

GOVDOC

TC 1.33

BOSTON PUBLIC LIBRARY



3 9999 06317 160 5

BOSTON  
PUBLIC  
LIBRARY







# SYNTHETIC ORGANIC CHEMICALS

United States Production  
and Sales, 1977

TC

1.33:

977



ITC PUBLICATION 920

RECENT REPORTS OF THE UNITED STATES INTERNATIONAL TRADE COMMISSION  
ON SYNTHETIC ORGANIC CHEMICALS

- Synthetic Organic Chemicals, United States Production and Sales, 1972  
(TC Publication 681, 1974), \$2.70
- \*Synthetic Organic Chemicals, United States Production and Sales, 1973  
(ITC Publication 728, 1975), \$3.25
- Synthetic Organic Chemicals, United States Production and Sales, 1974  
(USITC Publication 776, 1976), \$3.20
- Synthetic Organic Chemicals, United States Production and Sales, 1975  
(USITC Publication 804, 1977), \$3.10
- Synthetic Organic Chemicals, United States Production and Sales, 1976  
(USITC Publication 833, 1977), \$5.25

---

NOTE.--The report preceded by an asterisk (\*) is out of print. The other reports listed above may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. All U.S. International Trade Commission reports reproduced by the Government Printing Office may be consulted in the official depository libraries throughout the United States.

**SYNTHETIC  
ORGANIC CHEMICALS**

**United States Production  
and Sales, 1977**

**U.S. GOVERNMENT PRINTING OFFICE  
WASHINGTON : 1978**

**USITC PUBLICATION 920**

# 6.25

S/N

049-000-00048-1

# UNITED STATES INTERNATIONAL TRADE COMMISSION

## COMMISSIONERS

Joseph O. Parker, Chairman  
Bill Alberger, Vice Chairman  
George M. Moore  
Catherine Bedell  
Italo H. Ablondi  
Daniel Minchew

---

Kenneth R. Mason, Secretary to the Commission

---

OFFICE OF INDUSTRIES  
Norris A. Lynch, Director

---

This report was prepared principally by David B. Beck, Tedford C. Briggs, Edmund Cappuccilli, Louis N. DeToro, Janet L. Dietzman, John J. Gersic, J. Lawrence Johnson, Anne Klein, J. Ross Lewis, Daniel F. McCarthy, Bonnie Jean Noreen, K. James O'Connor, Jr., and Edward J. Taylor.

Assistance in the preparation of the report was provided by Mildred Higgs, Virginia Bailey, Frances Battle, Judith Bryant, Sharon Greenfield, Ralph Gray, Kenneth Kozel, Linda Mudd, and Loretta Willis. Automatic Data Processing input was provided by Patricia Augustine, Andre Fontaine, and James Gill.

Address all communications to  
Office of the Secretary  
United States International Trade Commission  
Washington, D.C. 20436



C O N T E N T S

	<u>Page</u>
Introduction-----	1
Summary-----	3
General-----	4
Section I. Tar and tar crudes:	
Synthetic organic chemicals from coal-----	7
Production and sales statistics-----	13
Section II. Primary products from petroleum and natural gas for chemical conversion:	
Free world prospects for olefins and aromatics-----	19
Production and sales statistics-----	26
Section III. Cyclic intermediates:	
Import penetration of U.S. markets for cyclic intermediates-----	35
Production and sales statistics-----	45
Section IV. Dyes:	
Dyes-----	87
Production and sales statistics-----	93
Section V. Organic pigments:	
Organic pigments (Color lakes and toners)-----	133
Production and sales statistics-----	140
Section VI. Medicinal chemicals:	
Medicinal chemicals-----	151
Production and sales statistics-----	159
Section VII. Flavor and perfume materials:	
The flavor and perfume chemical industry - an overview-----	185
Production and sales statistics-----	191
Section VIII. Plastics and resin materials:	
Synthetic resins and plastics materials-----	211
Production and sales statistics-----	220
Section IX. Rubber-processing chemicals-----	233
Section X. Elastomers:	
Synthetic elastomers: Role of U.S. imports-----	243
Production and sales statistics-----	248
Section XI. Plasticizers:	
Plasticizers-----	253
Production and sales statistics-----	261
Section XII. Surface-active agents:	
Surface-active agents-----	271
Production and sales statistics-----	278
Section XIII. Pesticides and related products:	
Pesticides - developments in 1977-----	313
Production and sales statistics-----	319

C O N T E N T S

	<u>Page</u>
Section XIV. Miscellaneous end-use chemical and chemical products:	
Organic flocculants-----	337
Production and sales statistics-----	341
Section XV. Miscellaneous cyclic and acyclic chemicals-----	355
APPENDIX	
Directory of manufacturers-----	400
U.S. imports of benzenoid chemicals and products-----	413
Cyclic intermediates: Glossary of synonymous names-----	415

## INTRODUCTION

This is the 61st annual report of the U.S. International Trade Commission on Domestic production and sales of synthetic organic chemicals and the raw materials from which they are made. The report consists of 15 sections, each covering a specified group (based principally on use) of organic chemicals as follows: Tar and tar crudes; crude products from petroleum and natural gas for chemical conversion; cyclic intermediates; dyes; organic pigments; medicinal chemicals; flavor and perfume materials; plastics and resin materials; rubber-processing chemicals; elastomers; plasticizers; surface-active agents; pesticides and related products; miscellaneous end-use chemicals and chemical products; and miscellaneous cyclic and acyclic chemicals. Data have been supplied by approximately 800 producers.

Each of the 15 statistical sections is headed by a short paper on recent developments in part or all of the given end-use group. This is followed by a summary of the statistical data. The first table in each section gives statistics on products and groups of products in as great detail as is possible without revealing the operations of individual producers. Statistics for an individual chemical or group of chemicals are given only when there are three or more producers, no one or two of which may be predominant. Moreover, even when there are three or more producers, statistics are not given if there is any possibility that their publication would violate the statutory provisions relating to unlawful disclosure of information accepted in confidence by the Commission.<sup>1</sup>

Data are reported by producers for only those items where the volume of production or sales or value of sales exceeds certain minimums. Those minimums for all sections are 5,000 pounds of production or sales or \$5,000 of value of sales with the following exceptions: Plastics and resin materials--50,000 pounds or \$50,000; pigments, medicinal chemicals, flavor and perfume materials, rubber-processing chemicals, and elastomers--1,000 pounds or \$1,000. They are usually given in terms of undiluted materials; however, products of 95 percent or more purity are considered to be 100 percent pure. Commercial concentrations are applied to dyes, certain plastics and resins, and a few solvents; such concentrations are specifically noted.

The statistics given in this report include data from all known domestic producers of the item covered and include the total output of each company's plants, i.e., the quantities produced for consumption within the producing plant, as well as the quantities produced for domestic and foreign sale. The quantities reported as produced, therefore, generally exceed the quantities reported as sold. Some of these differences, however, are attributable to changes in inventory.

The second table in each section lists all items for which data on production or sales have been reported, by primary manufacturers, identified by manufacturers' codes. Each code consists of not more than three capital letters which is assigned on a permanent basis.

The third table in each section is a directory, alphabetized by the codes of the manufacturers reporting in that section.

Table 1 of the Appendix is a directory, alphabetized by the names of the manufacturers reporting in all sections and includes their office addresses.

Table 2 of the Appendix summarizes and gives the competitive status of U.S. general imports in 1976 of benzenoid intermediates and finished benzenoid products, entered under schedule 4, parts 1B and 1C, of the Tariff Schedules of the United States.

Table 3 of the Appendix lists synonymous names for cyclic intermediates. Information on all synonymous names of the organic chemicals included in this report may be found in the *SOCMA Handbook: Commercial Organic Chemical Names*, published by the Chemical Abstracts Service of the American Chemical Society, or the *Colour Index* (Revised Third Edition), published jointly by the Society of Dyes and Colourists and the American Association of Textile Chemists and Colourists.

As specified in the reporting instructions sent to manufacturers, production and sales (unless otherwise specified) are defined as follows:

*PRODUCTION is the total quantity of a commodity made available by ORIGINAL MANUFACTURERS ONLY within the customs territory of the United States (includes the 50 states, the District of Columbia, and Puerto Rico). It covers synthetic organic chemicals, specified crudes from petroleum and coal tar, and certain chemically described natural products, such as, alkaloids, enzymes, and perfume isolates. It is the sum--expressed in terms of 100% active ingredient unless otherwise specified in the reporting instructions--of the quantities:*

*Produced, separated, and consumed in the same plant or establishment. A commodity is considered separated either when it is isolated from the reaction system or when it is not isolated, but weighed, analyzed, or otherwise measured. This includes byproducts and co-products that are not classifiable as waste materials;*

<sup>1</sup> Title 18, U.S.C. 1905 and Title 44, U.S.C. 3508.

## INTRODUCTION

Produced and not isolated, but directly converted to a finished or semifinished item not included in this report (e.g., polyester film, polyurethane tires, nylon fiber, bar soap, etc.). (See specific instructions in individual sections);

Produced and transferred to other plants or establishments of the same firm or 100%-owned subsidiaries or affiliates;

Produced and sold to, or bartered with, other firms (including less than 100% owned subsidiaries);

Produced for others under toll agreements (see general instructions);

Produced and held in stock.

PRODUCTION EXCLUDES:

Purification of a commodity, which is purchased by, or transferred from within, your company, unless inclusion of such processing is specifically requested in the reporting instructions for individual sections;

Intermediate products which are formed in the manufacturing process, but are not isolated from the reaction system—that is, not weighed, analyzed, or otherwise measured; except such products as described above as being produced and not isolated, but directly converted to a finished or semifinished item.

Materials that are used in the process but which are recovered for re-use or sale;

Waste products having no economic significance.

SALES are actual quantities of commodities sold by ORIGINAL MANUFACTURERS ONLY. Sales include the quantity and value of:

Shipments of a commodity for domestic use or for export, or segregation in a warehouse when title has passed to the purchaser in a bona fide sale;

Shipments of a commodity produced for you by others under toll agreements;

Shipments to subsidiary or affiliated companies, provided the ownership is less than 100%.

SALES EXCLUDES:

ALL intra-company transfers within a corporate entity;

ALL shipments to 100% owned subsidiary or affiliated companies;

ALL resales of imported or purchased material, including materials obtained by barter;

ALL shipments of a commodity produced for others under toll agreements.

VALUE OF SALES is the net selling price f.o.b. plant or warehouse, or delivered price. F.o.b. prices are preferred, but if they are not readily available from your records, delivered prices are acceptable.

## SUMMARY

Combined production of all synthetic organic chemicals, tar, tar crudes, and primary products from petroleum and natural gas in 1977 was 306,566 million pounds—an increase of 7.4 percent over the output in 1976 (see table 1). Sales of these materials in 1977, which totaled 161,106 million pounds, valued at \$33,961 million, were 6.1 percent larger than in 1976 in terms of quantity and 0.6 percent larger in terms of value. These figures include data on production and sales of chemicals measured at several successive steps in the manufacturing process, and therefore, they necessarily reflect some duplication.

In 1977, production of all synthetic organic chemicals, including cyclic intermediates and finished products, totaled 174,502 million pounds, or 9.8 percent more than the output in 1976. Each section showed an increase in production in 1977 over 1976. Flavor and perfume materials (150 million pounds) led the increase with a gain of 16.7 percent; miscellaneous end-use chemicals and chemical products (19,348 million pounds) increased 16.0 percent; plastics and resin materials (34,623 million pounds) were 15.4 percent greater than in 1976; plasticizers (1,792 million pounds) increased 12.9 percent; elastomers (synthetic rubber) (5,813 million pounds) increased 7.5 percent; miscellaneous cyclic and acyclic chemicals (86,968 million pounds) increased 7.5 percent; cyclic intermediates (18,726 million pounds) increased 5.8 percent; rubber-processing chemicals (402 million pounds) increased 4.6 percent; dyes (264 million pounds) increased 3.2 percent; surface-active agents (4,718 million pounds) increased 3.0 percent; medicinal chemicals (241 million pounds) increased 2.1 percent; pesticides and related products (1,388 million pounds) increased 1.7 percent; and organic pigments (69 million pounds) increased 1.4 percent.

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS AND THEIR RAW MATERIALS  
U.S. PRODUCTION AND SALES, 1976 AND 1977

	PRODUCTION			SALES					
	1976	1977	Increase, or decrease (-), 1977 over 1976 <sup>1</sup>	QUANTITY			VALUE		
				1976	1977	Increase, or decrease (-), 1977 over 1976 <sup>1</sup>	1976	1977	Increase, or decrease (-), 1977 over 1976 <sup>1</sup>
	Million pounds	Million pounds	Percent	Million pounds	Million pounds	Percent	Million dollars	Million dollars	Percent
Grand Total <sup>2</sup> -----	\$285,678	306,566	7.3	\$152,112	161,768	6.4	\$33,924	38,254	12.8
Tar-----	6,364	5,929	-6.8	2,905	2,924	0.7	96	...	...
Tar crudes <sup>3</sup> -----	7,182	(+)	(+)	4,519	(+)	(+)	285	(+)	(+)
Primary Crude products from Petro- leum and Natural Gas-----	112,873	126,133	11.8	59,083	61,008	3.3	5,490	5,820	6.0
Synthetic organic chemicals total <sup>2</sup> -----	\$159,259	174,502	9.6	\$85,605	97,836	14.3	\$28,053	32,434	15.6
Cyclic intermediates-----	\$17,700	18,726	5.8	7,664	7,986	4.2	2,387	2,596	8.8
Dyes-----	256	264	3.2	250	255	1.8	620	690	11.2
Organic pigments-----	68	69	1.4	54	57	6.0	261	268	2.6
Medicinal chemicals-----	236	241	2.1	161	162	1.0	742	794	7.1
Flavor and perfume materials-----	129	150	16.7	111	108	3.1	195	207	6.0
Plastics and resin materials-----	\$29,989	34,623	15.4	\$25,050	29,799	19.0	\$8,785	10,882	23.9
Rubber-processing chemicals-----	384	402	4.6	224	238	6.2	247	278	12.5
Elastomers (synthetic rubber)-----	5,386	5,813	7.9	3,710	4,177	12.6	1,529	1,940	26.9
Plasticizers-----	1,587	1,792	12.9	1,466	1,668	13.8	566	632	11.7
Surface-active agents-----	4,582	4,718	3.0	2,512	2,515	0.1	821	875	6.6
Pesticides and related products-----	1,364	1,388	1.7	1,193	1,263	5.9	2,410	2,808	16.5
Miscellaneous end-use chem- icals and chemical products-----	\$6,684	19,348	16.0	\$10,101	10,855	7.5	\$2,402	2,547	6.1
Miscellaneous cyclic and acyclic chemicals-----	\$80,892	86,968	7.5	\$33,110	38,753	17.0	\$7,088	7,919	11.7

<sup>1</sup> Percentages calculated from figures rounded to thousands.

<sup>2</sup> Because of rounding, figures may not add to the totals shown.

<sup>3</sup> Estimated in part to avoid disclosing individual company operations.

<sup>4</sup> Not available.

<sup>5</sup> Revised.

## SYNTHETIC ORGANIC CHEMICALS, 1977

## GENERAL

In this report synthetic organic chemicals are classified on the basis of their principal use as follows: cyclic intermediates, dyes, organic pigments, medicinal chemicals, flavor and perfume materials, plastics and resin materials, rubber-processing materials, elastomers, plasticizers, surface-active agents, pesticides and related products, miscellaneous end-use chemicals and chemical products, and miscellaneous cyclic and acyclic chemicals. Most of these groups are further subdivided either by use or by chemical composition. As intermediate chemicals are used in the manufacture of finished products, aggregate figures that cover both intermediates and finished products necessarily include considerable duplication.

Total production of synthetic organic chemicals (intermediates and finished products combined) in 1977 was 174,502 million pounds or 9.6 percent more than the output of 159,259 million pounds reported for 1976 and 66.6 percent more than the output of 104,711 million pounds reported for 1967 (see table 2). Sales of synthetic organic chemicals in 1977 amounted to 97,834 million pounds, valued at \$32,434 million, compared with 85,392 million pounds, valued at \$27,888 million in 1976 and 55,177 million pounds, valued at \$10,438 million in 1967. Production of all cyclic products (intermediates and finished products combined) in 1977 totaled 41,942 million pounds or 5.2 percent more than the 39,870 million pounds reported for 1976 and 25.3 percent more than the 33,479 million pounds reported for 1967, however, the transfer of several items, in 1976, from the cyclic intermediates section to the section on primary production from petroleum and natural gas has caused the output of cyclic products to appear much lower in relation to 1967 and 1976 than would otherwise have resulted. Production of all acyclic products in 1977 totaled 132,560 million pounds, or 10.8 percent more than the 119,692 million pounds reported for 1976 and 86.1 percent more than the 71,232 million pounds reported for 1967.

TABLE 2.--SYNTHETIC ORGANIC CHEMICALS: SUMMARY OF U.S. PRODUCTION AND SALES OF INTERMEDIATES AND FINISHED PRODUCTS, 1967, 1976, AND 1977

(Production and sales in thousands of pounds; sales value in thousands of dollars)						
CHEMICAL	1967 <sup>1</sup>	1976 <sup>2</sup>	1977	Increase, or decrease (-)		
				1977 over 1976	1977 over 1976	
Organic chemicals, cyclic and acyclic,				Percent	Percent	
Grand total:						
Production-----	104,711,357	159,259,344	174,501,873	66.7	9.6	
Sales-----	55,176,823	85,605,088	97,835,979	77.3	14.3	
Sales value-----	10,438,453	28,053,140	32,434,301	210.7	15.6	
Cyclic, total:						
Production-----	33,479,469	39,869,736	41,941,778	25.3	5.2	
Sales-----	19,328,628	24,253,265	26,041,307	34.7	7.4	
Sales value-----	4,610,293	12,433,093	14,170,157	207.4	14.0	
Acyclic, total:						
Production-----	71,231,888	119,692,607	132,560,095	86.1	10.8	
Sales-----	35,848,195	61,351,823	71,794,672	98.4	17.0	
Sales value-----	5,828,160	15,620,047	18,264,144	208.4	16.9	
1. Cyclic Intermediates						
Production-----	20,793,132	17,700,000	18,725,626	-9.9	5.8	
Sales-----	9,461,180	7,663,691	7,985,790	-15.6	4.2	
Sales value-----	1,000,359	2,386,993	2,596,627	159.6	8.8	
2. Dyes						
Production-----	206,240	256,250	264,369	28.2	3.2	
Sales-----	198,592	249,887	254,516	28.1	1.8	
Sales value-----	332,049	620,294	689,992	107.8	11.2	
3. Organic Pigments						
Production-----	53,322	67,727	68,707	28.8	1.4	
Sales-----	42,867	54,211	57,434	34.0	6.0	
Sales value-----	108,354	261,089	267,747	147.1	2.6	
4. Medicinal Chemicals						
Cyclic:						
Production-----	110,129	136,374	153,922	39.8	12.9	
Sales-----	70,120	79,581	83,586	19.2	5.0	
Sales value-----	348,873	642,829	718,392	105.9	11.8	
Acyclic:						
Production-----	69,941	99,431	86,811	24.1	-12.7	
Sales-----	56,804	81,253	78,798	38.7	-3.0	
Sales value-----	36,402	98,692	75,626	107.8	-23.4	

See footnotes at end of table.

## GENERAL

TABLE 2.--SYNTHETIC ORGANIC CHEMICALS: SUMMARY OF U.S. PRODUCTION AND SALES OF INTERMEDIATES AND FINISHED PRODUCTS, 1967, 1976, AND 1977--CONTINUED

[Production and sales in thousands of pounds; sales value in thousands of dollars]						
CHEMICAL	1967 <sup>1</sup>	1976 <sup>2</sup>	1977	Increase, or decrease (-)		
				1977 over 1967	1977 over 1976	
<i>5. Flavor and Perfume Materials</i>						
Cyclic:				Percent	Percent	
Production	57,970	55,090	58,452	0.8	0.1	
Sales	47,285	48,503	46,809	-1.0	-3.5	
Sales value	52,866	125,479	134,628	154.7	7.3	
Acyclic:						
Production	53,558	73,756	91,964	71.7	24.7	
Sales	49,311	62,445	60,756	23.2	-2.7	
Sales value	40,495	69,843	72,473	79.0	3.7	
<i>6. Plastics and Resin Materials</i>						
Cyclic:						
Production	5,033,497	9,252,262	10,802,389	114.6	16.8	
Sales	4,224,121	7,898,224	9,444,644	123.6	19.6	
Sales value	1,036,940	3,278,777	4,275,111	312.3	30.4	
Acyclic:						
Production	8,759,452	20,737,169	23,820,652	171.9	14.8	
Sales	7,753,242	17,151,982	20,354,360	162.5	18.7	
Sales value	1,635,690	5,505,923	6,606,712	303.9	20.0	
<i>7. Rubber-Processing Chemicals</i>						
Cyclic:						
Production	220,139	334,735	335,549	61.5	6.2	
Sales	169,970	186,393	202,251	19.0	8.5	
Sales value	116,318	218,263	248,756	113.9	14.0	
Acyclic:						
Production	43,994	49,688	46,464	5.6	-6.5	
Sales	30,873	37,879	35,833	16.0	-5.4	
Sales value	15,477	28,594	29,009	87.4	1.4	
<i>8. Elastomers (Synthetic Rubber)</i>						
Cyclic:						
Production	2,297,637	3,146,083	3,449,123	50.1	9.6	
Sales	1,940,099	1,970,636	2,157,680	11.2	9.5	
Sales value	439,530	560,386	760,128	72.9	35.6	
Acyclic:						
Production	1,524,908	2,239,717	2,364,113	55.0	5.6	
Sales	1,321,945	1,739,501	2,019,749	52.8	16.1	
Sales value	434,657	968,676	1,180,132	171.5	21.8	
<i>9. Plasticizers</i>						
Cyclic:						
Production	929,871	1,185,909	1,407,084	51.3	18.6	
Sales	865,084	1,110,869	1,390,319	60.7	25.2	
Sales value	167,827	360,453	474,781	182.9	31.2	
Acyclic:						
Production	332,908	401,525	384,956	15.6	-4.1	
Sales	296,767	354,842	277,303	-6.6	-21.8	
Sales value	93,142	205,812	157,540	69.1	-23.4	
<i>10. Surface-Active Agents</i>						
Cyclic:						
Production	1,418,444	2,312,728	989,564	-30.2	-57.2	
Sales	852,238	1,393,489	469,432	-44.9	-66.3	
Sales value	95,810	319,422	200,244	109.0	-37.3	
Acyclic:						
Production	2,060,851	2,269,670	3,728,608	80.9	64.3	
Sales	897,786	1,118,596	2,045,151	127.8	82.3	
Sales value	220,877	501,818	674,778	205.5	34.5	

See footnotes at end of table.

## SYNTHETIC ORGANIC CHEMICALS, 1977

TABLE 2.--SYNTHETIC ORGANIC CHEMICALS: SUMMARY OF U.S. PRODUCTION AND SALES OF INTERMEDIATES AND FINISHED PRODUCTS, 1967, 1976, AND 1977--CONTINUED

[Production and sales in thousands of pounds; sales value in thousands of dollars]

CHEMICAL	1967 <sup>1</sup>	1976 <sup>2</sup>	1977	Increase, or decrease (-)	
				1977 over - 1967	1977 over 1976
11. <i>Pesticides and Related Products</i>					
				Percent	Percent
Cyclic:					
Production-----	823,158	940,263	829,537	0.8	-11.8
Sales-----	681,532	838,814	691,136	1.4	-17.6
Sales value-----	627,742	1,843,896	1,664,098	161.9	-9.8
Acyclic:					
Production-----	226,505	424,128	557,982	146.3	31.6
Sales-----	215,831	353,790	571,821	164.9	61.6
Sales value-----	159,301	566,238	1,144,265	618.3	102.1
12. <i>Miscellaneous End-Use Chemicals and Chemical Products*</i>					
Cyclic:					
Production-----	( 1,535,922)	2,265,262	2,761,320	...	21.9
Sales-----	( 775,560)	1,739,863	2,213,649	...	27.2
Sales value-----	( 283,575)	1,180,206	1,479,800	...	25.4
Acyclic:					
Production-----	(58,159,771)	14,419,646	16,586,612	...	15.0
Sales-----	(25,225,631)	8,360,847	8,641,594	...	3.4
Sales value-----	( 3,192,119)	1,221,726	1,067,681	...	-12.6
13. <i>Miscellaneous Cyclic and Ayclic Chemicals*</i>					
Cyclic:					
Production-----	...	2,214,054	2,076,136	...	-6.2
Sales-----	...	1,019,104	1,044,011	...	2.4
Sales value-----	...	635,006	659,943	...	3.9
Acyclic:					
Production-----	...	78,677,877	84,891,933	...	7.9
Sales-----	...	32,090,688	37,709,300	...	17.5
Sales value-----	...	6,452,725	7,255,919	...	12.4

<sup>1</sup> Standard reference base period for Federal Government general-purpose index numbers.<sup>2</sup> Data revised for plastics and resin materials, intermediates (production only), and for the miscellaneous sections.<sup>3</sup> Includes ligninsulfonates.<sup>4</sup> Items in these two sections were previously included in the section named miscellaneous chemicals.

The following tabulation shows, by chemical groups, the number of companies that reported production in 1976 of one or more of the chemicals included in the groups listed in table 2:

Chemical group	Number of companies	Chemical group	Number of companies
Cyclic intermediates-----	172	Rubber-processing chemicals-----	28
Dyes-----	42	Elastomers (synthetic rubber)-----	35
Organic pigments-----	36	Plasticizers-----	55
Medicinal chemicals-----	95	Surface-active agents-----	169
Flavor and perfume materials-----	44	Pesticides and related products-----	86
Plastics and resin materials-----	251	Miscellaneous end-use chemicals and chemical products-----	133
		Miscellaneous cyclic and acyclic chem- icals-----	252



## Synthetic Organic Chemicals From Coal

John J. Gersic

The bulk of synthetic organic chemicals is currently made from petroleum or natural gas. In the past, however, the synthetic organic chemical industry was actually based on coal and remained so until after World War II when petroleum became relatively abundant and economical due, principally, to the discovery of the large oil fields in the Middle East. Now, coal derivatives are being increasingly studied as feedstocks for synthetic organic chemicals because shortages in petroleum and natural gas feedstocks are possible in the future.

This new interest in coal is resulting in old processes being restudied as well as new methods being developed. Some of the new methods are related to the renewed activity in processes to convert coal into other fuels such as synthetic crude oil and synthetic natural gas. In addition to use as fuels, these materials may also be used as synthetic organic chemical feedstocks. Further, methanol, made from coal for use as a fuel, can also be used as a feedstock to make other synthetic organic chemicals such as plastics.

This paper discusses the manufacturing processes for chemicals from coal and then some of the recent developments in this area. The paper will also address European and U.S. interests and support for coal-chemicals research, and the economics of coal versus natural gas and petroleum for chemical sources.

Chemicals from coal

It has been estimated that about one-quarter of a million chemical compounds can be obtained from coal or derived from its distillates. <sup>1/</sup> In the traditional coke-oven process, the principal sources of chemicals are coke-oven gas and coal tar (while the main product, coke, goes into the production of iron and steel). The main components of these two coke-oven byproducts are ammonia, pyridine bases, light oils, medium oils, and heavy oils.

The coke-oven byproducts have been the sources of many chemicals. The pyridine bases may be refined to obtain pyridine, picolines, and lutidines. The light oils, obtained from both the coke-oven gas and the coal tar, are the primary source of the major aromatics, such as benzene, toluene and xylenes. The middle oils, obtained from the coal tar, can be refined into phenol, cresols, and naphthalene. Obtainable from the heavy oils from coal are anthracene, acenaphthene, phenanthrene, pyrene, and chrysene.

---

<sup>1/</sup> Chemtech, October 1975, p. 260.

Although these chemicals are typical products of the usual coke-oven process (requiring a temperature of at least 900° C), others are possible depending upon the temperature of the coking operation. At temperatures below about 700° C, for example, the liquid products are mainly paraffinic rather than cyclic in structure.

Additional variables in the production of chemicals from coal include the type of coal used, oven design, timing of the coking cycle, and the severity of the distillation of the resulting coal tar. Thus, there can be much variation in the quantity, quality, and type of chemicals obtained as coking byproducts. Of particular concern are high manufacturing costs, sulfur content problems, and the increasing tendency of producers of light oils to sell these oils to petroleum refineries, which process them along with their petroleum fractions. However, this does not mean that the traditional coke-oven processes will be entirely replaced.

Most coke-ovens are built today to provide metallurgical coke, much of which is used in blast furnaces for iron and steel production. And, although the consumption of coke per ton of metal produced is decreasing because of the use of supplemental fuels which displace coal in blast furnaces, and other advancements in technology, steel production is expected to continue to increase. It can, therefore, be concluded that the byproduct chemicals from coke-oven operations may be prevalent for some time to come. The challenge is to improve the traditional processes and develop new ones so that improved quantity and quality of chemicals result without sacrifices to the coke characteristics.

#### Review of recent developments in chemicals from coal research and development

Many of the proposed and demonstrated new processes to obtain chemicals from coal are closely tied to the research to change coal into another fuel. In the ordinary burning of coal for fuel, it pollutes the atmosphere and leaves an ash which is dirty and difficult to dispose of. Therefore, chemicals from coal research may receive indirect help from the research expenditures on processes to convert coal into other fuels such as synthetic natural gas, methanol, and synthetic crude.

Coal can be converted into synthesis gas, which is a mixture of carbon monoxide and hydrogen. This synthesis gas is almost completely convertible into chemical products, particularly methanol or ammonia, without the production of any fuel byproducts. Although the production processes to make these two chemicals from synthesis gas are well established, it is possible that olefins (now the major-tonnage chemicals from petroleum), can also be produced from synthesis gas in future years. For, example, possible methods would include:

- steam cracking of hydrocarbons obtained from a Fischer-Tropsch reaction using synthesis gas; 1/
- the dehydration of alcohols from methanol homologation to ethanol and propanol and the dehydration of ethanol to ethylene and propanol to propylene; 2/
- the dehydration of linear primary alcohols from a Fischer-Tropsch reaction; 3/
- the cracking of methyl ether made from methanol which was in turn made from synthesis gas. 4/

The most promising routes to the olefins from coal appear to be those involving methanol as an intermediate. 5/

Another possibility for the manufacture of chemicals from coal is through the liquefaction of coal. Those processes under development include COED (Char Oil Energy Development Process), Garret Flash Pyrolysis Process, Toscoal (Toscoal Low Temperature Pyrolysis Process), Lurgi/Ruhr Gas Flash Carbonization Process, and the Lurgi Pressure-gasification Process. 6/ Indeed, the currently-practiced coke-oven operations are examples of coal liquefaction by pyrolysis.

Coal liquefaction can also be accomplished by hydrogenation. In this process, coal is treated with hydrogen while in liquid suspension, whereas in pyrolysis the coal is destructively distilled. The hydrogenation processes in general are versatile and can produce natural gas, paraffins of low-molecular weight, synthetic crude oil, and heavy fuel oils. Process variations have been developed by Hydrocarbon Research, Inc., U.S. Department of Energy, Gulf Oil Co., Consolidated Coal Co., and Exxon Co.

