzene	A
2) Toluene	A
2) Xylene	A
2. Petroleum Derived Basics	
Acyclic	
2) Ethylene	B
2) Propylene	B
2) Acetylene	B
2) Butadiene	B
Cyclic	
2) Benzene	A
2) Toluene	A
2) Xylene	A
B. Large-Volume Intermediates and Finished Organics Including:	
3. Resin Intermediates	
2) Ethyl benzene & styrene	A & B
2) Vinyl chloride	A & B
2) Ethyl acrylates & methylmethacrylates	C
2) Vinyl acetate	C

TABLE 1 (Continued)

	Develop Document Category
4. Fiber Intermediates	
2) Cyclohexane	A
Acrylonitrile	C
Adipic acid	C
Hexamethylene diamine & tetramine	B
2) Caprolactam	C
2) Dimethyl terephthalate	C
5. Chlorinated Hydrocarbons	
Methyl chloride	B
Methylene chloride	B
Chloroform	B
Carbon tetrachloride	B
Ethyl chloride	B
2) Ethylene dichloride	B
Trichloroethylene	B
Perchloroethylene	B
Methyl chloroform	B
Fluorinated hydrocarbons	B
6. Miscellaneous, Generally Derived From:	
C_1	
2) Methanol	B
2) Formaldehyde	B
Pentaerythritol	C
Phosgene	A
C_2	
2) Acetaldehyde	B & C
2) Acetic acid	C
Acetic anhydride	B
Ethanol	C
Ethyl cellulose	C
2) Ethylene oxide and glycol	B & C
2) Tetraethyl lead	C
C_3	
Glycerin	B
Isopropanol	B & C
Isocyanates	C
Propylene oxide	C
Propylene glycol	C
2) Acetone	C

TABLE 1 (Continued)

		Develop Document Category
	C_4	
	Methyl ethyl ketone	C
2)	Oxo chemicals (including long-chain alcohols)	C
	Aromatics	
	Cumene	A
2)	Phenol/Acetone	C
2)	Aniline	C
2)	Bisphenol	C
	Phthalic anhydride	B
2)	Para-cresol	C
C.	Small-Volume Intermediates and End Product Organics	
2) 7.	Dyes & organic pigments	D
8.	Rubber processing chemicals	D
9.	Flavors and fragrances	D
10.	Unformulated pesticides	D
2) 11.	Plasticizers	B & D
D.	Miscellaneous Intermediates	Not categorized

1) Development Document Category
   - A - Non-aqueous processes
   - B - Process water as steam diluent and/or absorbent
   - C - Aqueous liquid-phase reaction systems
   - D - Batch and semi-continuous processes

2) Draft document investigated effluent control costs for this product or product class

TABLE 2

SPECIFIC WATER POLLUTION CONTROL COSTS, BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE – 95% REMOVAL

Product	Develop Document Category [3]	Typical Plant Size [3] (million lb/yr)	Hydraulic Load [3] (gal/1000 lb)	Hydraulic Load [3] (gpd)	Abatement Cost [4] ($/yr)	Abatement Cost [4] (¢/lb)
Basic Organic Chemicals						
* Coal Tar	C	—	405 [1]		2)	2)
Large Volume Intermediates						
Resin Intermediates						
* Vinyl Chloride	A & B	400	336	379,000	310,000	0.08
* Ethyl Acrylate	C	250	3,000	2,113,000	2,950,000	1.18
* Methyl Methacrylate	C	80	260	59,000	450,000	0.56
* Vinyl Acetate	C	300	28	24,000	300,000	0.10
Fiber Intermediates						
Acrylonitrile	C				2)	2)
Adipic Acid	C				2)	2)
* Caprolactam	C	150	1,334	564,000	1,450,000	0.97
* Dimethyl Terephthalate	C	250	450	317,000	1,050,000	0.42
Chlorinated Hydrocarbons						
* Ethylene Dichloride	B	500	96	135,000	160,000	0.32
Miscellaneous Derived from C_1						
* Methanol	B	659	50	93,000	130,000	0.02
Pentaerythritol	C				2)	2)
Miscellaneous Derived from C_2						
* Acetaldehyde	B & C	300	61	52,000	440,000	0.15
* Acetic Acid	C	300	500	423,000	1,230,000	0.41
Acetic Anhydride	B				2)	2)
* Ethylene Oxide	B	200	20	11,000	50,000	0.03
* Ethylene Glycol	C	250	584	411,000	1,200,000	0.48
* Tetraethyl Lead	C	300	12,000	10,141,000	(6,900,000) [5]	(2.30) [5]
Ethanol	C				2)	2)
Ethyl Cellulose	C				2)	2)
Miscellaneous Derived from C_3						
Isopropanol	B & C				2)	2)
Isocyanates	C				2)	2)
Propylene Oxide	C				2)	2)
Propylene Glycol	C				2)	2)
* Acetone	C	120	230	78,000	120,000	0.10
Miscellaneous Derived from C_4						
Methyl Ethyl Ketone	C	2)	2)	2)	2)	2)
Miscellaneous Derived from Aromatics						
* Oxochemicals	C	200	420	237,000	860,000	0.43
* Phenol/Acetone	C	400	200	225,000	850,000	0.21
* Aniline	C	70	190	37,000	350,000	0.50
* Bisphenol A	C	50	67	9,400	(327,000) [5]	(0.65) [5]
* Para-cresol	C	10	1,291	36,000	350,000	3.50
Small Volume Intermediates & End Product Organics						
* Dyes & Organic Pigments	D	—	13,700/124,000		2)	2)
Rubber Processing Chemicals	D				2)	2)
Flavors & Fragrances	D				2)	2)
Unformulated Pesticides	D				2)	2)
* Plasticizers	B & D	75	78.3	16,500	2)	2)

1) Gal/1000 gal - does not include waste water from tar acid or tar base operations.
2) Insufficient data available to determine cost.
3) Based on data supplied by EPA, "Draft - Development Document for Effluent Limitations Guidelines and Standards of Performance - Organic Chemicals Industry"; Roy F. Weston, Inc., June 1973.
4) Derived by Contractor from source cited in footnote 3).
5) This data is suspect; a more detailed survey is required.

* - Draft document investigated effluent control costs for this product or product class.

After this adjustment was made to Tables VIII-2 and VIII-5 in EPA Development Document, we plotted waste treatment flow (gpd) versus annual cost (Figures 1 and 2).

For each of the products we next selected a typical plant size. This selection was based on our knowledge of the industry and was assisted by tabulation of plants given in the EPA Development Document for each product. Effluent flow to the treatment plant was then calculated by multiplying the plant size by the tabulated flow factor (gal effluent/1000 lb product). Annual cost was then read from Figure 1 or Figure 2 and unit cost (¢/lb product) calculated. These results are also summarized in Table 2.

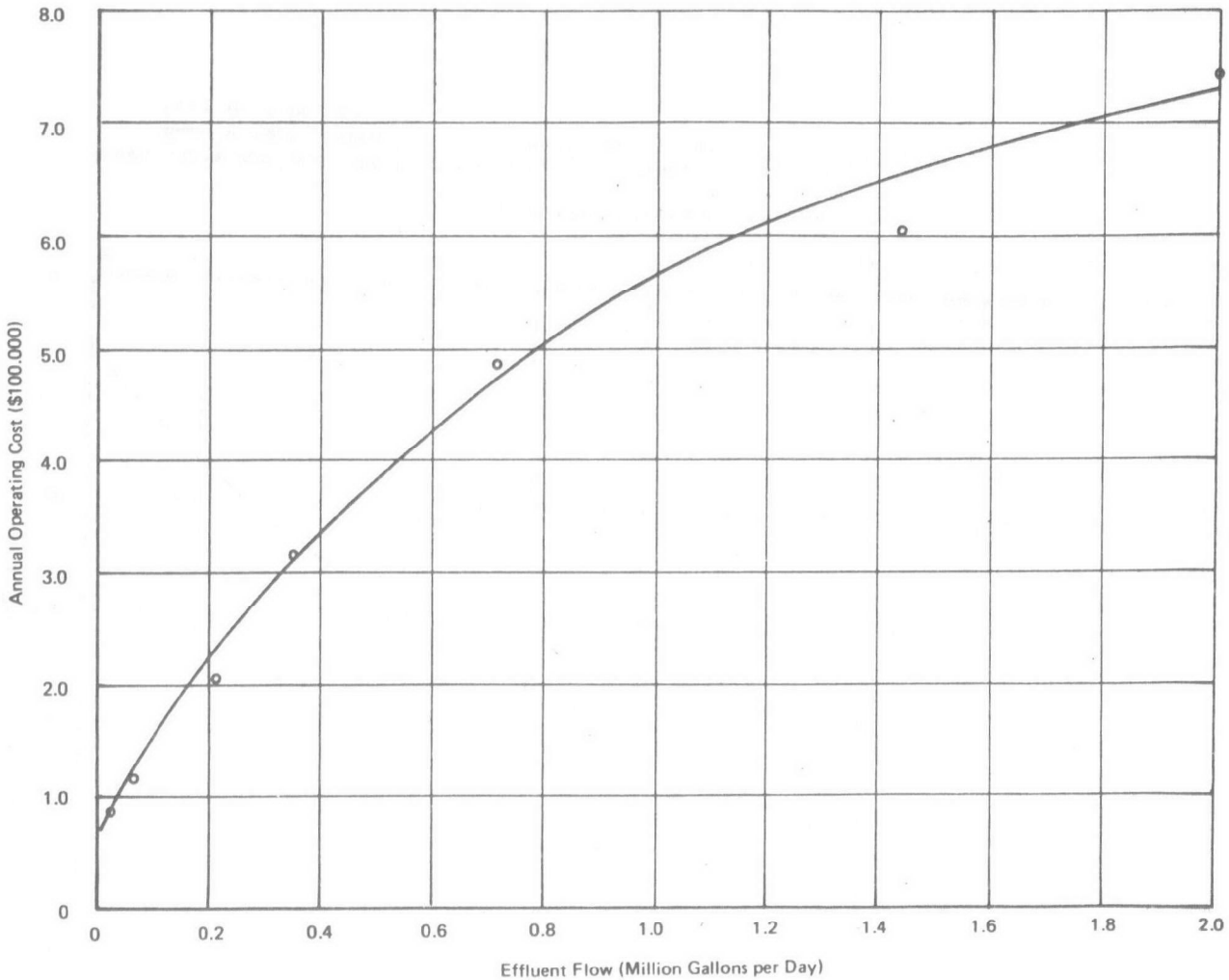
It is recognized that many of these products are manufactured at a common plant site with others, and therefore share a consolidated treatment plant. The EPA Development Document suggests this problem be analyzed for specific plant sites by a "building block" approach which sums up the contribution of each product. In a plant where all products had similar waste problems the result, as a back charge cost to each product, would be about the same as our calculation, and for the generalizations necessary at this time is the best estimate possible.

Costs of Advanced Levels of Control. Our discussion of the cost of pollution abatement has been addressed to best practicable control, that is, best practicable control technology currently available. We were also commissioned to consider: (1) best available technology economically achievable, (2) new source effluent standards, and (3) new source pretreatment standards. However, data to make an adequate study are sorely lacking. The cited Document recommends a single guideline for (1) and (2) above, and presents cost data (in its Table VIII-11) for only a single size of facility (720,000 gpd of effluent) with treatment based solely on activated carbon adsorption of impurities.

The best available technology investment for Category C is stated to be $1,178,000, and annual costs adjusted to our basis would be:

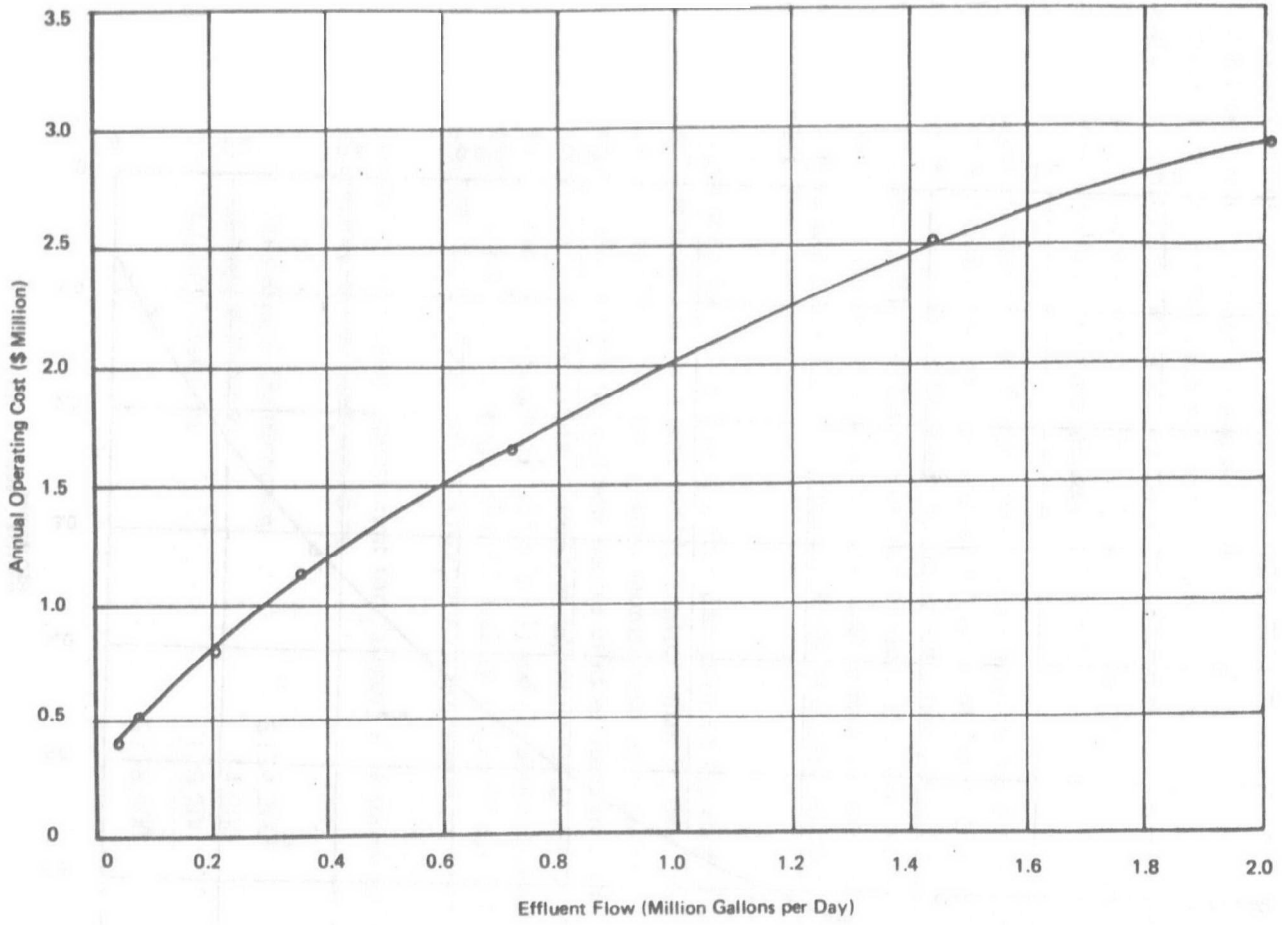
Operating & Maintenance	$124,200
Energy & Power	14,000
10.2% Investment	120,200
	$258,400

Only three products listed in Table 2 have effluent loads of 400,000 to 900,000 gpd; and any unit not in that range is not considered appropriate for application of this cost. These products and the result of adding treatment, on the basis of the data given in the EPA Development Document, are:



Source: Adapted from Table VIII-2 "Development Document for Effluent Limitations Guidelines and Standards of Performance – Organic Chemical Industry", Roy F. Weston Inc., June 1973.