In summary, coal can be gasified into synthesis gas or liquefied or pyrolyzed into liquids. The synthesis gas can be used to produce olefins and chemicals now made from natural gas. Coal liquids, on the other hand, are a rich source of cyclic organic chemicals. It does not appear to be economically feasible to make cyclic chemicals from synthesis gas or olefins from coal liquids. 7/

---

1/ Chem Systems Inc., Chemicals From Coal and Shale: An R&D Analysis for National Science Foundation, June 1975, p. 178,

2/ Ibid., p. 193.

3/ Ibid., p. 202.

4/ Ibid., p. 212.

5/ Ibid., p. 218.

6/ Ibid., p. 229.

7/ Ibid., p. 136.

European developments in coal processing

Because of relatively abundant supplies of domestic coal, Europe has kept abreast of the world's latest coal technology developments. During World War II coal provided the base for significant quantities not only of chemicals but of fuels as well, and historically, coal has played an important role in the European dye industry. The large scale development of acetylene chemistry in Europe is but another indication of that area's reliance on coal.

The United Kingdom is a leading coal producing nation. Much research on chemicals from coal has been carried out by organizations such as the British Steel Corp., the National Coal Board (NCB), and Coalite and Chemicals Ltd.

West Germany is also a leading coal producing nation and is noted worldwide for its coal research. The Bituminous Coal Mining Association in Essen, with a staff of 1,000 employees, remains the single largest coal research laboratory in the free world. 1/

A large part of the current European capacity for chemicals from coal is based on the usual coke-oven technology. However, as the production of synthetic natural gas from coal increases, the availability of coal liquids should increase dramatically. It is possible that this could cause the reintroduction of technology used during World War II to produce various products from these liquids. 2/ Also on the drawing board is a large coal complex in which the NCB has an interest that will use a combination of old and new technologies.

NCB is currently involved in the study of the extraction of chemicals from coal using solvents in their supercritical gaseous state. 3/ The chemicals recovered are mainly cyclic organic chemicals; the yield is reportedly as high as 35 to 40 percent of the coal feed. 3/ The recovered chemicals could be used as a feedstock or a substitute oil refinery fraction. NCB personnel are discussing the process with Royal Dutch/Shell scientists. Such discussion fits in with NCB's belief that the optimum site for a supercritical gas extraction plant would be next to both a coal mine and an oil refinery.

The breadth and depth of coal research in the United Kingdom is indicative of a country where the coal industry has been nationalized and is important to the country. Similar programs, though smaller, exist in France which also has a nationalized coal sector. However, even in those countries such as the United States and West Germany where the coal industry is still in private hands, much of the coal research and development is or soon will be funded by the respective governments. 1/ This interest of the governments should insure the long term availability of coal R. & D. funds.

---

1/ Organization for Economic Co-operation and Development, Energy R&D, 1975, p. 139.

2/ Oil and Gas Journal, Dec. 8, 1975, p. 84.

3/ Chemical and Engineering News, June 19, 1978, p. 10.

Coal versus petroleum and natural gas

As indicated previously, petroleum and natural gas are now the primary feedstocks for synthetic organic chemicals production. This situation prevails because petroleum and natural gas (especially in the United States) are readily available and low priced; in addition, both can be easily transported and stored. The result of this dependence is a worldwide network of facilities specifically designed to use petroleum and natural gas feedstocks. In some cases these facilities are so sensitive that even a change in sources of petroleum feedstocks can cause an increase in operating cost. Obviously then, essentially entirely new facilities would be needed to process entirely new feedstocks. The new investment that would be required is one of the drawbacks to a synthetic organic chemicals industry based on coal.

A recent study quantifies the increased investment cost. 1/ It indicates that a 100 million cubic feet per day hydrogen plant based on natural gas would require an investment of \$145 million, whereas the same plant based on coal would be \$298 million. 2/ In the case of an ammonia plant the same trend is observed. It would cost \$307 million based on natural gas, \$435 million based on residual oil and \$482 million based on coal. 2/ The investments needed for methanol and synthesis gas plants follow the same pattern.

Obviously, chemical plants based on coal as a feedstock are not now competitive with those based on natural gas or petroleum. Estimates vary as to how high prices of the current petroleum feedstocks would have to rise before coal based plants would be competitive. A wellhead price of about \$3.00 per million Btu's for natural gas (equivalent to about \$18 per barrel of crude petroleum) appears reasonable, however. 3/ Based on current indications, such a natural gas price may be reached by the mid-1980's based on the proposed oil pricing scheme outlined in The National Energy Plan. 4/

Spokesmen for the chemical industry argue that the economy would benefit the greatest from the use of coal as fuel rather than a synthetic organic chemical feedstock. 5/ This argument does not mean that byproduct chemicals from processes using coal as a fuel would be ignored. It does mean that petroleum and natural gas would continue to be the preferred synthetic organic chemicals feedstocks; therefore on-purpose coal-to-chemicals plants should not be built at this time. 5/

---

1/ Chemical Week, May 10, 1978, p. 62.

2/ Ibid., p. 64.

3/ Hydrocarbon Processing, Mar. 11, 1977, p. 15.

4/ Executive Office of the President, Energy and Policy Planning, The National Energy Plan, Apr. 29, 1977.

5/ Chemical Week, May 10, 1978, p. 64.



## Tar

Janet L. Dietzman

Coal tar is produced chiefly by the steel industry as a byproduct of the manufacture of coke; water-gas tar and oil-gas tar are produced by the fuel-gas industry. Production of coal tar, therefore, depends on the demand for steel; production of water-gas tar and oil-gas tar reflects the consumption of manufactured gas for industrial and household use. Water-gas and oil-gas tars have properties intermediate between those of petroleum asphalts and coal tar. Petroleum asphalts are not usually considered to be raw materials for chemicals.

The quantity of coal tar produced in the United States in 1977 amounted to 593 million gallons (see table 1). Production in 1977 was 6.8 percent less than the 636 million gallons of coal tar produced in 1976. Sales of coal tar in 1977 amounted to 292 million gallons compared with 291 million gallons in 1976. U.S. production of water-gas and oil-gas tars was not reported to the Commission for 1976 or 1977; production of these tars in 1968 amounted to 21 million gallons, according to trade publications.

## Tar Crudes

Tar crudes are obtained from coke-oven gas and by distilling coal tar, water-gas tar, and oil-gas tar. The most important tar crudes are benzene, toluene, xylene, creosote oil, and pitch of tar. Some of these products are identical with those obtained from petroleum. Data for materials obtained from petroleum are included, for the most part, with the statistics for like materials obtained from coke-oven gas and tars, and are shown in tables 1 and 1B.

Domestic production of industrial and specification grades of benzene reported by coke-oven operators and petroleum refinery operators in 1977 amounted to 1,435 million gallons--0.7 percent more than the 1,425 million gallons reported for 1976. These statistics include data for benzene produced from light oil and petroleum. Sales of benzene by coke-oven operators and petroleum refiners in 1977 amounted to 659 million gallons compared with 637 million gallons in 1976. In 1977 the output of toluene (including material produced for use in blending in aviation fuel) amounted to 1,018 million gallons--1.9 percent more than the 999 million gallons reported for 1976. Sales of toluene (Nitration grade, 1°) in 1977 were 396 million gallons compared with 534 million gallons in 1976. The output of xylene in 1977 (including that produced for blending in motor fuels) was 811 million gallons, compared with 722 million gallons in 1976. Over 99 percent of the 811 million gallons of xylene produced in 1977 was obtained from petroleum sources.

Production and sales figures on crude naphthalene from coal-tar oils in 1977 could not be published without disclosing the operations of individual companies. Production of petroleum-derived naphthalene in 1977 amounted to 151 million pounds, compared with 260 million pounds<sup>1</sup> in 1976. Production figures on road tar for 1977 cannot be published; in 1972 production amounted to 30 million gallons.

Some of the products obtained from tar and included in the statistics in table 1 are obtained from other products for which data are also included in the table. The statistics, therefore, involve considerable duplication, and for this reason no group totals or grand totals are given.

Data for 1977 tar crudes were supplied by 11 companies and company divisions.

---

<sup>1</sup> Revised figure for 1976.



TABLE 1.--TAR AND TAR CRUDES: U.S. PRODUCTION AND SALES, 1977

[Listed below are all tar crudes for which any reported data on production or sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists separately all products for which data on production and/or sales were reported and identifies the manufacturers of each]

TAR AND TAR CRUDES	UNIT OF QUANTITY	PRODUCTION	SALES		
			QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
				1,000 dollars	
Coal tar: <sup>2</sup> Coke-oven operators-----	1,000 gal--	592,935	292,393	...	...
Crude light oil: <sup>3</sup> Coke-oven opera- tors-----	1,000 gal--	178,420	94,226	...	...
Light-oil distillates:					
Benzene, all grades, total <sup>4</sup> -----	1,000 gal--	1,435,747	658,535	504,272	\$0.77
Coke-oven operators-----	1,000 gal--	64,571	64,851	553,081	.82
Petroleum refiners <sup>5</sup> -----	1,000 gal--	1,371,176	593,684	451,191	.76
Toluene, all grades, total <sup>4</sup> -----	1,000 gal--	1,017,546	456,841	253,260	.55
Coke-oven operators-----	1,000 gal--	9,618	9,483	56,023	.64
Petroleum refiners-----	1,000 gal--	1,007,928	7447,358	7247,237	.55
Xylene, all grades, total <sup>4</sup> -----	1,000 gal--	811,055	426,273	219,128	.51
Coke-oven operators-----	1,000 gal--	1,706	1,872	51,180	.63
Petroleum refiners-----	1,000 gal--	809,349	424,401	217,948	.51
Solvent naphtha: <sup>3</sup>					
Coke-oven operators-----	1,000 gal--	1,628	1,539	...	...
Crude tar-acid oils: <sup>3</sup>					
Coke-oven operators-----	1,000 gal--	3,366	3,355	...	...
Creosote oil (Dead oil) (tar dis- tillers) <sup>6</sup> (100% creosote basis), total-----	1,000 gal--	83,052	60,654	...	...
Distillate as such (100% creosote basis)-----	1,000 gal--	47,033	35,418	20,685	.58
Creosote content of coal tar solu- tion (100% creosote basis)-----	1,000 gal--	36,019	25,236	( <sup>7</sup> )	( <sup>8</sup> )
Tar, refined, for uses other than road tar-----	1,000 gal--	21,251	15,178	9,277	.61
Pitch of tar (tar distillers) <sup>8</sup> , total	1,000 tons-	815	743	97,663	131.44
Hard (water softening point above 160° F)-----	1,000 tons-	622	557	73,008	131.07
Other <sup>9</sup> -----	1,000 tons-	193	186	24,655	132.55

<sup>1</sup> Unit value per gallon or ton as specified.

<sup>2</sup> Includes only data for coal tar reported to the Office of Energy Data and Interpretation, Energy Information Administration, Department of Energy (Energy Data Reports, Coke & Coal Chemicals, March 22, 1978). At date of publication, sales value for coal tar was not available. Data on U.S. production of water-gas tar and oil-gas tar are not collected by the U.S. International Trade Commission, but according to trade publications, production of these tars amounted to 21 million gallons in 1968.

<sup>3</sup> Data reported by tar distillers are not included because publication would disclose the operations of individual companies. At date of publication, sales value for coke-oven operators was not available.

<sup>4</sup> Includes data for material produced for use in blending motor fuels. The annual production statistics for petroleum refiners on benzene, toluene, and xylene are not comparable with the combined monthly production figures because of fiscal year revisions.

<sup>5</sup> Sales value figures are estimated from Energy Data Reports, Coke & Coal Chemicals, monthly, December 1, 1977 thru March 22, 1978, and Mineral Industries Surveys, Coke and Coal Chemicals, monthly, March 25, 1977 thru September 15, 1977.

<sup>6</sup> Benzene, specification grades (1°, 2°) only.

<sup>7</sup> Toluene, specification grades (1°, 2°) only.

<sup>8</sup> Data from coke-oven operators was unavailable at time of publication.

<sup>9</sup> In 1977, production of coal-tar solution containing creosote (100% solution basis) amounted to 49,514 thousand gallons; sales were 32,845 thousand gallons, valued at 17,941 thousand dollars, with a unit value of \$0.55 per gallon.

## Footnotes--Continued

<sup>1</sup> Includes pitch emulsion, medium and soft pitch.

Note 1.--Statistics for materials produced in coke and gas-retort ovens are compiled by the Office of Energy Data and Interpretation, Energy Information Administration, Department of Energy. Statistics for materials produced in tar and petroleum refineries are compiled by the U.S. International Trade Commission.

Note 2.--Data for all other tars and tar crudes are not included in 1977 report because publication would disclose the operation of individual companies. Preliminary coke-oven operators data was obtained from cumulative totals reported in Energy Data Reports, Coke and Coal Chemicals, March 22, 1978, as the annual publication data was not available to include in this report.

TABLE 1A.--TAR: U.S. PRODUCTION AND CONSUMPTION, 1976 AND 1977

(In thousands of gallons)

TAR	1976	1977
PRODUCTION		
Coal tar from coke-oven byproduct plants, total <sup>1</sup> -----	636,382	592,935
CONSUMPTION		
Total-----	604,376	( <sup>2</sup> )
Tar consumed by distillation, total-----		
Coal tar distilled or topped by coke-oven operators <sup>1</sup> -----	433,747	( <sup>2</sup> )
Coal tar and oil-gas tar distilled by tar distillers <sup>3</sup> -----	163,051	( <sup>2</sup> )
	270,696	275,287
Tar consumed by the producers chiefly as fuel <sup>1</sup> -----		
	165,169	( <sup>2</sup> )
Coal tar consumed at coke-oven plants in miscellaneous uses <sup>1</sup> -----		
	5,460	( <sup>2</sup> )

<sup>1</sup> Reported to the Office of Energy Data Interpretation, Energy Information Administration, Department of Energy.

<sup>2</sup> Department of Energy data were not available at time of publication.

<sup>3</sup> Reported to the U.S. International Trade Commission. Represents tar purchased from companies operating include tar consumed other than by distillation by tar distillers.

TABLE 1B.--TAR AND TAR CRUDES: SUMMARY OF U.S. PRODUCTION OF SPECIFIED PRODUCTS, 1967, 1976, AND 1977

TAR AND TAR CRUDES	UNIT OF QUANTITY	1967 <sup>1</sup>	1976	1977	INCREASED, OR DECREASED (-)	
					1977 OVER	1977 OVER
					1967	1976
					Percent	Percent
Coal tar <sup>2</sup> -----	1,000 gal--	780,334	636,382	592,935	-24.0	-6.8
Benzene: <sup>3</sup>						
Coke-oven operators-----	1,000 gal--	90,642	60,411	64,571	-28.8	6.9
Petroleum refiners-----	1,000 gal--	878,704	1,364,811	1,371,176	56.1	0.5
Total-----	1,000 gal--	969,346	1,425,222	1,435,747	48.1	0.7
Toluene: <sup>3</sup>						
Coke-oven operators-----	1,000 gal--	19,357	8,824	9,618	-50.3	9.0
Petroleum refiners-----	1,000 gal--	624,454	990,152	1,007,928	61.4	1.8
Total-----	1,000 gal--	643,811	998,976	1,017,546	58.1	1.9
Xylene: <sup>3</sup>						
Coke-oven operators-----	1,000 gal--	5,488	1,496	1,706	-68.9	14.0
Petroleum refiners-----	1,000 gal--	449,349	720,518	809,349	80.1	12.3
Total-----	1,000 gal--	454,837	722,014	811,055	78.3	12.3
Naphthalene:						
Crude <sup>5</sup> -----	1,000 lb--	520,991	( <sup>6</sup> )	( <sup>6</sup> )	( <sup>6</sup> )	( <sup>6</sup> )
Petroleum naphthalene, all grades-----	1,000 lb--	376,679	107,191	150,737	-60.0	40.6
Total-----	1,000 lb--	897,670	( <sup>6</sup> )	( <sup>6</sup> )	( <sup>6</sup> )	( <sup>6</sup> )
Creosote oil (Dead oil): <sup>7</sup>						
Distillate as such (100% creosote basis)-----	1,000 gal--	108,832	77,126	847,033	( <sup>8</sup> )	( <sup>8</sup> )
Creosote content of coal tar solution (100% creosote basis)-----	1,000 gal--	17,402	36,841	836,019	( <sup>8</sup> )	( <sup>8</sup> )
Total-----	1,000 gal--	126,234	113,967	883,052	( <sup>8</sup> )	( <sup>8</sup> )

<sup>1</sup> Standard reference base period for Federal Government general-purpose index numbers.

<sup>2</sup> Includes only data for coal tar reported to the office of Energy Data and Interpretation, Energy Information Administration, Department of Energy.

<sup>3</sup> Data reported by tar distillers are not included because publication would disclose the operations of individual companies.

<sup>4</sup> Includes data for material produced for use in blending motor fuels. Statistics are not comparable with monthly figures which include some o-xylene.

<sup>5</sup> Naphthalene solidifying at less than 79°C. Figures include production by tar distillers and coke-oven operators and represent combined data for the commercial grades of naphthalene. Because of conversion between grades, the figures may include some duplication. Statistics on naphthalene refined from domestic crudes are reported in the section on "cyclic intermediates."

<sup>6</sup> Statistics for 1976 and 1977 cannot be published; to do so would disclose the operations of individual companies.

<sup>7</sup> Includes data for creosote oil produced by tar distillers and coke-oven operators and used only in wood preserving.

<sup>8</sup> Includes data for creosote oil produced by tar distillers only in wood preserving.

<sup>9</sup> Comparison not possible because 1977 data from the Department of Energy was not available at time of publication for inclusion in report.

TABLE 2.--TAR CRUDES FOR WHICH U.S. PRODUCTION OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURERS, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED WITH AN ASTERISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3]

TAR CRUDES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Light-oil distillates:	:
Ethylbenzene-----	: KPT.
*Solvent naphtha-----	: NEV.
Pyridine, crude bases-----	: KPT.
Naphthalene, crude, solidifying at:	:
Less than 74° C-----	: COP.
74° C. to less than 79° C.:	:
74° C. to less than 76° C-----	: ASC, KPT.
76° C. to less than 79° C-----	: ASC, KPT.
Methylnaphthalene-----	: KPT.
*Crude tar-acid oils: <sup>1</sup>	:
Tar-acid content 5% to less than 24%-----	: KPT.
Tar-acid content 24% to 50%-----	: ASC.
Cresylic acid, crude-----	: KPT, PRD.
*Creosote oil (Dead oil):	:
*Distillate as such-----	: ASC, CBT, COP, HUS, KPT, RIL, WTC.
*Creosote in coal tar solution-----	: ASC, KPT, RIL, WTC.
All other distillate products:	:
Carbon black oil-----	: KPT.
Creosote tar acid oil-----	: KPT.
Crude coal tar solvent-----	: KPT.
Crude tetralin-----	: KPT.
Priming and refractory oil-----	: KPT.
50° to 60° residue oil-----	: WTC.
All other-----	: ASC, KPT.
Tar, road-----	: KPT, RIL.
Tar for other uses:	:
Crude-----	: RIL.
*Refined-----	: ASC, KPT, RIL.
*Pitch of tar:	:
Soft (water softening point less than 110° F.)-----	: ASC, KPT.
Medium (water softening point 110° F. to 160° F.)-----	: ASC, COP, KPT, RIL.
*Hard (water softening point above 160° F.)-----	: ASC, KPT, RIL, WTC.
Pitch emulsion-----	: JEN.
Refined anthracene-----	: ASC.

<sup>1</sup> Does not include manufacturers' identification codes for producers who report to the Office of Energy Data and Interpretation, Energy Information Administration, Department of Energy. Those producers are listed in the U.S. Bureau of Mines Mineral Industry Survey, Nov. 6, 1976, entitled "Coke Producers in the U.S. in 1976."

TABLE 3.--TAR AND TAR CRUDES: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of tar and tar crudes to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
ASC	Allied Chemical Corp., Semet-Solvay Div.	KPT	Koppers Co., Inc. & Roads Materials Div.
CBT	Samuel Cabot, Inc.	NEV	Neville Chemical Co.
COP	Coopers Creek Chemical Corp.	PRD	Ferro Corp., Productol Chemical Div.
HUS	Husky Industries, Inc.	RIL	Reilly Tar & Chemical Corp.
JEN	Jennison-Wright Corp.	WTC	Witco Chemical Corp.

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.

# SECTION II -- PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS 19 FOR CHEMICAL CONVERSION

## Free World Prospects for Olefins and Aromatics

Louis DeToro

### Overview

Ethylene and propylene (olefins) and benzene, toluene, and xylene (aromatics) are petrochemicals of exceeding commercial importance. The olefins and aromatics are the "building blocks" for most of the synthetic organic chemicals covered in the Commission's report. These petrochemicals are the source of chemical intermediates, plastics, synthetic fibers, pesticides, detergents, and other products. In the 1976 edition of Synthetic Organic Chemicals, United States Production and Sales, the production total for these five commodities amounted to approximately 50 percent (by weight) of the primary products from petroleum and natural gas.

Because of lower feedstock costs and other factors, the United States has maintained a competitive edge in exports of petrochemicals in recent years. The President's National Energy Plan (NEP), should it meet the approval of the Congress, will increase the domestic cost of petroleum and natural gas, and probably erase at least some of the United States' competitive edge. <sup>1/</sup> The NEP cost effect is one of several factors which may affect the future price of U.S. petrochemicals and thus the volume of domestic exports.

Major petrochemical buildups are occurring throughout the free world and in Communist-dominated areas. These buildups may serve to dampen U.S. export prospects. Data on the potential for trade, and on existing capacity and production, is relatively scarce for the Communist bloc countries. Because of the scarcity of data on petrochemical markets in these nations, data in this paper are restricted to the free world. It is reported, however, that some Communist countries (notably the U.S.S.R., Communist China, Rumania, and Yugoslavia) are spending foreign exchange in efforts to increase petrochemical capacities. The U.S.S.R., for one, has definite plans to increase its aromatics trade in world markets. <sup>2/</sup> However, the most noteworthy buildups which could affect U.S. export markets are in Mexico, Canada, the Middle East, and Africa.

---

<sup>1/</sup> An example of the prospective effect of the NEP on "building block" prices is given in "Energy Program to Hurt Petrochemical Market," C&EN, May 23, 1977. The price of benzene from all sources could rise from 85 cents/gallon to \$1.40/gallon with the enactment of the National Energy Plan price policy for feedstocks, according to a consultant specializing in forecasts for petrochemicals.

<sup>2/</sup> Technip, of France, will market Russian aromatics. See Oil and Gas Journal, Oct. 10, 1977, pp. 86 and 91.

The Canadians are planning ethylene and aromatics projects in the Provinces of Ontario and Alberta. <sup>1/</sup> Because of the close proximity to the United States, the output from these plants is expected to impact U.S. markets. Plans for olefins and aromatics projects in OPEC countries (Saudi Arabia in particular) and by Mexico's state-controlled petroleum company (Pemex) also threaten to exacerbate the decline in the United States's competitive edge. <sup>2/</sup>

As of 1977, most of the free world's existing capacity in olefins and aromatics was concentrated in North America and Western Europe (table A). Free world construction plans show large olefins and aromatic buildups all over the world (table B). The figures shown in table A represents relative magnitudes of existing capacities in the free world and table B represents likely or planned projects through 1985. <sup>3/</sup> Because of the uncertainties involved in compiling such statistics, these figures can not be exact; but they are nonetheless representative of free world capacities and construction in coming years for the olefins and aromatics.

The U.S. International Trade Commission estimates of planned construction based on published data were made with a relatively optimistic view towards a stable and healthy world economy and growing petrochemicals demand in the free world. Toluene and mixed xylenes were excluded and replaced by ortho and para-xylene isomer figures because of the difficulty in isolating capacities or construction data for these primary aromatics, both of which are coproducts in refinery streams.

In line with burgeoning petrochemical buildups overseas, and rising U.S. feed stock costs (as discussed above), and with increased purchasing power in developing lands, world trade patterns should begin to shift slightly. Although most consumption should still occur in developed areas, trade among developing areas in the Middle East, Africa, and the Far East will begin. A weaker dollar could moderate the loss in U.S. exports of derivative petrochemicals; however, an ironic balancing effect could occur should the enactment of the NEP bolster the dollar, and thereby further weaken U.S. export competitiveness in petrochemicals.

---

<sup>1/</sup> "Slower Demand Growth Seen for Olefins," the Oil and Gas Journal, May 16, 1977, p. 50.

<sup>2/</sup> Argentina, Brazil, Canada, India, Kuwait, Qatar, Rumania, South Korea, Spain, Yugoslavia, and the European Community (EEC) are a few other areas where petrochemical projects are blossoming.

<sup>3/</sup> These data are estimates based upon several published sources. In general, the published numbers herein are compromises of divergent data with a bias toward the higher of the published figures.

Olefins and aromatics prices to 1985 are expected to resemble the pattern which occurred prior to 1973. 1/ In those years, a moderate decline in prices was the rule. The reason for this return to an old pattern is that a free world oversupply of the basic petrochemical building blocks is likely to exist. New capacities coming on line indicate rising supplies, while demand growth is seen as moderating to a certain extent. Although prices rose dramatically after 1973, following a long period of decline, the situation regarding supply and demand balance has already shifted in major producing-consuming areas.

U.S. prospects

U.S. ethylene forecasters as late as 1974 were concerned over a supply shortfall for the remainder of the 1970's. 2/ When the world economy went into a recession in 1974 and 1975, chemical economic forecasters made a sharp adjustment. Forecasts of demand growth were scaled down until they began to fall short of existing U.S. capacities. Forecasters now see a prospective oversupply into the next decade.

Ethylene supply in the United States is currently rising at about 7 percent per year, while demand is slowing down in line with a decreased growth rate in the U.S. gross national product. The expected oversupply situation is due to several factors; among these factors are maturing domestic derivatives markets, new developments in ethylene production technology, and declining derivatives export markets. 3/

U.S. propylene prospects call for higher demand growth rates than those for ethylene. Gulf Oil Chemicals has forecasted growth rates as high as 11 percent per year for 1976-80 and over 8 percent from 1980 to 1985, with domestic production and consumption in balance. 4/ More recent forecasts call for less rapid growth, although still at higher levels than projected for ethylene demand. Likely new target rates for demand growth are near 9 percent per year through 1980 and between 6 and 8 percent per year from 1980 to 1985. Supply projections indicate a balance between production and consumption throughout the period. 5/

---

1/ "Petrochemical Panel Forecasts Soft Prices and Surplus Supply in Basic Olefins and Aromatics," CMR, Nov. 14, 1977.

2/ "Ethylene Oversupply Could Last Until 1980," C&EN, Apr. 14, 1977.

3/ "Ethylene Growth Slips," CMR, Feb. 6, 1978.

4/ "Propylene Supply Tightens, Prices Rise," C&EN, Sept. 13, 1976.

5/ Various sources; see for example "Slower Demand Growth Seen for Olefins," Oil and Gas Journal, May 16, 1977, p. 50.

For aromatics in the United States, the outlook is one of abundant supply. 1/ A principal consideration in aromatics markets is the use of these products as replacements for lead to raise octane values of gasoline to acceptable levels. 1/

In the U.S. benzene market, demand is expected to grow at 6 plus percent per year through 1985. 2/ This represents a considerable reduction from previous estimates of consumption growth rates. According to one petrochemical company official, there is a need for only 100 million gallons of annual new effective capacity to cover demand into the early 1980's. 1/

U.S. toluene usage for chemicals is likely to increase, but only at a rate of 4.5 percent per year. 1/ The ratio between the value of toluene for chemicals and its value for gasoline could rise to 1.75 from the rule-of-thumb figure of 1.5 which has characterized the past. The demand growth for xylenes in the U.S. has stabilized since the middle 70's. Forecasts for 1978 consumption center on 1,150 million gallons. Sales growth has moderated in recent years.

#### Market prospects for major free world producers

In Western Europe, the future has been called "dim" for olefins and aromatics markets, especially in the EEC. 3/ Forecasted growth rates for petrochemical feedstocks, once much higher, have recently been scaled down by a considerable measure. Overcapacity and maturing markets are principal reasons for a demand/supply imbalance. The forecast average annual demand growth rate for ethylene through 1981 currently stands at 4.6 percent; for propylene, 5.6 percent. Average annual growth rates for the aromatics are projected at 4.0 percent for benzene; 4.7 percent for toluene; and 5 percent for ortho and para-xylene isomers. 4/

Specifically in the olefins market, European ethylene capacity will be larger than previously expected, and the overcapacity will last at least until 1981. The supply for propylene, another olefin, will be somewhat tighter. 5/ Because of petrochemical oversupplies, it is reported that the traditional EEC benzene import market could dry up. At least one expert expects benzene to flow westward across the Atlantic during the 1978-81 period. 6/

---

1/ "Aromatic Outlook: Abundant Supply," C&EN, Apr. 4, 1977.

2/ Various sources; see for example "Slower Demand Growth Seen for Olefins," Oil and Gas Journal, May 16, 1977, p. 50.

3/ "Outlook Dims for European Olefins, Aromatics," C&EN, Mar. 13, 1978.

4/ These more "pessimistic" forecasts are the outcome of a recent meeting of the Conseil European des Federations de l'Industrie Chimique (Cefic). The Economist has quoted ethylene demand growth at slightly under 4.0 percent through the early 1980's. "Europe's Chemical Moans," The Economist, June 3, 1978, p. 88.

5/ "Europe Carries Big Ethylene Load," Chemical Week, Mar. 8, 1978.

6/ Oil and Gas Journal, Mar. 28, 1977, p. 31.



In Japan, the olefins markets are causing some concern, according to trade journal articles. Overcapacity is plaguing the ethylene market just as in Europe. 1/ Burdened with excess capacity, Japan is likely to spend the next few years getting the supply/demand picture back into balance. Ethylene demand, without exports, is expected to increase from 6 to 7 percent a year through 1980, and it may take at least that long for demand to catch up with capacity already installed. In addition, new competition from the United States and from Southeast Asia is expected to shape Japanese strategy in world markets well into the 1980's.

While ethylene is in oversupply, the Japanese propylene market appears to have taken an opposite turn. Latest projections show that Japan may well have a deficit of the petrochemical in coming years. 2/

#### Capacity buildups outside traditional areas

Outside traditional producing areas, major petrochemical buildups planned for Mexico and the Middle East represent the most prominent changes. In the Middle East, 9 ethylene plants are being planned or are under construction. 3/ Even by conservative estimates, projects now under study for the Middle East and Africa could add 3 million metric tons a year of ethylene capacity in 1983 or soon after. 4/ In Saudi Arabia alone, plans have been detailed for three worldscale ethylene facilities to be built by joint-venture affiliates of Shell Oil (656,000 metric tons a year), of Mobil Oil (450,000 metric tons a year), and of Dow Chemical (400,000 metric tons a year). 5/

In Mexico, Petroleos Mexicanos (Pemex) has begun a vast construction program which will make Mexico a large-scale petrochemical producer. Since the domestic market is not large by world standards, Mexico may become an increasingly important petrochemical exporter. Sixty-six chemical plants are due to be constructed. An outline of the olefins and aromatics plants scheduled for completion through 1982 is shown in the tabulation below: 6/

---

1/ "Overcapacity Plagues Japanese Ethylene," C&EN, Apr. 4, 1978.