FIGURE 1 AQUEOUS POLLUTION ABATEMENT COSTS – CATEGORY B (PROCESS WATER CONTACTS AS STEAM DILUENT AND/OR ABSORBENT) Best Practicable Control Technology – 95% Removal



Source: Adapted from Table VIII-5 "Development Document for Effluent Limitations Guideline and Standards of Performance – Organic Chemical Industry", Roy F. Weston Inc., June 1973.

FIGURE 2 AQUEOUS POLLUTION ABATEMENT COSTS – CATEGORY C (AQUEOUS LIQUID – PHASE REACTION SYSTEMS) Best Practicable Control Technology – 95% Removal

Product	Effluent gpd	Plant Size (million lbs/yr)	Best Economically Achievable Control Cost ($/yr)	Best Economically Achievable Control Cost (¢/lb)	Best Practicable Control Cost (¢/lb)	Total Cost (¢/lb)
Caprolactam	564,000	150	258,400	0.17	0.97	1.14
Acetic Acid	423,000	300	258,400	0.09	0.41	0.50
Ethylene Glycol	411,000	250	258,400	0.10	0.48	0.58

This calculation indicates best economically achievable abatement would add only about 20% to the cost of best practicable control; it is a highly suspect result when one considers the uncertainty of guidelines which may, in fact, be proposed and when the specific problems for meeting those guidelines at specific locations are considered. We have included this calculation only to illustrate our point of view, and we do not recommend an attempt to extend it to other products.

The cost consideration of pretreatment for new plants using municipal facilities were not included in the study reported in the EPA Development Document. Its application would be to the segment of the industry typified by the large number of small plants in urban areas such as New Jersey. We have pointed out elsewhere in this report the special problems such plants pose; they will present severe economic impact problems and they require plant-by-plant analysis not possible in this assignment.

THE ECONOMIC IMPLICATIONS OF WATER POLLUTION ABATEMENT

The ability of a company to absorb or pass on the cost of water pollution control for its products depends on the products' average profitability and/or price elasticity in the marketplace. If the product or product class is producing a profit margin better than the industry in general, the producer may be able to absorb the increased cost due to water pollution control and if, in addition, he can pass on all or at least some of the cost to his customers in selling price, his profits will be depressed only slightly or not at all. At the other extreme is a company that currently suffers a poor profit margin and that will lose its market to other more efficient producers, imports or other competitive substitute products if it raises prices. In this case the company or the product is already marginal, and the cost of water pollution control, or a combination of water, air and solid waste pollution costs plus OSHA will act as severe pressures to close his plant or discontinue the particular product or product line, especially if he can see no opportunity to realize at least a positive cash flow. In many instances, because the product has not been very profitable, the plants are old and have not justified major reinvestment and the resulting depreciation will not generate sufficient cash flow to offset direct operating costs or warrant continued operation.

Production Costs. Production costs are very sensitive to capacity utilization, since organic chemicals are fairly high in their capital intensiveness, that is, the amount of fixed capital investment needed to generate a specific amount of sales, to say nothing of profits. For example, in 1967, the last year for which reasonably accurate statistics are available, organic chemical commercial shipments (nearly the same as sales) of about $5.6 billion required a depreciable fixed investment of $8.5 billion; that is, each dollar of fixed investment generated about $0.65 in sales. That fixed investment will obviously produce more profit if it is operating at 96% than at 78%, each an average figure experienced in one of the last five years.

Although fixed cost, particularly depreciation, is high, other fixed costs – such as technical service, distribution and sales costs – also contribute to total cost. Depreciation accounts on average for 10-15% of cost.

Variable costs for raw materials, labor and utilities loom very large in production costs, averaging for the industry 75-80% of total costs. In recent years raw materials and utility costs particularly have risen more rapidly than the price received for chemicals. Based on a price of 100 for 1967, the average price for all industrial commodities rose to an average of 117.9 in 1972, and utilities and fuels to 118.6. Organic chemicals were at 96.2 or less on average in that year.

Unit labor costs had been kept relatively stable, thanks primarily to increased productivity, which in turn is due largely to increased capital investment. It is likely that increased production costs due to pollution control cannot be absorbed by increased productivity, especially in view of the increases in cost being experienced by the chemical industry for its hydrocarbon feedstocks and energy. As a generalization, we believe production costs will

increase with or without the additional burden of air, water, or solid waste pollution costs, to say nothing of operating expenses required through OSHA.

Price Elasticity. If, as we believe, operating costs will not be reduced, nor for that matter maintained at their present level (especially as plants are already operating close to their capacities), it would appear that the only way organic chemical companies can recover the cost of water pollution control, if they are to recover it at all, is through increased selling prices in the marketplace.

Companies' ability to increase prices depends on whether the Government permits price increases (Price Control Phase IV and its sequence), whether more efficient or less realistic competitive organic chemical producers will also raise prices, or whether customers will feel justified in paying more for a particular chemical in preference to a competitive alternative chemical or a nonchemical product. In general terms, organic chemicals have grown at a rate of 8-1/2% in physical volume in part because their cost to customers has risen far less (in fact, dropped) in comparison to many competitive nonchemical materials. Hence, in general terms, it is reasonable to assume that even with an increase in selling price, and the resulting decline in the annual rate of growth, there will still be steady growth by the organic chemical industry. However, generalities do not take into account specific organic chemicals.

The Economic Impact of Water Pollution Control on Specific Organic Chemicals. We are assuming that those products in Development Document Category A – that is, those where water is not a process material, and aqueous waste is discharged only as utility unit blow-down or as an incidental wash stream – do not face a water pollution control problem of sufficient magnitude to justify further review in this study. Similarly, those products in Category B – where water is an inherent process material used as a steam diluent and/or absorbent but is discharged only as a purge stream in quantities small in comparison to the production rate – need no further attention in this study in view of Development Document estimates of the cost of control using the best practicable control technology currently available. (See Figure 1.)

However, Categories C&D – Aqueous Liquid-Phase Reaction Systems and Batch and Semi-Continuous Processes, respectively – require further review. One measure of the impact of pollution control is to compare the cost of treatment as a percent of selling price for those products which have developed sufficient data to permit us to estimate abatement cost per pound of product produced. The results are shown in Table 3. These products had sales of about $1,050 million in 1971 and the weighted average abatement cost, as a percent of sales price, was 4.23.

We have also evaluated the profit margin to absorb the increased cost and/or ability to pass on all or some of the increased cost to consumers for all products in Categories C&D. In general, a product that normally has a profit margin lower than the average of the organic

TABLE 3

COST OF WATER POLLUTION CONTROL COSTS AS PERCENT OF SALES PRICES FOR SPECIFIC ORGANIC CHEMICALS – BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

Product	Development Document Category	Abatement Cost [1] (¢/lb)	1972 Sales Price [2] (¢/lb)	Abatement Cost As Percent of Sales Price (%)
Large-Volume Intermediates				
Vinyl chloride	A & B	0.08	4.17	1.92
Ethyl acrylate	C	1.18	17.90	6.59
Methyl methacrylate	C	0.56	18.50*	3.03
Vinyl acetate	C	0.10	7.79	1.28
Fiber Intermediates				
Caprolactam	C	0.97	17.56	5.52
Dimethyl terephthalate	C	0.42	14.00 [3]	3.33
Chlorinated Hydrocarbons				
Ethylene dichloride	B	0.32	2.78	11.51
Miscellaneous				
Methanol	B	0.02	1.98	1.01
Acetaldehyde	B & C	0.15	9.00*	1.67
Acetic acid	C	0.41	5.71	7.18
Ethylene oxide	B	0.03	7.12	0.42
Ethylene glycol	C	0.48	6.40	7.50
Acetone	C	0.10	3.94	2.54
Oxo chemicals	C	0.43	11.00 [3]	3.91
Phenol	C	0.21	6.56	3.20
Aniline	C	0.50	11.19	4.47
Para-cresol	C	3.50	42.00*	8.31

1) from Table 2

2) Average sales price as derived from U. S. Tariff Commission preliminary "Synthetic Organic Chemicals" - 1971 and assuming price constant through 1972 because of price freeze, except where asterisks (*) price is that listed in June 26, 1972 Chemical Marketing Reporter, using lowest price quoted.

3) Arthur D. Little, Inc., estimates.

chemical industry has been put in that position because competitive pressures – more efficient producers, lower-cost imports, or other chemical or nonchemical alternatives – have precluded passing on increases in production costs. Hence we combined both factors in our judgment evaluation of chemicals or classes of chemicals with a potential water pollution impact and used a scale of 1 to 3 to grade the economic impact; for this we took 1972 as an average year and 6-7% as an average after-tax profit return on total capital employed.

A profitability index of 1 (Table 4) implies that the product enjoys above average margins and can, in general, pass on a large portion of increased costs without adversely affecting its market prospect. A profitability index of 2 implies the product has average industry margins and will have limited opportunity to pass on a major share of added costs without jeopardizing its market. A product with a profitability index of 3 is under severe competitive pressure, has profit margins below the average of the industry, and cannot pass on its increased cost in the face of competition from more efficient producers, imports or alternative products.

The results are shown in Table 4, as well as an abatement cost index for those products for which we have sufficient data to estimate water pollution control costs. These two indices combined give us a rough, but we believe valid, economic impact index.

Of the 70 products or classes of products considered as representative of about 75% of the value of sales of the organic chemical industry, approximately half are in categories A&B and hence face a minimal dislocation in meeting the proposed guidelines of 95% removal using best practicable control technology currently available. The other half, in categories C&D, as listed in Table 4, are all vulnerable to a significant degree in meeting the proposed guidelines. Of those 36 products in this group, we have estimates of abatement cost for only 17 products. Of these, about eight face a difficult problem either because of high abatement costs, a poor market picture or a combination of both. These eight products are discussed in further detail below. However, prior to discussing these products, it must be emphasized that we believe other products or classes of products listed in Table 4 face a significant problem, even though we do not have the cost data to back up our belief. In our judgment these include coal tar products, ethyl cellulose, dyes and organic pigments, and possibly some unformulated pesticides.

Ethylene Glycol. Ethylene glycol normally is made from ethylene oxide produced in the same complex. About half of the production goes directly to the automotive antifreeze market and a third to polyester fiber, films and resins. The balance is consumed in numerous small uses. Because prices for ethylene oxide have been depressed in the recent past, little new capacity has been added and ethylene glycol supply will be tight for the next few years, and prices are expected to improve. Although raw material and energy costs are expected to rise significantly in addition to the cost of pollution control, we expect that a good portion of the latter cost can be passed on to customers, particularly in antifreeze. Any plant closings will probably be restricted to the older small-capacity plants that account for about 5% of current capacity.

TABLE 4

PROFITABILITY AND IMPACT ON SPECIFIC ORGANIC CHEMICALS
BEST PRACTICABLE WATER POLLUTION CONTROL TECHNOLOGY CURRENTLY AVAILABLE
(95% REMOVAL)

Product	Profitability Index 1)	Abatement Cost Index 2)	Economic Impact Index 3)
Basic Organic Chemicals			
Coal Tar	3		
Large Volume Intermediates			
Resin Intermediates			
Vinyl Chloride	2	2	4
Ethyl Acrylate	1	3	3
Methyl Methacrylate	1	2	2
Vinyl Acetate	2	2	4
Fiber Intermediates			
Acrylonitrile	2		
Adipic Acid	1		
Caprolactam	2	3	6
Dimethyl Terephthalate	1	2	2
Chlorinated Hydrocarbons			
Ethylene Dichloride	2	4	8
Miscellaneous Derived from C_1			
Methanol	3	2	6
Pentaerythritol	2		
Miscellaneous Derived from C_2			
Acetaldehyde	2	2	4
Acetic Acid	2	3	6
Acetic Anhydride	2		
Ethylene Oxide	3	1	3
Ethylene Glycol	3	3	9
Tetraethyl Lead	1		
Ethanol	2		
Ethyl Cellulose	1		
Miscellaneous Derived from C_3			
Isopropanol	3		
Isocyanates	2		
Propylene Oxide	2		
Propylene Glycol	2		
Acetone	3	2	6
Miscellaneous Derived from C_4			
Methyl Ethyl Ketone	2		
Miscellaneous Derived from Aromatics			
Oxochemicals	2	2	4
Phenol	3	2	6
Aniline	2	3	6
Bisphenol A	2		
Para-cresol	1	4	4

TABLE 4 (Continued)

Product	Profitability Index 1)	Abatement Cost Index 2)	Economic Impact Index 3)
Basic Organic Chemicals			
Coal Tar	3		
Large Volume Intermediates			
Resin Intermediates			
Vinyl Chloride	2	2	4
Ethyl Acrylate	1	3	3
Methyl Methacrylate	1	2	2
Vinyl Acetate	2	2	4
Fiber Intermediates			
Acrylonitrile	2		
Adipic Acid	1		
Caprolactam	2	3	6
Dimethyl Terephthalate	1	2	2
Chlorinated Hydrocarbons			
Ethylene Dichloride	2	4	8
Miscellaneous Derived from C_1			
Methanol	3	2	6
Pentaerythritol	2		
Miscellaneous Derived from C_2			
Acetaldehyde	2	2	4
Acetic Acid	2	3	6
Acetic Anhydride	2		
Ethylene Oxide	3	1	3
Ethylene Glycol	3	3	9
Tetraethyl Lead	1		
Ethanol	2		
Ethyl Cellulose	1		
Miscellaneous Derived from C_3			
Isopropanol	3		
Isocyanates	2		
Propylene Oxide	2		
Propylene Glycol	2		
Acetone	3	2	6
Miscellaneous Derived from C_4			
Methyl Ethyl Ketone	2		
Miscellaneous Derived from Aromatics			
Oxochemicals	2	2	4
Phenol	3	2	6
Aniline	2	3	6
Bisphenol A	2		
Para-cresol	1	4	4

Ethylene Dichloride (EDC). The major use for ethylene dichloride is as an intermediate in vinyl chloride monomer (VCM) production. Well over 80% of production is used captively in complexes that produce ethylene and chlorine and make vinyl chloride monomer. In fact, in many instances it is not directly isolated and hence not reported in production figures. EDC is a convenient method of transporting chlorine and can expect to remain important in export for this reason. EDC and vinyl chloride monomer are in short supply and can be expected to remain so, at least through 1975. We would expect some plants to be retired as new capacity comes on-stream in 1975, 1976, and 1977.

Even though pollution abatement costs are high, we doubt that any plants will be closed for this reason alone, because EDC is an integral part of vinyl chloride production, which represents a substantial additional investment. In most cases pollution costs will be included in the transfer price of EDC to VCM, and will be passed on to VCM users at least in part. Because it takes about 1.72 pounds of EDC to produce a pound of VCM, the total water abatement cost carried by VCM will be 0.63¢/lb, equal to 15% of the 1972 sales price. It is unlikely that more than half this cost can be passed on in view of the fact that higher raw material costs will also be forcing the price of VCM to higher levels and threaten polyvinyl chloride's market share in competition with other plastics as well as competing metals and wood products. These higher prices will slow the growth of VCM from a growth rate of about 14% per year during the last decade to a level closer to 10% in the foreseeable future, a growth rate still substantially above the 8 to 8-1/2% average annual increase in volume experienced by the industry.

Caprolactam. Caprolactam is used primarily as a raw material for nylon 6. We expect that costs of water pollution abatement will be passed on by the four caprolactam producers through the nylon 6 prices.

Methanol. Methanol's chief market is formaldehyde, frequently produced at a separate location. About 40% goes to this use, with dimethyl terephthalate the second most important market. During the last two years, prices have dropped from 25¢ per gallon to a low of 10¢ per gallon; prices have risen slightly since that low was reached in 1972. The precipitous drop in price was due to new plant construction coming on-stream with capacity equal to over 50% of total demand. Many older smaller plants can be expected to close down. While pollution control may hasten their closing, it will not be instrumental. Producers are all large companies.

Acetic Acid. The production of cellulose acetate and vinyl acetate accounts for about three-fourths of acetic acid demand. All is produced by large companies in production complexes. Acetic acid is essential in its major uses; hence direct substitution is unlikely, although the major end products, cellulose acetate and vinyl acetate, may be vulnerable to substitution if pollution abatement costs of their own plus that of acetic acid are passed on to customers. With one exception it is unlikely that plants will be closed since most of the smaller ones produce acetic acid as a by-product of other chemicals.

Acetone. Acetone goes to many uses, including methyl methacrylate, cellulose acetate, bisphenol A, and many solvent applications. Half of the total capacity is produced in cumene process plants which has as a co-product, phenol. Small cumene plants, of which there are four, will be vulnerable to closure through the combined effects of scale efficiencies and pollution abatement costs for both phenol and acetone.

Phenol. Phenolic resins account for about half of phenol's markets. Caprolactam and bisphenol A are two other major markets. Since the major share of production is made via the cumene process, the total cost for the acetone/phenol will be allocated according to each company's policy. In general, we believe most of the costs due to water pollution abatement will be passed on to subsequent products and users except where noted under acetone above.

Aniline. Aniline's primary markets are in rubber processing chemicals, dyestuffs and increasingly in isocyanates, all products affected by the suggested water pollution guideline. Yet aniline is a critical component in all these products, and we anticipate the costs will be passed on without major dislocation in market growth or producing plants.

Coal Tar Products. Coal tar and its distillation products go into a variety of products – light oil distillates such as benzene, toluene, xylene, and solvent naphtha, and the heavy fractions – naphthalene, tar acids, cresylic acid, creosote, tar and pitch. The main pollution problem resides in the heavy fractions, the tar derivatives. The industry has been beset by many problems, a shrinking coal tar raw material as town gas plants closed down and steel mills used the tar captively as a low-sulfur fuel, loss in markets for naphthalene as synthetically made orthoxylene took over much of the phthalic anhydride market, price pressure from petroleum based pitches and lower-priced imports. With margins already depressed, in anticipation of the combined cost of federal and state and water pollution abatement and OSHA, at least three plants will be closed this year. More closures, especially of small isolated plants, can be expected over the next few years. This product area should receive a more detailed review by EPA.

Ethyl Cellulose. A special technical problem faces ethyl cellulose. It is manufactured from wood pulp fiber by a process which depends on the difference in solubility of the product in hot and cold water. Losses of product due to its solubility impose unusually high loads on the bioxidation system. While its profitability has been above average in the past, and its markets relatively price insensitive, we do not know how much it will cost to meet the proposed water pollution abatement guidelines.

Dyes and Organic Pigments. This group of organic chemicals consists of more than a dozen major classes of dyes and pigments consisting of more than a thousand different dyes produced in the United States. About two-thirds of the production goes to the textile industry, another sixth is used in paper production, and the balance is used mainly in leather and plastics. There are about 60 producers in the United States; many of them are small and many are located in urban or suburban areas of New Jersey.

While prices have risen by over 10% in the last five years, in contrast to many more basic organic chemicals, the profit margins of the small nonintegrated dye producers are slim. Foreign imports have been equivalent to over 10% of U.S. production, and a small number of U.S. and foreign controlled firms account for a major share of domestic sales. Furthermore, shifts in textile fashions – materials and colors – make those producers of a limited line of dyes vulnerable to erratic sales demand.

Many of the dyestuff producers in urban and suburban areas put their effluent into municipal sewer systems. No guidelines have been published for present plants dumping into municipal sewer systems, so we cannot comment on their potential vulnerability. It is likely, however, that the pretreatment standards which will ultimately be promulgated will affect expansion in built-up areas more because of limited space than any other reasons. Those small dyes and pigment producers located in rural areas and not currently using municipal systems will be faced with a potential problem.

We have insufficient data to estimate the extent of potential impact, but recommend this be reviewed by the EPA in further detail. The data offered by the Development Document can be used to make an arithmetic calculation of the cost of abatement for dyes and pigments. At the low end of the range, the result is a low cost (¢/lb) at a high hydraulic load. We have not included this calculation because it leads one to a probable erroneous conclusion that the industry has a minimal problem. As stated above, we regard it more likely that a number of smaller producers have a serious problem that will require individual consideration.

Unformulated Pesticides. These products are used in making insecticides, herbicides, fungicides, and other biologically active compounds for agricultural, home, health, and commercial uses. Many scattered small plants, particularly in the Midwest, many of them in rural areas, may face special problems. We have no effluent abatement costs for this segment of the organic chemical industry, but believe this area deserves a more detailed review by the EPA.

Extrapolating the Economic Impact of Water Pollution Control From the Specific to the General. We recognize the hazard of trying to draw general conclusions on the basis of very limited data, but will attempt to do so in this section. All of our comments are confined to the economic impact of the initial level – best practicable technology currently available – to be met by the organic chemical industry by 1977 and are based on the assumption that the water pollution abatement costs given to us by the EPA are accurate except where noted above. In view of the lack of data, we can make no comments regarding advanced levels.

Our coverage of about 75% of the value of the organic chemical industry's sales and the Development Document's coverage of about 75% of the industry's volume of production imply a conservative three-fourths coverage of the total organic chemical industry. Of that 75% covered, we found about half (both in number and sales value) was in Categories A&B. We assume, for the purpose of this study only, that the other 25% not identified has characteristics common to those covered in our work.

Water Pollution Abatement Operating Costs. On that basis, about half of 1972 sales of about $8 billion of organic chemicals have nominal water pollution abatement problems with costs equivalent to about 1% of sales value, that is, about $40 million annually. The other half, Draft Development Document Categories C&D, have in varying degrees a significant economic impact.

The cost of water abatement to achieve 95% removal with best practicable control technology currently available (shown in Table 3) had a weighted average of 4.23% of sales value, with a range from 0.42% to 11.51% of sales value. Mindful of the fact that total after-tax profits averaged 6-7% of capital employed and about 5% of sales in 1972, there would be a very serious economic impact if the industry were not able to pass these costs on to their customers. In any event, costs for this half of the industry are estimated at about $170 million annually, for a total industry cost, on the basis of 1972 sales, of $210 million per year when it is fully meeting suggested 1977 guidelines. As will be seen below, we believe this to be a minimum cost figure, with a figure of $590 million annually a maximum.

Impact on Profits. While the organic chemical industry will be under severe cost pressures because of increased prices for its hydrocarbon raw materials and energy as well as air, water, solid waste pollution control and OSHA, we estimate, purely on judgment, that it will be able to pass on about two-thirds of the minimum cost figures incurred in water pollution abatement. Again on the basis of 1972 values, the industry would have to absorb about $70 million of the cost. Assuming a 50% tax rate, this would represent a depression of after-tax earnings of about 9% per year for the industry when it is fully meeting 1977 requirements.

In our maximum estimate of $590 million annual cost, we question whether the industry would be able to pass on more than one-half of these total costs because of more efficient producers and fear of losing market share to competitive products and/or imports, and would have to absorb $295 million. As 1972 net after-tax profits for the industry were about $400 million, the maximum absorbed costs would depress earnings by 37% of the 1972 base.

Price Effects. Assuming the organic chemical industry can pass on two-thirds of the minimum cost of abatement, or about $140 million, this represents an average increase in prices of 1.75% over the period 1972-1977, while the maximum of $295 million would represent a rise in price of 3.7% over the period.

Effects on Growth of the Industry. Of course, it must be realized that different products would have different costs, with increases ranging from zero to ten percent or more. Price increases of 1-1/2% over five years will have very minor overall effects on the industry's growth, although again certain products and companies will suffer. Even a maximum increase of 3.7% will not present a major dampener on growth. However, increases due to inflation, raw materials and energy will be much greater and will be the main dampener on demand growth, which will slow below the average growth rate of

8-1/2% per year experienced in the 1960's. We are in no position to estimate how much effect these other factors will have on the organic industry's growth.

Capital Needs and Availability. The 1967 Census of Manufactures made a water usage census in 1968. The organic chemical industry reportedly discharged 2,162 billion gallons of water from a total of 239 establishments consuming water out of an industry total of 665 establishments contacted. (By comparison the 1967 Census of Manufactures tabulated 454 establishments; the discrepancy may be due to including warehouses, distribution facilities and other nonproductive establishments in the industry.) Of this total, 413.3 billion gallons was process water. This process water usage is equivalent to an average discharge per establishment (plant) of 1.73 billion gallons per year or 4.7 million gallons per day.

Although we are not saying a plant with such a discharge exists, since some may have much greater and many lesser water usage, it is a useful figure from which to estimate the fixed capital required by the industry to meet water pollution guidelines using the best practicable control technology currently available.

According to the data supplied to us by the EPA, the capital cost using best practical technology for each category having a volume of 720,000 gallons per day is as shown below. Our estimates of a 4.7-million-gpd plant in each category are also included. The latter are based solely on a 0.7 exponential factoring (not 0.6, because of the need for land).

Category	Best Practicable Technology	720,000 gpd	4,700,000 gpd
A	–	$1,410,000	$ 5,231,000
B	95% removal	$2,538,000	$ 9,416,000
C	95% removal	$8,144,000	$30,214,000
D	90% removal	$1,878,000	$ 6,967,000

On the assumption that the industry's volume is divided about equally among the four categories A, B, C, and D (and from Table 1 this appears reasonable) about 60 establishments in each of the four categories will have to make fixed investments in water treatment facilities. The total capital required on this basis is $3,110 million. However, we assumed facilities already installed would partially fulfill the 1977 needs. From data collected by the Manufacturing Chemists Association[1] we estimate the organic chemical industry already had invested $230 million in water abatement facilities by the beginning of 1972. Hence, total new fixed investment to meet proposed 1977 guidelines will be $2,880 million by 1977, averaging $576 million per year. It does not take into account the cost of developing new processes to reduce the effluent load, which should at least correspondingly reduce the capital needed to treat the effluent.

1. Manufacturing Chemists Association "Environmental Commitment – 1972," June 1972.

The fixed capital invested by the basic chemical industry in the United States in 1972 was $2.18 billion; we estimate the organic chemical industry invested $525 million of the total in that year. Obviously, if the capital cost figure for water pollution abatement is correct, the industry will be hard pressed to raise the capital needed for both nonproductive water pollution abatement facilities and for production units needed to supply the growing demand and replace obsolete units. Furthermore, amortizing this investment alone would be a burden of about $295 million annually, substantially more than the $210 million total water pollution abatement operating cost we cited above, based on the average cost in the Draft Development Document for a very limited number of products. Because annual amortization costs are about half total annual costs, a figure of $590 million per year may be considered as a maximum figure of added cost, while $210 million should be considered the minimum figure. We recommend a more detailed review of this question in any further work undertaken by the EPA.

Plant Closings. Even at the minimum level of water pollution abatement costs for the organic chemical industry, some plants will be closed. These plants, in relation to others in the same product or product line, are the marginal plants, probably old, inefficient, seldom in a complex, and frequently small. The capital cost of putting in pollution abatement facilities may well hasten their closure. Although many of the large companies have such plants, they are more apt to be prevalent in small companies, which make up the bulk of companies, as can be seen in Table 5.

Table 5 is a compilation of the Internal Revenue's 1970 tax returns from 3,287 companies classified by the Internal Revenue in SIC 281, Basic Chemicals. While we have no similar breakdown for the organic chemical industry, it is reasonable to assume a similar profile. Ninety-five percent of these companies had assets of less than $5 million; many of these probably have no plants, but some do. (See Table A-10 of Appendix A.) Within the organic chemical industry 220 establishments of the 665 establishments in the industry employ less than ten people. It is primarily in the small plants owned by small companies that most closures will take place. The industry will be further concentrated in the larger companies.

We cannot estimate the number or location of plant closures, although the tabulation of plants producing the chemicals in categories C and D, the potential serious pollution problems (see Appendix B) give some indication of likely candidates.

Employment Effects. Products made in chemical complexes are less vulnerable than those in isolated locations, since such complexes will have a commonly shared water pollution abatement facility. Because each product must carry its own share of the cost, the complex is not likely to be in jeopardy, although the product may be discontinued. It is likely that the personnel connected with the discontinued operation can be absorbed in other operations in the complex. In the case of isolated plants, they will be unemployed. Although the impact on the individuals and small companies will be substantial, it probably will not be substantial to the communities involved, since in most cases it will be the smaller plants that will close.

TABLE 5

COMPANIES IN THE BASIC CHEMICAL INDUSTRY ACCORDING TO ASSETS

Assets ($1000)	Number of Companies	Percent of Total	Cumulative Percent
0 - 100	1161	35.4	35.4
100 - 250	645	19.6	55.0
250 - 500	539	16.4	71.4
500 - 1,000	387	11.8	83.2
1,000 - 5,000	390	11.8	95.0
5,000 - 10,000	59	1.8	96.8
10,000 - 25,000	36	1.1	97.9
25,000 - 50,000	20	0.6	98.5
50,000 - 100,000	12	0.4	98.9
100,000 - 250,000	15	0.4	99.3
Over 250,000	23	0.7	100.0

Source: Internal Revenue Service

TABLE 5 (Continued)

	Profitability Index 1)	Abatement Cost Index 2)	Economic Impact Index 3)
Small-Volume Intermediates & End-Product Organics			
Dyes & Organic Pigments	2		
Rubber Processing Chemicals	1		
Flavors & Fragrances	1		
Unformulated Pesticides	1		
Plasticizers	3		

1) 1 = Product had better than industry average profitability in 1972.
2 = Product had industry average profitability in 1972.
3 = Product had below industry average profitability in 1972.