2/ "Propylene: Crystal Ball Gazing," Chemical Engineering, May 23, 1977, p. 99.

3/ Oil and Gas Journal, Oct. 17, 1977, p. 54.

4/ "U.S. Leads Olefins Investment, East Bloc Dominates Ammonia," European Chemical News, Feb. 24, 1978.

5/ "Saudi Arabia Details Plans for Chemicals," C&EN, Mar. 6, 1978.

6/ As of 1977.

<u>Product</u>	<u>Location</u>	<u>Capacity tons/year</u>	<u>Completion date</u>
Ethylene	Allende, Ver.	500,000	1981
	La Cangrejera, Ver.	500,000	1979
	Poza Rica, Ver.	182,000	1978
	Undecided	500,000	--
Propylene	Poza Rica, Ver.	300,000	1980
Benzene	La Cangrejera, Ver.	168,000	1979
	La Cangrejera, Ver.	49,000	1979
	La Cangrejera, Ver.	82,000	1979
	Undecided	75,000	1982
Orthoxylene Isomer	La Cangrejera, Ver.	55,000	1979
	Undecided	25,000	1982
Paraxylene Isomer	La Cangrejera, Ver.	240,000	1979
	Undecided	100,000	1982

---

Source: "Mexico Shoots for Big Petroleum Role," Oil and Gas Journal, Feb. 7, 1977.

II -- PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS  
FOR CHEMICAL CONVERSION

25

Table A.--Free world existing (design) capacities in olefins and aromatics, 1977

(In millions of metric tons per year)

	Ethylene	Propylene	Benzene	p-Xylene	o-Xylene
Africa-----	0.2	0.1	1/	2/	2/
South America-----	1.0	.4	0.6	0.2	0.1
Far East-----	6.0	3.5	2.8	.8	.3
Western Europe-----	14.1	7.8	5.9	1.2	.9
Middle East-----	.1	1/	2/	2/	2/
North America-----	15.0	7.7	7.9	1.9	.7
Total-----	36.4	19.5	17.2	4.1	2.0

1/ Negligible.

2/ Not available.

Source: Compiled from estimates of the U.S. International Trade Commission.

Table B.--Free world construction projects: Olefins and aromatic plants planned for completion in 1978 to 1985 1/

(In millions of metric tons per year)

	Ethylene	Propylene	Benzene	p-Xylene	o-Xylene
Africa-----	1.3	0.2	2/	2/	2/
South America-----	3.1	.8	3/ 0.9	0.4	0.1
Far East-----	3.4	1.4	1.4	.6	.1
Western Europe-----	5.5	3.0	2.2	.3	.1
Middle East-----	1.4	2/	.9	.4	.2
North America-----	5.5	3.0	4/ .8	.3	.1
Total-----	20.2	8.4	6.2	2.0	0.6

1/ As of 1977.

2/ Not available.

3/ Bolivia has a \$640 million BTX unit planned.

4/ Canada has a \$225 million benzene plant in the offering.

Source: Compiled from estimates of the U.S. International Trade Commission.

## Primary Products From Petroleum And Natural Gas

Louis N. DeToro and J. Ross Lewis, Jr.

Primary products that are derived from petroleum and natural gas<sup>1</sup> are related to the intermediates and finished products made from such primary materials in much the same way that crude products derived from the distillation of coal tar are related to their intermediates and finished products. Many of the primary products derived from petroleum are identical with those derived from coal tar (e.g., benzene, toluene, and xylene). Considerable duplication exists in the statistics on the production and sales of primary petroleum products because some of these primary chemicals are converted to other primary products derived from petroleum and because data on some production and sales are reported at successive stages in the conversion process. The statistics are sufficiently accurate, however, to indicate trends in the industry. Many of the primary products for which data are included in the statistics may be used either as fuel or as basic materials from which to derive other chemicals. In this report every effort has been made to exclude data on materials that are used as fuel; however, data are included on toluene and xylene which are used in blending aviation and motor fuel.

The output of primary products derived from petroleum and natural gas as a group amounted to 125,911 million pounds in 1977. Production in 1976 was 112,873 million pounds. The output of aromatic and naphthenic products from petroleum amounted to 52,263 million pounds in 1977, compared with 48,167 million pounds in 1976. Sales amounted to \$2,469 million in 1977 and \$2,757 million in 1976. Production of benzene, toluene, and xylene from petroleum increased marginally in 1977, while the unit values of these products remained nearly the same (table 1).

Production of all aliphatic hydrocarbons and derivatives from petroleum and natural gas was 67,902 million pounds in 1977, compared with 64,706 million pounds in 1976. Sales of these products were valued at \$2,994 million in 1977 compared with \$2,732 million in 1976. Production of ethylene was 25,426 million pounds in 1977--13.1 percent more than the 22,475 million pounds produced in 1976. The output of 1,3-butadiene in 1977 (3,259 million pounds) decreased from the production in 1976 (3,507 million pounds).

Data for 1977 crude products from petroleum and natural gas for chemical conversion were supplied by 76 companies and company divisions.

---

<sup>1</sup> Statistics on aromatic chemicals from coal tar are given in the report on "Tar and Tar Crudes."

TABLE 1.--PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION: U.S. PRODUCTION AND SALES, 1977

[Listed below are the primary products from petroleum and natural gas for chemical conversion for which any reported data on production or sales may be published. (Leaders (...) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists separately all primary products from petroleum and natural gas for chemical conversion for which data on production and/or sales were reported and identifies the manufacturers of each]

PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	126,133,316	61,008,376	5,820,390	\$0.095
AROMATICS AND NAPHTHENES <sup>2</sup>				
Total-----	52,262,978	24,120,593	2,469,213	.102
Alkyl aromatics <sup>3</sup> -----	394,160	345,269	33,992	.098
Benzene (1° and 2°)-----	10,037,010	4,345,770	451,191	.104
Cumene-----	2,644,259	1,294,122	160,081	.124
Cyclohexane-----	3,019,895	2,197,591	261,405	.119
Dicyclopentadiene (including cyclopentadiene)-----	56,374	55,202	4,547	.082
Ethylbenzene-----	8,311,535	211,483	27,875	.132
Naphthalene, all grades-----	150,737	92,671	12,869	.139
Naphthenic acid-----	20,673	14,627	1,985	.136
Styrene-----	6,867,418	2,798,973	520,498	.186
Toluene, all grades, total-----	7,297,395	3,387,165	247,237	.073
Nitration grade, 1°-----	4,189,864	2,856,841	210,696	.074
Pure commercial grade, 2°-----	2,131,507	530,324	36,541	.069
All other <sup>4,5</sup> -----	976,024	...	...	...
Xylenes, mixed, total-----	6,151,055	3,225,450	217,948	.068
3° grade-----	1,649,777	1,256,311	84,565	.067
5° grade-----	1,933,702	1,357,912	90,762	.067
All other <sup>5</sup> -----	2,567,576	611,227	42,621	.070
o-Xylene-----	984,605	810,051	88,402	.109
p-Xylene-----	3,172,247	1,840,549	270,995	.147
All other aromatics and naphthenes <sup>6</sup> -----	3,155,615	3,501,670	170,188	.049
ALIPHATIC HYDROCARBONS				
Total-----	78,870,338	36,887,783	3,351,177	.091
C <sub>2</sub> Hydrocarbons, total-----	32,710,208	13,907,446	1,260,483	.091
Acetylene <sup>7</sup> -----	270,459	48,256	7,999	.166
Ethane-----	7,013,644	5,676,436	268,007	.047
Ethylene-----	25,426,105	8,182,754	984,477	.120
C <sub>3</sub> Hydrocarbons, total-----	21,529,401	13,880,735	997,365	.072
Propane-----	8,200,936	8,574,314	494,761	.058
Propylene <sup>8</sup> -----	13,328,465	5,306,421	502,604	.095
C <sub>4</sub> Hydrocarbons, total-----	12,652,328	5,377,040	683,200	.127
Butadiene and butylene fractions-----	754,495	346,054	56,643	.188
1,3-Butadiene, grade for rubber (elastomers)-----	3,258,972	2,471,399	440,997	.178
n-Butane-----	3,347,892	866,138	45,843	.053
1-Butene-----	75,549	62,741	11,936	.190
1-Butene and 2-butene, mixed <sup>9</sup> -----	2,105,572	376,717	29,733	.079
Isobutane-----	1,554,071	204,010	13,091	.064
Isobutylene, 2-butene and mixed butylenes-----	948,810	694,969	62,721	.090
All other <sup>10</sup> -----	606,968	355,012	22,236	.063

See footnotes at end of table.

TABLE 1.--PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION:  
U.S. PRODUCTION AND SALES, 1977--CONTINUED

PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION	PRODUCTION	SALES			UNIT VALUE <sup>1</sup>
		QUANTITY	VALUE		
	1,000	1,000	1,000		Per
	pounds	pounds	dollars		pound
ALIPHATIC HYDROCARBONS--Continued					
C <sub>5</sub> Hydrocarbons, total-----	1,233,769	604,235	52,642		\$0.087
Amylenes and pentenes-----	179,404	71,045	12,298		.173
Isoprene (2-Methyl-1,3-butadiene)-----	166,275	96,531	13,193		.137
All other <sup>11</sup> -----	888,090	436,659	27,151		.062
All other aliphatic hydrocarbons, derivatives, and mixtures, total-----	5,744,631	3,118,327	357,487		.115
Alpha olefins <sup>12</sup> -----	389,887	353,722	70,899		.200
Dodecene (Tetrapropylene)-----	293,929	...	...		...
Heptenes, mixed-----	115,052	55,718	5,473		.098
Hexane-----	674,142	327,412	24,757		.076
Hydrocarbon derivatives <sup>13</sup> -----	141,047	83,194	20,735		.249
Nonene (Tripropylene)-----	346,198	168,202	15,956		.095
n-Paraffins, total <sup>14</sup> -----	1,641,518	1,162,937	79,676		.069
Polybutene-----	...	206,001	30,636		.149
All other <sup>15</sup> -----	2,142,858	761,141	109,355		.144

<sup>1</sup> Calculated from rounded figures.

<sup>2</sup> The chemical raw materials designated as aromatics are in some cases identical with those obtained from the distillation of coal tar; however, the statistics given in the table above relate only to such materials as are derived from petroleum and natural gas. Statistics on production or sales of benzene, toluene, and xylene from all sources are given in tables 1 and 1B of the report on "Tar and Tar Crudes."

<sup>3</sup> Includes cyclohexane, decylbenzene, and other alkyl aromatics.

<sup>4</sup> Includes toluene, solvent grade, 90 percent.

<sup>5</sup> Includes toluene and xylene used as solvents, as well as that which is blended in aviation and motor gasolines.

<sup>6</sup> Includes data for crude cresylic acid, cyclohexene, phenols, polyethylbenzene, distillates, solvents, and miscellaneous cyclic hydrocarbons.

<sup>7</sup> Production figures for acetylene from calcium carbide for chemical synthesis are collected by the U.S. Bureau of the Census.

<sup>8</sup> Includes data for refinery propylene.

<sup>9</sup> The statistics represent principally the butene content of crude refinery gases from which butadiene is manufactured.

<sup>10</sup> Includes data for butanes, mixed C<sub>4</sub> streams.

<sup>11</sup> Includes data for C<sub>5</sub> hydrocarbon mixtures, pentanes, and piperlyenes.

<sup>12</sup> Includes data for the following molecular weight ranges: C<sub>6</sub>-C<sub>7</sub>; C<sub>8</sub>-C<sub>10</sub>; C<sub>11</sub>-C<sub>15</sub>; C<sub>15</sub>-C<sub>20</sub>; C<sub>16</sub>-C<sub>18</sub>; and C<sub>16</sub>-C<sub>30</sub>.

<sup>13</sup> Includes data for methyl, ethyl, propyl, butyl, octyl, nonyl, decyl, hexadecyl, and miscellaneous mercaptans, and other hydrocarbons derivatives.

<sup>14</sup> Includes data for the following chain lengths: C<sub>6</sub>-C<sub>9</sub>; C<sub>9</sub>-C<sub>15</sub>; C<sub>10</sub>-C<sub>14</sub>; C<sub>10</sub>-C<sub>16</sub>; C<sub>15</sub>-C<sub>17</sub>; and others.

<sup>15</sup> Includes production and/or sales data for cyclooctadiene, di-isobutylene, di-isopropyl, dodecene, eicosane, methane, methyl acetylene propadiene, mixtures of C<sub>2</sub> and C<sub>3</sub>, C<sub>6</sub> and C<sub>7</sub>, and C<sub>5</sub> and C<sub>9</sub> hydrocarbons, neohexane, n-heptane, n-octane, polybutene, propylene tetramer, propylene trimer, triisobutylene, and other hydrocarbons.

TABLE 2.---PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*) CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT]

PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
AROMATICS AND NAPHTHENES	
*ALKYL AROMATICS:	
Cyclohexane	SHC.
Decylbenzene	QH, UCC.
Alkyl aromatics: all other	ACC.
*BENZENE:	
* Benzene 10 (99-100 %)	AMO, APR, ASH, AFR, CCP, CPI, CSD, CSO, CSP, EKK, ENJ, GOC, GES, HES, MOC, MON, PLC, PFB, QH, SHC, SKO, SH, SOB, SUN, TOC, TX, UCC, UOC.
Benzene 20 (98-98.9%)	DOM, SOC.
Cresylic acid (Less than 75 percent distilling over 215°C)	PRD.
Cresylic acid, refined	AFB, ENJ.
Cumene (Isopropyl benzene)	ACC, ASH, CLK, CSP, DOM, GOC, MOC, MON, SHC, SKO, SOC, SUN, TX, UCC.
*Cyclohexane	CSD, ENJ, GOC, GES, PLC, PPR, SHO, SUN, SWC, TX, UOC.
Cyclohexane (Tetrahydrobenzene)	PLC.
Cyclopentane	DOM, ENJ, GOC, MON.
Cyclopentadiene (Including cyclopentadiene)	ACC, AFR, CSD, DOM, ELP, FG, GOC, KPP, MCB, MON, OXI, SOC, STY, SUN, TOC, UCC.
Ethylbenzene	PLC.
Methylcyclopentane	ASH, COL, RON, TID.
Naphthalene	
*NAPHTHENIC ACID:	
Naphthenic acid, acid number 150-199	GOC, PRD, SOC, SUN.
Naphthenic acid, acid number 200-224	AFR, PRD.
Naphthenic acid, acid number less than 150	AFR, SUN, TX.

TABLE 2.--PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
AROMATICS AND NAPHTHENS--Continued	
Petroleum phenols--	SKO.
Sodium carboxylate and phenate, crude--	ATR.
* Styrene (vinylbenzene)--	ACC, CSO, DOM, ELP, FG, GOC, KPP, MCB, MON, OXI, SHC, SUN, TBO, TX, UCC.
* TOLUENE ALL GRADES, TOTAL:	
* Toluene, 10 (99.5-100%)--	ASH, AFR, CCP, CPI, CSD, ENJ, GOC, GRS, KPP, MOC, MON, PLC, PPR, QH, SHC, SKO, SOG, SUN, TCC, TOC, TX, UCC, UOC.
* Toluene, 20 (98.5-99.4%)--	ACC, MO, ATR, DOM, ELP, HES, PPR, SUN.
* Toluene, 90-99.8% (non-fuel)--	CSP, FG, MON, SKO, SH.
* XYLENES, MIXED, TOTAL:	
* Xylene, 50 (99-100%)--	CCP, CPI, CSD, CSO, PPR, QH, SHC, UCC.
* Xylene, 50 (99-100%)--	TR, EM, GSR, HCF, HES.
* Xylene, 90 (99-99.8%)--	MO, EN, CSP, MCB, SUN, TOC.
* Xylene (90-100% of o-xylene isomer)--	ATR, CPI, CSD, ENJ, MON, PPR, SHC, SOC, SUN, TOC.
* p-Xylene (90-100% of p-xylene isomer)--	ACC, MTR, ENJ, HCB, PLC, PPR, SHC, SOC, SOG, STX, SUN, TOC.
* ALL OTHER AROMATICS AND NAPHTHENS:	
Arenatics, C9--	MOC.
Carbon black feedstock--	ENJ.
Hydrocarbon polymer--	JCC.
Polyethylbenzene--	PG.
All other products from petroleum and natural gas, cyclic--	ACU, CPI, DOM, EXX, ENJ, NMP, SOG, SUN, TNA, TX.
ALIPHATIC HYDROCARBONS	
C/1 HYDROCARBONS:	
Methane--	MOC, MON, SHO.
* C/2 HYDROCARBONS:	
* Acetylene (for chemical use only)--	DOM, MO, RR, UCC, USR.
* Ethane--	ACU, ATR, ENJ, MOC, MON, OHC, PAN, PLC, PUE, SHO, SM, TX, USI.
* Ethylene--	ACU, ACU, AMO, ATR, BAS, BFG, CBN, CO, CPK, DOM, DUP, SKK, ELE, ENJ, GOC, JCC, KPP, MOC, MON, NMP, OHC, PLC, PUE, SHC, SHO, SM, SNO, SUN, TX, UCC, USI.



TABLE 2.--PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
ALIPHATIC HYDROCARBONS--Continued	
*C/3 HYDROCARBONS:	
*Propane (Commercial and hd-5)-	AMO, APR, ASH, ATR, CCP, COR, CFI, CSD, CSO, CSP, ENJ, GRS, MOC, OMC, PAN, PLC, PUE, SIO, SB, SOG, SUN, TX, UCC, UOC, USI
*Propylene-	ACC, ACU, AMO, ASH, ATR, BFG, CBN, CLK, CO, CPX, CSD, CSO, DOM, DUP, EKI, ELP, ENJ, GOC, JCC, KPP, MOC, MON, NWP, OMC, PLC, PUE, SHC, SHO, SIO, SKO, SM, SOC, SOG, SUN, TX, UCC
Propylene tetramer	ATR, SUN
Propylene triaer	ATR
Hydrocarbons, C2-C3, mixtures	CSO
Methyl acetylene propadiene-	MON
*C/4 HYDROCARBONS:	
*Butadiene and butylene fractions	ACU, ATR, CO, CPX, CSD, DOM, EKI, GOC, UCC
*1,3-Butadiene, grade for rubber (Elastomers)	ACC, ATR, BFG, CPT, DOM, ELP, ENJ, FRS, MON, NWP, PLC, PTT, PUE, SHC, SM, TUS, UCC
*n-Butane	AMO, APR, ATR, COR, CSD, CSO, CSP, ELP, MOC, OMC, PLC, SHO, SM, SUN, UCC, USI
Butanes, mixed-	ENJ
*1-Butene	GOC, PLC, PTT, SHO, TNA
*2-Butene	MON, PLC, SHO
*1-Butene and 2-butene, mixed	AMO, ATR, CSD, DOM, ENJ, GOC, MOC, SHC, SHO
Butylenes, mixed-	MON, SM
Chemical butane-	SH
Hydrocarbons, C4, fraction	JCC
Hydrocarbons, C4, mixtures	GOC
*Isobutane (2-methylpropane)-	AMO, ATR, CSD, CSO, CSP, ELP, ENJ, MOC, PLC, SHO, SH, SUN, TBO, TX, USI
*Isobutylene (2-methylpropene)-	ENJ, OCC, PTT, SHC
Hydrocarbons, C6, all other-	BFG, CBN, TNA
*C/5 HYDROCARBONS:	
*Alkenes	SHC, SHO
Dibutylized aromatic concentrate	CO, CPX, DUP, JCC, OMC
Isosilylene	CBN
Isopentane (2-methylbutane)-	PLC, SHO
*Isoprene (2-methyl-1,3-butadiene)-	BFG, DOM, ENJ, MOR
n-pentane-	APR, ATR, MOC, PLC
*Pentenes, mixed-	CSO, DOM, ENJ, TX, UCC

TABLE 2.--PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
ALIPHATIC HYDROCARBONS--Continued	
*C/5 HYDROCARBONS--Continued	
Piperylene (1,3-Pentadiene)	MON.
Hydrys (5,6,11,other)	BFG, CSO, DOM, PLC, PUE, SHC, UCC.
*ALL OTHER ALIPHATIC HYDROCARBONS, DERIVATIVES, AND MIXTURES:	
C/6 HYDROCARBONS:	
Di-isopropyl (2,3-Dimethylbutane)	PLC.
*Hexane	APB, ENJ, HMY, PLC, SHO, SOG, UOC.
Hydrocarbons, C5-C6, mixtures	COR.
Methylcyclopentadiene	ENJ.
Neohexane (2,2-Dimethylbutane)	PLC.
Hydrocarbons, C6, all other	PLC, SWC.
C/7 HYDROCARBONS:	
n-Heptane	EMX, SOG, UOC.
*Heptenes, mixed	ACC, AIP, ENJ, TLD.
Hydrocarbons, C6-C7, mixtures	CPI.
Hydrocarbons, C7, all other	ENJ.
C/8 HYDROCARBONS:	
Cyclooctadiene	CBN.
Di-Isobutylene (DI-Isobutene)	BFG, PTT, IX.
n-Octane	SOG.
Hydrocarbons, C8, all other	ENJ.
C/9 AND ABOVE HYDROCARBONS (EXCEPT ALPHA OLEFINS):	
*Dodecene (Tetrapropylene)	ATB, CO, ENJ, SOC, SUN, IX.
Sicosane	HMI.
*Nomena (Tripropylene)	AIP, ATH, ENJ, TLD, UOC.
*ALPHA OLEFINS:	
Alpha olefins, C6-C7	GOC, SHC, SOC, TNA.
Alpha olefins, C8-C10	GOC, SOC, TNA.
Alpha olefins, C11-C15	GOC, SOC, TNA.
Alpha olefins, all other	GOC, SOC, INA.
*N-PARAFFINS - CARBON CHAIN LENGTH:	
n-Paraffins, C6-C9	SOG, UCC.
n-Paraffins, C9-C15	BFG, SHO, SOG.
n-Paraffins, 10-C15	ENJ, SHO, SOG, DOC.
n-Paraffins, C10-C16	ENJ, SHO, SOG, DOC.
n-Paraffins	ENJ, GOC.

TABLE 2.--PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
ALIPHATIC HYDROCARBONS--Continued	
ALL OTHER ALIPHATIC HYDROCARBONS, DERIVATIVES, AND MIXTURES--Continued	
Hydrocarbons, C5-C9, mixtures-	PPR, ACC, CSD, SOC.
* Polybutene - - - - -	TX.
Tri-isobutylene- - - - -	
* HYDROCARBON DERIVATIVES:	
n-Butyl mercaptan (1-Butanethiol)- - - - -	PLC.
tert-Butyl mercaptan (2-Methyl-2-propanethiol) - - - - -	PAS, PLC.
Di-tert-butyl disulfide- - - - -	PLC.
Ethyl mercaptan (Ethanolthiol) - - - - -	PAS, PLC.
Hexadecyl mercaptans - - - - -	PAS.
Isopropyl mercaptan (2-Propanethiol) - - - - -	PAS.
Methyl mercaptan (Methanethiol)- - - - -	DOM, PAS.
t-Nonyl mercaptan- - - - -	PAS.
tert-Octyl mercaptan (2,4-Trimethyl-2-pentanethiol)- - - - -	PAS.
n-Propyl mercaptan (1-Propanethiol)- - - - -	PAS, PLC.
n-Tetradecyl mercaptan - - - - -	PAS.
Hydrocarbon derivatives: all other hydrocarbon derivatives- - - - -	ACC, PAS, PLC, TX.
Hydrocarbons, C9 and above, all other, including mixtures - - - - -	CO, ENJ, SOC.

TABLE 3.--PRIMARY PRODUCTS FROM PETROLEUM AND NATURAL GAS FOR CHEMICAL CONVERSION: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of primary products from petroleum and natural gas for chemical conversion to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
ACC	Amoco Chemicals Corp.	KPP	Arco/Polymers, Inc.
ACU	Allied Chemical Corp., Union Texas Petroleum Div.	MCB	Borg-Warner Corp., Borg-Warner Chemicals
AIP	Air Products & Chemicals, Inc.	MNO	Monochem, Inc.
AMO	Amoco Oil Co.	MOC	Marathon Oil Co., Texas Refining Div.
AMO	Amoco Texas Refining Co.	MON	Monsanto Co.
APR	Atlas Processing Co.	NWP	Northern Petrochemical Co.
ASH	Ashland Oil, Inc.	OCC	Oxirane Chemical Co.
ATR	Atlantic Richfield Co.	OMC	Olin Corp.
BAS	BASF Wyandotte Corp.	OXI	Oxirane Chemical Co. (Channelview)
BFG	B. F. Goodrich Co., B. F. Goodrich Chemical Co. Div.	PAN	Amoco Production Co.
CBN	Cities Service Co., Petrochemical Div.	PAS	Penwalt Corp.
CCP	Crown Central Petroleum Corp.	PLC	Phillips Petroleum Co.
CLK	Clark Oil & Refining Corp.	PPR	Phillips Puerto Rico Core, Inc.
CO	Continental Oil Co.	PRD	Ferro Corp., Productol Chemical Div.
COL	Collier Carbon & Chemical Corp.	PTT	Petro-Tex Chemical Corp.
COR	Commonwealth Oil & Refining Co., Inc.	PUE	Puerto Rico Olefins Co.
CPI	Commonwealth Petrochemicals, Inc.	QH	Quintana-Howell Joint Venture
CPX	Chemplex Co.	RH	Rohm & Haas Co.
CPY	Copolymer Rubber & Chemical Corp.	SHC	Shell Oil Co., Shell Chemical Co. Div.
CSD	Cosden Oil & Chemical Corp.	SHO	Shell Oil Co.
CSD	Cities Service Co.	SIO	Standard Oil Co.
CSP	Coastal States Petrochemical Co.	SKO	Getty Refining & Marketing Co.
DOW	Dow Chemical Co.	SM	Mobil Oil Corp. & Mobil Chemical Co.
DUP	E. I. duPont de Nemours & Co., Inc.	SNO	SunOlin Chemical Co.
EXK	Eastman Kodak Co., Texas Eastman Co. Div.	SOC	Standard Oil Co. of California, Chevron Chemical Co.
ELP	El Paso Products Co.	SOC	Charter International Oil Co.
ENJ	Exxon Chemical Co. U.S.A.	STY	Styrochem Corp.
FC	Foster Grant Co., Inc.	SUN	Sun Company, Inc.
FRS	Firestone Tire & Rubber Co., Firestone Synthetic Rubber & Latex Co. Div.	SWC	Corco Cyclohexane, Inc.
GOC	Gulf Oil Corp., Gulf Oil Chemicals Co.-U.S.	TBO	Tauber Oil Co.
GRS	Champlin Petroleum Co.	TID	Getty Refining & Marketing Co.
HCF	Hercofina	TNA	Ethyl Corp.
HCR	Hercor Chemical Corp.	TOC	Tenneco Oil Co.
HES	Amerada Hess Corp. (Hess Oil Virgin Islands Corp.)	TUS	Texas-U.S. Chemical Co.
HMY	Humphrey Chemical Co.	TX	Texaco, Inc.
JCC	Jefferson Chemical Co., Inc.	UCC	Union Carbide Corp.
		UOC	Union Oil Co. of California
		USI	National Distillers & Chemicals Corp., U.S. Industrial Chemicals Co.
		USR	Uniroyal, Inc., Uniroyal Chemical Div.

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.

Import Penetration of U.S. Markets for Cyclic Intermediates

Daniel F. McCarthy

Summary of current status of imports

Imports of cyclic (benzenoid) intermediates in 1977 amounted to 307 million pounds valued at \$325.9 million. Imports of cyclic intermediates are covered in part 1 B, Schedule 4 of the TSUS. In the import statistics, they are referred to as benzenoid chemicals and include a certain amount of noncyclic chemicals which were manufactured from cyclic raw materials. Imports more than doubled in 1972-77 (\$150 million in 1972: \$326 million in 1977; table A). However, because of inflation in the United States and the different inflation rates in exporting countries, these value figures may not reflect the true impact of imports on the U.S. market for cyclic intermediates. On the basis of quantity, imports of organic cyclic intermediates amounted to 221 million pounds in 1972 and have increased irregularly through 1977 to 307 million pounds, which represents an average growth rate of 6.8 percent per year.

The ratio of the value of imports of cyclic intermediates to that of domestic sales ranged from 6.5 percent to 9.8 percent in 1972-77. Measured, however, on the basis of volume the ratio of imports to sales did not exceed 2.8 percent in the last 5 years. In 1974 when imports of cyclic intermediates peaked at 2.8 percent of U.S. sales, they amounted to 401 million pounds, valued at \$259 million. Sales of such products in 1974 by domestic producers amounted to 14.2 billion pounds, valued at \$3.4 billion.

The principal cyclic intermediate imports (along with those benzenoid non-cyclic chemicals referred to in the first paragraph) in 1977 were phthalic anhydride, (53 million pounds), cyclohexane (22 million pounds), and acetone (18 million pounds). Increased U.S. consumption of phthalate plasticizers, especially those used to increase flexibility of polyvinyl chloride (PVC) plastics materials, and increased use of polyester resins provided an increase in the market for imports of phthalic anhydride over that of 1976 when such imports amounted to 31.5 million pounds.

Increased domestic consumption of nylon 6 and nylon 66 resulted in the increased demand for cyclohexane as a precursor material for these products. Increased consumption of acetone for such uses as the manufacture of methyl methacrylate and for bisphenol A were contributing factors to the large volume of acetone imports in 1977. Bisphenol A is used in the manufacture of epoxy resins and polycarbonate resins, which are expected to grow from 7 to 10 percent a year according to industry estimates. Methyl methacrylate is likewise used as a raw material for plastics and resins.

Derivation and uses of principal cyclic intermediates

The cyclic intermediates included here are derived principally from the basic petrochemical raw materials: benzene, toluene, xylene and naphthalene. The principal intermediates derived from benzene include cyclohexane, phenol, styrene, detergent alkylates, maleic anhydride, and aniline. Cyclohexane is used mostly in the production of the nylons. Styrene is polymerized to polystyrene and used in plastics products. Styrene is also used in synthetic rubber, polyester resins and alkyd protective coatings. Phenol is used in the manufacture of phenolic resins and of bisphenol A. Other products obtained from phenol include caprolactam used to produce nylon 6, alkylated phenols, and chlorinated phenol to make the herbicide 2, 4-D. A byproduct in the production of phenol from cumene, alpha-methylstyrene, is used as an additive in resin formulations to increase their high-temperature performance. The alkylbenzenes are used mostly to make synthetic detergents. Maleic anhydride is used to make alkyd resins, some agricultural chemicals, and styrene-maleic anhydride resins. Aniline is used to produce isocyanates which, in turn, are used to make polyurethanes for insulation, cushioning, and other applications of foamed plastics. Aniline is also used in the production of dyes, drugs, and photographic chemicals such as hydroquinone. Monochlorobenzene has been used in the manufacture of the pesticide DDT, drugs, perfumes, and in solvents. Ortho-dichlorobenzene is used mostly as a solvent for metal degreasing. Para-dichlorobenzene, on the other hand, is used as a moth repellent for wool. Resorcinol (meta-dihydroxybenzene) is used by the tire industry in a resorcinol-formaldehyde resin to bond the tire cord to the rubber. Resorcinol-formaldehyde resins are also used as wood adhesives.

Intermediates derived from toluene include toluene diisocyanate (TDI), benzoic acid and phenol. Toluene diisocyanates, when reacted with polyols or polyesters, make polyurethanes. The flexible polyurethane foams are used for cushioning and padding in automobiles and furniture. The semi-rigid urethane foams are used for crash pads in automobiles, whereas the rigid urethane foams are used in plastic panels for home construction and insulation.

The principal intermediates produced from xylene include phthalic anhydride from ortho-xylene, isophthalic acid made from meta-xylene, and terephthalic acid from para-xylene. The major uses of phthalic anhydride include plasticizers, alkyd resins and unsaturated polyester resins. Isophthalic acid is also used to make unsaturated polyester and alkyd resins. Terephthalic acid (TPA) and its dimethyl ester (DMT) are primarily (90 percent) used to make polyester fibers and the remaining 10 percent is used to make polyester plastic film.

Intermediates derived from naphthalene include phthalic anhydride, insecticide intermediates and beta-naphthol which is used in the manufacture of dyes, rubber, perfume, and pharmaceuticals.

U.S. production and sales

In 1977, the volume of U.S. production of all industrial organic chemicals (principally cyclic intermediates) amounted to 43 billion pounds, representing an increase of 27.4 percent over the 34 billion pounds produced in 1976. Of that 1977 volume, the output of cyclic intermediates was about 16 percent more than in 1976; sales, however, were only 1.6 percent larger than in 1976. Production of cyclic intermediates amounted to 36.9 billion pounds in 1977 and sales amounted to 13.2 billion pounds, valued at \$3.4 billion (the difference between the two sets of numbers being captive consumption). In addition to the cyclic intermediates, there is an estimated production in 1977 of miscellaneous industrial organic chemicals amounting to approximately 6.5 billion pounds; sales amounted to 2.3 billion pounds, valued at \$1.3 billion.

Comparison of the output of some of the principal cyclic intermediates in 1977 with that in 1976 shows an increase in 1977 of 44.1 percent for ethylbenzene, 38.1 percent for cyclohexane, 9.0 percent for styrene monomer, 7.4 percent for aniline, 7.1 percent for dimethyl terephthalate, 3.5 percent for toluene diisocyanate (80/20 mixture), and 1.4 percent for bisphenol A. The output of synthetic phenol in 1977 increased 10.7 percent over 1976, whereas, the output of monochlorobenzene decreased 1 percent. Production of cresols and cresylic acid, however, decreased 11.5 percent; production of straight-chain dodecylbenzene decreased only slightly. For this group of selected intermediates, which account for 67.7 percent of the 1977 output of all industrial organic chemicals, there was an increase of 17.5 percent in output in 1977 over the 1976 output.

Sales of intermediates in 1977 were influenced by several factors including changes in consumer demand for the end products of the chemical industry. The severe weather conditions in the eastern United States in the first quarter of 1977 hampered transportation and thereby reduced sales of chemicals. There was a slight increase in the demand for housing which resulted in an increased demand for plastics and in turn a demand for plasticizers made from phthalic anhydride. Increased sales of automobiles had a favorable effect on the sales of alpha-methylstyrene-based plastics. Along with increased sales of intermediates in 1977, raw materials had increased 6.5 percent; one producer announced that his intermediates prices will be increased by 5.0 percent. 1/

Industry changes

In 1977, there were 172 producers of cyclic intermediates, compared with 175 producers in 1976. There were approximately 1400 cyclic intermediates produced by these manufacturers, many items produced by only one manufacturer. In 1977, one large producer of many of these cyclic intermediates was reported to be negotiating with a foreign producer for the purpose of selling the company. The sale will probably be consummated in 1978.

---

1/ Chemical Marketing Reporter, Mar. 13, 1978 p. 55.

### Concentration in the industry

In 1977, 5 of the 172 companies accounted for 37 percent of the sales value and 10 companies accounted for 56 percent. These ratios are significantly higher than those in 1973 when 5 companies accounted for 25 percent and 10 companies 36.5 percent. The trend in overall concentration seems to be increasing in favor of the larger companies. However, there is a large number of producers of the large-volume cyclic intermediates. For example, there are 10 producers of phthalic anhydride, 17 producers of phenol, and 15 producers of styrene monomer.

### Regulations

There are many Government regulations which affect the production and sales of chemicals in the United States. However, of particular interest is the Toxic Substances Control Act, which was passed in late 1976, with the Environmental Protection Agency (EPA) being responsible for establishing standards for the use of toxic chemicals. In 1977 para-phenylenediamine (PPD) and 2,4-diaminoanisole (2,4-D) were found in tests conducted by the National Cancer Institute to have a positive link to cancer in animals. <sup>1/</sup> In December, 1977 the Environmental Protection Agency (EPA) published a notice on inventory reporting regulations. <sup>2/</sup> These regulations required that, effective January 1, 1978, persons who manufacture or import chemical substances: (1) report the identity of each; (2) estimate the amount manufactured; and (3) indicate whether each chemical substance is manufactured and used only within one site.

Although precise data are not available for the cyclic intermediates industry, expenditures for pollution control by the entire chemical industry in 1977 amounted to 11 percent of total capital expenditures. The chemical industry spent \$301 million for water pollution control, \$470 million for air purification, and \$96 million for solid waste control; a total of \$867 million. <sup>3/</sup>

### International trade

In 1973-77, the value of U.S. exports of industrial (benzenoid) organic chemicals exceeded imports in this group by an average ratio of 3.3 to 1. Analysis of the 1977 U.S. foreign trade statistics for this group of chemicals showed a lower unit value for exports (28 cents per pound) than for imports (\$1.06 per pound).

Imports of industrial (benzenoid) organic chemicals in 1977 amounted to \$326 million compared with \$294 million in 1976. Since 1972, imports have

---

<sup>1/</sup> Chemical Week, Jan. 25, 1978, p. 13.

<sup>2/</sup> Federal Register, Dec. 23, 1977, p. 64572.

<sup>3/</sup> McGraw-Hill Publications, annual Survey of Pollution Control Expenditures.



grown from \$150 million to \$326 million in 1977 or by an average growth rate of 16.8 percent per year (table A). On the basis of quantity, however, the average annual growth rate in 1972-77 for imports of industrial organic chemicals was 6.8 percent per year compared with 6.6 percent for exports and 6.9 percent for domestic production. The principal sources of imports of cyclic intermediates in 1972-77 were West Germany and Japan and, in 1975-77, Italy, the United Kingdom, and Switzerland were also important sources. In 1977 these five countries accounted for nearly 80 percent of the total imports for consumption of cyclic intermediates (benzenoid chemicals) (table B). Analysis of benzenoid intermediates imports in 1974 through 27 customs districts showed that imports through the port of New York accounted for 64 percent of the total, followed by Houston, Tex. (8 percent); Norfolk, Va. (4.5 percent); Philadelphia, Pa. (3.4 percent) and Wilmington, N.C. (3.3 percent).

The principal products imported, which vary from year to year, reflect the demand for such products in the United States. Analysis of benzenoid cyclic intermediate imports in 1976 showed that 77 percent of the total quantity was accounted for by the following functional-group products: phenols and phenol alcohols (17.9 percent); polycarboxylic acids (17.3 percent); hydrocarbons (15.9 percent); amine-function compounds (8.7 percent); oxygen-function amines (6.0 percent); ketones (4.1 percent); hydrocarbon derivatives, (3.9 percent); and halogenated hydrocarbons (3.4 percent). In 1977, on the basis of an analysis of imports of benzenoid chemicals and products by the U.S. International Trade Commission, phthalic anhydride (53 million pounds) was the principal product imported. The principal sources of phthalic anhydride were Italy, Canada, Venezuela, Mexico, and Argentina. Cyclohexane (22 million pounds) was the second most important cyclic intermediate imported in 1977. Cyclohexane was imported from Argentina and West Germany. Acetone (18 million pounds) came from Italy, Brazil, West Germany, and the Netherlands. (Imports of nonbenzenoid acetone, made from isopropyl alcohol, were insignificant in 1977). Other imports of lesser volume in 1977 included maleic anhydride, para-cresol, caprolactam, styrene monomer, m,p-cresol, copper phthalocyanine crude, phenol, fumaric acid, 1-chloro-2-nitrobenzene, H acid, p-nitroaniline, and beta-naphthol. Imports of these 15 intermediates accounted for approximately 63 percent of the total quantity of intermediates imported in 1977.

There were 819 benzenoid intermediates imported in 1977: 67 more than the 752 imported in 1976. During 1977, imports from member countries of the Organization for Economic Cooperation and Development (OECD) accounted for 89 percent of the total value of imports of cyclic intermediates; with 11 percent coming from less developed countries. The nine European Economic Community (EEC) countries accounted for 54 percent of the total and Japan for 20 percent.

Prices of imported benzenoid cyclic intermediates are usually lower than those of the competitive domestic products. However, the values of competitive imports are appraised by the U.S. Customs Service for duty purposes based on the American selling price (ASP) of the domestic products. Since the oil embargo of 1974, some prices of benzenoid chemicals imported from Europe have been higher than like or similar domestic products. In addition, prices of some imports of cyclic intermediates, especially from Europe, by U.S. subsidiaries of foreign manufacturers may not reflect the true market value of these products. These related-party transactions amounted to 32 percent of the total value of imports of cyclic intermediates in 1976, the latest year for which statistics are available.

#### Exports of cyclic intermediates

The United States maintains a positive balance of trade in cyclic intermediates. In 1973-77, the value of exports ranged from 3 to 3.8 times the value of imports. Exports went principally to the Netherlands, Canada, Brazil, Mexico, and Belgium in 1976 and 1977. These countries accounted for approximately 45 percent by value of the total exports of cyclic intermediates in 1977. The principal industrial organic chemical products exported in 1977 were styrene monomer, lubricating oil additives, toluene diisocyanates (TDIs), detergent alkylates, rubber-processing chemicals, and cyclohexane. These products accounted for 48 percent of the total value of exports of cyclic intermediates in 1977.

#### Balance of trade

In each year since 1966, exports of cyclic intermediates have been much larger than imports (tables A and B). In 1976 and 1977, the United States has had a negative balance of trade with West Germany, Japan, Italy, the United Kingdom, Switzerland, and France. Imports from West Germany in 1977 exceeded exports to that country by \$100 million; imports from Japan exceeded exports to Japan by \$35 million <sup>1/</sup>; imports from Italy exceeded exports by \$33 million. Our negative balance of trade with the United Kingdom, Switzerland, and France was considerably smaller. On the other hand, our trade balance with Belgium, Canada, the Netherlands, Mexico, and Brazil has been positive (table C). In 1977, our exports to the Netherlands exceeded imports by \$152 million, exports to Canada were \$75 million larger than imports; exports to Mexico were \$58 million larger than imports; and exports to Brazil were \$78 million larger. Brazil has become a sizeable export market for industrial organic chemicals in the past 2 or 3 years.

---

<sup>1/</sup> However, the U.S. surplus was \$512 million for all chemicals traded with Japan in 1977.

Outlook

Although data were not available for the cyclic intermediates industry, the sales by majority-owned foreign affiliates of U.S. chemical companies in 1976 amounted to \$43.1 billion, a 15 percent increase over the \$37.6 billion reported for 1975. 1/ This trend may have continued into 1977.

According to the U.S. Department of Commerce, the value of shipments for the Industrial Organic Chemicals Industry (SIC code 2869) is expected to increase by 10 percent in 1978 over 1977. 2/ However, "three important unknowns are clouding the year ahead in the industry." 3/ The unknowns referred to are: (1) dependence on petroleum feedstocks, including natural gas; (2) the Toxic Substances Control Act; and (3) the scheduled trade negotiations (General Agreements on Tariffs and Trade) regarding tariff reductions and trade restrictions. "Until a clearer picture emerges, a wait and see attitude seems to have developed, affecting decisions on new plant investments in 1977 and perhaps into 1978." 3/

---

1/ Survey of Current Business, Mar. 1978, p. 34.

2/ U.S. Industrial Outlook, 1978, p. 93.

3/ Ibid., p. 85.

Table A.--Industrial organic chemicals: 1/ U.S. production, imports, exports, and apparent consumption, 1966-77

Year	Production <u>2/</u>	Imports <u>3/</u>	Exports <u>4/</u>	Apparent consumption	Ratio of imports to consumption
	<u>Million dollars</u>	<u>Million dollars</u>	<u>Million dollars</u>	<u>Million dollars</u>	<u>Percent</u>
1966-----:	2,391 :	48 :	211 :	2,228 :	2.1
1967-----:	2,503 :	48 :	231 :	2,320 :	2.1
1968-----:	2,915 :	67 :	292 :	2,690 :	2.5
1969-----:	3,325 :	84 :	290 :	3,119 :	2.7
1970-----:	3,229 :	91 :	336 :	2,984 :	3.0
1971-----:	3,467 :	129 :	304 :	3,292 :	3.9
1972-----:	3,730 :	150 :	320 :	3,560 :	4.2
1973-----:	4,110 :	169 :	484 :	3,795 :	4.5
1974-----:	8,037 :	259 :	930 :	7,366 :	3.5
1975-----:	7,569 :	205 :	779 :	6,995 :	2.9
1976-----:	8,882 :	294 :	1,008 :	8,168 :	3.6
1977-----:	12,217 :	326 :	995 :	11,548 :	2.8

1/ Principally cyclic benzenoid intermediates. Some acyclic organic chemical compounds derived from benzenoid chemicals are also included.

2/ Partly estimated. Statistics include duplication since some of the chemicals represent successive steps in production. Value of production calculated using the average unit values of sales of all products.

3/ For the most part, imports have been "competitive" with domestic production and have been valued for duty purposes at the "American selling price." Data represents customs import value--the value appraised by the U.S. Customs Service in accordance with the legal requirements of sec. 402 and 402a of the Tariff Act of 1930, as amended.

4/ Includes exports of some finished products. Figures include estimates and are not strictly comparable with imports or production.

Source: Production, U.S. International Trade Commission, Synthetic Organic Chemicals, United States Production and Sales; imports compiled from official statistics of the U.S. Department of Commerce. Exports are partly estimated, compiled from official statistics of the U.S. Department of Commerce.

Table B.--Industrial organic chemicals: 1/ U.S. imports for consumption, by principal sources, 1972-77

(In thousands of dollars 2/)

Source	1972	1973	1974	1975	1976	1977
West Germany-----	66,085	72,715	84,059	62,145	94,768	105,172
Japan-----	36,181	29,793	65,027	49,243	61,228	65,770
Italy-----	11,305	10,705	17,323	19,073	30,678	32,711
United Kingdom-----	7,605	10,433	21,119	18,820	24,709	31,132
Switzerland-----	11,593	16,063	15,846	14,773	17,280	21,956
France-----	1,611	4,233	8,585	9,797	12,371	15,763
Belgium-----	1,220	7,919	10,494	1,871	2,154	9,839
Canada-----	4,301	5,515	4,826	4,352	8,081	7,270
Netherlands-----	5,067	4,724	10,291	6,738	8,987	4,858
Mexico-----	35	486	1,812	388	3,452	4,673
Argentina-----	3	-	-	657	1,927	3,353
All other-----	5,031	6,892	19,190	17,625	28,201	23,403
Total-----	150,037	169,478	258,572	205,482	293,836	325,900

1/ Principally cyclic benzenoid intermediates. Some acyclic organic chemical compounds derived from benzenoid chemicals are also included.

2/ Customs import value, the value appraised by the U.S. Customs Service in accordance with the legal requirements of sec. 402 and 402a of the Tariff Act of 1934, as amended.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table C.--Industrial organic chemicals: U.S. trade, by principal trading partners, 1976 and 1977.

(In thousands of dollars)

Source	Imports <u>1/</u>	Exports <u>2/</u>	Trade Balance
1976:			
West Germany-----	94,768	10,487	-84,281
Japan-----	61,228	27,380	-33,848
Italy-----	30,678	<u>3/</u>	-30,000
United Kingdom-----	24,709	15,497	-9,212
Switzerland-----	17,280	2,681	-14,599
France-----	12,371	11,401	-970
Belgium-----	2,154	46,779	44,625
Canada-----	8,081	93,471	85,390
Netherlands-----	8,987	178,111	169,124
Mexico-----	3,452	63,964	60,512
Argentina-----	1,927	<u>3/</u>	-1,500
Brazil-----	98	59,444	59,346
All other-----	28,103	498,985	470,882
Total-----	293,836	1,008,200	714,364
1977:			
West Germany-----	105,172	5,038	-100,134
Japan-----	65,770	30,736	-35,034
Italy-----	32,711	<u>3/</u>	-32,500
United Kingdom-----	31,132	27,458	-3,674
Switzerland-----	21,956	6,541	-15,415
France-----	15,763	<u>3/</u>	-15,500
Belgium-----	9,839	61,126	51,287
Canada-----	7,270	82,676	75,406
Netherlands-----	4,858	156,581	151,723
Mexico-----	4,673	62,965	58,292
Argentina-----	3,353	6,283	2,930
Brazil-----	538	78,512	77,974
All other-----	22,865	477,469	454,604
Total-----	325,900	995,385	669,485

1/ Data represent customs import value--the value appraised by the U.S. Customs Service in accordance with the legal requirements of sec. 402 and 402a of the Tariff Act of 1930, as amended.

2/ Includes exports of some finished products. Figures include estimates and are not strictly comparable with imports.

3/ Not available.

Source: Imports compiled from official statistics of the U.S. Department of Commerce. Exports are partly estimated, compiled from official statistics of the U.S. Department of Commerce.

Note.--Because of rounding, figures may not add to the totals shown.

## Cyclic Intermediates

Daniel F. McCarthy and Bonnie Noreen

Cyclic intermediates are synthetic organic chemicals derived principally from petroleum and natural gas and from coal-tar crudes produced by destructive distillation (pyrolysis) of coal. Most cyclic intermediates are used in the manufacture of more advanced synthetic organic chemicals and finished products, such as dyes, medicinal chemicals, elastomers (synthetic rubber), pesticides, and plastics and resin materials. Some intermediates, however, are sold as end products without further processing. For example, refined naphthalene may be used as a raw material in the manufacture of 2-naphthol or of other more advanced intermediates, or may be packaged and sold as a moth repellent or as a deodorant. In 1977 about 43 percent of the total output of cyclic intermediates was sold; the rest was consumed chiefly by the producing plants in the manufacture of more advanced intermediates and finished products.

Total production of cyclic intermediates in 1977 amounted to 18,726 million pounds, a 6 percent increase from the 17,700 (revised) million pounds produced in 1976. Sales of cyclic intermediates in 1977 were 7,986 million pounds, valued at \$2,597 million, compared with 7,664 million pounds, valued at \$2,387 million in 1976. These totals for 1976 and 1977 cannot be compared with 1975 figures because several items were transferred to the primary products from petroleum and natural gas section.<sup>1</sup>

Intermediates which were produced in excess of 2 billion pounds in 1977 were dimethyl terephthalate (5,410 million pounds), and phenol (2,338 million pounds). Other large-volume intermediates produced in 1977 were isocyanates (1,057 million pounds), phthalic anhydride (926 million pounds), cyclohexanone (745 million pounds), aniline (584 million pounds), nitrobenzene (552 million pounds), alkylbenzenes (526 million pounds), bisphenol A (455 million pounds), monochlorobenzene (326 million pounds), toluene-2,4-diamine (222 million pounds), and 2,4-dinitrotoluene (209 million pounds). The 12 chemicals noted above accounted for 71 percent of the total output of intermediates in 1977.

---

<sup>1</sup> Items transferred from cyclic intermediates to primary products from petroleum and natural gas are ethylbenzene, cyclohexane, cyclohexene, styrene, m-xylene, o-xylene, p-xylene, and cumene.





TABLE 1.--CYCLIC INTERMEDIATES: U.S. PRODUCTION AND SALES, 1977

[Listed below are all cyclic intermediates for which any reported data on production and sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists alphabetically all cyclic intermediates on which data on production and/or sales were reported and identifies the manufacturers of each]

CYCLIC INTERMEDIATES	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	18,725,626	7,985,790	2,596,627	\$0.33
o-Acetoacetanilide-----	...	1,276	1,879	1.47
o-Acetoacetoroluidide-----	...	1,268	946	.75
Acetophenone, tech-----	4,299	...	...	...
Alkylbenzenes <sup>2</sup> -----	526,121	456,491	116,969	.26
3'-Amino-p-acetanilidide-----	739	...	...	...
1-Amino-2-bromo-4-hydroxyanthraquinone-----	800	...	...	...
p-[(p-Aminophenyl)azo]benzenesulfonic acid-----	277	...	...	...
Aniline (Aniline oil)-----	584,078	175,892	42,081	.24
2-Anilinoethanol-----	130	20	24	1.24
Anilinomethanesulfonic acid and salt-----	350	...	...	...
Benzoic acid, tech-----	79,637	30,854	7,489	.24
2-Benzothiazolethiol, sodium salt-----	...	4,106	2,636	.64
Biphenyl-----	68,274	26,826	7,364	.27
p-tert-Butylphenol-----	22,531	19,402	7,358	.38
Butylphenols, mixed-----	1,389	574	198	.34
6-tert-Butyl-2,4-xylene-----	285	...	...	...
Chlorobenzene, mono-----	325,518	174,840	35,049	.20
4-Chlorophthalic acid-----	619	...	...	...
Cresols, total <sup>3</sup> -----	92,842	82,106	41,075	.50
o-Cresol-----	21,060	15,710	6,636	.42
All other <sup>4</sup> -----	71,782	66,396	34,439	.52
Cresylic acid, refined <sup>3</sup> -----	46,449	41,801	13,868	.33
p-[(2-Cyanoethyl)methylamino]benzaldehyde-----	100	...	...	...
Cyclohexanone-----	744,949	32,618	11,743	.36
Cyclohexylamine-----	6,868	6,490	4,799	.74
1,4-Diaminoanthraquinone-----	47	...	...	...
o-Dichlorobenzene-----	47,371	55,741	15,250	.27
p-Dichlorobenzene-----	65,094	62,039	14,235	.23
2,4-Dichlorophenol-----	...	8,889	5,387	.61
N,N-Diethylaniline-----	2,118	1,833	1,740	.95
1,4-Dihydroxyanthraquinone (Quinizarin)-----	1,690	...	...	...
N,N-Dimethylaniline-----	13,060	8,672	4,810	.55
N,N-Dimethylbenzylamine-----	66	...	...	...
2,4-Dinitrotoluene-----	209,091	...	...	...
Dinonylphenol-----	1,717	1,819	577	.32
p-Dodecylphenol-----	32,307	...	...	...
N-Ethylaniline, refined-----	992	1,115	960	.86
2-(N-Ethylanilino)ethanol-----	292	...	...	...
N-Ethyl-N-phenylbenzylamine-----	1,263	...	...	...
3-(N-Ethyl-m-toluidiio)propionitrile-----	154	103	221	2.14
Hydroquinone, tech-----	...	11,892	16,559	1.39
p-Hydroxybenzenesulfonic acid-----	...	10,089	3,380	.33
Isocyanic acid derivatives, total-----	1,057,315	951,346	462,806	.49
Polymethylene polyphenylisocyanate-----	352,250	316,491	146,477	.46
Toluene-2,4- and 2,6-diisocyanate (80/20 mixture)-----	583,610	532,498	240,571	.45
Other isocyanic acid derivatives-----	121,455	102,357	75,758	.74
4,4'-Isopropylidenediphenol (Bisphenol A)-----	454,942	121,438	45,597	.38
3,4-Lutidine-----	...	145	231	1.60
Melamine-----	125,918	76,091	26,710	.35
d1-p-Mentha-1,8-diene (Limonene)-----	8,755	6,994	725	.10
Metanilic acid (m-Aminobenzenesulfonic acid)-----	1,336	...	...	...
3-(N-Methylanilido)propionitrile-----	64	...	...	...

See footnotes at end of table.

TABLE 1.--CYCLIC INTERMEDIATES: U.S. PRODUCTION AND SALES, 1977--CONTINUED

CYCLIC INTERMEDIATES	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
4,4'-Methylenebis[N,N-dimethylaniline] (Methane base)-----	998	...	...	...
$\alpha$ -Methylstyrene-----	60,245	54,725	9,507	\$0.17
Nitrobenzene-----	552,329	19,193	4,182	.22
5-Nitro-o-toluenesulfonic acid [SO <sub>3</sub> H=1]-----	5,890	...	...	...
Nonylphenol-----	102,852	39,486	9,961	.25
1-[(7-Oxo-7H-benz[de]anthracene-3-yl)amino]anthraquinone-----	155	...	...	...
Phenol, total <sup>3</sup> -----	2,337,836	1,205,733	231,692	.19
From cumene-----	2,131,661	1,116,733	212,328	.19
Other-----	206,175	89,000	19,364	.22
2,2'-[(Phenyl)imino]diethanol (N-Phenyldiethanol-amine)-----	501	264	189	.71
Phthalic anhydride-----	925,952	566,794	128,492	.23
Salicylic acid, tech.-----	45,291	5,812	4,857	.84
Terephthalic acid, dimethyl ester <sup>5</sup> -----	5,409,672	...	...	...
Toluene-2,4-diamine (4-m-Tolylenedifamine)-----	222,400	...	...	...
1,3,3-Trimethyl- $\Delta^2,3$ -indolineacetaldehyde-----	373	...	...	...
1,3,3-Trimethyl-2-methyleneindoline-----	910	...	...	...
7,7'-Oxylenebis[4-hydroxy-2-naphthalenesulfonic acid]-----	260	...	...	...
Violanthrone (Dibenzanthrone)-----	236	...	...	...
All other cyclic intermediates-----	4,529,877	3,721,013	1,315,081	.35

<sup>1</sup> Calculated from unrounded figures.

<sup>2</sup> Includes straight-chain dodecylbenzene, tridecylbenzene, and other straight-chain alkylbenzenes. Branched-chain alkylbenzenes are included in "All other cyclic intermediates."

<sup>3</sup> Does not include data for coke ovens and gas-retort ovens, reported to the Office of Energy Data and Interpretation, Energy Information Administration, Department of Energy.

<sup>4</sup> Figures include (o,m,p)-cresol from coal tar and some m-cresol and p-cresol.

<sup>5</sup> The figures for terephthalic acid, dimethyl ester (DMT) include both the acid itself and the dimethyl ester without double counting. The acid production figure was multiplied by the factor 1.16 to convert it to equivalent DMT.