2) Abatement cost as percent of sales cost based on Table 3.

1 = less than 1%
2 = 1 to 4%
3 = 4 to 8%
4 = 8 to 12%
5 = more than 12%

3) Abatement cost index X profitability index.

APPENDIX A

THE ORGANIC CHEMICAL INDUSTRY

Definition of the Industry

For the purpose of this study, the organic chemical industry is defined as primary producers of products listed in Standard Industrial Classification[1] Industry numbers 2865 (formerly 2815), "Cyclic (coal tar) Crudes, and Cyclic Intermediates, Dyes, and Organic Pigments (Lakes and Toners)," and SIC number 2869 (formerly 2818) "Industrial Organic Chemicals, not elsewhere classified," with minor modifications.

To make the results of this study more meaningful, it was desirable to break down these two major SIC numbers into smaller segments. We have developed a grouping of chemicals into four major segments and eleven subsegments. See Table A-1. In making these groupings we have taken into consideration four major factors: (1) the naturally occurring business segmentation, (2) the availability of statistics, largely those of the Bureau of the Census and the U.S. Tariff Commission, (3) a commonality of production economics based on process and scale, and (4) compatibility with four basic water effluent treatment categories established by the EPA.[2] In an industry as diverse as organic chemicals, it is difficult to satisfy the four major factors listed above without some compromises and omissions. Nevertheless the breakdown shown in Table A-1 is a realistic segmentation of the industry, and sales from this grouping account for 55% to 60% of total shipments and 75% to 80% of commercial shipments (sales), as estimated by the U.S. Bureau of the Census. (Based on commercial shipments being 77.5% of total shipments or $6.576 billion in 1970 versus $4.947 billion accounted by our industry segmentation.[3])

The Size of the Industry

In the absence of any better statistics, we must depend upon the data provided by the Bureau of the Census and U.S. Tariff Commission. Even these data must be accepted with reservation; generally they have errors of omission.

The Organic Chemical Industry consists of those establishements (plants or parts of plants) classified as primarily producers of Cyclic Intermediates and Crudes and of Industrial

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1. See pages 121-123 of "Standard Industrial Classification Manual," Statistical Policy Division, Office of Management & Budget, Executive Office of the President, GPO 1972.

2. Category A – Non-aqueous processes; Category B – Process water contact as steam diluent and/or absorbent; Category C – Aqueous liquid-phase reaction system; and Category D – Batch and semi-continuous processes.

3. See Tables A-3 and A-4.

TABLE A-1

ORGANIC CHEMICAL INDUSTRY SEGMENTS

A. Basic Organic Chemicals

1. Coal Derived Basics (Tar & Tar Crudes) SIC 28155

Coal tar acids
Coal tar crudes
Coal tar distillates
Benzene
Toluene
Xylene
Naphtha solvents
Naphthalene
Anthracene
Creosote
Cresols
Cresylic acid
Pitch
Tar

2. Petroleum Derived Basics - Part of SIC 2818 & 2815

Acyclic

Ethylene
Propylene
Acetylene
Butadiene

Cyclic

Benzene
Toluene
Xylene

B. Large Volume Intermediates and Finished Organics Including:

3. Resin Intermediates - Part of SIC 2815 & 2818

Ethyl benzene & styrene
Vinyl chloride
Ethyl acrylates & methylmethacrylates
Vinyl acetate

TABLE A-1 (continued)

4. Fiber Intermediates - Part of SIC 2818 & 2815

Cyclohexane
Acrylonitrile
Adipic acid
Hexamethylene diamine & tetramine
Caprolactam
Dimethyl terephthalate

5. Chlorinated Hydrocarbons - Part of SIC 2818

Methyl chloride
Methylene chloride
Chloroform
Carbon tetrachloride
Ethyl chloride
Ethylene dichloride
Trichloroethylene
Perchloroethylene
Methyl chloroform
Fluorinated hydrocarbons

6. Miscellaneous Generally Derived From: Part of SIC 2815 & 2818

C_1	C_2	C_3	C_4	Aromatics
Methanol	Acetaldehyde	Glycerin		Cumene
Formaldehyde	Acetic acid	Isopropynol		Phenol
Pentaerythritol	Acetic anhydride	Isocyanates		Acetone
Phosgene	Ethanol		Methyl ethyl ketone	Aniline
	Ethyl cellulose	Propylene oxide		Bisphenol
	Ethylene oxide and glycol	Propylene glycol		Phthalic anhydride
		Acetone		
	Tetraethyl lead			

C. Small Volume Intermediates and End Product Organics

7. Dyes & organic pigments SIC 2815 2 & 3
8. Rubber processing chemicals SIC 28183 31
9. Flavors & fragrance SIC 28183 11
10. Unformulated pesticides SIC 2818 4
11. Plasticizers SIC 28183 51

D. Miscellaneous Intermediates

Organic Chemicals n.e.c. In addition, they produce other secondary products classified in other industries; similarly, other industries produce some organic chemicals. The dimensions of the industry can be seen from the value of shipments for 1967 (Table A-2), the latest year for which detailed statistics are available.

Total shipments of organic chemicals equalled $7,193.6 million in 1967. Commercial shipments in that year are estimated by the Bureau of the Census at about $5,560 million, or 77.5% of total shipments. Commercial shipments are about 88% of the $6,325 million sales reported by the U.S. Tariff Commission in 1967.[4] The difference in all shipments from Tariff Commission's reported sales is due primarily to intracompany (plant or plant section) transfer of material for further processing. The Census' lower commercial shipments can be explained by differences in classifications, for example, including coke oven operations, not just tar distillers in the Tariff statistics. The former are omitted from the Census statistics.

Total shipments of organic chemicals for other years are shown in Table A-3, while Table A-4 shows the sales of organics that are included within the segmentation of the industry as used in this report, and Tables A-5 and A-6 yearly sales value and production volume of the segments for 1963-1971. On the assumption that 1972 shipments rose about 12% above those in 1971, total industry shipments would be nearly $10 billion in that year, with commercial shipments on sales about $7.75 billion. Rounding this figure off to the nearest billion because of inadequate statistics we assume in this report that organic chemical industry sales in 1972 were $8 billion.

Characteristics of the Industry

Companies. About 454 companies produce organic chemicals; they operate a total of 665 establishments. The four largest companies account for a minimum of 36% of the industry's shipments and the hundred largest companies account for over 92% of all shipments. (See Table A-7.) The U.S. Tariff Commission in 1970 identified 281 companies as producers of chemicals in segments of the industry. (See Table A-8.)

Companies producing chemicals in five or more of the twelve segments are listed in Table A-9. Tables A-8 and A-9 are based on U.S. Tariff Commission data and hence probably omit some producers. Furthermore, the miscellaneous segment, which accounts for about one-quarter of all sales, has not been included. While many companies in other segments also produce miscellaneous chemicals, a small number produce only these miscellaneous products and they are missing from the list.

Establishments. The Bureau of the Census defines an establishment as "producing a single product or more or less closely related group of products." Within the cyclic intermediates, dyes, organic pigments (lakes and toners) and cyclic (coal tar) crudes and

4. See 1967 Census of Manufactures MC 67(2)-28A-2.

TABLE A-2

THE DIMENSIONS OF THE U. S. ORGANIC CHEMICAL INDUSTRY 1967

(millions of dollars)

Total Shipments	By Establishments Classified Primarily In:		Subtotal	By Establishments In Other Industries	Total
	Cyclic Intermediates and Crudes (SIC 2865)	Industrial Organic Chemicals n.e.c. (SIC 2869)			
Cyclic Intermediates & Crudes	1,092.1	360.2	1,452.3	201.9	1,654.2
Industrial Organic Chemicals	168.4	4,461.2	4,629.6	909.8	5,539.4
Other Products & Service Not Included in Above SIC	336.3	1,556.4	1,892.7		
Total Shipments	1,596.8	6,377.8	7,974.6		
Value of All Organic Chemical Shipments					7,193.6

Source: U. S. Bureau of the Census MC 67(2)-28A

TABLE A-3

VALUE OF SHIPMENTS OF ORGANIC CHEMICALS

(millions of dollars)

A. BY ALL MANUFACTURERS

Year	Cyclic Intermediates and Crudes	Industrial Organic Chemicals n.e.c.	Total
1947	444.9	965.9	1,410.8
1954	778.7	2,027.5	2,806.2
1958	893.8	2,787.3	3,681.1
1963	1,195.2	4,183.8	5,379.0
1964	1,277.0	4,457.1	5,734.1
1965	1,452.0	5,023.3	6,475.3
1966	1,591.1	5,366.1	6,957.2
1967	1,654.2	5,539.4	7,193.6
1968	1,786.9	6,056.8	7,843.7
1969	1,896.3	6,356.0	8,252.3
1970	2,014.4	6,470.4	8,484.8
1971	2,077.5	6,814.8	8,892.3

B. BY ALL MANUFACTURERS IN SIC 2815 AND 2818

SIC No.		1971	1970	1967
2815	Cyclic intermediates & crudes	(2,077.5)	(2,014.4)	(1,654.2)
28151	Cyclic intermediates	1,308.9	1,308.8	1,066.1
28152	Synthetic organic dyes	434.7	397.4	325.6
28153	Synthetic organic pigments, lakes & toners	178.2	169.1	162.2
28155	Cyclic (coal tar) crudes	110.9	100.3	87.6
28150	Cyclic intermediates & crudes, nsk	44.8	38.8	12.7
2818	Industrial organic chemicals, n.e.c.	(6,814.8)	(6,470.4)	(5,539.2)
28181	Miscellaneous cyclic chemical products	393.4	371.2	315.1
28182	Miscellaneous acyclic chemicals & products	4,696.7	4,525.6	4,052.2
28183	Synthetic organic chemicals (except surface active)	785.5	718.7	585.6
28184	Pesticides and other unformulated organics	387.1	331.2	308.2
28185	Ethyl alcohol and other industrial organic chemicals	492.1	466.2	239.4
28180	Industrial organic chemicals, nsk	60.0	57.5	38.7

Source: Bureau of the Census

TABLE A-4

ORGANIC CHEMICAL INDUSTRY

SALES VALUE FOR 1967 & 1970

(millions of dollars)

	1970	1967	Average Price ($/lb) 1970	Average Price ($/lb) 1967
A. Basic Organic Chemicals	870	728	.031	.036
1. Coal Derived Basics	178	132		
2. Petroleum Derived Basics	692	596		
a) acyclic	419	363		
b) cyclic	273	233		
B. Large Volume Intermediates and Finished Organics	2,221	1,879	.076	.092
1. Resin Intermediates	368	278		
2. Fiber Intermediates	345	236		
3. Chlorinated Hydrocarbons	407	338		
4. Miscellaneous	1,101	1,027		
C_1	104	95		
C_2	463	520		
C_3	133	120		
C_4	39	41		
Aromatics	362	251		
C. Small Volume Intermediates and End Organics	1,856	1,713	.685	.659
1. Dyes & Organic Pigments	513	440		
2. Rubber Processing Chemicals	149	132		
3. Flavors and Fragrances	89	93		
4. Unformulated Pesticides	870	787		
5. Plasticizers	235	261		
D. Miscellaneous Intermediates	?	?		
Total	4,947*	4,320*		

* Excludes Miscellaneous from Total

Source: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. Production and Sales.

TABLE A-5

ORGANIC CHEMICAL INDUSTRY

SALES VALUE

(millions of dollars)

	1963	1964	1965	1966	1967	1968	1969	1970	1971*
A. Basic Organic Chemicals	529	579	648	747	728	737	815	870	833
1. Coal Derived Basics	121	129	139	139	132	138	178	178	159
2. Petroleum Derived Basics	408	450	509	608	596	599	637	692	674
B. Large Volume Intermediates and Finished Organics	1,549	1,684	1,764	1,890	1,879	2,023	2,198	2,221	2,208
3. Resin Intermediates	222	250	243	273	278	312	359	368	384
4. Fiber Intermediates	148	185	226	243	236	299	362	345	329
5. Chlorinated Hydrocarbons	265	292	317	339	338	339	389	407	409
6. Miscellaneous	913	958	979	1,035	1,027	1,073	1,089	1,101	1,086
C. Small Volume Intermediates and End Products	1,053	1,170	1,305	1,500	1,713	1,867	1,873	1,856	2,033
7. Dyes and Organic Pigments	320	348	386	439	440	490	518	513	553
8. Rubber Processing Chemicals	119	123	123	138	132	151	144	149	159
9. Flavors and Fragrances	77	84	85	93	93	97	94	89	84
10. Unformulated Pesticides	369	427	497	584	787	849	851	870	979
11. Plasticizers	168	188	214	246	261	280	266	235	258
Grand Total Accounted for:	3,131	3,433	3,717	4,137	4,320	4,627	4,886	4,947	5,074
D. Miscellaneous Intermediates									

Note: Totals do not add up due to rounding.
*Preliminary

Source: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. production and sales.

TABLE A-6

ORGANIC CHEMICAL INDUSTRY

PRODUCTION VOLUME

(billions of pounds)

	1963	1964	1965	1966	1967	1968	1969	1970	1971*
A. Basic Organic Chemicals	27.9	31.6	34.9	38.9	41.6	46.1	56.9	58.1	57.9
1. Coal Derived Basics	5.5	5.8	6.2	6.0	5.6	6.0	12.1	11.6	10.1
2. Petroleum Derived Basics	22.4	25.8	28.7	32.9	36.0	40.1	44.8	46.5	47.8
B. Large Volume Intermediates and Finished Organics	34.1	39.0	43.0	49.6	50.8	58.0	66.5	69.3	69.9
3. Resin Intermediates	6.2	7.9	8.8	9.9	10.1	12.0	14.7	14.7	15.6
4. Fiber Intermediates	3.1	3.7	4.6	5.9	5.3	6.7	7.4	6.6	7.1
5. Chlorinated Hydrocarbons	4.4	5.0	5.7	7.1	7.6	8.7	10.5	12.2	12.2
6. Miscellaneous	20.5	22.4	24.0	26.6	27.8	30.7	34.0	35.8	35.0
C. Small Volume Intermediates and End Products	2.1	2.3	2.6	2.9	2.9	3.2	3.2	3.1	3.4
7. Dyes and Organic Pigments	.2	.2	.3	.3	.3	.3	.3	.3	.3
8. Rubber Processing Chemicals	.2	.3	.3	.3	.3	.3	.3	.3	.3
9. Flavors and Fragrances	.1	.1	.1	.1	.1	.1	.1	.1	.1
10. Unformulated Pesticides	.8	.8	.9	1.0	1.1	1.2	1.1	1.0	1.1
11. Plasticizers	.8	1.0	1.1	1.2	1.3	1.3	1.4	1.3	1.5
Grand Total Accounted for:	64.1	72.9	80.5	91.4	95.3	107.3	126.6	130.5	131.2
D. Miscellaneous									

Note: Totals do not add up due to rounding.
*Preliminary

Source: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. production and sales.

TABLE A-7

CONCENTRATION OF THE ORGANIC CHEMICAL INDUSTRY 1967

	Companies	Establishments		Value of Shipments		Number of Employees		Production Workers	
		No.	%	$ MM	%	thousand	%	thousand	%
Cyclic Intermediates & Crudes - SIC 2865 (formerly 2814 & 2815)									
Total industry	115	177		1,596.8		30.0		20.3	
4 largest companies		21	12	719	45	13.2	44	9.3	46
8 largest companies		44	25	1,021	64	18.0	60	12.4	61
20 largest companies		71	40	1,326	83	24.5	83	17.1	84
50 largest companies		110	62	1,550	97	28.8	96	19.7	97
Industrial Organic Chemicals, NEC - SIC 2869 (formerly 2818)									
Total industry	339	488		6,377.8		95.1		62.4	
4 largest companies		29	6	2,868	45	40.0	42	26.8	43
8 largest companies		49	10	3,700	58	50.4	53	34.3	55
20 largest companies		98	20	4,770	75	67.5	71	44.2	71
50 largest companies		175	36	5,860	92	83.7	88	54.9	88

Source: Bureau of the Census, 1967 Census of Manufactures, Concentration Ratios in Manufacturing - MC67(S)2.1, 2 & 3.

TABLE A-8

ORGANIC CHEMICAL INDUSTRY

PRODUCING COMPANIES – 1970

A.	Basic Organic Chemicals		71
	1. Coal Derived Basics	14	
	2. Petroleum Derived Basics	60	
B.	Large Volume Intermediates		101
	1. Resin Intermediates	38	
	2. Fiber Intermediates	26	
	3. Chlorinated Hydrocarbons	24	
	4. Miscellaneous	67	
C.	Small Volume Intermediates		185
	1. Dyes and Organic Pigments	56	
	2. Rubber Processing Chemicals	27	
	3. Flavors and Fragrances	49	
	4. Unformulated Pesticides	78	
	5. Plasticizers	54	
	Total		281

Note: Totals do not represent additions. Companies have not been double counted.

If a category is manufactured in more than one division of a company, the reference is to the company and not to the individual division.

Does not include producers of miscellaneous intermediates.

Source: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. Production and Sales, 1970 - TC Publication 479.

TABLE A-9

COMPANIES MANUFACTURING SIX OR MORE CATEGORIES *

Company Name	Basic Organics		Large Volume				Small Volume					Total
	Coal Derived Basics	Petroleum Derived Basics	Resin Intermediates	Fiber Intermediates	Chlorinated Hydrocarbons	Miscellaneous	Dyes and Organic Pigments	Rubber Processing Chemicals	Flavors and Fragrances	Unformulated Pesticides	Plasticizers	
Allied Chemical Corp.	X	X	X	X	X	X	X	X	X	X	X	11
American Cyanamid Co.			X	X	X	X	X	X		X	X	8
B. F. Goodrich Chemical Company		X	X	X	X			X		X	X	7
Dow (-Badische, -Corning) Chemical Co.	X		X	X	X	X			X	X	X	8
E. I. du Pont de Nemours & Co., Inc.		X	X	X	X	X	X	X		X	X	9
Eastman Kodak Co.		X				X	X	X	X		X	6
FMC Corp.					X	X	X	X		X	X	6
Hercules, Inc.					X	X	X		X	X	X	6
Monsanto Company		X	X	X		X		X	X	X		7
Tenneco Chemicals, Inc.			X	X		X	X		X	X		6
Union Carbide Corporation		X	X	X	X	X			X	X	X	8

* Except miscellaneous

industrial organic chemicals, not elsewhere classified, which is the SIC classification used to define the organic chemicals industry, there are about one dozen closely related groups. As the organic chemical industry is, in general, highly integrated, many large plants produce one or more closely related groups; quite frequently, therefore, a plant may, in Census terms, consist of more than one establishment.

Table A-10 shows the size distribution (by employment) of the establishments in the organic chemical industry as of 1967. The number of establishments and employees in 1972, our base year, is not significantly different from 1967, because the industry's normal growth, particularly in employment, was halted and reversed during the recession of 1970/71. The geographic distribution of the industry is shown in Table A-11. The Middle Atlantic and West South Central states together account for 46% of the establishments and 54% of employees in the organic chemical industry.

Growth of the Industry. Over the last decade those companies whose primary production is in cyclic intermediates grew at a rate of about 6% per year, a slower rate than in industrial organics, n.e.c. The average growth in sales for both together between 1958 and 1972 was 7-1/2% per year. (See Table A-12.) The industry is maturing; hence, despite any impact of pollution control, the industry's average rate of growth can be expected to continue to decline. The impact of pollution control and the availability and cost of hydrocarbons and energy will, if anything, accelerate that decline in growth rate.

In a very real sense, the value of shipments does not reflect the increase in physical volume. Unlike many industries, where inflation and price increases overstate the growth of the industry, the decline in prices of organic chemicals understates the rate of growth in physical volume. As can be seen from the last column of Table A-12, the physical volume of shipments of the organic chemical industry grew at a rate of about 8-1/2% per year between 1958 and 1972.

Prices in the Industry. The Bureau of Labor Statistics collects price information and develops price indices for the chemical industry in connection with the development of the wholesale price index. While these prices are based primarily on list prices, and hence do not take into account the widespread discounting practiced in the chemical industry when capacity utilization is low, the indices do nevertheless represent the best available general indicator of price trends. Tables A-13 and A-14 show this trend from 1958 through 1972. Table A-15, which is based on prices realized and reported to the U.S. Tariff Commission, shows price trends in the segments of the industry since 1963; these trends generally correspond to the price indices.

In general the decline in prices has not been accompanied by a similar decline in cost. While unit labor costs have been held down by improved productivity, the cost of raw materials from outside the industry, the cost of energy, and the cost of construction have risen at a much more rapid rate. The price index for all industrial commodities rose to an average of 117.9 (1967 = 100) during 1972; fuels, related products and power rose to 118.6, and construction materials and components have risen to 126.2 (to say nothing of the cost of erecting plants).

TABLE A-10

ESTABLISHMENT BY EMPLOYMENT SIZE IN THE ORGANIC CHEMICAL INDUSTRY 1967

Establishments by Size (No. of Employees)	Cyclic Intermediates and Crudes (SIC 2815/2865)	Industrial Organic Chemicals, n.e.c. (SIC 2818/2869)	Total
1 - 4	26	125	151
5 - 9	20	49	69
10 - 19	24	46	70
20 - 49	27	69	96
50 - 99	16	50	66
100 - 249	37	70	107
250 - 499	13	38	51
500 - 999	7	21	28
1,000 - 2,499	7	13	20
2,500 or more	0	7	7
Total Establishments	177	488	665
Companies Represented	I15	339	454
Total Employees (1000)	30.0	95.1	125.1
Production Workers	20.3	62.4	82.7
Total Payroll ($ million)	251.1	844.9	1,096.0

Source: 1967 Census of Manufactures, Industrial Chemicals 28A.

TABLE A-11

GEOGRAPHIC DISTRIBUTION OF THE ORGANIC CHEMICAL INDUSTRY 1967

	Cyclic Intermediates and Crudes (SIC 2815/2865)		Industrial Organic Chemicals, n.e.c. (SIC 2818/2869)		Total		
	Establish-ments	Total Employees (1000)	Establish-ments	Total Employees (1000)	Establish-ments	Employees (1000)	%
Northeast Region	95	16.6	168	26.6	263	43.2	34.5
New England	17	0.9	36	3.9	53	4.8	
Middle Atlantic	78	15.7	132	22.7	210	38.4	
New York	18	3.1	37	6.0	55	9.1	
New Jersey	43	10.0	75	14.8	118	24.8	
Pennsylvania	17	2.5	20	1.9	37	4.4	
North Central Region	29	6.0	98	17.3	127	23.3	18.7
East North Central	26	∿ 6.0	80	14.5	106	20.5	
Ohio	12	1.8	28	2.7	40	4.5	
West North Central	0	0	18	2.9	18	2.9	
South Region	44	7.1	160	47.8	204	54.9	43.9
South Atlantic	20	3.6	55	13.5	75	17.1	
East South Central	10	1.2	25	7.2	35	8.4	
West South Central	14	2.3	80	27.2	94	29.5	
Louisiana	3	n.a.	26	n.a.	29	n.a.	
Texas	11	n.a.	52	18.7	63	18.7+	
West Region	9	0.3	62	3.3	71	3.6	2.9
Total	177	30.0	488	95.1	665	125.1	100.0

Source: U. S. Bureau of the Census

TABLE A-12

VALUE OF SHIPMENTS OF THE ORGANIC CHEMICAL INDUSTRY

(millions of dollars)

	Cyclic Intermediates and Crudes (SIC 2815/2865)	Industrial Organic Chemicals, n.e.c. (SIC 2818/2869)	Total	Volume of Shipments in Constant 1967 Organic Chemical Dollars (1)
1958	934.4	3,098.0	4,032.4	3,616.5
1959	1,114.8	3,609.2	4,724.0	4,236.8
1960	1,127.2	3,712.9	4,840.1	4,348.7
1961	1,136.2	3,947.2	5,083.4	4,737.6
1962	1,152.0	4,430.1	5,582.1	5,393.3
1963	1,212.8	4,840.2	6,053.0	6,010.9
1964	1,289.6	5,265.3	6,554.9	6,614.4
1965	1,456.3	6,012.5	7,468.8	7,521.5
1966	1,556.3	6,541.1	8,097.4	8,129.9
1967	1,596.8	6,377.8	7,974.6	7,974.6
1968	1,716.1	6,965.8	8,681.9	8,769.6
1969	1,847.9	7,383.0	9,230.9	9,536.1
1970	1,804.0	7,379.7	9,183.7	9,371.1
1971	1,967.6	8,214.3	10,181.9	10,368.5
1972 est.	2,100	8,800	10,900	11,331
Percent average annual growth 1958-1972	6	8	7 1/2	8 1/2

(1) $\frac{\text{Value of Shipments}}{\text{Price Index Organic Chemicals}}$ (See Table A-13)

Sources: U. S. Bureau of the Census 1958-1971; 1972, Arthur D. Little, Inc., estimates.

TABLE A-13

PRICE TRENDS IN THE CHEMICAL INDUSTRY 1958-1972

(1967 = 100)

	Chemicals & Allied Products (SIC 28) [1]	Industrial Chemicals (SIC 281) [1]	Organic Chemicals (SIC 2815 & 2818) [1]	Cyclic Intermediates (SIC 28151)	Misc. Acyclic Chemicals (SIC 28182)
1958	102.0	102.6	111.5		
1959	101.6	102.9	111.5		
1960	101.8	103.2	111.3		
1961	100.7	101.0	107.3		
1962	99.1	98.9	103.5		
1963	97.9	97.3	100.7		
1964	98.3	96.7	99.1		
1965	99.0	97.5	99.3		
1966	99.4	98.3	99.6		
1967	100.0	100.0	100.0	100.0	100.0
1968	99.8	101.0	99.0	95.3	100.0
1969	99.9	100.3	96.8	91.4	91.6
1970	102.2	100.9	98.0	89.7	90.0
1971	104.2	102.0	98.2	86.6	88.7
1972	104.2	101.2	96.2	84.5	86.3

1) While the Department of Labor's classification is different from the Standard Industrial Classification, it corresponds roughly to the SIC numbers shown here.

Note: These indices are based on list prices, hence do not reflect discounts off list prices.

Source: Bureau of Labor Statistics, U. S. Department of Labor.

TABLE A-14

PRICE TRENDS IN THE ORGANIC CHEMICAL INDUSTRY 1958-1972

(1967 = 100)

	Organic Crudes (06-12-01)	Organic Intermediates (06-12-02)	Dyes (06-12-03)	Organic Chemicals n.e.c. (06-12-04)
1958	123.9	121.4	94.9	108.2
1959	120.1	118.9	92.8	110.2
1960	120.6	118.7	93.7	110.5
1961	114.8	118.7	95.8	106.2
1962	107.5	110.6	94.2	102.5
1963	101.4	107.2	89.0	100.5
1964	95.6	103.8	89.4	100.1
1965	96.4	101.5	97.2	99.9
1966	97.0	102.3	100.0	99.3
1967	100.0	100.0	100.0	100.0
1968	99.6	94.2	100.9	99.7
1969	97.8	91.1	104.8	96.9
1970	99.1	90.4	116.3	97.8
1971	103.8	89.4	125.9	96.8
1972	104.4	87.3	128.4	93.9

Note: These indices are based on list prices, hence do not reflect discounts off list prices.

Source: Bureau of Labor Statistics, U. S. Department of Labor.

TABLE A-15

ORGANIC CHEMICAL INDUSTRY

SALES VALUE

($/lb)

	1963	1964	1965	1966	1967	1968	1969	1970	1971*
A. Basic Organic Chemicals	.040	.040	.038	.038	.036	.034	.032	.031	.031
1. Coal Derived Basics	.034	.035	.034	.035	.034	.035	.026	.026	.027
2. Petroleum Derived Basics	.042	.042	.039	.038	.036	.033	.034	.033	.032
B. Large Volume Intermediates and Finished Organics	.110	.102	.098	.094	.092	.084	.078	.076	.073
3. Resin Intermediates	.096	.087	.080	.082	.079	.072	.066	.061	.060
4. Fiber Intermediates	.110	.107	.101	.087	.085	.087	.090	.092	.093
5. Chlorinated Hydrocarbons	.117	.112	.113	.111	.107	.096	.082	.081	.082
6. Miscellaneous	.112	.103	.098	.096	.093	.085	.079	.077	.070
C. Small Volume Intermediates and End Products	.563	.564	.568	.592	.659	.666	.669	.685	.687
7. Dyes and Organic Pigments	1.43	1.63	1.69	1.78	1.82	1.88	1.98	1.90	2.00
8. Rubber Processing Chemicals**	67	.67	.64	.66	.66	.64	.63	.65	.65
9. Flavors and Fragrances**	1.15	1.05	.96	.94	.97	.89	.90	.97	1.25
10. Unformulated Pesticides**	.57	.62	.65	.71	.88	.88	.92	.99	1.03
11. Plasticizers**	.22	.21	.28	.21	.22	.23	.21	.19	.18
Weighted Average of Those Above	.107	.104	.099	.098	.100	.095	.086	.083	.086
D. Miscellaneous Intermediates									

* Preliminary

** As reported by the U. S. Tariff Commission

Source: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. production and sales.

The cost-price squeeze has, in general, come out of profits. While the level of capacity utilization is a major component of profitability, the average profitability of the basic chemical industry, which is the closest corresponding to the organic chemical industry (but which also includes inorganics, plastics, resins, fibers and fertilizers), has declined substantially since 1964, and the average in the sixties was substantially below those experienced in the 1950's. Table A-16 shows the profitability of the basic chemical industry since 1960.

Water Consumption by the Organic Chemical Industry

The data collected in connection with the 1967 Census of Manufactures on water usage in 1968, insofar as it relates to the organic chemical industry (i.e., SIC 2815 and 2818), is shown in Table A-17.