Note.--The data for production (in thousands of pounds) for cyclic intermediates for 1976 have been revised as shown below:

Grand total-----	17,700,000
Terephthalic acid, dimethyl ester-----	5,051,049

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977

(CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT. COMPANY IDENTIFICATION CODES WHICH ARE FOLLOWED BY AN "(E)" ARE SO LABELED BECAUSE THE COMPANY FAILED TO SUPPLY THE U.S. INTERNATIONAL TRADE COMMISSION WITH THEIR DATA IN SUFFICIENT TIME FOR ITS INCLUSION IN THIS REPORT. THE COMPANY IS PRESUMED TO HAVE CONTINUED PRODUCTION OF THE COMPOUND IN QUESTION IN 1977 AND THE VOLUME OF PRODUCTION AND SALES HAS BEEN ESTIMATED BY THE USITC STAFF MEMBERS)

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
8-Acetamido-1-(4-acetamido-2-hydroxy-5-nitrophenylazo)-	TRC.
2,7-naphthol	
3-(4-Acetamido-4-aminophenylazo)-1,5-naphthalenedisul-	TRC.
6-sulfonic acid	HST.
5-Acetamido-2-ethoxy-N-(2-cyanoethyl)aniline	HST.
5-Acetamido-2-ethoxy-N-(2-cyanoethyl)ethylaniline	HST.
5-Acetamido-2-ethoxyethyl-N-(2-cyanoethyl-N-hydroxy-	
ethyl)aniline	HST.
2,2'-(3-Acetamido-6-ethoxyphenyl)imino]diethanol	HST.
2,2'-(5-Acetamido-2-ethoxyphenyl)imino]diethanol	TCH.
2,2'-(3-Acetamido-6-ethoxyphenyl)imino]diethanol	HST.
2,2'-(3-Acetamidophenyl)imino]diethanol	TCH.
3-Acetamido-N-(2-succinimidoethyl)-N-ethylaniline	EKT.
4-Acetaminophenacyltrimeethylammonium chloride	DUP.
Acetanilide, N.F.	SAL.
Acetanilide, tech.	ARA.
p-Acetanilide	EKT.
Acetoacetanilide	SDC.
o-Acetoacetanilide	EKT.
*o-Acetoacetanilide	FMP, HST.
*o-Acetoacetotoluamide	EKT, FMP, HST, SDH.
2,4,4'-Acetoacetotoluidide	EKT, FMP, HST.
1-Acetonaphthone	EKT, HST.
Acetone phenylhydrazone	GIV.
Acetophenone, crude	DUP.
*Acetophenone, tech.	ACS.
p-Acetoatoluidide	MON.
N-(2-Acetoxyethyl)-N-(2-cyanoethyl)aniline	SKO, UCC.
	EK.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
4-Acetylamino-p-toluenesulfonamide	SDM.
N-Acetylanthranilic acid	SM.
p-Acetylbenzenesulfonamide	LIL.
p-Acetylbenzenesulfonic acid, sodium salt	LIL.
p-Acetylbenzenesulfonamide	LIL.
N-Acetylsulfanilic chloride	ACY, ARA.
*ALKYLBENZENES:	
Alkylbenzene straight-chain (Except dodecyl and tri-decyl)	MON(E), WTC.
DODECYLBENZENE (INCLUDING TRIDECYLBENZENE):	
Dodecylbenzene, straight-chain	CO, MON(E), UCC, WTC.
Dodecylbenzene, other	CC, SOC, WTC.
Alkylbenzene all other (Except dodecyl, tridecyl and straight-chain)	WTC.
Alkylphenols, alkyl-	PED.
3'-Aminoacetanilide	AC.
4'-Aminoacetanilide (Acetyl-p-phenylenediamine)	GAF, SAL, TRC.
*3'-Amino-p-acetanilide	ERT, HST, SDC.
3'-Aminocetophenone	ARA.
3'-Amino-p-acetophenone	HST.
3'-Amino-p-acetophenidine	TRC.
5-Amino-2-(p-aminophenyl)benzenesulfonic acid	DUP.
4-Amino-3-((4-aminophenyl)azo)-5-hydroxy-6-phenylazo-2,1-naphthalenesulfonamide	TRC.
2-(p-aminophenyl)nitrobenzenesulfonic acid	PCW.
1-Amino-p-anisidine and salt	ACY, TRC.
6-Amino-3,4-azobenzenesulfonic acid (C.I. Acid Yellow 8)	TRC.
p-Amino-benzamide	SAL, SDH.
1-Amino-4-benzamidoanthraquinone	ACY, TRC.
7-(p-Aminobenzamido)-4-hydroxy-2-naphthalenesulfonic acid	TRC.
o-Aminobenzethiol	FMI.
p-Aminobenzoic acid, tech.	PD, SAL.
2-Amino-6-benzothiazolecarboxylic acid	DUP.
2-Amino-6-benzothiazolesulfonic acid	DUP.
1-Amino-4-bromo-9,10-dihydro-9,10-dioxo-2-anthracenesulfonic acid and sodium salt	AC, TRC.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES		MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
1-Amino-2-bromo-4-hydroxyanthraquinone		AC, DUP, GAF, VPC.
1-Amino-2-chloroanthraquinone		TRC.
4-Amino-2-chloro-5-benzene disulfonamide		TRC.
2-Amino-5-chlorobenzophenone sulfonamide chloride		AB.
1-Amino-5-chlorobenzophenone sulfonamide		AB.
1-Amino-2-chloro-4-hydroxyanthraquinone		TRC.
1-Amino-5-chloro-2-hydroxyanthraquinone		TRC.
3-Amino-6-chloropyridazine		ACY.
2-Amino-5-chloro-p-toluenesulfonic acid [SO <sub>3</sub> H*1]		ACY, HSC.
6-Amino-4-chloro-m-toluenesulfonic acid [SO <sub>3</sub> H*1]		ACY, DUP.
2-Amino-p-cresol		SM.
1-Amino-2,4-dibromoanthraquinone		DUP, GAF, VPC.
1-Amino-2,4-dichloroanthraquinone		TRC.
2-Amino-5,6-dichlorobenzothiazole		SAL.
5-Amino-4,5'-dihydroxy-3,4'-[(2-methoxy-5-ethyl-p-phenylene bis(azo))di-2,7-naphthalenedisulfonic acid, 5'-benzenesulfonate		TRC.
5-Amino-2,4-dimethylacetanilide		PD.
3-Amino-9-ethylcarbazole		AC, SDC.
3-Amino-8-ethylhydrocinnaamic acid-		SDM.
4-Amino-ethyl-N-(β-methylsulfonamidoethyl)-m-toluidine-phosphate		MAY.
4-Amino-5-hydroxy-2,7-naphthalenedisulfonic acid, benzenesulfonate		TRC.
3-Amino-9-ethylcarbazole		AC, SDC.
4-Amino-4-hydroxy-2-naphthalenesulfonic acid, sodium salt		TRC.
7-Amino-4-hydroxy-2-naphthalenesulfonic acid, sodium salt		AC, TRC.
3-Amino-2-hydroxy-5-nitrosacetanilide		TRC.
2-(2-Amino-5-hydroxy-7-sulfo-1-naphthylazo)-5-nitrobenzoic acid-		ACY, TRC.
2-(6-Amino-3-imino-3H-xanthen-9-yl)-benzoic acid, hydrochloride		TRC.
3-Amino-2-mercaptopbenzoic acid		ER.
		X.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
5-Amino-6-methoxy-2-naphthalenesulfonic acid	TRC.
5-[[4-Amino-3-methoxyphenyl]azo]benzenesulfonic acid	AC, TRC.
2-Amino-4-methoxytoluene	HST.
4-Amino-5-methoxy-o-toluenesulfonic acid	ATI.
4-[(4-Amino-5-methoxy-o-tolyl)azo]-4-hydroxy-2,7-naphthalenedisulfonic acid, benzenesulfonate	TRC.
3-[(4-Amino-5-methoxy-o-tolyl)azo]-1,5-naphthalenedisulfonic acid	TRC.
7-[(4-Amino-5-methoxy-o-tolyl)azo]-1,3-naphthalenedisulfonic acid	TRC.
3-Amino-4-methylbenzamide	SAL.
5-Amino-3-methyl-1-(4-chlorophenyl)pyrazole	DUP.
4-Amino-4-(3-methyl-5-oxo-2-pyrazolin-1-yl)-2,2'-stilbenedisulfonic acid	TRC.
2-Amino-6-methylpyridine	RIL.
2-Amino-4-methylpyrimidine (2-Amino-4-methyl-1,3-diazine)	ACY.
2-Amino-4-(methylsulfonyl)phenol	TRC.
2-Amino-5-methyl-1,3,4-thiadiazole	ACY.
2-Amino-1,5-naphthalenedisulfonic acid	ACI, SDH.
3-Amino-1,5-naphthalenedisulfonic acid (C Acid)	TRC.
6-Amino-1,3-naphthalenedisulfonic acid (Amino I acid)	AC, TRC.
7-Amino-1,3-naphthalenedisulfonic acid (Amino G acid)	AC, TRC.
2-Amino-1-naphthalenesulfonic acid (Tobias acid)	ACI, SW.
6-Amino-2-naphthalenesulfonic acid (Stoerner's acid)	TRC.
7-Amino-1,3-naphthalenedisulfonic acid	TRC.
8-Amino-1,3-naphthalenedisulfonic acid	AC.
8-Amino-2-naphthol	AC, TRC.
2-Amino-4-nitroacetamide	SDC.
2-Amino-5-nitrobenzenesulfonic acid [50-H]	TRC.
4-Amino-4-nitrobenzothiazole	HST, SAL.
2-Amino-5-nitro-1,4,2-dithiadisulfonic acid	AC, GAP, TRC.
3-Amino-5-nitrothiazole	PCM.
4-Amino-5-nitrothiazole	ATL, TRC.
4-Amino-5-nitrothiazole	ATL.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURERS, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS* IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
6-Aminopenicillanic acid	: WVT.
p-Aminophenethyl alcohol	: EMT.
o-Aminophenol	: TRC.
p-Aminophenol	: MAL, SDC.
m-[(p-Aminophenyl)azo]benzenesulfonic acid	: TRC.
p-[(p-Aminophenyl)azo]benzenesulfonic acid	: ACY, DUP, TRC.
7-[(4-Aminophenyl)azo]-1,3-naphthalenedisulfonic acid	: TRC.
5-Amino-8-(phenylazo)-2-naphthol	: ALL.
5-[(p-Aminophenyl)azo]salicylic acid	: ATL, TRC.
2,2'-(p-Aminophenylamino)diethanol, diacetate ester	: DUP.
2-(p-Aminophenyl)-6-methylbenzothiazole	: DEP.
2-(p-Aminophenyl)-6-methylbenzothiazolesulfonic acid	: DUP.
2-(p-Aminophenyl)-6-methyl-7-benzothiazolesulfonic acid and salt	: DUP, TRC.
1-(p-Aminophenyl)-5-oxo-2-pyrazoline-3-carboxylic acid	: TRC.
m-Aminophenylphosphonic acid	: ICI.
2-Aminopyridine	: NEP, RLL.
3-Aminopyridine	: RIL.
4-Aminopyridine	: RIL.
3-Amino-p-toluenamide	: SDH.
α-Amino-p-toluenesulfonamide	: SEM.
4-Amino-8-toluenesulfonic acid [SO <sub>3</sub> H=1]	: ACI, DUP.
5-Amino-8-toluenesulfonic acid [SO <sub>3</sub> H=1]	: DUP, ROH.
6-Amino-8-toluenesulfonic acid [SO <sub>3</sub> H=1]	: DUP.
m-[(4-Amino-3-tolyl)azo]benzenesulfonic acid	: TRC.
n-[(4-Amino-3-tolyl)azo]benzenesulfonic acid	: TRC.
7-[(4-Amino-3-tolyl)azo]-1,3-naphthalenedisulfonic acid	: TRC.
7-[(4-Amino-3-tolyl)azo]-1,3-naphthalenedisulfonic acid	: ACY, DUP, PST, MAL, ROH, BUC, USR.
8-Amino-3-toluenesulfonic acid	: ACY.
8-Amino-3-toluenesulfonic acid	: X.
2-Aminino-6-diethylamino-3-methylfluoran	: X.
*2-Amininoethanol	: EMT.
*7-Aminino-4-hydroxy-2-naphthalenesulfonic acid	: TRC, MLL, TCH.
*Anilinoethanesulfonic acid and salt	: AC, ACY, ATL, DUP, TRC.
B-Anilino-1-naphthalenesulfonic acid (Phenyl peroxide)	: EK, SDC.
3-Anilinoisopropionitrile	: DUP.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
o-Absaldehyde	ASL
o-Anisidine	DUP
p-Anisidine	DUP
p-Aminodimethanesulfonic acid	ATI, GAF, TRC
Aspartic acid	DUP
9,10-Anthracenedicarboxaldehyde	EK
Anthranilic acid (o-Aminobenzoic acid)	SW
Anthranilic acid, methyl ester	SW
Anthraquinone, 100%	TRC
N,N'-(1,5-Anthraquinonylene)diathranilic acid	TRC
4-Azidobenzaldehyde	EK
1-(p-Azo-azobenzene)-2-hydroxy-3,6-disulfonaphthalene, disodium salt	BCC
Benzaldehyde, tech.	HN, KLM, MNR(E), UOP
1-Benzamide-5-chloroanthraquinone	TRC
7-Benzamido-4-hydroxy-2-naphthalenesulfonic acid	ATI, TRC
Benzanilide	DUP
7H-Benz[e]lanthracen-7-one (Benzanthrone)	ACY, DUP, TRC
Benzenesulfonic acid	EK, UPF
Benzenesulfonic acid, propyl ester	CNN
Benzenesulfonyl chloride	UPF, USR
1,2,4-Benzenetetracarboxylic-1,2,4,5-dianhydride	DUP
1,2,4-Benzenetetracarboxylic-1,2-anhydride (Trimesitic anhydride)	ACC
Benzenesulfonic-4-chloro-3-(4,5-dihydro-3-methyl-5-oxo-4-(phenylazo)-1H-pyrazol-1-yl)sodium salt	BCC
Benzhydrol (Diphenylmethanol)	UOP
Benzidine hydrochloride and sulfate	GAF
Benzil	LEM
Benzilic acid	LEM
Benzoic acid, methyl ester	HPC
Benzoic acid, tech.	HN, KLM, PFZ, VEL
Benzoin	SFS
Benzoin isobutyl ether	SFS
Benzoin isopropyl ether	LEM, SFS



TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Benzoinoxime	BSA.
Benzonitrile	VEL.
2-Benzquinone dioxime	SDC.
2-Benzothiazolethiol	USR.
*2-Benzothiazolethiol, sodium salt	ACT, GYR, USB.
1-Benzocyclohexane	SW.
Benzoylacetic acid, ethyl ester	EKT, GAF.
o-Benzoylbenzoic acid	HK, VEL.
N-Benzyl chloride	SDS.
N-Benzylacetamide	MS, MLS.
N-Benzylamine	ABB.
4-Benzyl-6-chloro-3-keto-2-methyl-7-sulfa-1,2,4-benzothiadiazine-1,1-dioxide	ABB.
4-Benzyl-6-chloro-3-keto-7-sulfa-1,2,4-benzylthiadiazine-1,1-dioxide	ABB.
Benzyl ether (dibenzyl ether)	UOP.
3-Benzylethylaminoacetanilide	EKT.
4,4'-Benzylidenedi-o-toluidine	ACY.
Benzylidene phthalide	LIL.
6-Benzylideneaminopenicillanic acid, tertiary octylamine salt	TBD.
N-Benzylloxycarbonyl-5-norbornene-2,3-dicarboximide	X.
6-N-Benzylloxycarbonyl-tri-N-salicylidene kanamycin A	X.
1-Benzyl-4-phenylisonipicotonic acid	SDM.
1-Benzyl-4-phenylisonipicotonitrile	SDM.
Benzyltrimethylammonium chloride	MLS.
Benzyltrimethylammonium hydroxide	MLS.
[3,3']-Blanthra[1,9-cd]pyrazole]-6,6'-(2H,2'H)-dione (pyrazolanthrone Yellow)	TRC.
[4,4'-Bi-7H-benz[de]anthracene]-7,7'-dione	ACY, DUP.
Biphenyl	CHI, DON, GOC, MON, SUN, TCC.
3-[bis(2-acetoxethylamino)-p-acetonisidide]	TCR.
Bis-p-aminocyclohexylethane	DUP.
1,2-bis(2-aminophenyl)ethane	X.
1,4-bis[1-anthraquinonylamino]anthraquinone	TRC.
1,8-bis[1-anthraquinonylamino]anthraquinone and 1,4-bis[5-chloro-1-anthraquinonylamino]anthraquinone (mixed)	TRC.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
2,6-bis(p-azidobenzylidene)-4-methylcyclohexanone	X.
N-8-Bis [cyanobethyl]aniline	DUP.
4,4'-Bis[diethylamino]benzhydrol, 2,6-naphthalenedisulfonate	X.
4,4'-Bis[diethylamino]benzhydrol salt, 2,7-naphthalenedisulfonic acid mixture	TRC.
4,4'-Bis[diethylamino]benzophenone (ethyl ketone base)	X.
4'-Bis[diethylamino]phenyl methyl-2,7-naphthalenedisulfonic acid, leuco form	TRC.
1,4-Bis-(2,6-diethylphenyl)-9,10-anthracenedione	TRC.
4,4'-Bis[diethylamino]benzhydrol (Michler's hydrol)	EX.
4,4'-Bis[diethylamino]benzophenone (Michler's ketone)	X.
Bis(p-dimethylaminoethyl)phenylacetone nitrile	WV.
1,5-Bis[2,4-dinitrophenoxy]-4,6-dinitroanthraquinone	VPC.
3,3'-Bis[3,3'-(1'-ethyl-2'-methyl)indolyl]phthalide	X.
3'-Bis[2-hydroxyethylamino]acetanilide	GAF.
3-[Bis(2-hydroxyethylamino)benzanilide ester]	DUP.
3'-[Bis(2-hydroxyethylamino)benzanilide, diacetate ester]	TCR.
3-[Bis(2-hydroxyethylamino)-4-methoxyacetanilide]	EX.
4,4'-Bis(p-hydroxyphenylazo)-2,2'-stilbenedisulfonic acid (C.I. Direct Yellow 4)	ATL, TRC.
Bis(p-nitrophenyl)ether	DUF.
1,2-Bis(tribromophenoxy)ethane	VEL.
p-Bromocaniline	EX.
p-Bromocanisole	OPC.
3-Bromo-7H-benz[de]lanthracen-7-one (3-Bromoanthrone)	ACI.
Erosbenzenes-mono	GTI, HCC.
2-Bromo-6-chloro-4-nitroaniline	AC, HST.
2-Bromo-4-chlorophthalocyanine, copper salt	BCC.
2-Bromo-4,6-dinitroaniline	AC, HST, SDC.
2-(2-Bromo-4,6-dinitrophenylazo)-5-dimethylaminocetanilide	TRC.
Bromoethylbenzene	BSA.
2-Bromo-4'-nitroacetophenone	GAF, BSA.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
N-(4-Bromopentyl)-phthalimide	SDM.
(p-Bromophenyl)acetone trile	SFS.
4-Bromoresorcylic acid	PCW.
4-Bromoresorcylic acid, ethanolate	PCW.
Bromothephylane	CHT.
p-Bromotoluene	EK, SFS.
a-Bromotoluene	WCC.
2-Bromo-1,3,5-triethylbenzene	DUP.
p-Butylaniline	HDM.
3-(N-Butylanilino)propionitrile	MIL.
2-tert-Butylanthraquinone	DUP.
p-tert-Butylbenzaldehyde	GIV.
tert-Butylbenzene	UOE.
p-tert-Butylbenzoic acid	SHC.
o-(p-tert-Butylbenzoyl)benzoic acid	DUP.
2-tert-Butyl-p-cresol	ACY.
6-tert-Butyl-m-cresol	KPT.
2-tert-Butyl-4'-6'-dimethylacetophenone	GIV.
2-tert-Butyl-4-ethylphenol	ACY.
tert-Butylhydroquinone	X.
2-tert-Butyl-5-methylanisole	GIV.
o-sec-Butylphenol	TNA.
p-tert-Butylphenol	TNA.
Butylphenols, mixed	DCM, PRD, SCM.
p-Tert-Butyltoluene	DCM, PRD, SCM.
5-tert-Butyl-1,2,3-trimethylbenzene	GIV, SHC.
5-tert-Butyl-2-xylylene	GIV.
4-Y-Campesulifone	PII.
Carbamic acid, ZN-(2-cyano)ethyl phenylaminoethyl ester	KF, PRD, RH.
(3-Carbasoyl-3,3-diphenylpropyl)diisopropylmethyllasonium iodide	GAF.
Carboethoxyimidazole	SK.
N-[(3-Carboxy-4-chlorophenyl)-sulfonyl]anthranilic acid	ARM.
	TRC.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
2-Carboxydiphenyl sulfide	: PD.
2-(p-Carboxyphenoxy)-2-pivaloyl-2(4)-dichloroacetanilide	: EK.
Cedrene	: GIV.
o-Chloroanil	: DFJ.
2-Chloroacetamido-5-chlorobenzophenone	: WYT.
2'-Chloroacetacetanilide	: ENT, HST.
4'-Chloroacetophenone	: LLL.
3'-Chloro-p-acetotoluidide	: EK.
4'-(Chloroacetyl)acetanilide	: DUP.
9-Chloroacridine	: EK.
o-Chloroaniline	: DUP.
p-Chloroaniline	: DUP.
2-(o-Chloroanilino)ethanol	: MON.
3-(o-Chloroanilino)propionitrile	: ENT, TCH.
1-Chloroanthraquinone	: DUP, TCH.
2-Chloroanthraquinone	: ACY, TRC.
o-Chlorobenzaldehyde	: HN.
p-Chlorobenzaldehyde	: HN.
*Chloro-7H-benz[de]lanthracen-7-one (Chlorobenzanthrone)	: TRC.
Chlorobenzene, none	: ACS, DM, HTO, PPG, SCC.
p-Chlorobenzene, finaic acid	: TRC.
p-Chlorobenzene, sulfonamide	: HNC.
p-Chlorobenzene, sulfonic acid	: IMC.
p-Chlorobenzene, ethiol	: SCA, UPP.
o-Chlorobenzoic acid	: HN.
p-Chlorobenzoic acid, ethyl ester	: VFL.
p-Chlorobenzophenone	: OFC.
p-Chlorobenzoyl chloride	: HN.
N-(o-Chlorobenzyl)-N-ethyl-p-toluidine	: DUP.
4,4'-(o-Chlorobenzylidene)di-2,5-xylidine	: GAF.
p-Chlorobenzylsulfonamide	: PFZ.
Chloro(p-chlorobenzyl)phenylsulfane	: OFC, UOP.
7-Chloro-1,3-dihydro-3-hydroxy-5-phenyl-2H-1,4-benzodiazepin-2-one acetate ester	: WYT.
7-Chloro-1,3-dihydro-5-phenyl-2H-1,4-benzodiazepin-2-one-n-oxide	: WYT.

TABLE 2. --CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
4'-Chloro-2', 5'-dimethoxyacetanilide-	PCM.
4-Chloro-2,5-dimethoxyaniline - - - - -	PCM.
Chlorodimethoxybenzene - - - - -	PCM.
2-Chloro-10-[3-(diethylamino)propyl]phenothiazine - - - - -	SK.
1-Chloro-2,4-dinitrobenzene (Dinitrochlorobenzene) - - - - -	SDC.
3-Chloro-4,6-dinitrobenzenesulfonic acid - - - - -	TRC.
3-Chlorodiphenylamine - - - - -	SK.
Chlorodiphenylmethane - - - - -	OPC.
N-(2-Chloroethyl)-N-ethylaniline - - - - -	GAF.
N-(2-Chloroethyl)methylamino benzaldehyde - - - - -	DUP.
2-(2-Chloroethyl)oxy benzoic acid - - - - -	EK.
4-Chloro-4-hydroxyquinidine hydrochloride - - - - -	PD.
1-Chloro-3-telluric acid - - - - -	BCC.
4-Chloro-2-methylanthraquinone - - - - -	ACY, TRC.
4-Chloro-2-methylanthracene, crude - - - - -	SFS.
5-Chloro-2-(N-methyl-2-nitrobenzenesulfonamide) - - - - -	TRC.
ar-Chloro-methylstyrene - - - - -	ARB.
Chloronaphthalenes - - - - -	DOW.
2-Chloro-4-nitroaniline (o-Chloro-p-nitroaniline) - - - - -	KPT.
4-Chloro-2-nitroaniline (p-Chloro-o-nitroaniline) - - - - -	DUP.
1-Chloro-5-nitroanthracenol - - - - -	DUP.
1-Chloro-2-nitrobenzene (Chloro-o-nitrobenzene) - - - - -	TRC.
1-Chloro-4-nitrobenzene (Chloro-p-nitrobenzene) - - - - -	DUP, MON.
2-Chloro-5-nitrobenzenesulfonic acid - - - - -	DUP, MON.
4-Chloro-3-nitrobenzenesulfonic acid - - - - -	TRC.
2-Chloro-5-nitrobenzenesulfonic acid - - - - -	AC, DUP, EXT, TRC.
4-Chloro-3-nitrobenzenesulfonic acid - - - - -	TRC.
4-Chloro-5-nitrobenzenesulfonic acid - - - - -	TRC.
2-Chloro-4-nitrobenzoic acid - - - - -	EXT, VPC.
2-Chloro-5-nitrobenzoic acid - - - - -	SAL.
2-Chloro-4-nitrobenzoic acid, potassium salt - - - - -	TRC.
5-Chloro-2-nitro-dithoxybenzene - - - - -	SAL.
4-Chloro-3-nitro-N,N-dimethylbenzenesulfonamide - - - - -	HST.
2-Chloro-5-nitrophenyl methyl sulfone - - - - -	EK1.
4-Chloro-3-nitrophenyl methyl sulfone - - - - -	TRC.
2-Chloro-4-nitrotoluene - - - - -	TRC.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
o-Chlorophenol	DOH, MON.
p-Chlorophenol	DOH, MON, RDA.
p-Chlorophenol, hydrazine sulfate	HST.
(p-Chlorophenyl)acetoneitrile	OPC, SK, UOP.
4-Chloro-o-phenyl-o-cresol	MON.
(m-Chlorophenyl)Methanolamine	HST.
o-Chlorophenyl-1-hydroxycyclopropyl-N-methylketimine	PP.
2,2'-[(m-Chlorophenyl)imino]diethanol	TCH.
2,2'-[(m-Chlorophenyl)imino]diethanol, diacetate ester	SDC.
3-(o-Chlorophenyl)-5-methyl-4-isoxazole carboxylic acid chloride	ARS.
1-(o-Chlorophenyl)-3-methyl-2-pyrazolin-5-one	HST.
1-(m-Chlorophenyl)-3-methyl-2-pyrazolin-5-one	TRC.
1-(p-Chlorophenyl)-3-methyl-2-pyrazolin-5-one	VPC.
p-Chlorophenyl methyl sulfone	TRC.
*4-Chlorophthalic acid	DUP, HSC, SW.
(3-Chloropropyl)benzene	SDM.
1-(3-Chloropropyl)-4-methylpiperazine	SK.
4-Chlororesorcinol	PCW.
5-Chlorosalicylic acid	PCW.
o-Chlorotoluene	HR, HN.
m-Chlorotoluene	HN.
p-Chlorotoluene	HN.
p-Chlorotoluene (benzyl chloride)	MON, SFS.
3-Chloro-p-toluidine [M <sub>2</sub> =1]	DUP.
4-Chloro-o-toluidine [M <sub>2</sub> =1] and hydrochloride	PCW.
1-(3-Chloro-o-tolyl)azojarsosine	ALC, ATL.
p-(3-Chloro-o-tolyl)-3-methyl-2-pyrazolin-5-one	HST.
4-Chloro-2,6-difluorotoluene	PCW.
Cholic acid	HL.
o-Chlorophenylcyclopentyl ketone	ARA.
Cinnamic acid	SFS.
Cinnamyl chloride	PK.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*CREOLSOL:	
m-Cresol	KPT.
*O-CRESOL:	
o-Cresol, from coal tar	KPT, PRD.
o-Cresol, from petroleum	MER, NPC(E), PRD, SM.
p-Cresol	SM.
CRESOLS, MIXED:	
(M,P)-CRESOL:	
(M,P)-Cresol, from coal tar	KPT, PRD.
(O,M,P)-Cresol, from petroleum	MER, NPC(E), PRD.
(M,P)-CRESOL:	
Cresol, p-Cresol, from coal tar	KPT.
Cresol, m-Cresol, from coal tar	PIT.
*CRESYLIC ACID, REFINED	
Cresylic acid, refined from coal tar	KPT, PRD.
Cresylic acid, refined from petroleum	MER, NPC(E), PRD.
p-Cumylphenol	X.
2-[p-(Cyanooacetamido)phenyl]-6-methyl-7-benzothiazole-sulfonic acid	DUP.
4-(Cyanooacetyl)morpholine	PCW.
N-[(2-Cyanoethyl)ethylamino]-o-tolualdehyde	DUP, GAP.
N-(2-Cyanoethyl)-N-ethyl-m-toluidine	EXT.
N-[(2-Cyanoethyl)ethylamino]benzaldehyde	ATL, DUP, GAP.
N-[(N-[2-Cyanoethyl]m-toluidino)ethyl]succinimide	EXT.
Cyclododecatriene (CDDT)	DUP.
1,2-Cyclohexanedicarboxylic anhydride	ACS.
1,3-Cyclohexanedione	PD.
*Cyclohexanol	ALF, DUP, MON.
Cyclohexanone	CAF, CEL, CHF, DBC, DUP, MDN, UCC.
Cyclohexanone oxime	UCF.
3-Cyclohexene-1-carboxaldehyde	UCF.
4-Cyclohexene-1,2-dicarboximide	PCW.
4-Cyclohexene-1,2-dicarboxylic acid	PCW.
4-Cyclohexene-1,2-dicarboxylic anhydride	PCW.
Cyclohexene oxide	USR.
β-(1-Cyclohexenyl)ethylamine	MIS.
*Cyclohexylamine	ABB, BRC, VGC.
2-Cyclopentanone-5-(2,5-dihydroxybenzene) ethyl ketone	Y.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Cyclopentyl sodiumes bromide	ARA.
2-(3-Cyclopropylmethyl-N-phthalimidooctyl)-amino-5-chlorobenzophenone	PD.
p-Cysene	HFC.
Deoxycholic acid	WIL.
Diacephatol 1,2-1,1',2'-1]fluoranthene (Decacyclone)	SDC.
3,5-Diacetamido-2,4,6-triiodobenzoic acid	SDM.
Dialkylbenzene	SOC.
1,4-Diaminoanthraquinone	DUP, SDC, TRC.
3,3'-Diaminobenzanilide	TRC.
2,4-Diaminobenzenesulfonic acid [SO <sub>3</sub> H=1]	DUP, TRC.
3,5-Diaminobenzenesulfonic acid [SO <sub>3</sub> H=1]	TRC.
3,5-Diaminobenzoic acid	SAL.
4,4'-Diamino-2,2'-biphenyldisulfonic acid	ACI.
1,3-Diaminocyclohexane	DUP.
1,4-Diamino-2,3-dichloroanthraquinone	DUP.
1,4-Diamino-2,3-dicyanoanthraquinone	DUP.
1,8-Diamino-2,3,5-trihydroxythiobenzene	DUP.
4,8-Diamino-2,3,5-trihydroxythiobenzene	DUP.
4,8-Diamino-2,3,5-trihydroxy-9,10-dioxo-2,6-naphthoquinolonic acid	ACI, DUP, HSH, TRC.
4,8-(and 6,5)-Diamino-9,10-dihydro-1,5-(and 1,8)-dihydroxy-9,10-dioxo-2,6-(and 2,7)-anthracenedisulfonic acid	TRC.
1,4-Diamino-9,10-dihydro-9,10-dioxo-2,3-anthracenedicarboxylic acid	TRC.
1,5-Diamino-4,8-dihydroxyanthraquinone	DUP.
2,4-Diamino-phenol-dihydrochloride	VPC.
2,4-Diamino-6-phenyl-s-triazine	EK.
2,6-Diaminopyridine	VEL.
4,4'-Diamino-2,2'-stilbenedisulfonic acid	RII.
3,5-Diamino-2,4,6-triiodobenzoic acid	SDM.
2-Diazo-1-naphthol-5-sulfonic acid, sodium salt	CGY(E), GAF, TRC, X.
6,11-Dibenzamido-16β-dinaphthol[2,3-a',3'-i]carbazole-5,10,15,17-tetrone	HST.
4,5'-Dibenzamido-1,1'-iminodianthraquinone	ACY.
Dibenzyl, defChrysene-7,14-dione	TRC.
1,5-Dibenzoylnaphthalene	GAF, TRC.



TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
2,1-Dibenzylamino-6,4-diethyl(aminofluoran)-	Xi
2-(Di benzylamino)ethanol	DUP
N,N'-Dibenzylethylenediamine	MI
N,N'-Dibenzylethylenediamine diacetate	MI
N,N'-Dibenzylidene-toluene- $\alpha,\alpha$ -diamine	MI
3,9-Dibromo-7H-benz[de]anthracen-7-one	SDH
2,6-Dibromo-4-nitroaniline	DUP, TFC
3,5-Dibromo-3'-trifluoromethylsalicylamide (Fluoro- phene)	SDC
p-Dibutoxybenzene (DBB)	PCW
2,5-Dibutoxy-4-morpholinobenzenediazonium sulfate salt (DEB Sulfate)	ALL
2,6-Di-tert-butyl-4-nonylphenol	ALL
2,4-Di-tert-butylphenol	GAP
2,6-Di-sec-butylphenol	PIT
2,6-Di-tert-butylphenol	TNA, PRD
3,4-Dichloroaniline	TNA
2,3-Dichloroanisole	DUP, MON
1,5-Dichloroantiquinone	HST
4,6-Dichlorobenzaldehyde	TFC
Dichlorobenzanthrone	DUP
o-Dichlorobenzene	ACY
m-Dichlorobenzene	MTO
p-Dichlorobenzene	ACS, DOM, MON, PP2, SCC(E), ACS, DOM, DVC, PP3, SCC(E), ABB, ARE, CWN, IAK
1,6-Dichloro-o-m-benzenedisulfonamide	ABB
3,3'-Dichloro-o-benzenedisulfonyl chloride	ABB
2,4-Dichlorobenzidine base and salts	CWN
2,4-Dichlorobenzic acid	MTO
2,4-Dichlorobenzyl chloride	HN
Dichlorobenzyl chloride	HN
2,4-Dichloro-3,5-dinitro- $\alpha,\alpha$ -trifluorotoluene	SFS
Dichlorodiphenylsilane	GAF
2,4-Dichloro-6-isopropylamino- $s$ -triazine	DCC
2,5-Dichloro-4-(3-methyl-5-oxo-2-pyrazolin-1-yl)benzene- sulfonic acid	VTC
	HST, TBC

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Dichloroethylphenylsilane	
1,2-Dichloro-4-nitrobenzene	CWN, DCC.
1,4-Dichloro-2-nitrobenzene	DUP, RON.
1,8-Dichloro-2-nitrobenzene (Nitro-p-dichlorobenzene)	ALL.
*2,4-Dichlorophenol	DOM, RON, RDA.
2,6-Dichlorophenol (2,6-DCP)	RD.
2,4-Dichlorophenoxyacetic acid, dimethylamine salt	PD.
2,6-Dichloropyrazine	ACV.
3,6-Dichloropyrazine	ACV.
4,7-Dichloropyridazine	ACV.
4,7-Dichloroquinoline	PD.
2,5-Dichlorosulfanilic acid [SO <sub>2</sub> H=1]	DUP, VPC.
2,5-Dichloro-4-sulfobenzenediazonium sulfate	TRC.
p,p'-Dichlorotoluene	HN.
4,4'-Dichlorotoluene (Benzal chloride)	SFS.
2,6-Dichlorotoluene	DUP.
Dicyclohexylamine	ABB, VGC.
Dicyclopentadiene (includes Cyclopentadiene)	VEL.
Dicyclopentadiene diepoxide	VEI.
Dicyclopentadiene dioxide	VEI.
Didodecylbenzene	CC.
p-Diethoxybenzene	ALL.
3-Diethylaminoacetanilide	DUP.
p-(Diethylamino)benzaldehyde	ATL.
3'-[2-(Diethylamino)ethyl]-4'-hydroxyacetanilide	PD.
α-[(2-Diethylamino)ethyl]-α-phenylcyclohexanemethanol, hydrochloride	ACV.
7-Diethylamino-4-methylcoumarin, crude	X.
7-Diethylamino-3-ethyl-1-phenyl-spiro[1]benzopyranol2,3-cyclopentadiene-4,11,13-trisubenzofuren-3'-one	X.
α-(Diethylamino)phenol (N,N-Diethyl-3-aminophenol)	ACV.
3-(4-N,N-Diethylamino)phenylazo]-H-1,2,4-triazole	TRC.
3-(Diethylamino)propophenone	ACV.
4-(Diethylamino)-o-tolualdehyde	DUP.
*N,N-Diethylamine	ACS, ACV, BCC, DUP.
2,6-Diethylamine	TRM.
N,N-Diethyl-1-methylamine	DUP.
Diethylbenzene	DOM.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
M,N-Diethylcyclohexylamine	DUP.
N,N-Diethyl-4-methoxymethylamide	PCN.
N,N-Diethyl-4-nitrosophenethidine	GAF.
N,N-Diethyl-m-phenetidine	GAF.
N,N-Diethyl-p-phenylenediamine oxalate	EK.
N,N-Diethyl-p-toluidine	DUP.
N,N-Diethyl-p-toluidine	RSB.
6,11-Dihydrodibenz(b,f)oxepin-11-one	PFZ.
9,10-Dihydro-9,10-dioxo-1,5-anthracenedisulfonic acid	TRC.
9,10-Dihydro-9,10-dioxo-1,5-anthracenedisulfonic acid, disodium salt	TRC.
9,10-Dihydro-9,10-dioxo-1,8-anthracenedisulfonic acid, potassium salt	TRC.
9,10-Dihydro-9,10-dioxo-1,5-(and 1,8)-anthracenedisulfonic acid and salt	TRC.
9,10-Dihydro-9,10-dioxo-2,6-anthracenedisulfonic acid and salt	TRC.
9,10-Dihydro-9,10-dioxo-2,7-anthracenedisulfonic acid	TRC.
9,10-Dihydro-9,10-dioxo-1-anthracenesulfonic acid and salt	TRC.
[Dihydroquin 3,3'-phtalocyanine]disulfonate(2-)copper	ACY, TRC.
9,10-Dihydro-5-nitro-9,10-dioxo-1-anthracenesulfonic acid	ATI.
1,2-Dihydro-2,4,7-tetraethylquinoline	TRC.
1,2-Dihydrotriamcinolone	EKT.
1,2-Dihydro-2,4-triethylquinoline	UPL.
*1,4-Dihydroxyanthraquinone (Quinizarin)	EKT.
1,5-Dihydroxyanthraquinone	TRC.
1,5-(and 1,8)-Dihydroxyanthraquinone	TRC.
1,8-Dihydroxyanthraquinone	TRC.
2,5-Dihydroxy-p-benzenedisulfonic acid, dipotassium salt	TRC.
2,5-Dihydroxybenzenesulfonic acid, potassium salt	EK.
2,4-Dihydroxybenzophenone	EK.
1,5-Dihydroxy-4,6-dinitroanthraquinone	ACY, DUP, EKT.
1,8-Dihydroxy-4,5-dinitroanthraquinone	TRC, VFC.
	EKT, VFC.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES		MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
N,N-Di(6-hydroxyethyl)- <i>n</i> -chloroaniline		MIL.
17 $\alpha$ ,21-Dihydroxy-16 $\alpha$ -methylpregna-1,4,9(11)-triene-		X.
3,20-dione		X.
17 $\alpha$ ,21-Dihydroxy-16 $\beta$ -methylpregna-1,4,9(11)-triene-		X.
3,20-dione, 21-benzoate		MW.
6,7-Dihydroxy-2-naphthalenesulfonic acid		SOC, WY.
3,3'-Dihydroxy-2-naphthanalide		X.
11 $\beta$ ,21-Dihydroxypregna-4,16-diene-3,20-dione, 21-acetate		X.
11 $\beta$ ,21-Dihydroxypregna-1,4,16-triene-3,20-dione, 21-acetate		X.
4,6-Dihydroxypyrimidine		KP.
16,17-dihydroxyviolanthrone (Dihydroxydibenzanthrone)		ACY, DUP.
Diisopropylbenzene		DOH.
N,N'-Diisopropyl- <i>p</i> -phenylenediamine		DUP.
2,5-Dimethoxyaniline		EKT, PCW.
1,5 (and 1,8)-dimethoxyanthraquinone		TRC.
2,5-Dimethoxybenzaldehyde		CWN, DUP.
<i>m</i> -Dimethoxybenzene		ACY, ABS, GAP.
<i>p</i> -Dimethoxybenzene		ACY, ABS.
3,3'-Dimethoxybenzidine hydrochloride		ARS(E).
2,6-Dimethoxybenzoic acid		CWN.
2,6-Dimethoxybenzyl chloride		ARS(E).
N,N'-[(3,3'-Dimethoxy-4,4'-biphenylene)bis(azo)]bis[ <i>N</i> -methylaurine]		X.
2,5-Dimethoxy- <i>o</i> -methylphenethylamine		ATL, GAP.
1,4-Dimethoxy-2-nitrobenzene		X.
2,5-Dimethoxytetrahydrofuran		EKT.
<i>p</i> -(Dimethylamino)benzaldehyde		HEX.
<i>m</i> -(Dimethylamino)benzoic acid		DUP, EK, GAP.
6-Dimethylamino-2-[2-(2,4,5-dimethyl-1-phenyl-3-pyridyl)-vinyl]-1-methyl-1-quinolinium methyl sulfate		X.
2-[(2-(Dimethylamino)ethyl)-( <i>p</i> -methoxybenzyl)amino]pyridine		EK.
2-[(2-(Dimethylamino)ethyl)-2- <i>tert</i> -butylamino]pyridine		HEX.
6-Dimethylaminoethyl-4-nitro-6-ethoxyphenol		ARB.
6-Dimethylamino-1-methylquinaldinium methyl sulfate		EK.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES		MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
m-(Dimethylamino)phenol		ACY.
1-[3-(Dimethylamino)propyl]-1'-hydroxy-dibenz(b,e)		PEZ, SK.
6-(Diethylamino)quinoline		EC.
N-Diethylamide		ACS, ACY, BCC, DUP, TNA.
7,12-Dimethylbenzoflantracene		EC.
3,3'-Dimethylbenzidine hydrochloride		PK.
N,N-Dimethylbenzylamine		AB, MLS, BH.
α,α-Dimethylbenzyl hydroperoxide		USS.
2,2'-Dimethyl-1,1'-bianthraquinone		ACY, TBC.
5,5'-Dimethyl-1,3-cyclohexanedione		PMT.
N,N-Dimethylcyclohexylamine		ABB, DUP.
5,5-Dimethylhydantoin		GLV.
2,6-Dimethylhydroquinone		ABA.
2,3-Dimethylindole		DDP.
2,5-Dimethyl-4(2)-morpholinylmethylphenol, hydrochloride		HAV.
2,3-Dimethyl-5-nitrobenzenesulfethanolamide		TBC.
N,N-Dimethyl-p-nitroaniline		ACY.
2,6-Dimethylol-p-cresol		SW.
N,N-Dimethyl-p-phenylenediamine monohydrochloride		EK.
1,4-Dimethylpiperazine		JCC.
3,5-Dimethylpyrazole		X.
N,N-Dimethyl-p-toluidine		RSA.
N,N-Dimethyl-p-toluidine		EK, RSA.
1,1-Dimethyl-3-(3-trifluoromethylphenyl)urea		HST.
2,4-Dinitroaniline		HST, SDC.
3,3'-Dinitrobenzamide		SDC, TBC.
m-Dinitrobenzene		DUP.
2,4-Dinitrobenzenesulfonic acid		TBC.
3,5-Dinitrobenzoic acid		SAL.
3,5-Dinitrobenzoyl chloride		EK.
Dinitroacrylphenol		RR.
2,4-Dinitroacene		DUP.
3,5'-Dinitro-2'-hydroxyacetanilide		TBC.
2,6-Dinitro-4-isopropylphenol		SDC.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
2,4-Dinitrophenol, tech.	SDC, YFC.
3,5-Dinitrosalicylic acid	SAI.
3,5-Dinitrosalicylic acid, 5-nitrofurylidene hydrazone	LEM.
2,4-Dinitrotoluene-2,2'-disulfonic acid	AC, GY(E), GAP, X.
2,4-Dinitrotoluene-2,2'-disulfonic acid	ACS, DHP, RUC, MOB, UCC.
2,4-Dinitrotoluene-2,2'-disulfonic acid	APD, DHP, MOB, UCC.
2,4-Dinitrotoluene-2,2'-disulfonic acid	GAP, JCC, MON.
2,4-Di-tert-pentylphenol	PAS.
Di-tert-pentylphenoxycetyl chloride	EK.
1,5-Diphenoxanthraquinone	VPC.
Diphenylamine	ACY, DDP, ORG, RUC, USR.
2,5-Diphenyl-p-benzoquinone	EK.
N,N-Diphenylethylenediamine	RPK.
Diphenylmethane	PD.
2,5-Diphenyloxazole	EK.
4,4'-Dithiodianiline	ACY.
1,4-Di-p-toluidinoanthraquinone	HSB.
p-Tolylmercapto-2,5-dithoxybenzenediazonium chloride, zinc chloride salt	HST.
Divinylbenzene	DOM, FG.
Dodecylaniline	X.
Dodecylbenzene (See Alkylbenzenes)	
Dodecylbenzyl chloride	SFS.
p-Dodecylphenol	RH.
p-Dodecylphenol	GAP, MCB, MON, TX.
Ethoxylated and propoxylated-m-toluidine	TCH.
6-(2-Ethoxy-1-naphthamido)penicillanic acid	WT.
2-Ethoxy-1-naphthoic acid	WT.
2-Ethoxy-1-naphthoic acid	WT.
4-[(p-Ethoxyphenyl)azo]-m-phenylenediamine monohydrochloride	ORC, WYT.
N-(6-Ethoxy-3-pyridazinyl)sulfanilamide	EK.
3-(Ethylamino)acetanilide	ACY.
N-Ethyl-N-(p-aminoethyl)-m-toluidine	X.
3-(Ethylamino)-p-toluenesulfonic acid [SO <sub>3</sub> H=]	SM.
o-Ethylaniline	TNA.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*N-Ethylaniline, refined-	ACS, ACY, BCC, DDP.
2-(N-Ethylanilino)ethanol-	DFE, MIL, TCH.
1-[2-(N-Ethylanilino)ethyl]ene]pyridinium chloride-	GAP.
{2-(N-Ethylanilino)ethyl}trimethylammonium chloride-	DOE.
3-(N-Ethylanilino)propionitrile-	MIL, TCH.
a-(N-Ethylanilino)-m-toluenesulfonic acid-	GAP, X.
a-(N-Ethylanilino)-p-toluenesulfonic acid-	SM, TRC.
Ethylbenzyl chloride	SFS.
d(-)Ethy1-3-(a-carboxybenzyl)aminc crotonate, potassium salt	KP.
2-(N-Ethyl-N-β-cyanoethyl)-4-acetamidobenzoic acid-	SDC, TCH, VPC.
N-Ethylcyclohexylamine (Herbicide intermediate)-	ABB.
N-Ethyl-N-(2,3-dihydroxypropyl)-m-toluidine-	EKT.
Ethylene-bis-tetrahydrophthalide	LEM.
3,3'-Ethylenedioxydiphenol	WAY.
N-Ethylmaleimide	ER.
2-[N-Ethyl-p-[(6-methoxy-2-benzothiazoyl)azo]anilino]ethanol-	TRC.
dl-13β-Ethyl-3-methoxy-8,14-secoopona-1,3,5(10),9(11)-6-ene-1,7,7-dione-	WVT.
N-Ethyl-N-β-ethylamino-	TNA.
9-Ethyl-3-[(2-methylsulfonylamino)ethyl]-m-toluidine	X.
a-Ethyl-3-nitrocarbazole	SDC.
p-Ethylphenol-toluenesulfonic acid	SDW.
*N-Ethyl-N-phenylbenzylamine	ACY, SW.
2-Ethylpyridine-	DUP, GAP, X.
6-Ethyl-1,2,3,4-tetrahydro-1,4,4-tetramethyl-naphthalene	RIL.
N-Ethyl-p-toluenesulfonamide	GIV.
N-Ethyl-o-toluidine-	NES.
N-Ethyl-m-toluidine-	DUP.
2-(N-Ethyl-m-toluidino)ethanol	DUP.
*3-(N-Ethyl-m-toluidino)propionitrile	DCH.
a-(N-Ethyl-m-toluidino)-m-toluenesulfonic acid	DUP, MIL, TCH.
o-Formylbenzenesulfonic acid (o-sulfobenzaldehyde)	X, GAP.
Fuchsin acid	ER.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES		MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Furan		
Furfuryl acetate		PLC, QKO.
Furfuryl alcohol		EM
Furanyl alcohol		QKO.
Glycid anhydride		PKC.
p-Glycolylarsinic acid, sodium salt		SDM.
p-Heptylbenzoyl chloride		PK.
Hexachlorobenzene		DYC.
Hexachlorocyclopentadiene		VEL, X.
1,4,5,6,7,7-Hexachloro-5-norbornene-2,3-dicarboxylic acid		X.
1,4,5,6,7,7-Hexachloro-5-norbornene-2,3-dicarboxylic anhydride (Chlorendic anhydride)		VEL.
Hexahydro-1-methyl-4-phenyl-1H-azepine-4-carbonitrile		WVT.
Hexahydro-1-methyl-4-phenyl-1H-azepine-4-carboxylic acid		CEL, DUP.
Hexamethylenimine		SFS.
Hippuric acid		GAP, STG.
p-Hydrazinobenzenesulfonic acid		LAK.
Hydrazobenzene		NES.
Hydroquinonesulfonic acid, potassium salt		CRS, EKT, GYR.
* Hydroquinone, tech.		TRC.
4-Hydroxyacetanilide		ARA, X.
3-Hydroxyacetophenone		DOM.
p-Hydroxybenzaldehyde		PER, UPF, USS.
* p-Hydroxybenzenesulfonic acid		HN.
p-Hydroxybenzoic acid		SDM.
3-Hydroxy-2-(N-benzyl-N-methylamino)acetophenone hydrochloride		EX.
α-Hydroxy-α-α-bis(p-hydroxyphenyl)-o-toluenesulfonic acid, γ-sultone		X.
N-Hydroxy-5-endo-cis-norbornene-2,3-dicarboximide		TFC.
4-(2-Hydroxyethoxy)acetanilide		BJL.
3-[1-(2-Hydroxyethyl)anilino]propanitrile		DUP, MIL, TCH.
3-[1-(2-Hydroxyethyl)anilino]propanitrile, acetate		MIL, TCH.
N-(β-Hydroxyethyl)-3,5-dihydroxybenzamide		WAY.
N-(β-Hydroxyethyl)-8-ethyl-m-toluidine		MIL.



TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
1-(2-Hydroxyethyl)-1,2,3,4-tetrahydro-2,4,7-tetraethylquinoline	EKT.
1-(2-Hydroxyethyl)-1,2,3,4-tetrahydro-2,4-trimethylquinoline	EKT.
N-[7-Hydroxy-8-(2-hydroxy-5-methylsulfonylphenylazo)-1-naphthyl]acetamide	TRC.
7-Hydroxy-8-[(4s)-[(p-hydroxyphenylazo)-3,3'-dimethyl-4-biphenyl]azo]-1,3-naphthalenedisulfonic acid	ATL, TRC, DUP, TRC.
4-Hydroxymetanilic acid	DUP, TRC.
3-Hydroxy-2-methylcinnamic acid	DUP, TRC.
4-Hydroxy-N1-methylacetanilide	DUP, GAP.
1-(2-Hydroxyethyl-5- <i>o</i> -methylisidazole hydrochloride	PD, TNA.
3-Hydroxyethyl-2-pyrrolidone	GAP.
3-Hydroxy-N-(3-N-morpholino-7-propyl)-2-naphthamide	MAY.
3-Hydroxy-2,7-naphthalenedisulfonic acid	TRC.
7-Hydroxy-2,7-naphthalenedisulfonic acid, disodium salt	ACY, TRC.
6-Hydroxy-2,7-naphthalenedisulfonic acid, disodium salt	ACY, TRC.
8-Hydroxy-1-naphthalenesulfonic acid, sodium salt	ACY, TRC.
3-Hydroxy-2-naphthalenesulfonic acid, $\gamma$ -sultone	TRC.
3-Hydroxy-2-naphthoic acid (B. C. N.)	ACY, PCM.
3-Hydroxy-2-naphthoic acid, (diethylenetriamine)amide	PCM.
3-Hydroxy-2-naphthoic acid, morpholinopropylamide	PCM.
3-Hydroxy-2-naphthoic acid, ethanamide	PCM.
3-Hydroxy-2-naphthoic acid, ethyl ester	PCM.
3-Hydroxy-2-naphthoic acid, sodium salt	PCM.
1-(2-Hydroxy-1-naphthylazo)-6-nitro-2-naphthol-4-sulfonic acid	ATL.
N-(7-Hydroxy-1-naphthyl)acetamide	TRC.
1-(2-Hydroxy-1-naphthylazo)-6-nitro-2-hydroxynaphthalene-4-sulfonic acid	TRC.
2-Hydroxy-5-nitroetanilic acid	TRC.
1-Hydroxy-6-octadecyloxy-2-naphthoic acid	ARA.
2-Hydroxy-4-n-octoxybenzophenone	ACY, CCM.
11 $\alpha$ -Hydroxyprogesterone	JPJ.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
2-Hydroxy-4-sulfo-1-naphthalenediazonium hydroxide, inner salt	: : ACY.
1-Hydroxy-4-p-toluidinoanthraquinone	: : HSH.
1,1'-Ieinobis[4-aminocanthraquinone]	: : ACY.
1,1'-Ieinobis[4-benzaidoanthraquinone]	: : ACY.
1,1'-Ieinobis[5-benzaidoanthraquinone]	: : TRC.
1,1'-Ieinobis[4-nitroanthraquinone]	: : ACY, TRC.
1,1'-Ieinobis[4-nitroanthraquinone] (1,1'-dianthrindole)	: : ACY.
2-Androcarboxylic acid	: : ARK.
Indane-2,3-dione	: : DUP.
1-(4H)-indolizino[1,2-b]pyridine-2,3-dione	: : DUP.
2-Indacetamide-5-chloride, dihydrate-3-oxo, disodium salt	: : BCC.
10-(p-Tolophenyl)undecanone	: : FR.
Isatoic anhydride-canonone acid, ethyl ester	: : SA.
Isobutylbenzene	: : SP.
* ISOCYANIC ACID DERIVATIVES:	: : PLC, TWA.
Bitolylene diisocyanate (TODI)	: : CWK, UPJ.
p-Chlorophenyl isocyanate	: : MCE.
Diphenylmethane-4,4'-diisocyanate (MDI)	: : MOB, UPJ.
Phenylisocyanate	: : MOB, UPJ.
* Polyacetylene polyphenylisocyanate	: : JCC, MOB, RUC, UPJ.
Toluene 2,4'-diisocyanate	: : JCC, MOB, RUC, UPJ.
Toluene 2,4'-and 2,6'-diisocyanate (80/20 Mixture)	: : ACS, BAS.
Toluene 2,4'-and 2,6'-diisocyanate (65/35 Mixture)	: : ACS, MOB, DUP, MCB, OMC, RUC, UCC.
Toluene 2,4'-and 2,6'-diisocyanate (65/35 Mixture) and (80/20 Mixture)	: : DUP, MOB.
p-Toluenesulfonyl isocyanate	: : DUP.
Trimers of toluene 2,4 and 2,6 diisocyanate	: : CWK.
Tris(2-isocyanate-p-tolyl isocyanate)	: : DUF.
Tris(2-isocyanate-p-tolyl isocyanate)	: : DUF.
Isocyanic acid derivatives, all other	: : MCE, UCC.
2-Isocitrosoacetanilide	: : DUP.
Isocitrophenol	: : DUP.
Isophthalic acid (Benzene-1,3-dicarboxylic acid)	: : PRD(F).
	: : ACC.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Isophthalic acid, diphenyl ester	: BJJ.
Isophthalonitrile	: SW.
Isophthaloyl chloride	: DUP.
N-isopropylamine	: USE.
3,4'-isopropylidenebis(2-hydroxy-2-oxo-1,4-dioxane)	: DOW.
3,4'-isopropylidenebis(2-hydroxy-2-oxo-1,4-dioxane)	: GE, SHC, UCC.
4,4'-isopropylidenediphenol, ethoxylated	: ICI.
4,4'-isopropylidenediphenol, propoxylated	: ICI.
4-isopropylphenol	: PFD.
Isopropylphenol, mixed	: FMP.
4-isopropyl-2-phenylenediamine	: DUP, SCN, TNA.
Isobutyric acid, phenyl ester	: EK.
2,4,6-trichloro-1,3,5-triazine	: HSH, TBC.
2,4,6-trichloro-1,3,5-triazine	: KPT, RIL.
2,4,6-trichloro-1,3,5-triazine	: RIL.
3,4-Lutidine	: KPT, RIL, UCC.
3,4-Lutidine	: KF.
Mandelonitrile	: ACS, ACY, MLC.
Melamine	: GIV.
p-Menthyl-4(8)-diene	: ARZ, HPC, NCI.
p-Menthyl-1,8-diene (Limonene)	: GIV.
p-Menthyl-1,8-diene (Carvomenthene)	: AMB.
o-Mercaptobenzoic acid	: DUP, TBC, USM.
Metanilic acid (o-Aminobenzenesulfonic acid)	: HST.
2-Methoxy-5-acetamino-N-bis(acetoxyethyl)aniline	: DUP.
1-Methoxyanthraquinone	: AC.
4-Methoxymethanilic acid	: ARA.
4-Methoxy-2-(p-methoxyphenyl)acetophenone	: SFS.
Methoxyethylidiphenyl oxide	: TBC.
N-(2-Methoxy-1-naphthyl)acetamide	: SDW.
6-Methoxy-8-nitroquinoline	: DOP.
(p-Methoxyphenyl)acetic acid	: DUP.
6-Methoxyquinoline	: DUP.
Methylacetoacetic ester enamine of D-2-amino-2-(1,4-cyclohexadienyl)acetic acid, sodium salt	: TRD.
1-(Methylamino)anthraquinone	: ACY.
1-(Methylamino)-4-p-toluidinoanthraquinone	: VFC.

TABLE 2.-CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
2-(4-Methylanilino)ethanol	: TCH.
*3-(N-Methylamino)propionitrile	: DUP, ML, TCH.
5-Methyl-o-anisidine [NH <sub>2</sub> =1]	: SW.
5-Methyl-o-anisidinesulfonic acid	: ACS, BCC.
n-Methylanisole	: GIV.
2-Methylanthraquinone	: ACY.
3-Methylbenzof[quinoline]	: ACY.
2-Methylbenzothiazole	: FMT.
N-Methylbenzylamine	: SDM.
Methyl biphenyl	: DOW.
N-Methyl-N-carboxyanthranilic anhydride	: SW.
1-Methyl-4-(3-chloropropyl)piperazine hydrochloride	: SK.
3-Methylolanthrene	: EK.
Methylcyclohexane	: PLC.
N-Methylcyclohexylamine	: ABB.
N-Methyldicyclohexylamine	: ABB.
N-Methylenecaniline	: PCK.
4,4'-Methylenebis[2-chloroaniline]	: ADC, DUP.
4,4'-Methylenebis[2-chloroaniline] and 4,4'-methylenebis[aniline], mixed	: DUP.
4,4'-Methylenebis[N,N-diethylaniline]	: ACY.
*4,4'-Methylenebis[N,N-dimethylaniline] (Methane base)	: ACY, DUP, X.
Methylenediazine	: MOR.
4,4'-Methylenediamine	: ACS.
5,5'-Methylenedisulcyllic acid	: ACS, DOM, DUP, RUC.
2-Methyl-6-ethylaniline	: TNA.
Methylhydroquinone	: HN.
N-Methyl-p-nitroaniline	: EXT.
4-Methyl-2-nitroanisole	: ACY, EK.
2-Methyl-5-nitroimidazole	: SW.
2-Methyl-5-norbornene-2,3-dicarboxylic anhydride	: RDA.
5-Methyl-5-norbornene-2,3-dicarboxylic anhydride	: BCC, VEL.
m-(3-Methyl-5-oxo-2-pyrazolin-1-yl)benzenesulfonamide	: VFC.
p-(3-Methyl-5-oxo-2-pyrazolin-1-yl)benzenesulfonic acid	: TRC.
p-(3-Methyl-5-oxo-2-pyrazolin-1-yl)benzenesulfonic acid	: GAF, TRC.



TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977.--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
3 <sup>o</sup> -Nitroacetophenone	X.
o-Nitraniline	MON, X.
m-Nitraniline	X.
p-Nitraniline	DUP, MON.
2-Nitroaniline	DUP.
4-Nitro-p-azobenzidine [NH <sub>2</sub> =1]	DUP.
o-Nitro-p-azobenzidine [NH <sub>2</sub> =1]	DUP.
o-Nitroanisole	DUP.
5-Nitroanthranilic acid	SW, TRC.
1-Nitroanthraquinone	XY, TRC.
m-Nitrobenzaldehyde	ACY, DUP, FST, MOB, RUC.
*Nitrobenzene	DUP, USN.
m-Nitrobenzenesulfonic acid, sodium salt	DUP.
m-Nitrobenzoic acid	SAT.
p-Nitrobenzoic acid	DUP.
n-Nitrobenzoic acid, sodium salt	SAT.
2-(4 <sup>o</sup> -Nitrobenzoylamino)-6-naphthol- $\beta$ -sulfonic acid	TRC.
m-Nitrobenzoyl chloride	ARS.
p-Nitro- $\alpha$ -bromotoluene	DUP.
Nitrochlorodimethoxybenzene	PCW.
2-Nitro-p-cresol	SW.
p-Nitro-N-(2-diethylamino)ethylbenzamide	PD.
Nitrodiphenylamine	ACY, MON.
5-Nitro-2-furamethanediol, diacetate	X.
5-Nitroisatoic anhydride	SW.
5-Nitroisophthalic acid	SAL.
1-Nitronaphthalene	DUP.
3-Nitro-1,45-naphthalenedisulfonic acid	TRC.
7( and 8)-Nitronaphth[1,2-d][1,2,3]oxadiazole-5-sulfonic acid	GAF, TRC.
4 <sup>o</sup> -Nitrooxanilic acid	ATL.
o-Nitrophenol	DUP, MON.
p-Nitrophenol	DUP.
p-Nitrophenoxyethanol	TCH.
4-(p-Nitrophenyl)acetophenone	ASH.
2-(o-Nitrophenylazo)-6-di-tert-pentylphenol (OH=1)	TRC.
4-Nitro-o-phenylenediamine	ASH, FMT.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
(p-Nitrophenyl)hydrazine	Ek.
2,2'-(m-Nitrophenyl)amino]ethanol, diacetate ester	DUP.
2-(p-Nitrophenyl)-2H-naphtho[1,2-d]triazole-6,8-disulfonic acid	TRC.
m-Nitrophenylphosphonic acid	ICI.
4-Nitrosodiphenylamine	USR.
4-Nitroso-N-ethyl-N-(p-methylsulfonamidoethyl)-m-toluidine	X.
p-Nitrosophenol	ATL, SDC.
β-Nitrostyrene	ATL, SDC.
4-Nitro-4'-(5-sulfo-2H-naphtho[1,2-d]triazol-2-yl)-2,2'-stilbenedisulfonic acid	CWV.
3-Nitro-p-toluamide	ATL, TRC.
o-Nitrotoluene	X.
m-Nitrotoluene	DUP, FST.
p-Nitrotoluene	DUP, FST.
Nitrotoluene mixtures	DUP, FST.
p-Nitrotoluene-o-sulfonic acid	CGI(E).
3-Nitro-p-toluenesulfonic acid [50 H <sub>2</sub> O]	TRC.
5-Nitro-o-toluenesulfonic acid [50 H <sub>2</sub> O]	DUP, GAF, X.
3-Nitro-p-toluic acid methyl ester	S.
2-Nitro-p-toluidine [H <sub>2</sub> O]	PCV.
5-Nitro-o-toluidine [H <sub>2</sub> O]	PCV.
2-Nitro-o-toluidine hydrochloride	DUP.
m-Nitro-m-xylene	USR.
Nonyl dihydroxyphenol, mixture	ACV.
Nonyl dihydroxyphenols	GAF, JCC, KLM, MCB, MON, PRD, BH, SCM, UCC.
Octylphenol	RJI.
Nonarane-2,3-dicarboxylic acid, monomethyl ester	BH, SCN.
Octylphenoxydiethoxy chloride	RH.
Oxanilide	Ek.
*1-(7-Oxo-7H-benz[de]anthracene-3-yl)amino]-anthraquinone	ACV, DUP, TRC.
1,1'-(7-Oxo-7H-benz[de]anthracene-3,9-ylene)-diamino]dianthraquinone	DUP, TRC.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
5-Oxo-1-phenyl-2-pyrazoline-3-carboxylic acid, ethyl ester	STG.
5-Oxo-1-(p-sulfofenyl)-2-pyrazoline-3-carboxylic acid (Pyrazolone 1)	ACY, STG.
4,4'-Oxydianiline	DUP.
Pentabromochlorocyclohexane	DOM.
Pentabromoethylbenzene	GIL.
2,3,4,5,6-Pentabromotoluene	WCC.
Pentachloropyridine	DOM.
Pentylanthraquinone	DUP.
o-(p-tert-Pentylbenzoyl)benzoic acid	DUP.
p-Pentylbenzoyl chloride	ER.
p-Tert-Pentylphenol (o-Amylphenol)	PAS.
3,4,9,10-Perylenetetracarboxylic acid	BCC, MON.
3,4,9,10-Perylenetetracarboxylic-3,4,9,10-dilimide	ACS, ECC.
2-Phenethylamine	MS.
o-Phenethylbenzoic acid	LL.
p-Phenetidine	MON.
*PHENOL:	
NATURAL:	
FROM COAL TAR:	
Natural phenol from coal tar, 390 C., M.P.	PRD.
Natural phenol from coal tar, all other	RPT.
FROM PETROLEUM:	
Natural phenol from petroleum, all other	MEB, NPC(E), PRD.
SYNTHETIC:	
BY CAUSTIC FUSION:	
Synthetic phenol by caustic fusion, U.S.P.	RCI, TOC.
Synthetic phenol by caustic fusion, all other	SW.
*Synthetic phenol from cumene by oxidation, U.S.P.	ACS, CLK, DOW, GP, MON, SHC, SOC, UCC, USS.
Synthetic phenol from toluene by oxidation, U.S.P.	KLM.
Phenolsulfonaphthalein, sodium salt	EK.
Phenolsulfonic acid, sodium salt	SAL.
Phenoxyacetic acid, sodium salt	SFS.
2-(Phenoxyethyl)benzoic acid	PFZ.



TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Phenylacetic acid, ethyl ester, tech.-	: ORC, SFS.
Phenylacetic acid, methyl ester-	: ORC.
Phenylacetic acid, potassium salt-	: OTC, SFS.
Phenylacetic acid, sodium salt -	: OTC.
Phenylacetoneitrile ( $\alpha$ -Tolualtrile)	: OTC, SFS, UOP.
Phenylacetyl chloride--	: OTC.
2,2'-[(Phenylamino)diethanol, diacetic ester-	: SDC, TEC.
p-Phenylazoaniline (C.I. Solvent Yellow 1) and hydro-	: ACY, ATL.
chloride --	: EK.
4-(Phenylazo)diphenylamine --	: EK.
Phenyl-1,2,3-butanetriolone-2-oxime --	: BPC.
$\alpha$ -Phenyl-o-cresol--	: EK.
1-Phenyl-4,4-dimethyl-3-pyrazolidinone	: DJE, SW, TRC.
o-Phenylenediamine --	: DJE, SDC.
m-Phenylenediamine --	: DJE.
p-Phenylenediamine --	: DJE, SDC.
d-Phenylephrine --	: SDC.
dl-Phenylephrine --	: SDC.
Phenyl ether, (diphenyl oxide) --	: DOM, MON.
diphenylcyclohexane (racemic) --	: KF.
diphenylcyclohexane (trans) --	: DUP, KF, UPJ.
N-(2-phenylhydrazine)carboxylic acid, sodium salt --	: X.
N-(2-phenylhydrazine)carboxylic acid, hydrochloride	: KF, UPJ.
3-(2-phenylhydrazine)carboxylic acid, hydrochloride	: BCC.
N-Phenylglycine potassium salt--	: ACS.
N-Phenylglycine sodium and potassium salts--	: BCC.
Phenylglycine sodium salt --	: BCC, LIL.
5-Phenylhydantoin --	: ARE.
* 2,2'-[(Phenylamino)diethanol (N-Phenyldiethanolamine)]	: EKT, ML, TCH.
chloride --	: X.
Phenylmalonic acid --	: SFS.
Phenylmalonic acid, diethyl ester--	: ARS.
3-Phenyl-5-methylisoxazole-4-carbonyl chloride	: DOM, RCI.
o-Phenylphenol --	: DOM.
p-Phenylphenol --	: DOM.
o-Phenylphenol, sodium salt--	: DOM.
N-Phenyl-p-phenylenediamine--	: USR.
Phenylphosphinic acid--	: SFS.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Phenylphosphonothioic dichloride	SFA.
Phenylphosphorus dichloride	SFA.
1-Phenyl-1,2-propanediol	ORT, PD.
Phenyl-2-propanone	ORT.
1-Phenyl-3-pyrazolidinone	EK.
dl-Phenylsuccinic acid	PD.
4-Phenylsulfanyl-1,2-phenylenediamine	ARA.
4-Phenylthiosorboline-1,1'-dioxide	EMT.
Phenylundecanoic acid	EK.
1(2H)-Phthalazinone	A.
Phthalic acid	EK.
Phthalic anhydride	PCS, BAS, ENJ, HK, KPT, MON, PTO, SOC, STP, USS.
Phthalide	EMT.
Phthalimide	SM.
Phthalidooacetic acid	PD.
Phthalidooacetyl chloride	PD.
Phthalocyaninato(2-)copper	DUP.
PICOLINES:	
Picoline (3,4-mixture)	KPT.
2-picoline ( $\alpha$ -picoline)	RIL.
3-picoline ( $\beta$ -picoline)	MEP, RIL.
4-picoline ( $\gamma$ -picoline)	MEP, RIL.
Picolinic acid	BSA.
Picolinonitrile	MEP.
Picolinitrile (2-cyanopyridine)	RIL.
3-picolyamine	RIL.
Picric acid (trinitrophenol)	SDC.
2-pipecoline	LIL.
Piperidine	ABB, RIL.
3-piperidinopropiophenone hydrochloride	ACY.
Polychlorobenzene	DCM.
Polychlorobiphenyl	MOB.
Polydichlorodiphenylsulfone	UCC.
Polyethylbenzene (80 percent diethylbenzene)	ELP, UCC.
Potassium phthalide	PD.
Propiophenone	ORT, UOP.
Propyl Red	EK.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
8,16-Pyranthrene-dione	TRC.
PYRIDINE, REFINED:	
20 Pyridine, refined	KPT, NEP.
Pyridine hydrochloride	EK.
2-Pyridinol	CGY(E).
2-Pyrrolidinone	GAP.
Quinaldine	ACY.
QUINOLINE:	
Quinolone, 1 $\alpha$ and 2 $\alpha$	KPT.
Quinolone, other grades	KPT.
2,4-quinolinediol	PCM.
Resorcinol, tech.	KPT.
$\beta$ -Resorcylic acid	HST, KPT.
Salicylaldehyde	DOM, PDA.
Salicylaldehyde oxime	EK.
Salicylanilide	PCM.
Salicylic acid, ammonium chrosium complex	TRC.
Salicylic acid, phenyl ester	DOM.
Salicylic acid, tech.	DOM, HN, MON, SDH.
Salicylleneaminoguanidine oleate	DUP.
Stigmasterol	UPJ.
Sulfanilamide, tech.	SAL.
Sulfanilic acid (p-Aminobenzenesulfonic acid) and salt	ACY.
4-Sulfo-o-sec-butylphenol	VTC.
5-Sulfo-o-sec-butylphenol	VTC.
5-Sulfisophthalic acid, 1,3-dimethyl ester	PCM, X.
5-Sulfisophthalic acid, lithium salt	PCM.
N,5'-Sulfisophthalic acid, sodium salt	PCM.
4,4'-Sulfonaphthalic acid	TRC.
4,4'-Sulfonaphthalene	TRC.
4-Sulfophthalic acid (4,4'-dihydroxydiphenyl sulfone)	UPF.
Sulfur trioxide pyridine complex	CMN.
Terephthalic acid	UPJ.
Terephthalic acid, dimethyl ester	ACC, DUP, HCF.
Terephthaloyl chloride	ACC, DUP, EKT, HCF, HST.
Terephthaloyldiacetic acid, diethyl ester	DUP.
	PCM.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Terphenyl (Phenylbiphenyl) (m-o-, and p-isomers)	MON.
3,3',4,4'-Tetraazabenzophenone	BJL.
3,3',5,5'-Tetraazo-o-cresol-sulfonphthalein	EK.
Tetrahydrophthalic anhydride	VEL.
1,4,5,8-Tetrachloroanthraquinone	DUP.
1,2,4,5-Tetrachlorobenzene	OCM.
1,2,4,5-Tetrachloro-3-nitrobenzene	SDH.
2,3,5,6-Tetrachloropyridine	DOM.
4,4',2,6'-Tetrachlorotoluene	DUP.
Tetrahydrobenzyl alcohol	DUP.
Tetrahydrofuran	DUP.
Tetrahydrofuryl dimethacrylate	SAB.
1,2,13,4-Tetrahydro-6-methoxyquinoline	GAF, QKO.
1,2,13,4-Tetrahydro-6-methoxyquinoline	DUP.
Tetrahydrophthalene-1,4-tetrahydrophthalone-1-	UCC.
1,2,3,4-Tetrahydro-2,4,7-triazethyloquinoline	EKT.
1,4,5,8-Tetrachloro-3,6,8-triazethyloquinoline	TRC.
p-(1,1',3'-Tetraethylbutyl)phenol	GAF.
m,m',m''-Tetraethyl-p-phenylenediamine, dihydrochlor-	EK.
2-Thiophenecarboxaldehyde	ABB.
Thiophenol	SFA.
s-Thyrol	GIV, KPT.
*Toluene-2,4-diazine (4-m-Tolylenediazine)	ACS, ONC, RUC, UCC.
Toluene-2,4-(and 2,6)-diamine	AIP.
Toluene-3,4-diazine	EK.
p-Toluenesulfonic acid, sodium salt	NES.
o-(and p)-Toluenesulfonic acid	TEN.
p-Toluenesulfonic acid	NES.
p-Toluenesulfonic acid monohydrate	UPF.
p-Toluenesulfonyl chloride	MON.
p-Toluic acid	SFS.
p-Toluic acid, methyl ester	DUP.
o-Toluidine	DUP, EST.
m-Toluidine	DUP.

TABLE 2. --CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
p-Toluidine	DUP.
p-Toluidine hydrochloride	EK.
Toluidines, mixed	DUP.
2-o-Toluidinoethanol	TCH.
o-Toluidinomesethanesulfonic acid	FEC.
m-Toluidinomesethanesulfonic acid	ATL.
o-(p-Toluoyl)benzoic acid	GAF.
p-Toluoyl chloride	TNA.
4-(o-Polyazo)-o-toluidine (C.I. Solvent Yellow 3)	SDH.
4-(o-Rilyazo)-o-toluidine hydrochloride	ARL.
1-p-Tolyldecane	K.
p-Tolylhydroquinone	UPJ.
2,2'-(o-Tolylimino)diethanol	TCH.
2,2'-(m-Tolylimino)diethanol	GIL, TCH.
2,2'-(p-Tolylimino)diethanol, diacetate ester	SBC.
Tolyltriazole	SK.
1,6-Triamino-5-nitrosopyrimidine	SK.
1,4,6-Triazolo[3,5-d]pyridine	EK.
1,4,6-Triazolo[3,5-d]pyridine	WLS.
2,4,6-Tribenzonol	VEL.
3,4,5-Tribromosalicylanilide	PCW.
1,2,3,4 and 1,2,4,5-trichlorobenzene	PPG, SCC(E).
1,2,4-Trichlorobenzene	DOH, SCC, X.
1,1,1-Trichloro-2,2-diphenylethane	CWN, SCC.
1,2,4-Trichloro-5-nitrobenzene	ALL.
Trichlorophenylsilane (Benzotrifluoride)	DCC.
a, a-Trichlorotoluene	HK, VEL.
a, 2, 4-Trichlorotoluene	HN.
a, 3, 4-Trichlorotoluene	NIL.
2,4,6-Trichloro-s-triazine	CGY(E).
Tri(dimethylaminomethyl)phenol	MLS.
2-(Trifluoromethyl)phenothiazine	SK.
a, a, a-Trifluoro-N-phenyl-m-toluidine methyl)diphenylamine	(3-(Trifluoro- methyl)diphenylamine) - SK.
a, a, a-Trifluorotoluene	HK.
2,4,3-Trihydroxydiphenyl	PCW, PIT.

TABLE 2.--CYCLIC INTERMEDIATES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

CYCLIC INTERMEDIATES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Triacetic anhydride, acid chloride	ARS.
Trimesic acid	ARB.
1,2,3-Trimethylbenzene (Healbelline)	SUN.
1,2,4-Trimethylbenzene (Pseudocumene)	SUN.
3,3,5-Trimethylcyclohexanol (M-Homenthol)	ARS.
*2,3,3-Trimethyl-3H-Indole	GAF, VPC.
*3,3-Trimethyl-0 <sub>2</sub> , 2-Indolineacetaldehyde	ALL, DUP, GAF, TRC, VPC.
*1,3,3-Trimethyl-2-methyleneindoline	DUP, GAF, VPC.
Trimethylphenylammonium chloride	KC.
1,4,9-Trimethylpyridine	KPT, PFN.
*4,8-Dimethylfluoren-9-one	EA.
Triphenylmethane	EK.
Triphenylmethane aldehyde	CMN.
2,4,6-Trisopropylbenzaldehyde	Y.
2,4,6-Trisopropylbenzaldehyde	CMN.
*4,6-Trisopropylbenzaldehyde	RR.
*4,6-Trisopropylbenzaldehyde	RR.
Tris(2-methyl-1-aziridinyl)phosphine oxide	ARS.
*2,7-pyrenebis[4-hydroxy-2-naphthalenesulfonic acid]	DUP, GAF, TRC.
5-Vinyl-2-picoline (MVP)	PIC.
2-Vinylpyridine	RIL.
4-Vinylpyridine	RIL.
*Violanthrone (Dibenzanthrone)	ACS, RCC, DUP, TRC.
Xanthene-9-carboxylic acid	MAL.
Xylenesulfonic acid, mixed isomers	NES.
2,6-Xylenol	GE, KPT.
Xylenol crystals	PRD.
XYLIDINES:	
2,4-Xylidine (m-4-Xylidine)	DUP.
2,6-Xylidine	DUP.
Xylidine, original mixture	DUP.
Cyclic intermediates, all other	ARS, ACS, ALL, ABA, ARS, BUL, CMN, DUP, EGR, EK, GAF, HK, HS, ICI, KP, LIL, MIL, MOB, MEK, PD, PF2, PIC, PRD, RSA, SAL, SDC, SD4, SA, SRL, STC, SW, TCH, TRC, VPC, WCC, X, X, X, X, X.

TABLE 3.--CYCLIC INTERMEDIATES: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of cyclic intermediates to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
ABB	Abbott Laboratories	GAF	GAF Corp.
AC	American Color & Chemical Corp.	GE	General Electric Co.
ACC	Amoco Chemicals Corp.	GIV	Givaudan Corp.
ACS	Allied Chemical Corp., Specialty Chemicals Div.	GLY	Glyco Chemicals, Inc.
ACY	American Cyanamid Co.	GNW	Greenwood Chemical Co.
ADC	Anderson Development Co.	GOC	Gulf Oil Corp., Gulf Oil Chemicals Co.-U.S.
AIP	Air Products & Chemicals, Inc.	GP	Georgia-Pacific Corp., Plaquemine Div.
ALD	Aldrich Chemical Co., Inc.	GTL	Great Lakes Chemical Corp.
ALF	Allied Chemical Corp., Fibers Div.	GYR	Goodyear Tire & Rubber Co.
ALL	Alliance Chemical Corp.		
AMB	American Bio-Synthetics Corp.	HCF	Hercofina
ARA	Araphahoe Chemicals, Inc. Sub/Syntex U.S.A., Inc.	HDW	Hardwicke Chemical Co.
ARK	Armstrong Cork Co.	HEX	Hexagon Laboratories, Inc.
ARS	Arsynco, Inc.	HK	Hooker Chemicals & Plastics Corp.
ARZ	Arizona Chemical Co.	HN	Tenneco Chemicals, Inc.
ASH	Ashland Oil, Inc., Ashland Chemical Co.	HPC	Hercules, Inc.
ASL	Ansul Chemical Co.	HSC	Chemetron Corp., Pigments Div., Sub. of Allegheny Ludlum Industries, Inc.
ATL	Atlantic Chemical Corp.	HSB	Harshaw Chemical Co.
		HST	American Hoechst Corp.: Hoechst Fibers Industries Div. Industrial Chemicals Div.
BAS	BASF Wyandotte Corp.		
BCC	Buffalo Color Corp.	ICI	ICI United States, Inc., Chemical Specialties Co.
BJL	Burdick & Jackson Laboratories, Inc.	IMC	IMC Chemical Group, Inc.
BUC	Synalloy Corp., Blackman-Uhler Chemical Div.	JCC	Jefferson Chemical Co., Inc.
CCW	Cincinnati Milacron Chemicals, Inc.	KF	Kay-Fries Chemicals, Inc.
CEL	Celanese Corp., Celanese Chemical Co.	KLM	Kalama Chemical, Inc.
CGY	Ciba-Geigy Corp.	KPT	Koppers Co., Inc.
CHL	Chemol, Inc.		
CHT	Chattem Drug & Chemical Co.	LAK	Bofors Lakeway, Inc.
CLK	Clark Oil & Refining Corp.	LEM	Napp Chemicals, Inc.
CNP	Nipro, Inc.	LII	Eli Lilly & Co.
CO	Continental Oil Co.		
CRS	Carus Chemical Co.	MAL	Mallinckrodt, Inc.
CWN	Upjohn Co., Fine Chemical Div.	MCB	Borg-Warner Corp., Borg-Warner Chemicals
		MER	Merichem Co.
DBC	Dow Badische Co.	MIL	Milliken & Co., Milliken Chemical Div.
DCC	Dow Corning Corp.	MLC	Melamine Chemicals, Inc.
DKA	Denka Chemical Corp.	MLS	Miles Laboratories, Inc., Summer Div.
DOW	Dow Chemical Co.	MNR	Monroe Chemical Co.
DUP	E. I. duPont de Nemours & Co., Inc.	MOB	Mobay Chemical Co.
DVC	Dover Chemical Corp., Sub of ICC Industries, Inc.	MON	Monsanto Co.
		MRK	Merck & Co., Inc.
EGR	Eagle River Chemical Corp.	MTO	Montrose Chemical Corp. of California
EK	Eastman Kodak Co.:		
EKT	Tennessee Eastman Co. Div.	NCI	Union Camp Corp.
ELP	El Paso Products Co.	NEP	Nepera Chemical Co., Inc.
ENJ	Exxon Chemical Co. U.S.A.	NES	Nease Chemical Co., Inc.
		NIL	Nilok Chemicals, Inc.
FER	Ferro Corp., Ottawa Chemical Div.	NOR	Morton-Norwich Products, Inc., Norwich
FG	Foster Grant Co., Inc.		Eaton Pharmaceutical Div.
FMP	FMC Corp., Industrial Chemical Div.	NPC	Northwest Petrochemical Corp.
FMT	Fairmount Chemical Co., Inc.		
FST	First Chemical Corp.		

TABLE 3.--CYCLIC INTERMEDIATES: DIRECTORY OF MANUFACTURERS, 1977--CONTINUED

Code	Name of company	Code	Name of company
OMC	Olin Corp.	SKO	Getty Refining & Marketing Co.
OPC	Orbis Products Corp.	SOC	Standard Oil Co. of California, Chevron Chemical Co.
ORO	Chevron Chemical Co.	SRL	G. D. Searle & Co.
ORT	Roehr Chemicals	STC	American Hoechst Corp., Sou-Tex Works
PAS	Pennwalt Corp.	STG	Stange Co.
PCW	Pfister Chemical, Inc.	STP	Stepan Chemical Co.
PD	Parke, Davis & Co. Sub. of Warner-Lambert Co.	SUN	Sun Company, Inc.
PFN	Pfanstiehl Laboratories, Inc.	SW	Sherwin-Williams Co.
PFZ	Pfizer, Inc. & Pfizer Pharmaceuticals, Inc.	TCC	Tanatex Chemical Corp.
PIT	Pitt-Consol Chemical Co.	TCH	Emery Industries, Inc., Tylon Div.
PLC	Phillips Petroleum Co.	TEN	Cities Service Co., Copperhill Operations
PGP	PPG Industries, Inc.	TNA	Ethyl Corp.
PRD	Ferro Corp., Productol Chemical Div.	TOC	Tenneco Oil Co.
PTO	P. R. Chemical Co., Inc.	TRC	Toms River Chemical Corp.
PTT	Petro-Tex Chemical Corp.	TRD	Manufacturing Enterprises, Inc., Squibb Manufacturing, Inc., Trade Enterprise, Inc., Ersana, Inc.
QKO	Quaker Oats Co.	TX	Texaco, Inc.
RBC	Fike Chemicals, Inc.	UCC	Union Carbide Corp.
RCI	Reichhold Chemicals, Inc.	UOP	UOP, Inc., Chemical Div.
RDA	Rhodia, Inc.	UPF	Jim Walter Resources, Inc.
RH	Rohm & Haas Co.	UPJ	Upjohn Co.
RIL	Reilly Tar & Chemical Corp.	USM	USM Corp., Bostik Div.
RPC	A. Kewanee Industry, Millmaster Chemical Group, Refined-Onyx Co. Div.	USR	Uniroyal, Inc., Uniroyal Chemical Div.
RSA	R.S.A. Corp.	USS	USS Chemicals Div. of U.S. Steel Corp.
RUC	Rubicon Chemicals, Inc.	VEL	Velsicol Chemical Corp.
SAL	Salsbury Laboratories	VGC	Virginia Chemicals, Inc.
SAR	Sartomer Industries, Inc.	VIK	Viking Chemical Co.
SCC	Standard Chlorine of Delaware, Inc.	VPC	Mobay Chemical Corp., Verona Div.
SCN	Schenectady Chemicals, Inc.	VTC	Vicksburg Chemical Co. Sub. of Vertac Consolidated
SDC	Martin-Marietta Corp., Sodyeco Div. Sterling Drug, Inc.:	WAY	Philip A. Hunt Chemical Corp., Organic Chemical Div.
SDH	Hilton-Davis Chemical Co. Div.	WCC	White Chemical Corp.
SDW	Winthrop Laboratories Div. Stauffer Chemical Co.:	WLL	Inolex Corp., Inolex Pharmaceutical Div.
SFA	Agricultural Div.	WTC	Witco Chemical Corp.
SFC	Calbio Chemicals, Inc.	WYT	Wyeth Laboratories, Inc., Wyeth Laboratories Div. of American Home Products Corp.
SFS	Specialty Div.		
SHC	Shell Oil Co., Shell Chemical Co. Div.		
SK	SmithKline Laboratories		

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix. The above codes identify those of the 172 reporting companies and company divisions for which permission to publish was not restricted.



## Dyes

Edmund Cappuccilli

Synthetic benzenoid dyes are compounds or mixtures which usually possess a color and can be used to impart that color to various items such as cloth, rugs, paper, plastic, or leather, with or without the use of a bonding substance. In the United States, the textile industry is the principal consumer of dyes. At the present time, there are several hundred dyes produced in the United States to meet the demands of the domestic and foreign consumers. Dyes are classified by the chemical composition (e.g., azoic, anthraquinone, and so forth) and also by the type of reaction occurring in the application process. Some of the more common application classes are acid, basic, direct, disperse, solvent, and vat dyes.

The synthetic benzenoid dye industry in 1977 continued to recover from the low production registered in 1975. One of the primary reasons for the increased production is the upturn in the U.S. economy after 1976. This economic recovery by the industry helped to offset the increased pressures from imports and Federal regulations.

Production and sales

In 1977, the production of synthetic dyes in the United States increased by 3 percent to 264 million pounds. Although this increase was not nearly so large as the 24-percent increase of the previous year, it does represent a sign of continued economic improvement in the dye industry. The quantity of sales of domestically produced dyes increased by 2 percent (to 255 million pounds) with a 11-percent increase in the value of sales (to \$690 million). A 10-percent increase in the average unit value of sales from \$2.48 in 1976 to \$2.72 was also registered in 1977. The somewhat slower rise in prices in 1977 (from the 30-percent increase in 1976) is due principally to the easing of the overall inflation rate coupled with increasing imports. This increase in imports, especially lower priced competitive imports, contributed to the smaller rise in dye prices since the domestic dye producers had to insure that their products remained competitive in the domestic market.

Some industry sources anticipate that production of dyes in 1978 will continue to increase but not to the extent recorded in 1977. An increase of 1 or 2 percent is expected even though increasing Government regulations, including pollution controls, and imports will continue to affect the dye industry. These adverse factors, however, should be offset by increased production in the dye-consuming industries (e.g., textiles and paper products).

Over the past several years, the major classes of dyes (e.g., acid; basic; direct; disperse; food, drug and cosmetic (FD&C); fluorescent brightening agents; solvent; and vat) have shown changes in production for a variety of reasons. For example, the classes of dyes which have a variety of uses or are closely associated with a stable market have had the most constant output over the past several years. Conversely, those dye classes which depend mainly on the volatile textile markets have experienced large fluctuations during the same period. The following examples illustrate recent trends in the dye industry.

Because of their specialized applications, the output of certain classes of dyes for the past several years has varied greatly compared to the overall dye industry. For example, fluorescent brightening agents have shown the smallest change of all the major dye classes. They are used primarily in household detergent formulations to produce a brightening effect on clothes. The synthetic detergent industry, which manufactures these formulations, has been quite stable for the past several years. Because of this stability, the demand for fluorescent brightening agents has remained relatively constant when compared to other classes of dyes.

Basic dyes, on the other hand, are used in the textile industry mainly on acrylic and modacrylic fibers. The decrease in the production of textiles made from these fibers during the recession of 1975 greatly affected the production of basic dyes. In 1975, the production of basic dyes decreased by 41 percent while the overall production of dyes declined only 25 percent.

#### Changes in the dye industry

During 1970-77, the number of dye plants in the United States declined as several companies closed their plants or sold them to foreign companies. In most cases, the plants were owned by U.S. companies. As a result, the U.S. dye industry is slowly being dominated by subsidiaries of foreign firms. In 1970, there were approximately 45 dye producers in the United States. By 1977, the number of companies reporting production or sales of dyes to the U.S. International Trade Commission had declined to 41.

Several companies allege that increasing production costs and foreign imports are the main reasons they have sold part or all of their dyestuff plants in the past few years. Most sales of dyestuff plants in the past few years were to foreign firms. For example, one large U.S. chemical company recently sold its dyestuff business to a West German firm because of declining profits.<sup>1</sup> The foreign producers can usually supply their subsidiaries with lower cost intermediates or semifinished dyes with a lowering of production costs. It is the belief of the dye industry that there will continue to be sales and mergers of dye plants as the cost of production continues to rise and competition from imports continues to increase.

Some dye producers have stopped producing certain classes of dyes for a variety of reasons. For example, in late 1977, DuPont discontinued the production of vat dyes because of the increased costs of dye intermediates and of required pollution controls.<sup>2</sup> The estimated increase in the selling price of the finished product would eliminate any competitive edge over the imported vat dyes.

Government regulations and controls, which are considered by many people to be a major factor in the decline of domestically owned dye plants in the United States are also affecting the competitiveness between certain classes of domestic dyes and similar imported products.

---

<sup>1</sup> American Dyestuff Reporter, September 1977, pp. 17-18.

<sup>2</sup> Ibid., October 1977, p. 68.

Increasing pollution controls have affected the vat dyes to a greater extent than other classes because of the need to control the effluents from the vat dye production process. Vat dyes had consistently been one of the lowest priced classes of dyes produced in the United States and one of the more competitive compared with similar imports. The increased cost of vat dyes owing to pollution control costs is expected to decrease the competitiveness of these products in future years.

Another example of the effect of Government regulations on the dye industry is the withdrawal by the Food and Drug Administration (FDA) of certain dyes which have proven potentially harmful to man. At the present time the two classes most affected by these regulations are the FD&C dyes and the direct dyes based on benzidine. A short time ago, Red Dye 40, a food coloring dye, was withdrawn by the FDA from the domestic market because it was a suspected carcinogen. In 1978, however, it was shown in laboratory tests that Red Dye 40 did not cause cancer in mice as had previously been suspected. Its fate is now being decided by the FDA. Other dyes are still undergoing tests. Three benzidine-based direct dyes, C.I. Direct Blue 6, C.I. Direct Black 38, and C.I. Direct Brown 95, have all been reported to cause cancer in rats and may be withdrawn from the domestic market in the near future.<sup>1</sup>

In addition, the output of other dyes in coming years will probably be affected either by restrictions or by withdrawals from production as a result of increased testing for carcinogens. At the present time, direct dyes, especially those based on benzidine, are the main subject of investigations by the FDA and National Institute for Occupational Safety and Health; they will probably experience a decline in production in the near future as alternative dyes are found to replace them.

#### Foreign trade

Imports of synthetic benzenoid dyes in 1977 (TSUS 406.50) amounted to 21.3 million pounds valued at \$101.7 million (table A), an increase of 13.9 percent in quantity and 15.7 percent in value over the 1976 level.

West Germany and Switzerland continued to supply the bulk of the dye imports to the United States in 1977 despite increased imports from several other countries (e.g., Japan and the United Kingdom). Total imports from West Germany and Switzerland were 14.4 million pounds in 1977. Although this quantity amounted to 67 percent of the total dyes imported in 1977, it was 2.7 percent less than the combined total reported in 1976.

Large volumes of dyes are shipped by producers in West Germany and Switzerland to their U.S. subsidiaries; such shipments in 1977 are estimated to have comprised 85 percent (about 12 million pounds) of total imports from these countries.<sup>2</sup>

---

<sup>1</sup> Chemical Week, May 1978, p. 57.

<sup>2</sup> Estimated from items examined by the Commission for TSUS 406.50.

Future sources of imported dyes, especially the noncompetitive products, are not expected to vary greatly from the present ones because of the secure position of major chemical companies in West Germany and Switzerland in the dyestuff field. Minor shifts in the importing patterns may occur in the coming years, however, because some European and Japanese companies are constructing dye plants in several developing countries where low labor rates and minimal pollution controls now exist. Also, the possibility of a duty exemption for dyes imported under TSUS item 406.50 applicable to eligible countries under the Generalized System of Preferences provision of the 1974 Trade Act may have been a factor in the decision to construct dye plants in these countries.

During the past few years, the major imported dye by far has been Vat Blue 1, 20%, which is used for dyeing cotton fiber items (i.e., denim) and for printing. In 1977, 4.1 million pounds of Vat Blue 1, 20%, was imported into the United States. This quantity was an increase of 20.6 percent from the 3.4 million pounds imported in 1976. Imports of Vat Blue 1, 20%, and several other major imported dyes in 1975-77 by quantity are shown in table B. Future imports of Vat Blue 1, 20%, will depend upon the use of this product in textiles, and on the ability of the U.S. producer to market a competitive product despite costs of pollution controls. At the present time, it appears that U.S. imports of Vat Blue 1, 20% will increase for several years, depending on consumer demand.

The future of dye imports, in general, may depend upon the outcome of the current trade negotiations in Geneva, Switzerland. Topics for discussion in the Geneva trade negotiations include: (1) the elimination of the American selling price (ASP) method of valuation of imports for duty purposes; (2) the substitution of the ASP method by one of assessing import duties based on transaction values; and (3) the possible reduction of duty rates by 60 percent. Industry sources have indicated that the adoption of any one or all of the above proposals may have a significant effect on the domestic dye industry in the future. Irrespective of the outcome to these proposals, imports of dyes are expected to continue to increase by 5 to 10 percent per year over the next few years, because of the predicted growth of consumer products (e.g., clothing, rugs, and paper products) which utilize dye products in their production. This rate of increase, however, could accelerate if new trade developments, such as adoption of any of the above trade-agreement proposals, should occur.