TABLE A-16

PROFITABILITY OF U. S. BASIC CHEMICAL INDUSTRY

Year	Net Sales ($ billion)	Net Profit [1] ($ billion)	Return on Equity [2] (percent)	Return on Total Capital [2] (percent)
1960	12.7	1.1	11.1	8.6
1961	13.0	1.1	10.5	8.2
1962	14.3	1.2	11.6	8.8
1963	15.8	1.3	12.5	9.2
1964	18.4	1.6	14.2	10.1
1965	20.9	1.7	14.3	9.7
1966	23.6	1.9	14.0	9.5
1967	24.4	1.6	10.9	7.3
1968	26.2	1.7	11.1	7.4
1969	27.1	1.6	10.5	7.0
1970	27.4	1.4	8.6	5.6
1971	29.5	1.5	8.7	5.8
1972	33.2	1.8	10.0	6.7

1) After tax.

2) Total capital employed = long-term debt (+ other nonrecurring liabilities) + stockholders' equity.

Rounding of profits, equity and total capital does not permit checking against above figures.

Source: Securities & Exchange Commission 1960-1972.

TABLE A-17

WATER USAGE, ORGANIC CHEMICAL INDUSTRY 1968

	Cyclic Intermediates and Crudes	Industrial Organic Chemicals, n.e.c.	Total
Value of shipments ($ million)	1,301.7	6,000.5	7,302.2
Value added ($ million)	611.0	3,386.9	3,997.9
Employees of those consuming water (thousands)	25.0	88.0	113.0
Water intake (billion gallons)	139.1	2,140.3	2,279.4
Of which treated prior to use (billion gallons)	16.8	172.3	189.1
Total used including recycled (billion gallons)	366	3,965	4,331
Water use (billion gallons)			
Process	19.3	394.0	413.3
Air conditioning	1.1	24.5	25.6
Steam electric power generation	0.8	483.8	484.6
Other cooling and condensing	107.0	1,180.1	1,287.1
Boiler feed, sanitary & misc.	11.0	57.9	68.9
Water discharged (billion gallons)	129.0	2,033.3	2,162.3
Of which treated prior to discharge	50	142	192
Water discharge, by point of discharge (billion gallons)			
Public utility sewer	4.7	39.2	43.9
Surface water body	56.9	860.4	917.3
Tidewater body	66.7	1,107.9	1,174.6
Ground	0.5	8.4	8.9
Transferred to other uses	0.2	17.4	17.6
	129.0	2,033.3	2,162.3

TABLE A-17 (continued)

WATER USAGE, ORGANIC CHEMICAL INDUSTRY 1968

	Cyclic Intermediates and Crudes	Industrial Organic Chemicals, n.e.c.	Total
Number of establishments treating water prior to recirculation or reuse			
Total establishments consuming water in industry	62	177	239
Total treating water	31	93	124
Of which:			
Aeration	4	14	18
Coagulation	1	8	9
Filtration	6	14	20
Softening	2	12	14
Ion exchange	3	10	13
Corrosion control	24	71	95
pH	19	60	79
Settling	2	15	17
Flotation	-	2	2
Other	4	14	18
Number of establishments treating water prior to discharge			
Total treating water	46	114	160
Of which:			
Coagulation	6	12	18
Settling - Primary	23	57	80
Settling - Secondary	8	21	29
Trickling filters	1	5	6
Activated sludge	7	13	20
Digestion	4	8	12
Ponds or lagoons	17	57	74
pH	29	63	92
Sand filtration	2	2	4
Chlorination	5	13	18
Flotation	10	24	34
Other	16	63	79

Source: 1967 Census of Manufactures, Water Use in Manufacturing MC67(1)-7

APPENDIX B

REGIONAL PLANT LOCATIONS FOR MAJOR ORGANIC CHEMICALS WITH POTENTIAL WATER POLLUTION PROBLEMS

Notes

1. Standard Metropolitan Statistical Areas (SMSA) including a group of cities (example: Allentown-Bethlehem-Easton, Pa. –N.J. SMSA) are listed by the name of the first city (e.g., Allentown SMSA).

2. When products are made in towns of two different states which belong to the same SMSA, the SMSA is repeated under all states concerned; the products are listed only under that state in which they are produced.

3. Products made in the same plant are joined by a vertical line.

4. Capacities, when available, are listed in parentheses in millions of pounds per year.

Sources

For organic chemical producers by location: *1973 Directory of Chemical Producers, United States of America,* Stanford Research Institute, Menlo Park, California.

For organic chemical producers by location: *Chemical Economics Handbook,* Stanford Research Institute, Menlo Park, California.

For town/city locations by county: *Directory of Post Offices,* United States Postal Service, July 1971.

For SMSA and county components: *Standard Metropolitan Statistical Areas,* Executive Office of the President, Bureau of the Budget, 1967.

KEY TO ABBREVIATIONS OF CHEMICAL PRODUCTS

Abbreviations	Chemicals[1]
AcAc	Acetic Acid
AcAn	Acetic Anhydride
Acet	Acetone
Aceth	Acetaldehyde
Acryl	Acrylonitrile
Adip	Adipic Acid
Anil	Aniline
Anth	Anthracene
Bis A	Bisphenol A
Cap	Caprolactam
CP	Coal Tar Acids Coal Tar Crudes Coal Tar Distillates Pitch Tar
CRE	Creosote
Cresyl	Cresylic Acid
CRL	Cresols
DMT	Dimethyl Terephthalate
D & P	Dyes & Organic Pigments
EC	Ethyl Cellulose
EDC	Ethylene Dichloride
EG	Ethylene Glycol
EO	Ethyl Oxide
EtAcr	Ethyl Acrylates
EtOH	Ethanol
F & F	Flavors & Fragrances
Isc	Isocyanates
Isp	Isopropanol
MEK	Methyl Ethyl Ketone
MMC	Methyl Methacrylates
MeOH	Methanol-Synthetic
Nap	Naphthalene
Naphtha	Naphtha Solvents
OXO	Oxo Chemicals
P-CRL	Para-Cresols
Pent	Pentaerythritol
Pest	Unformulated Pesticides
Ph	Phenol
PG	Propylene Glycol
Pl	Plasticizers

KEY TO ABBREVIATIONS OF CHEMICAL PRODUCTS (Continued)

Abbreviations	Chemicals[1]
PO	Propylene Oxide
RP	Rubber Processing Chemicals
TEL	Tetraethyl Lead
VAM	Vinyl Acetate Monomer
VCM	Vinyl Chloride Monomer

1. From Table 2.

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

NEW ENGLAND STATES

	Connecticut					Maine	Massachusetts				Rhode Island
	Bridgeport SMSA	New Haven SMSA	New London SMSA	Waterbury SMSA	Non-SMSA Area	Non-SMSA Area	Boston SMSA	Fall River SMSA	Springfield SMSA	Non-SMSA Area	Providence SMSA
American Hoechst Corporation											D & P
Benzenoid Organics, Inc.										D & P	
Childs Pulp Colors, Inc.									D & P		
Hampden Color & Chemical Company									D & P		
The Humphrey Chemical Company		RP									
I C I America Inc.										RP D & P	
Monsanto Company							P1			Pest	
Nyanza Inc.							D & P				
Pfizer Inc.			F & F								
Sobin Chemicals, Inc.						Pest					
Solvent Chemical Company, Inc.							Pest				
Stepan Chemical Company										RP	
Teknor Apex Company											P1
Uniroyal, Inc.				Pest RP Anil							
United Merchants & Manufacturers, Inc.								D & P			
R. T. Vanderbilt Company, Inc.					RP Pest						
Westville Chemical Corporation	RP										
Woonsocket Color & Chemical Company											Pest

Capacities listed in parenthesis when available in millions of pounds per year.

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID-ATLANTIC STATES

	New Jersey							New York						Pennsylvania						
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
Acetic Chemical Co., Inc.				F & P RP																
Akzona Incorporated																PI				
Allan Wood Steel Co.																CP Naphtha				
Alco Standard Corporation																F & P			Peat	
Allied Chemical Corporation				D & P					CP D & P			CP Peat				Acet(270) Ph(300) F & P Acet				
Amchem Products, Inc.																Peat				
American Aniline Products, Inc.																				D & P
American Cyanamid Company			RP Peat				RP Anil(80) D & P Peat													
American Polymers, Inc.				EC			Peat													
Ashland Chemical Company	Peat						RP													
Atlantic Chemical Industries, Inc.			D & P																	
Baychem Corporation		D & P																		
Berncolors-Poughkeepsie, Inc.													D & P							
Bethlehem Steel Corporation									Cr					CP	CP Naphtha					
Blue Spruce Company							Peat													
Borden Inc.													Peat							
Celanese Corporation			Peat																	
Chase Chemical Corporation																				
Chem-Fleur, Inc.			F & P																	
Chempar Chemical Co., Inc.													Peat							
Chevron Chemical Company							Peat													
Ciba-Geigy Corporation		D & P	Peat																	
Cincinnati Milacron, Inc.							PI Peat													
W. A. Cleary Corporation							RP Peat													

1) Pennsylvania share of Allentown SMSA is listed under Pennsylvania; New Jersey share under New Jersey.
2) Pennsylvania share of Philadelphia SMSA is listed under Pennsylvania; New Jersey share under New Jersey.
3) See Delaware for Delaware share of Wilmington SMSA.

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID-ATLANTIC STATES (Continued)

	New Jersey							New York						Pennsylvania						
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[2] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
Cloray NJ Corp.			F & F																	
Commercial Solvents Corp.														Past Pent(20)						
Continental Oil Company			RP																	
Cosan Chemical Corporation				Past																
Crompton & Knowles Corp.																		D & P D & P		
Diamond Shamrock Chemical Co.		P1																		
Donner-Hanna Coke Corporation									CP											
E. I. du Pont de Nemours & Co., Inc.			Past		DMT(280) Anil(135) RP Past	Ino(120) RP D & P														
Dye Specialties, Inc.		D & P																		
Eastern Gas and Fuel Associates																CP				
Eastman Kodak Company											RP P1									
Emkay Chemical Company			P1																	
Evans Chemetics, Inc.													F & F							
Exxon Corporation			Acet(120) MEK(210)																	
Fabricolor Manufacturing Corp.				D & P																
Fairmount Chemical Co., Inc.				F & F RP																
Felton International Inc.										F & F										
Filo Color and Chemical Corp.			Past P1																	
Fine Organics, Inc.				RP																
FMC Corporation									Past RP											AcAn(60)
Foster-Heaton Company				D & P																
Fritzsche Dodge & Olcott Inc.			Past F & F																	
GAF Corporation		D & P Past		D & P				D & P F & F												
Gane's Chemical Works, Inc.				Past																
Givaudan Corporation				F & F P1																P1
Glyco Chemicals, Inc.																				
The Goodyear Tire & Rubber Co.									RP											

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID-ATLANTIC STATES (Continued)

	New Jersey							New York						Pennsylvania						
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
W. R. Grace & Co.							Pl													
Guardian Chemical Corporation										RP										
Hercules Incorporated					DMT(75) Pest P-CRL								Pest D & P							
Hoffmann-La Roche Inc.			F & F																	
Hooker Chemical Corporation									Pest RP Pest	Pl										
E. F. Houghton & Company																Pl				
Hummel Chemical Company, Inc.							F & F													
Inmont Corporation				D & P																
International Flavors & Fragrances, Inc.							F & F													
Jones & Laughlin Steel Corporation																	CP Naphtha CP			
Kay-Fries Chemicals Inc.										Pl										
Kenrich Petrochemicals, Inc.		RP																	D & P	
Keystone Color Works, Inc.																				
H. Kohnstamm & Co., Inc.					D & P					D & P										F & F
Koppers Company, Inc.		CP														D & P				
C. Lever Company, Inc.																				RP
Lord Corporation																				
MacAndrews & Forbes Co.					F & F															
MacKenzie Chemical Works, Inc.										Pest										
Magruder Color Company, Inc.			D & P																	
Mallinckrodt Chemical Works		Pest																		
Max Marx Color and Chemical Company			D & P																	
Otto B. May, Inc.			D & P																	Pest
Merck & Co., Inc.				Pest																
Millmaster Onyx Corporation			RP F & F Pest Pl	RP			Pl													
Mobil Oil Corporation							Pl													
Monsanto Company					Pl					F & F										

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID-ATLANTIC STATES (Continued)

	New Jersey							New York						Pennsylvania						
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
Mooney Chemicals, Inc.																				Pest
Morton-Norwich Products, Inc.				D & F																
Motomco, Incorporated			Pest																	
Nease Chemical Company, Inc.																				Pest
Neville Chemical Company																	Pl RP F & F			
N L Industries, Inc.		F & F Pl																		
Norda Inc.			F & F F & F																	
Olin Corporation											Pest									
Orbis Products Corporation			F & F																	
Passaic Color & Chemical Co.				D & F																
S. B. Penick & Company			F & F Pest	Pl Pest																
Pfizer Inc.										Pl										
Phelps Dodge Corporation										Pest										
Polak's Frutal Works													F & F							
Polychemical Laboratories, Inc.										F & F										
Prentiss Drug & Chemical Co., Inc.			Pest																	
Publicker Industries Inc.																AcAc(80) Acet(35) Acrnl(70) EtOH(400) F & F				
PVO International, Inc.			Pl F & F																	
Reichhold Chemicals, Inc.			Pl				Pl													
Rhodia Inc.							F & F													
The Richardson Company				RP																
Richardson-Merrell, Inc.	F & F Pl Pest																			
Robinson-Wagner Company, Inc.										Pl										

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID-ATLANTIC STATES (Continued)

	New Jersey							New York						Pennsylvania						
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
Rohm and Haas Company																Pl MMC(60) Pest Pest				
Royce Chemical Company				Pest																
R.S.A. Corporation										F & F										
Sandoz-Wander, Inc.				Pest Pest																
Scher Brothers, Inc.				Pl F & F																
Shenango Incorporated																	CP			
Sobin Chemicals, Inc.			Pl F & F Pest																	
Southern California Chemical Co., Inc.							Pest													
Standard Chlorine Chemical Co., Inc.	Pest Nap																			
Stauffer Chemical Company							F & F			Pest										
Stepan Chemical Company				F & F				Pest												
Sterling Drug Inc.			D & P							D & P										
Sun Chemical Corporation																				
Sybron Corporation				F & F Pl Pest	RP													D & P		
Tenneco Chemicals, Inc.			RP Pest D & P	Pest F & F			Pest F & F													
Toms River Chemical Corporation							D & P													
Troy Chemical Corporation			Pest							D & P										
Paul Uhlich & Company																				
Ungerer & Company, Inc.				F & F																
Union Carbide Corporation							F & F Acet(50) Ph(150) Pest													

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID-ATLANTIC STATES (Continued)

	New Jersey							New York						Pennsylvania							
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
United States Steel Corporation																CP	Pl CP CRE Nap Cresyl(20) Ph CP CRE Naphtha			
Universal Oil Products Company				F & P																
Ventron Corporation				RF Pest																
Vineland Chemical Company							Pest													
West Chemical Products Inc.																	Pest			
Wheeling-Pittsburgh Steel Corp.																	CP			
White Chemical Corporation	Pl Pest																			
Whittaker Corporation		Pest																		
Wilson Pharmaceutical & Chemical Corp.																F1				
Witco Chemical Corporation										Pl										

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

SOUTH ATLANTIC STATES – Part A

	Delaware	Maryland		Virginia		West Virginia				
	Wilmington[1] SMSA	Baltimore SMSA	Non-SMSA Area	Norfolk SMSA	Non-SMSA Area	Charleston SMSA	Huntington[2] SMSA	Steubenville SMSA	Wheeling SMSA	Non-SMSA Area
Alco Standard Corporation		Pest								
Allied Chemical Corporation		Pest			Adip(20) Cap(330) Pest				RP	
American Cyanamid Company										Anil(40) D & P
Antox, Incorporated								RP		
Bethlehem Steel Corporation		CP Naphtha Pest								
Borg-Warner Corporation										RP
Celanese Corporation			AcAn		AcAn					
Chemical Formulators, Inc.						Pest				
Chemetron Corporation							D & P			
E. I. du Pont de Nemours & Company, Inc.						MMC F & F Pest				
Fike Chemicals, Inc.						Pest RP				
FMC Corporation		Pest				Pl				
Getty Oil Company	OXO(40)									
Hercules Incorporated					EC(25)					
I C I America Inc.	EG(10)									
Koppers Company, Inc.								Nap Cresyl(60) Ph		
Mobay Chemical Company										RP Isc(200) Anil(100)
Monsanto Company						Pest RP				
National Steel Corporation								CP		
Sharon Steel Corporation										CP
Standard Chlorine Chemical Co., Inc.	Pest Nap									

1) See New Jersey for New Jersey share of Wilmington SMSA
2) See Kentucky and Ohio for their shares of the Huntington-Ashland SMSA

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

SOUTH ATLANTIC STATES – Part A (Continued)

	Delaware	Maryland		Virginia		West Virginia				
	Wilmington[1] SMSA	Baltimore SMSA	Non-SMSA Area	Norfolk SMSA	Non-SMSA Area	Charleston SMSA	Huntington[2] SMSA	Steubenville SMSA	Wheeling SMSA	Non-SMSA Area
Stauffer Chemical Company										P1
Sun Olin Chemical Company	EO(100)									
Tenneco Chemicals, Inc.			P1							
Union Carbide Corporation						Aceth(400) Isc(55) PG(80) Acet(150) OXO P1 RP F & F Pest				
Virginia Chemicals Inc.				Pest						
Wheeling-Pittsburgh Steel Corporation								CP		
Witco Chemical Corporation	Pest									
The J. S. Young Company		D & P								

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

SOUTH ATLANTIC STATES – Part B

	Florida					Georgia			North Carolina						South Carolina	
	Jacksonville SMSA	Miami SMSA	Orlando SMSA	Pensacola SMSA	Non-SMSA Area	Augusta SMSA	Macon SMSA	Non-SMSA Area	Charlotte SMSA	Fayetteville SMSA	Greensboro SMSA	Raleigh SMSA	Wilmington SMSA	Non-SMSA Area	Charleston SMSA	Non-SMSA Area
Air Products and Chemicals, Inc.				MeOH(50)												
American Hoechst Corporation																DMT(140)
Arizona Chemical Company					F & F											
Borden Inc.										Pest						
Carochem Corporation								F & F								
Celanese Corporation								AcAn								Pest AcAn
Chemical Products Corporation								Pest								
Chemol, Incorporated											Pl					
Chevron Chemical Company			Pest													
Cindet Chemicals, Inc.											Pl F & F					
Comutrix Corporation			Pest													
Cyclo Chemicals Corporation		Pl														
Diamond Shamrock Chemical Company								Pl	Pl							
E. I. du Pont de Nemours & Company, Inc.											Pest					
Florida Chemical Company, Inc.					F & F											
Henkel Inc.									Pl							
Hercules Incorporated								F & F Pest					Pest DMT(600)			
Kewanee Oil Company														D & P		
Mallinckrodt Chemical Works												Pest				
Martin Marietta Corporation									RP D & P							
McLaughlin Gormley King Company																Pest F & F
Mobil Oil Corporation																Pest
Monsanto Company				Adip(540)												
National Starch and Chemical Corporation														Pl		
Nipro, Inc.						Cap(160)										
PCR, Incorporated					Pest											
Pfizer Inc.											Pest Pl F & F					

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

SOUTH ATLANTIC STATES – Part B (Continued)

	Florida					Georgia			North Carolina						South Carolina	
	Jacksonville SMSA	Miami SMSA	Orlando SMSA	Pensacola SMSA	Non-SMSA Area	Augusta SMSA	Macon SMSA	Non-SMSA Area	Charlotte SMSA	Fayetteville SMSA	Greensboro SMSA	Raleigh SMSA	Wilmington SMSA	Non-SMSA Area	Charleston SMSA	Non-SMSA Area
Reichhold Chemicals, Inc.								Pest	Pest							Pest
SCM Corporation	F & P															
Sonoco Products Company																AcAc
Sun Chemical Corporation																Pest
Synalloy Corporation															F & P D & P	
Tenneco Chemicals, Inc.				F & P												
Triangle Chemical Company							Pest									
Union Camp Corporation	F & P															
Uniroyal, Inc.														Pest		
Woolfolk Chemical Works, Ltd.								Pest								
BASF Wyandotte Corporation									D & P							

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST NORTH CENTRAL STATES – Part A

	Illinois				Indiana				Michigan					Wisconsin	
	Chicago SMSA	Peoria SMSA	St. Louis[1] SMSA	Non-SMSA Area	Gary SMSA	Indianapolis SMSA	Terre Haute SMSA	Non-SMSA Area	Detroit SMSA	Grand Rapids SMSA	Kalamazoo SMSA	Muskegon SMSA	Non-SMSA Area	Milwaukee SMSA	Non-SMSA Area
Abbott Laboratories	F & F Pest														
Akzona Incorporated	F & F														
Aldrich Chemical Company, Inc.														Pest F & F	
Allied Chemical Corporation									Nap(200) CP						
American Bio-Synthetics Corporation														F & F	
The Ansul Company															F & F Pest
Ashland Chemical Company		Pl													
Borden Inc.															Pest
Chemetron Corporation										D & P					
Citizens Gas & Coke Utility						CP									
Clark Oil & Refining Corporation	F & F Acet(25) Ph(75)														
Commercial Solvents Corporation							F & F Pl EtOH Acet								
Cosden Oil & Chemical Company	Pest														
Crucible Steel Co. of America													CP		
Diamond Shamrock Corporation														CP	
Dow Chemical U.S.A.													Pl F & F RP Ph(100) Pest		
E. I. du Pont de Nemours & Company, Inc.					Pest										
Farmers Chemical Company											F & F				
Florasynth Inc.	F & F														
Ford Motor Company									CP						
General Electric Company								Bis A(60)							

[1] See Missouri for Missouri share of St. Louis SMSA

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST NORTH CENTRAL STATES – Part A (Continued)

	Illinois				Indiana				Michigan					Wisconsin	
	Chicago SMSA	Peoria SMSA	St. Louis[1] SMSA	Non-SMSA Area	Gary SMSA	Indianapolis SMSA	Terre Haute SMSA	Non-SMSA Area	Detroit SMSA	Grand Rapids SMSA	Kalamazoo SMSA	Muskegon SMSA	Non-SMSA Area	Milwaukee SMSA	Non-SMSA Area
General Motors Corp.	CP														
Glenn Chemical Company, Inc.	Pest														
The B. F. Goodrich Company				RP											
Granite City Steel Corp.			CP												
Great Lakes Carbon Corporation									CP						
Guardsman Chemical Coatings, Inc.									P1						
The C. P. Hall Company	P1 F & F														
Indiana Gas & Chemical Corporation							CP								
Industrial Color Inc.	D & P														
Inland Steel Company					CP										
Interlake, Inc.	Nap CP														
International Harvester Company	P														
Kingsford Chemical Company													AcAc		
Koppers Company, Inc.	Nap														
Lachat Chemicals Inc.	F & F RP														
Lawter Chemicals, Inc.	Pest														
Eli Lilly and Company						Pest		Pest							
Lonza Inc.		Pest													
Lowe's, Inc.				Pest											
Michigan Chemical Corporation													Pest		
Miles Laboratories, Incorporated										RP					
Monsanto Company			Pest P1 RP												
Morton-Norwich Products, Inc.	F & F														
National Distillers and Chemical Corporation				EtOH(450)											

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST NORTH CENTRAL STATES – Part A (Continued)

	Illinois				Indiana				Michigan					Wisconsin	
	Chicago SMSA	Peoria SMSA	St. Louis[1] SMSA	Non-SMSA Area	Gary SMSA	Indianapolis SMSA	Terre Haute SMSA	Non-SMSA Area	Detroit SMSA	Grand Rapids SMSA	Kalamazoo SMSA	Muskegon SMSA	Non-SMSA Area	Milwaukee SMSA	Non-SMSA Area
National Steel Corporation			Nap(<2)						Nap						
Nor-Am Agricultural Products, Inc.	Pest														
Northern Natural Gas Company	EO(240) EG(300)														
Olin Corporation	Pest														
Pennwalt Corporation									RP Pest						
PPG Industries, Inc.															Pest
Reilly Tar & Chemical Corporation			Nap												
Republic Steel Corporation	Nap CP Naphtha														
Riverdale Chemical Company	Pest														
The Sherwin-Williams Co.	P1 P-CRL														
Southern California Chemical Co., Inc.	Pest														
Standard Oil Company (Indiana)	DMT(100)														
Stange Co.	D & P														
Sterling Drug Inc.															F & F
Story Chemical Corporation												Isc(neg)			
Su Crest Corporation	P1														
Union Carbide Corporation					Isp(330) Acet(110)										
United States Steel Corporation					Nap CP Naphtha										
Universal Oil Products Company	RP														
Velsicol Chemical Corporation				Pest											
Warner-Lambert Company										F & F					
Witco Chemical Corporation	Pest P1														
Wm. Wrigley Jr. Company	F & F														
BASF Wyandotte Corporation									PO(160)						
Youngstown Sheet & Tube Co.					CP										

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST NORTH CENTRAL STATES – Part B

	Ohio										
	Akron SMSA	Canton SMSA	Cincinnati SMSA	Cleveland SMSA	Hamilton SMSA	Huntington[1] SMSA	Lima SMSA	Lorain SMSA	Toledo SMSA	Youngstown SMSA	Non-SMSA Area
Allied Chemical Corporation						CP Pl					
American Cyanamid Company											D & P RP
Armco Steel Corporation					CP Nap CP						
Chevron Chemical Company				Pest							
Cincinnati Milacron, Inc.			D & P Pest								
Cities Service Company, Incorporated			D & P								
Detroit Steel Corp.											CP CRE
Diamond Shamrock Corporation				CP							
Dover Chemical Corporation											Pest
E. I. du Pont de Nemours & Company, Inc.				RP					Pest		
Emery Industries, Inc.			Pl								
Ferro Corporation				Pest							
The General Tire & Rubber Company	RP										Isc(40)
The Goodyear Tire & Rubber Company	RP										
The B. F. Goodrich Company	RP							Pl			
Interlake, Inc.									Nap CP		
Kewanee Oil Company				Nap Anth Pest				Nap Anth Pest			
Monsanto Company			Pest								
Nease Chemical Company, Inc.											Pest
Pan American Chemical Corporation									Pent(25)		
PPG Industries, Inc.	Pest										
The Procter & Gamble Company			F & F								
Reilly Tar & Chemical Corporation				Nap							
Republic Steel Corporation		CP		Nap CP						Nap CP	
										Nap CP Naphtha	

[1] See Kentucky and West Virginia for their share of Huntington-Ashland SMSA

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST NORTH CENTRAL STATES – Part B (Continued)

	Ohio										
	Akron SMSA	Canton SMSA	Cincinnati SMSA	Cleveland SMSA	Hamilton SMSA	Huntington[1] SMSA	Lima SMSA	Lorain SMSA	Toledo SMSA	Youngstown SMSA	Non-SMSA Area
The Shepherd Chemical Company			Pest								
The Sherwin-Williams Co.			F & F								
The Standard Oil Company (Ohio)							Acryl(350) Pest				
Stauffer Chemical Company				Pest							
Sterling Drug Inc.			D & P								
Sun Chemical Corporation			D & P								
Union Camp Corporation											PI F & F
Union Carbide Corporation											Bis A(40)
Uniroyal, Inc.				VCM							
United States Steel Corporation											Acet(130) Ph(215) OXO(70)
Youngstown Sheet & Tube Co.										CP	

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

WEST NORTH CENTRAL STATES

	Iowa	Kansas			Minnesota		Missouri			
	Non-SMSA Area	Kansas City[1] SMSA	Wichita SMSA	Non-SMSA Area	Duluth Superior SMSA	Minneapolis St. Paul SMSA	Kansas City[2] SMSA	St. Joseph SMSA	St. Louis[3] SMSA	Non-SMSA Area
Ansbhem Products, Inc.	Pest							Pest		
Chemagro Corporation							Pest			
Chevron Chemical Company	Pest								Pest	
Gordon Corporation		Pest								
Grain Processing Corp.	EtOH									
Gulf Oil Corporation				Pest						
Hercules Incorporated										Pest Pent(40) Pl
Imperial, Inc.	Pest									
Koppers Company, Inc.						CP				
Mallinckrodt Chemical Works									Pest	
Monsanto Company	Pest								Pl F & P	
McLaughlin Gormley King Co.						Pest				
North Eastern Pharmaceutical & Chemical Company										Pest
The Procter & Gamble Company		F & P								
Reichhold Chemicals, Inc.		Pest								
Rhodia Inc.						Pest	Pest	Pest		
Skelly Oil Company			F & P Acet(30) Ph(50)							
Thompson Chemicals Corp.									Pest	
Thompson-Hayward Chemical Co.		Pest								
United States Steel Corporation					CP					
Vulcan Materials Company			Pest							
Warner-Jenkinson Company									D & P	

1) See Missouri for Missouri share of Kansas City SMSA
2) See Kansas for Kansas share of Kansas City SMSA
3) See Illinois for Illinois share of St. Louis SMSA

Capacities listed in parenthesis when available in millions of pounds per year.

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST SOUTH CENTRAL STATES

	Alabama					Kentucky			Mississippi	Tennessee				
	Birmingham SMSA	Gadsden SMSA	Mobile SMSA	Tuscaloosa SMSA	Non-SMSA Area	Huntington[1] SMSA	Louisville SMSA	Non-SMSA Area	Non-SMSA Area	Chattanooga SMSA	Knoxville SMSA	Memphis SMSA	Nashville SMSA	Non-SMSA Area
Alabama By-products Corporation	CP Naphtha													
Alco Standard Corporation										RP				
Allied Chemical Corporation						CP								
American Can Company								Pest						
Borden Inc.					Pest		Pest							
Buckman Laboratories, Inc.												RP		
Chemetron Corporation														RP
Ciba-Geigy Corporation					Pest D & P									
Commercial Chemical Company												Pest		
Continental Oil Company									P1					
E. I. du Pont de Nemours & Company, Inc.							Aceth(10)					Pest MMC(120) Acryl(180)	DMT(230)	
Eastman Kodak Company														AcAc DMT(325) AcAn(600) Acet(80) MEK P1 F & F RP Pest D & P
Empire Coke Company				CP										
First Mississippi Corporation									Pest Anil(70)					
Forest Products Chemical Company												AcAc		
GAF Corporation								D & P Pest						
The B. F. Goodrich Company								Pest VCM(1000) EDC(900)						
Gulf Oil Corporation									Pest					
Hercules Incorporated									Pest					
Kerr-McGee Corporation									Pest					
Kewanee Oil Company							D & P							

1) See West Virginia and Ohio for their share of Huntington-Ashland SMSA

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST SOUTH CENTRAL STATES (Continued)

	Alabama					Kentucky			Mississippi	Tennessee				
	Birmingham SMSA	Gadsden SMSA	Mobile SMSA	Tuscaloosa SMSA	Non-SMSA Area	Huntington[1] SMSA	Louisville SMSA	Non-SMSA Area	Non-SMSA Area	Chattanooga SMSA	Knoxville SMSA	Memphis SMSA	Nashville SMSA	Non-SMSA Area
The Mead Corporation	Nap (<2)													
Mobil Oil Corporation														Past
Monsanto Company					Past									
Olin Corporation					Past			EO(110) EG(50) PO(130) PG(45) Past						
Reichhold Chemicals, Inc.				Past Pent(12) Ph(135)										
Republic Steel Corporation	Nap CP Naphtha	Nap CP Naphtha												
Rohm and Haas Company							MMC				P1 MMC			
Shell Chemical Company			Past											
Standard Oil Company (Indiana)					DMT(180)									
Stauffer Chemical Company			Past				Past							Past
Thiokol Chemical Corporation									P1					
Tull Chemical Company, Inc.					Past									
United States Pipe & Foundry Company	CP													
United States Steel Corporation	Nap CP CRE													
R. T. Vanderbilt Company, Inc.								RP						
Velsicol Chemical Corporation										Past F & F P1		Past		
Witco Chemical Corporation			Past											
Woodward Iron Company	CP Naphtha									CP Naphtha				

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

WEST SOUTH CENTRAL STATES

	Arkansas	Louisiana					Texas								
	Non-SMSA Area	Baton Rouge SMSA	Lake Charles SMSA	Monroe SMSA	New Orleans SMSA	Non-SMSA Area	Beaumont SMSA	Brownsville SMSA	Corpus Christi SMSA	Dallas SMSA	El Paso SMSA	Galveston SMSA	Houston SMSA	Odessa SMSA	Non-SMSA Area
Allied Chemical Corporation		Pest F & F VCM(300) EDC(650)													
American Cyanamid Company					MMC(80) Acryl(175) Pest										
The Ansul Company	Pest														
Armco Steel Corporation													CP		
Atlantic Richfield Company													Isp(50) MEK(50)		
Borden Inc.						VA(150) MeOH(160) AcAc(115)									Pest
Bromet Company	Pest														
Calcasieu Chemical Corporation			EO(165) EG(180)												
Celanese Corporation									F & F MeOH(90) Pent(50) Aceth(240) AcAc(100) EG(5) PO(10) PG(10) Acet(35) Pest				VAM(350) MeOH(200) Aceth(500) AcAc(300) EO(300) EG(300)		F & F VAM(300) Adip(125) Aceth(250) EtAcr VAM Aceth(10) AcAc(550) AcAn MEK(115)
Ciba-Geigy Corporation						Pest									
Commercial Solvents Corporation				Pest MeOH(50)											
Continental Oil Company			Pest F & F VCM(600) EDC(1000)												
Crowley Tar Products Company, Inc.													CRL Cresyl		
Diamond Shamrock Chemical Company													Pest EDC(260) Pest		
Dixie Chemical Company													EG Acet(24) MEK		

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

WEST SOUTH CENTRAL STATES (Continued)

	Arkansas	Louisiana					Texas								
	Non-SMSA Area	Baton Rouge SMSA	Lake Charles SMSA	Monroe SMSA	New Orleans SMSA	Non-SMSA Area	Beaumont SMSA	Brownsville SMSA	Corpus Christi SMSA	Dallas SMSA	El Paso SMSA	Galveston SMSA	Houston SMSA	Odessa SMSA	Non-SMSA Area
Dow Badische Company													F & F EtAcr Cap(250) OXO(200)		
Dow Chemical U.S.A.	Pest					VCM(390) EDC(1160) EO(400) EG(470) PO(200) PG(100) Pest							Bis A(100) PO(700) VCM(200) EDC(1100) EO(200) EG(240) PG(150) Pest		
													VCM(700) EDC(1000) Acet(240) Ph(400) Pest		
E. I. du Pont de Nemours & Company, Inc.						Pest	Pest Acryl(200) MeOH(200) Anil(200)						Pest VAM(300) RP		Adip(300) Pest
							Adip(300) MeOH(115)								
Eastman Kodak Company															Aceth(500) EtOH(165) EO(60) EG(75) Isp OXO(275) F & F Pl
El Paso Natural Gas Company														Adip(80) F & F Pl	
Ethyl Corporation		Pest VCM(325) EDC(550) TEL											VCM(150) EDC(260) Pest TEL		
Exxon Corporation		Pl EtOH(400) Isp(680) OXO(200)													
FMC Corporation													Pest AcAc(40)		
GAF Corporation												Pest			

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

WEST SOUTH CENTRAL STATES (Continued)

	Arkansas	Louisiana					Texas								
	Non-SMSA Area	Baton Rouge SMSA	Lake Charles SMSA	Monroe SMSA	New Orleans SMSA	Non-SMSA Area	Beaumont SMSA	Brownsville SMSA	Corpus Christi SMSA	Dallas SMSA	El Paso SMSA	Galveston SMSA	Houston SMSA	Odessa SMSA	Non-SMSA Area
Georgia-Pacific Corporation						MeOH(100) Acet(120) Ph(200)									
The Goodyear Tire & Rubber Company													RP		
Great Lakes Chemical Corp.	Pest														
Hercules Incorporated						MeOH(80) Pest									
Jefferson Chemical Company, Inc.							Pest EDC(70) EO(500) EG(360) PO(160) PG(50)								
Kennecott Copper Corporation													Pest		
Koch Industries, Inc.							EO(50) EG(40)								
Lone Star Steel Company															CP Naphtha
The Merichem Company													Ph		
Michigan Chemical Corp.	Pest														
Mobay Chemical Company													Isc(150)		
Mobil Oil Corporation							AcAc(30)								
Monochem, Inc.						VCM(300)									
Monsanto Company						Adip(50) Pest						AcAc(300) MeOH(100) Aceth(5) OXO(150) Pl	Acryl(370) Acet(240) Ph(375) Pest		
National Distillers and Chemical Corporation													VAM(300)		
National Starch and Chemical Corporation															VAM(60)
Olin Corporation			RP										Pest PO(500) PG(180) Acet(60)		
Pennwalt Corporation													RP		Pest
Phelps Dodge Corporation											Pest				
Phillips Petroleum Company											F & F RP				

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

WEST SOUTH CENTRAL STATES (Continued)

	Arkansas	Louisiana				Texas								
	Non-SMSA Area	Baton Rouge SMSA	Lake Charles SMSA	Monroe SMSA	New Orleans SMSA	Non-SMSA Area	Beaumont SMSA	Brownsville SMSA	Corpus Christi SMSA	Dallas SMSA	El Paso SMSA	Galveston SMSA	Houston SMSA	Odessa SMSA	Non-SMSA Area
PPG Industries, Inc.			VCM(400) EDC(1000) Pest				EO(85) EG(100) TEL(100) Pest								
Publicker Industries Inc.					EtOH EtOH										
Reichhold Chemicals, Inc.													Pest		
Rohm and Haas Company													Pest EthAcr MMC(400) MeOH(22)		
Rubicon Chemicals Inc.						Isc(110) Anil(52) Pest RP									
Shell Chemical Company						Aceth(5) Acet(100) MEK(50) Pest EO(300) EG(100) OXO(150)							VCM(840) EDC(1200) EtOH(265) Isp(610) Acet(430) MEK(100) Ph(60) Bis A(150) OXO(200) Pest F & F		
The Signal Companies, Inc.													Acet		
Sonford Chemical Company							Pest								
Southern California Chemical Co., Inc.										Pest					
Tenneco Chemicals, Inc.													VCM(225) MeOH(80)		
Thompson-Hayward Chemical Company					Pest										
Union Carbide Corporation						EtAcr EDC(150) EO(450) EG(530) AcAc(90) Pest Pl		AcAn MEK(75) AcAc(540)				VAM(245) EDC(150) EtOH(660) Isp(570) Acet(110) OXO(200) Pest F & F			EO(730) EG(530) OXO(200) F & F
Uniroyal, Inc.						RP Pest									
The Upjohn Company													Isc(200)		

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

WEST SOUTH CENTRAL STATES (Continued)

	Arkansas	Louisiana				Texas								
	Non-SMSA Area	Baton Rouge SMSA	Lake Charles SMSA	Monroe SMSA	New Orleans SMSA	Non-SMSA Area	Beaumont SMSA	Brownsville SMSA	Corpus Christi SMSA	Dallas SMSA	El Paso SMSA	Galveston SMSA	Houston SMSA	Odessa SMSA	Non-SMSA Area
Velsicol Chemical Corporation													Pest		
Vulcan Materials Company						EDC(240) Pest									
Witco Chemical Corporation						Pest									
BASF Wyandotte Corporation						EO(175) EG(150) Isc(40)									
Wright Chemical Corporation	Pest														

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MOUNTAIN STATES

	Colorado			Idaho	Nevada	Montana		Utah	
	Denver SMSA	Pueblo SMSA	Non-SMSA Area	Other SMSA	Las Vegas SMSA	Great Falls SMSA	Non-SMSA Area	Provo-Orem SMSA	Salt Lake City SMSA
Alpha Laboratories Inc.	Pest								
American Smelting and Refining Co.	Pest								
The Anaconda Company						Pest			
Borden Inc.							Pest		
CF&I Steel Corporation		Nap(L2)							
Great Western Sugar Company			F & F						
Shell Chemical Company	Pest								
Stauffer Chemical Company					Pest RP				
Syntex Corporation	Pest F & F								
United States Steel Corporation								CP	
VWR United Corporation				Pest					Pest

Capacities listed in parenthesis when available in millions of pounds per year.

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

PACIFIC STATES

	California							Oregon			Washington		
	Anaheim SMSA	Los Angeles SMSA	Sacramento SMSA	San Bernardino SMSA	San Francisco SMSA	San Jose SMSA	Non-SMSA Area	Eugene SMSA	Portland SMSA	Non-SMSA Area	Seattle SMSA	Tacoma SMSA	Non-SMSA Area
Amchem Products, Inc.					Pest								
American Chemical Corporation		VCM(175) EDC(325) Pest											
Borden Inc.					Pest			Pest		Pest	Pest		
Chempar Chemical Co., Inc.									Pest				
Chevron Chemical Company					Acet(30) Ph(55) Pest								
Diamond Shamrock Chemical Company					Pl F & F								
Dow Chemical U.S.A.					Pest								
E. I. du Pont de Nemours & Company, Inc.					TEL(340)								
Georgia-Pacific Corporation													Eth
E. F. Houghton & Company					Pl								
Imperial West Chemical Company					Pest								
Kaiser Steel Corporation				Ph CP									
Kalama Chemical Inc.													F & F Ph(55)
Kerr-McGee Chemical Corp.		Pest											
Liquid Chemical Corp.							Pest						
Los Angeles Chemical Company		Pest											
Mobil Oil Corporation		Pest											
Monsanto Company								Pest			F & F		
Montrose Chemical Corporation of California		Pest											
Neville Chemical Company	Pl												
Niklor Chemical Company, Inc.		Pest											
Pennwalt Corporation									Pest				
The Procter & Gamble Company			F & F										
Productol Chemical Company		Ph RP											
Reichhold Chemicals, Inc.										Pest Pest		Pest	
Rhodia Inc.									Pest				

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

PACIFIC STATES (Continued)

	California							Oregon			Washington		
	Anaheim SMSA	Los Angeles SMSA	Sacramento SMSA	San Bernardino SMSA	San Francisco SMSA	San Jose SMSA	Non-SMSA Area	Eugene SMSA	Portland SMSA	Non-SMSA Area	Seattle SMSA	Tacoma SMSA	Non-SMSA Area
F. Ritter & Company		F & F											
Shell Chemical Company		Isp(250) Acet(100) MEK			F & F								
Skelly Oil Company								Pest					
Southern California Chemical Co., Inc.		Pest											
Specialty Organics, Inc.		Pest											
Stauffer Chemical Company					Pest								
Stimson Lumber Company													Ph
Sunkist Growers, Inc.				F & F									
Tenneco Chemicals, Inc.		RP Pest			D & P								
Thompson-Hayward Chemical Company	Pest												
William Underwood Company						F & F							
VWR United Corporation								Pest					Pest
Witco Chemical Corporation		Pest											

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

Puerto Rico

Fibers International Corporation	Adip (65)
Oxochem Enterprise	F & F OXO (245)
PPG Industries, Inc.	Pest VCM (500) EDC (835) EO (400) EG (400)
Reichhold Chemicals, Inc.	VAM
Union Carbide Corporation	EO (610) EG (610) Acet (120) Ph (200) Bis A (140) OXO (140) EtOH (960)
Vineland Chemical Company	RP Pest

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15. Supplementary Notes

16. Abstracts

An initial analysis of the economic impact of proposed water effluent guidelines upon the organic chemical industry (SIC 2815/2865 and 2818/2869) was performed based on abatement cost data supplied by the EPA. In view of limited cost data available, the impact was based on best practicable control technology currently available. On this basis, with 75% coverage of the industry, the following specific chemicals appear to face significant water pollution control problems: ethylene glycol, ethylene dichloride, caprolactam, methanol, acetic acid, acetone, phenol, aniline, coal tar products, ethyl cellulose, dyes & pigments, and unformulated pesticides. Extrapolating to the entire industry, minimum total annual cost by 1977 would be an estimated $210 million with the maximum cost $590 million. On the basis of maximum cost, a very severe fixed capital requirement of $576 million per annum over the period 1973-1977 would be imposed on the industry. This is about $50 million per annum more than is currently spent on all capital investment by the industry. On the minimum impact basis, prices would rise by 1.75% over the five-year period and profits after taxes in years of full compliance depressed by 9% below that of the 1972 base year. On the basis of maximum impact, prices would rise by about 3.7% over the five years, and annual profits would be depressed by 37% of the 1972 base year.

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

Economic Analysis
Effluent Guidelines
Organic Chemicals
Organic Chemical Industry

17b. Identifiers/Open-Ended Terms

17c COSATI Field/Group

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