Table A.--Synthetic dyes: 1/ U.S. imports, by principal sources, 1975-77

Source	1975	1976	1977
Quantity (1,000 pounds)			
West Germany----	5,652	8,407	8,889
Switzerland----	2,585	4,742	5,507
United Kingdom--	1,497	1,901	2,130
Japan-----	704	1,153	1,639
France-----	820	831	933
All other-----	650	1,704	2,248
Total-----	11,908	18,738	21,346
Value (1,000 dollars)			
West Germany----	23,001	39,906	41,765
Switzerland----	12,108	25,248	30,620
United Kingdom--	6,348	9,075	11,266
Japan-----	3,432	4,849	6,069
France-----	3,049	3,622	4,372
All other-----	2,493	5,221	7,615
Total-----	50,431	87,921	101,707
Unit value (per pound)			
West Germany----	\$4.07	\$4.75	\$4.70
Switzerland----	4.68	5.32	5.56
United Kingdom--	4.24	4.77	5.29
Japan-----	4.88	4.21	3.70
France-----	3.72	4.36	4.69
All other-----	3.84	3.06	3.39
Total-----	4.24	4.69	4.77

1/ TSUS item 405.60.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table B.--Synthetic dyes: U.S. imports by principal products, 1/ 1975-77 2/

(In thousands of pounds)

Item	1975	1976	1977
Vat Blue 1, 20%-----	5,995	3,409	4,111
Solvent Black 5-----	692	263	<u>3/</u>
Phorwite CL <u>4/</u> -----	675	<u>3/</u>	<u>3/</u>
Phorwite RKH <u>4/</u> -----	359	<u>3/</u>	<u>3/</u>
Disperse Blue 73-----	331	901	<u>3/</u>
Food, Drug, and Cosmetic			
Yellow 5-----	281	<u>3/</u>	<u>3/</u>
Fluorescent Brightening			
Agent 351-----	209	644	480
Disperse Blue 79-----	<u>3/</u>	734	388
Fluorescent Brightening			
Agent 119-----	<u>3/</u>	248	<u>3/</u>
Basic Yellow 2-----	<u>3/</u>	117	280
Solvent Black 7-----	<u>3/</u>	<u>3/</u>	499
Direct Black ANBN-----	<u>3/</u>	<u>3/</u>	322
Acid Blue 277-----	<u>3/</u>	<u>3/</u>	247

1/ Selected on the basis of items examined by the Commission for TSUS item 406.50.

2/ The 7 dyes imported in the largest quantities are shown for each year.

3/ Not applicable.

4/ A fluorescent brightening agent.

Source: Compiled from official statistics of the International Trade Commission, July 1978.

## Dyes

Edmund Cappuccilli

Synthetic dyes are derived in whole or in part from cyclic intermediates. Approximately two-thirds of the dyes consumed in the United States are used by the textile industry to dye natural and synthetic fibers or fabrics; about one-sixth is used for coloring paper; and the rest is used chiefly in the production of organic pigments and in the dyeing of leather and plastics. Of the several thousand different synthetic dyes that are known, more than one thousand are manufactured by one or more domestic producers. The large number of dyes results from the many different types of materials to which dyes are applied, the different conditions of service for which dyes are required, and the costs that a particular use can bear. Dyes are sold as pastes, powders, lumps, and solutions; concentrations vary from 6 percent to 100 percent. The concentration, form, and purity of a dye are determined largely by the use for which it is intended.

Total domestic production of dyes in 1977 amounted to 264 million pounds, or 3.2 percent greater than the 256 million pounds produced in 1976 (table 1). Sales of dyes in 1977 amounted to 255 million pounds, valued at \$690 million, compared with 250 million pounds, valued at \$620 million, in 1976. In terms of quantity, sales of dyes in 1977 were 1.9 percent greater than in 1976 and in terms of value, 11.3 percent greater. The average unit value of sales of all dyes in 1977 was \$2.71 per pound compared with \$2.48 per pound in 1976.

The production of six classes of dyes continued to increase in 1977, while the remaining three major classes registered slight to moderate declines in their production. Acid dyes increased by 8.7 percent from 28.2 million pounds in 1976 to 30.7 million in 1977. The other five classes of dyes increased by the following percentages: basic dyes (17.2), disperse dyes (10.6), fiber-reactive dyes (47.0), solvent dyes (8.9), and vat dyes (13.6).





TABLE 1.--DYES: U.S. PRODUCTION AND SALES, 1977

[Listed below are all dyes for which any reported data on production or sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists all dyes for which data on production and/or sales were reported and identifies the manufacturers of each]

DYES	SALES			
	PRODUCTION	QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	264,369	254,516	689,992	\$2.71
ACID DYES				
Total-----	30,705	29,003	98,188	3.42
Acid yellow dyes, total-----	11,323	10,821	30,646	2.83
Acid Yellow 17-----	201	208	667	3.21
Acid Yellow 19-----	563	545	1,225	2.25
Acid Yellow 23-----	430	458	1,884	4.12
Acid Yellow 40-----	58	...	...	...
Acid Yellow 151-----	2,284	2,061	3,417	1.66
All other-----	7,787	7,549	23,453	3.11
Acid orange dyes, total-----	4,079	3,627	11,443	3.16
Acid Orange 7-----	380	353	808	2.29
Acid Orange 8-----	218	241	567	2.35
Acid Orange 10-----	210	166	395	2.39
Acid Orange 24-----	547	536	1,342	2.50
Acid Orange 60-----	521	497	1,618	3.25
All other-----	2,203	1,834	6,713	3.66
Acid red dyes, total-----	4,925	4,694	19,525	4.16
Acid Red 1-----	438	445	1,070	2.41
Acid Red 4-----	53	56	209	3.76
Acid Red 14-----	77	77	293	3.82
Acid Red 73-----	129	124	584	4.73
Acid Red 88-----	48	...	...	...
Acid Red 114-----	240	163	736	4.51
Acid Red 137-----	129	118	591	5.00
Acid Red 151-----	503	524	1,413	2.70
Acid Red 182-----	96	78	348	4.45
Acid Red 266-----	259	299	1,119	3.74
Acid Red 337-----	1,429	1,268	5,209	4.11
All other-----	1,524	1,542	7,953	5.16
Acid violet dyes, total-----	194	165	804	4.86
Acid Violet 3-----	58	56	245	4.36
All other-----	136	109	559	5.13
Acid blue dyes, total-----	5,311	5,347	20,282	3.79
Acid Blue 25-----	238	541	3,379	6.25
Acid Blue 27-----	77	95	383	4.05
Acid Blue 40-----	600	531	2,449	4.61
Acid Blue 113-----	409	353	1,279	3.63
All other-----	3,987	3,827	12,792	3.34
Acid green and brown dyes, total-----	1,907	1,741	7,070	4.06
Acid Brown 14-----	419	427	1,409	3.30
All other-----	1,488	1,314	5,661	4.31
Acid black dyes, total-----	2,966	2,608	8,418	3.23
Acid Black 1-----	425	354	1,128	3.19
Acid Black 52-----	617	459	1,357	2.96
Acid Black 107-----	178	231	978	4.24
All other-----	1,746	1,564	4,955	3.17

See footnotes at end of table.

TABLE 1.--DYES: U.S. PRODUCTION AND SALES, 1977--CONTINUED

DYES	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
<b>AZOIC DYES AND COMPONENTS</b>				
<i>Azoic Diazo Components, Bases (Fast Color Bases)</i>	<i>1,000 pounds</i>	<i>1,000 pounds</i>	<i>1,000 dollars</i>	<i>Per pound</i>
Azoic Diazo Components, Bases (Fast Color Bases)				
Total-----	581	533	1,229	\$2.31
<i>Azoic Diazo Components, Salts (Fast Color Salts)</i>				
Total-----	1,271	1,235	1,602	1.30
Azoic Diazo Component 6, salt-----	78	81	115	1.42
All other azoic diazo components, salts-----	1,193	1,154	1,487	1.29
<b>BASIC DYES</b>				
Total-----	17,103	16,249	57,353	3.53
Basic yellow dyes, total-----	5,772	5,135	16,694	3.25
Basic Yellow 11-----	753	222	222	2.93
Basic Yellow 13-----	275	208	516	2.48
All other-----	4,744	4,927	16,178	3.28
Basic orange dyes, total-----	1,638	1,712	4,751	2.77
Basic Orange 2-----	486	603	1,430	2.37
Basic Orange 21-----	559	580	1,637	2.82
All other-----	593	529	1,684	3.18
Basic red dyes, total-----	3,070	2,846	10,262	3.61
Basic Red 14-----	876	718	1,505	2.09
Basic Red 18-----	591	600	1,395	2.33
Basic Red 49-----	104	103	377	3.66
All other-----	1,499	1,425	6,985	4.90
Basic violet dyes, total-----	3,129	3,187	11,699	3.67
Basic Violet 1-----	1,039	1,112	3,661	3.29
All other-----	2,090	2,075	8,038	3.87
Basic blue dyes, total-----	2,956	2,750	11,690	4.25
Basic Blue 3-----	909	692	2,156	3.11
All other-----	2,047	2,058	9,534	4.63
All other basic dyes-----	538	619	2,257	3.65
<b>DIRECT DYES</b>				
Total-----	30,735	33,120	88,467	2.67
Direct yellow dyes, total-----	11,896	12,128	32,841	2.71
Direct Yellow 4-----	707	1,023	1,976	1.93
Direct Yellow 6-----	246	264	1,030	3.90
Direct Yellow 11-----	2,838	2,908	5,477	1.88
Direct Yellow 28-----	84	74	421	5.70
Direct Yellow 34-----	127	111	392	3.51
Direct Yellow 44-----	467	419	1,302	3.11
Direct Yellow 50-----	196	206	740	3.60
Direct Yellow 84-----	239	340	624	1.84
Direct Yellow 105-----	258	223	694	3.11
Direct Yellow 106-----	1,170	1,497	3,344	2.23
All other-----	5,564	5,063	16,841	3.33
Direct orange dyes, total-----	1,857	1,622	4,826	2.98
Direct Orange 15-----	636	523	872	1.67
Direct Orange 39-----	158	134	365	2.72
Direct Orange 72-----	236	227	688	3.03
Direct Orange 102-----	323	307	1,146	3.73
All other-----	504	431	1,755	4.07

See footnotes at end of table.

TABLE 1.--DYES: U.S. PRODUCTION AND SALES, 1977--CONTINUED

DYES	PRODUCTION		SALES	
	1,000 pounds	1,000 pounds	QUANTITY	VALUE
			1,000 pounds	1,000 dollars
				UNIT VALUE <sup>1</sup> Per pound
DIRECT DYES--Continued				
Direct red dyes, total	5,515	5,050	15,324	\$3.03
Direct Red 2	81	64	275	4.31
Direct Red 23	192	186	813	4.38
Direct Red 24	213	214	838	3.93
Direct Red 72	371	324	1,121	3.46
Direct Red 80	465	481	1,671	3.47
Direct Red 81	1,806	737	2,804	3.80
All other	2,387	3,044	7,802	2.56
Direct violet dyes	145	143	567	3.97
Direct blue dyes, total	6,380	6,147	19,501	3.17
Direct Blue 1	186	145	627	4.32
Direct Blue 15	530	514	1,502	2.92
Direct Blue 80	472	441	1,956	4.44
Direct Blue 86	911	739	2,502	3.38
Direct Blue 98	278	203	559	2.75
Direct Blue 218	...	888	3,126	3.52
All other	4,003	3,217	9,229	2.87
Direct green dyes	399	393	1,721	4.38
Direct brown dyes	639	795	2,328	2.93
Direct black dyes, total	3,904	6,842	11,359	1.66
Direct Black 22	856	1,110	1,517	1.37
All other	3,048	5,732	9,842	1.72
DISPERSE DYES				
Total	43,262	40,811	158,140	3.87
Disperse yellow dyes, total	8,160	8,005	21,098	2.64
Disperse Yellow 23	814	829	1,997	2.41
Disperse Yellow 42	663	655	1,414	2.16
Disperse Yellow 54	1,058	1,065	3,278	3.08
All other	5,625	5,456	14,409	2.64
Disperse orange dyes, total	6,551	5,727	16,249	2.84
Disperse Orange 3	134	113	304	2.70
Disperse Orange 25	451	530	1,409	2.66
All other	5,966	5,084	14,536	2.86
Disperse red dyes, total	9,827	8,761	41,132	4.69
Disperse Red 1	345	323	864	2.68
Disperse Red 5	67	79	205	2.60
Disperse Red 17	202	191	516	2.70
Disperse Red 50	427	255	1,163	4.56
Disperse Red 60	2,388	1,980	7,510	3.79
Disperse Red 65	253	187	639	3.42
Disperse Red 177	320	...	...	...
All other	5,825	5,746	30,235	5.26
Disperse violet dyes, total	584	520	2,310	4.44
Disperse Violet 1	62	35	185	5.32
Disperse Violet 27	45	68	186	2.71
All other	477	417	1,939	4.65
Disperse blue dyes, total	15,664	15,424	70,846	4.59
Disperse Blue 3	1,106	1,091	3,488	3.20
Disperse Blue 64	363	499	1,192	2.39
Disperse Blue 79	2,636	2,946	8,016	2.72
All other	11,559	10,888	58,150	5.34
Disperse green and brown dyes	1,317	1,159	3,769	3.25
Disperse black dyes	1,159	1,215	2,736	2.25

See footnotes at end of table.

TABLE 1.--Dyes: U.S. PRODUCTION AND SALES, 1977--CONTINUED

DYES	PRODUCTION		SALES	
	1,000 pounds	1,000 pounds	QUANTITY	UNIT VALUE <sup>1</sup>
			1,000 dollars	Per pound
<b>FIBER-REACTIVE DYES</b>				
Fiber-reactive dyes, total-----	5,153	4,742	25,758	\$5.43
Reactive yellow dyes-----	1,019	965	5,486	5.68
All other reactive dyes-----	4,134	3,777	20,272	5.37
<b>FLUORESCENT BRIGHTENING AGENTS</b>				
Fluorescent brightening agents, total-----	33,254	31,003	50,899	1.64
Fluorescent Brightening Agent 28-----	1,042	1,003	1,494	1.49
Fluorescent Brightening Agent 61-----	115			
All other fluorescent brightening agents-----	32,097	30,000	49,405	1.65
<b>FOOD, DRUG, AND COSMETIC COLORS</b>				
Total-----	5,744	5,381	37,278	6.93
<i>Food, Drug, and Cosmetic Dyes</i>				
Total-----	5,366	5,030	33,412	6.64
FD&C Blue No. 1-----	259	316	1,969	6.24
FD&C Red No. 3-----	461	479	5,097	10.63
FD&C Red No. 40-----	1,712	1,486	11,990	8.07
FD&C Yellow No. 5-----	1,658	1,528	7,944	5.20
FD&C Yellow No. 6-----	1,142	1,059	4,866	4.59
All other food, drug, and cosmetic dyes-----	134	162	1,546	9.54
<i>Drug and Cosmetic and External Drug and Cosmetic Dyes</i>				
Total-----	378	351	3,866	11.00
D&C Red No. 7-----	66	58	401	6.90
D&C Red No. 9-----	114	71	345	4.83
D&C Red No. 19-----	15	...	...	...
All other drug and cosmetic and external drug and cosmetic dyes-----	183	222	3,120	14.05
<b>MORDANT DYES</b>				
Total-----	695	594	2,173	3.66
Mordant orange dyes-----	78	72	214	2.99
All other mordant dyes-----	617	522	1,959	3.75
<b>SOLVENT DYES</b>				
Total-----	12,999	9,955	32,251	3.24
Solvent yellow dyes-----	1,400	1,350	5,324	3.94
Solvent orange dyes-----	821	690	2,616	3.79
Solvent red dyes, total-----	2,774	2,795	8,164	2.92
Solvent Red 24-----	73	58	255	4.37
All other-----	2,701	2,737	7,909	2.89
Solvent blue dyes-----	3,959	1,308	9,079	6.94
All other solvent dyes-----	4,045	3,812	7,068	1.85
<b>VAT DYES</b>				
Total-----	60,478	59,815	101,887	1.70
Vat yellow dyes-----	1,609	1,485	4,300	2.90

See footnotes at end of table.

TABLE 1.--DYES: U.S. PRODUCTION AND SALES, 1977--CONTINUED

DYES	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
VAT DYES--Continued				
Vat orange dyes, total-----	2,392	2,233	11,253	\$5.04
Vat Orange 15, 10%-----	207	...	...	...
All other-----	2,185	2,233	11,253	5.04
Vat red dyes-----	429	378	2,651	7.02
Vat violet dyes-----	704	432	1,724	3.99
Vat green dyes, total-----	4,263	4,542	7,223	1.59
Vat Green 3, 10%-----	1,318	1,129	2,462	2.18
All other-----	2,945	3,413	4,761	1.39
Vat black dyes, total-----	3,887	3,865	8,957	2.32
Vat Black 25, 12-1/2%-----	2,241	2,368	4,773	2.02
All other-----	1,646	1,497	4,184	2.79
All other vat dyes-----	47,194	46,880	65,779	1.40
All other dyes <sup>3</sup> -----	22,389	22,075	34,767	1.57

<sup>1</sup> Calculated from unrounded figures.

<sup>2</sup> The data include dyes which are similar to, but not chemically identical with, the indicated *Colour Index* name.

<sup>3</sup> The data include azoic compositions, azoic coupling components, sulfur dyes, and miscellaneous dyes. Statistics for those groups of dyes may not be published separately because publication would disclose information received in confidence.

TABLE 1A.--DYES: U.S. PRODUCTION AND SALES, BY CLASS OF APPLICATION, 1977

CLASS OF APPLICATION	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Total-----	264,369	254,516	689,992	\$2.71
Acid-----	30,705	29,003	98,188	3.39
Azoic dyes and components:				
Azoic diazo components, bases (Fast color bases)--	581	533	1,229	2.31
Azoic diazo components, salts (Fast color salts)--	1,271	1,235	1,602	1.30
Basic-----	17,103	16,249	57,353	3.53
Direct-----	30,735	33,120	88,467	2.67
Disperse-----	43,262	40,811	158,140	3.87
Fiber-reactive-----	5,153	4,742	25,758	5.43
Fluorescent brightening agents-----	33,254	31,003	50,899	1.64
Food, drug, and cosmetic colors-----	5,744	5,381	37,278	6.93
Mordant-----	695	594	2,173	3.66
Solvent-----	12,999	9,955	32,251	3.24
Vat-----	60,478	59,815	101,887	1.70
All other <sup>2</sup> -----	22,389	22,075	34,767	1.57

<sup>1</sup> Calculated from unrounded figures.

<sup>2</sup> The data include azoic compositions, azoic coupling components, sulfur dyes, and miscellaneous dyes. Statistics for those groups of dyes may not be published separately because publication would disclose information received in confidence.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); CHEMICALS DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DAYS ARE CENSORED FOR CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT.]

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C I D D Y E S	
*ACID YELLOW DYES:	
Acid Yellow 1-	
Acid Yellow 3-	ACV.
Acid Yellow 11-	ACS, ACY, BCC.
Acid Yellow 14-	BDO, CMG.
*Acid Yellow 17-	TRC.
*Acid Yellow 19-	AC, ATI, CMG, SDH, TRC.
*Acid Yellow 23-	AC, ALT, ATI, BAS, ICI.
Acid Yellow 29-	AC, ACY, ALT, GAF, MRX, SDH, TRC, VPC, WJ.
Acid Yellow 34-	TRC.
Acid Yellow 36-	ATL.
Acid Yellow 38-	DUP, GAF, TRC.
*Acid Yellow 40-	GAF.
Acid Yellow 42-	ALT, ATL, TRC.
Acid Yellow 49-	AC, ACY, GAF.
Acid Yellow 54-	DUP, VFC.
Acid Yellow 63-	AC, TRC.
Acid Yellow 65-	AC.
Acid Yellow 73-	ATL, TRC.
Acid Yellow 76-	BCC, SDH.
Acid Yellow 99-	TRC.
Acid Yellow 99-	GAF, TRC.
Acid Yellow 114-	TRC.
Acid Yellow 121-	GAF.
Acid Yellow 127-	TRC.
Acid Yellow 128-	TRC.
Acid Yellow 129-	AC, TRC.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C I D Y E S--Continued	
*ACID YELLOW DYES--Continued:	
Acid Yellow 135-	ICI.
Acid Yellow 151-	AC, ALT, ATL, DUP, TRC, VFC.
Acid Yellow 159-	ALT, TRC, VFC.
Acid Yellow 169-	TRC.
Acid Yellow 174-	AC, DUP, VFC.
Acid Yellow 198-	DUP.
Acid Yellow 199-	ICI.
Acid Yellow 200-	DUP.
Acid Yellow 216-	VFC.
Acid Yellow 219-	TRC.
Acid Yellow 221-	BAS.
Acid yellow dyes, all other-	ACY, ALT, VFC.
*ACID ORANGE DYES:	
Acid Orange 1-	AC, GAP.
Acid Orange 5-	AC, GAP.
Acid Orange 7-	AC, ACY, ATL, BDO, GAP, PDC, TRC, VFC.
Acid Orange 8-	AC, ACY, ATL, GAP, TRC, VFC.
Acid Orange 10-	AC, ACY, ATL, GAP, PDC, TRC.
Acid Orange 12-	PSC.
Acid Orange 24-	ACY, ALT, ATL, FAB, GAP, TRC.
Acid Orange 47-	TRC.
Acid Orange 50-	AC.
Acid Orange 51-	TRC.
Acid Orange 52-	ATL.
Acid Orange 60-	AC, ALT, ATL, DUP, GAP, TRC, VFC.
Acid Orange 62-	TRC.
Acid Orange 63-	TFC.
Acid Orange 64-	DUP.
Acid Orange 72-	ACY.
Acid Orange 74-	GAP, TRC.
Acid Orange 86-	TRC.
Acid Orange 116-	AC, ALT, GAP.
Acid Orange 119-	TRC.
Acid Orange 128-	DUP, PDC.
Acid Orange 132-	DUP.
Acid Orange 132-	DUP.
Acid Orange 132-	DUP.

TABLE 2.--DYES FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C I D D Y E S--Continued	
*ACID ORANGE DYES--Continued:	
Acid Orange 156	TRC.
Acid Orange dyes, all other--	ALT, AFL, DUP, TRC.
*ACID RED DYES:	
*Acid Red 1	AC, ACY, ATL, BDO, DUP, GAF, TRC, VFC.
*Acid Red 4	AC, ATL, BDO, GAP, PDC, TRC.
*Acid Red 14	ATL, BDO, GAP, PDC.
Acid Red 18	TRC.
Acid Red 26	ACY.
Acid Red 27	ATL.
Acid Red 33	BDO.
Acid Red 37	AC, ATL, TRC.
Acid Red 51	BDO.
Acid Red 57	BDO.
Acid Red 59	ICI, TRC.
Acid Red 76	VFC.
*Acid Red 85	AC, ATL.
Acid Red 87	ACI, ATL, GAP, HSH, PSC, TRC.
Acid Red 88	PAB, GAP.
*Acid Red 89	SPH.
Acid Red 97	BDO, GAF, PDC, TRC.
Acid Red 99	GAP.
Acid Red 111	AC, PAB.
*Acid Red 114	VFC.
Acid Red 115	ALT, AFL, DUP, TRC.
Acid Red 119	ALT.
Acid Red 133	GAP.
Acid Red 134	TRC.
*Acid Red 137	ATL, DUP, GAP, TRC, VFC.
Acid Red 138	ALT.
*Acid Red 151	AC, ACY, ATL, DUP, HSH, ICI, TRC, VFC.
Acid Red 167	ATL, TRC.
Acid Red 179	TRC.
*Acid Red 182	AC, ALT, ATL, DUP, VFC.
Acid Red 183	CMG.
Acid Red 186	AC.



TABLE 2.--DYES FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C I D D Y E S--Continued	
*ACID RED DYES--Continued:	
Acid Red 194	: TRC.
Acid Red 211	: TRC.
Acid Red 213	: TRC.
Acid Red 225	: VPC.
Acid Red 257	: TRC.
*Acid Red 266	: ALT, ATL, DUP, GAF, ICI, TRC.
Acid Red 277	: VPC.
Acid Red 278	: VPC.
Acid Red 299	: ALT.
Acid Red 309	: TRC.
*Acid Red 337	: ALT, ATL, DUP, TRC, VPC.
Acid Red 364	: DUP.
Acid Red 384	: DUP.
Acid Red 388	: DUF.
Acid Red dyes, all other	: AC, ACY, ALT, ATL, BCC, DUP, TRC, VPC.
*ACID VIOLET DYES:	
Acid Violet 1	: BDO.
*Acid Violet 3	: ACY, ATL, TRC.
Acid Violet 4	: SDH.
Acid Violet 7	: ATL, BDO, GAF.
Acid Violet 12	: BDC.
Acid Violet 17	: GAF, SDH.
Acid Violet 43	: HSH.
Acid Violet 49	: SDH, TRC.
*ACID BLUE DYES:	
Acid Blue 7	: SDH.
Acid Blue 9	: GAF, X.
Acid Blue 15	: GAF.
Acid Blue 23	: ATL.
*Acid Blue 27	: ATL, DUP, HSH, ICI, TRC, VPC.
Acid Blue 29	: ATL, BDO, GAF, VPC.
Acid Blue 39	: PDC.
*Acid Blue 40	: ATL, BDO, DUP, GAF, ICI, TRC, VPC.
Acid Blue 41	: ATL, BDO, GAF.
Acid Blue 43	: ATL, TRC.
Acid Blue 45	: TRC.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C I D D Y E S--Continued	
*ACID BLUE DYES--Continued:	
Acid Blue 62	: BDO, CMG.
Acid Blue 74	: DUP.
Acid Blue 78	: TRC.
Acid Blue 80	: TRC.
Acid Blue 83	: VFC.
Acid Blue 92	: ATL, FAB.
Acid Blue 93	: HSC.
Acid Blue 104	: ATL, GAP.
*Acid Blue 113	: AC, ALT, GAF, HSH, VFC.
Acid Blue 119	: AC.
Acid Blue 122	: DUP.
Acid Blue 145	: ACS, BCC, HSH.
Acid Blue 158, 159: 1, and 159:2	: AC, TRC.
Acid Blue 203	: VFC.
Acid Blue 205	: VFC.
Acid Blue 230	: DUP.
Acid Blue 231	: GAF, TRC.
Acid Blue 277	: TRC.
Acid Blue 299	: DUF.
Acid Blue dyes, all other	: AC, ACY, ALT, ATL, TBC, VFC.
ACID GREEN DYES:	
Acid Green 1	: ACY.
Acid Green 3	: TRC.
Acid Green 5	: NJ.
Acid Green 16	: TRC.
Acid Green 20	: TRC.
Acid Green 22	: BDO, HSH, TRC.
Acid Green 52	: TRC.
Acid Green 70	: TRC.
Acid Green dyes, all other	: ALT.
ACID BROWN DYES:	
*Acid Brown 14	: AC, ACY, ALT, ATL, FAB, GAP, TRC.
Acid Brown 19	: TRC.
Acid Brown 31	: GAF.
Acid Brown 45	: TRC.
Acid Brown 83	: VFC.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C I D D Y E S--Continued	
ACID BROWN DYES--Continued:	
Acid Brown 90	ACY.
Acid Brown 97	ACY.
Acid Brown 98	ACY, PDC, TRC.
Acid Brown 147	TRC.
Acid Brown 152	GAP.
Acid Brown 158	GAP.
Acid Brown 160	BAS.
Acid Brown 161	BAS.
Acid Brown 163	BAS.
Acid Brown 165	BAS.
Acid Brown 223	VPC.
Acid Brown 239	TRC.
Acid Brown 343	GAP.
Acid Brown 354	ACY.
*ACID BROWN dyes, all other	ALT, ATL, VPC.
*ACID BUC DYES:	
Acid Black 2	AC, ACY, ATL, BDO, GAP, HSH, PDC, TRC, VPC.
Acid Black 24	ACY.
Acid Black 29	AC.
Acid Black 41	GAP.
*Acid Black 52	PDC.
Acid Black 58	AC, ALT, ATL, FAB, GAP, TRC.
Acid Black 60	TRC.
Acid Black 92	ACY.
*Acid Black 107	ALT, GAP, TRC, VPC.
Acid Black 172	VPC.
Acid Black 194	BAS.
Acid Black dyes, all other	AC, ALT, ATL, TRC, VPC.
A Z O I C D Y E S A N D C O M P O N E N T S	
AZOIC COMPOSITIONS:	
Azoic Yellow	
Azoic Yellow 1	ALL, BUC.
Azoic Yellow 2	ALL.
Azoic Yellow compositions, all other	ALL.

TABLE 2.--DYES FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A Z O I C D Y E S A N D C O M P O N E N T S--Continued:	
AZOIC COMPOSITIONS--Continued	
AZOIC ORANGE COMPOSITIONS:	
Azoic Orange 3	ALL, BUC.
AZOIC RED COMPOSITIONS:	
Azoic Red 1	ALL, BUC, X.
Azoic Red 2	ALL, BUC.
Azoic Red 6	ALL, BUC.
Azoic Red compositions, all other	ALL, ATL.
AZOIC VIOLET COMPOSITIONS:	
Azoic Violet 1	BUC.
Azoic Violet compositions, all other	ALL.
AZOIC BLUE COMPOSITIONS:	
Azoic Blue 3	ALL, BUC, GAF, SDH.
Azoic Blue compositions, all other	ATL.
AZOIC BROWN COMPOSITIONS:	
Azoic Brown 9	ALL, BUC, GAF.
Azoic Brown 10	BUC.
Azoic Brown compositions, all other	ALL.
AZOIC BLACK COMPOSITIONS:	
Azoic Black 4	BUC.
Azoic Black compositions, all other	ATL.
*AZOIC DIAZO COMPOUNDS, BASES:	
Azoic diazo component 4, base	BUC.
Azoic diazo component 4, base	ALL, BUC, SDH.
Azoic diazo component 7, base	AF.
Azoic diazo component 13, base	BUC, PCW, SDH.
Azoic diazo component 14, base	BUC.
Azoic diazo component 14, base	ALL.
Azoic diazo component 32, base	ALL.
Azoic diazo component 34, base	ALL.
Azoic diazo components, base, all other	ALL.
*AZOIC DIAZO COMPOUNDS, SALTS:	
Azoic diazo component 1, salt	ALL, BUC.
Azoic diazo component 2, salt	BUC.
Azoic diazo component 3, salt	ALL, BUC.
Azoic diazo component 5, salt	ALL, BUC.
Azoic diazo component 6, salt	ALL, BUC, GAF.
Azoic diazo component 8, salt	ALL, BUC.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
AZOIC DYES AND COMPONENTS--Continued:	
*AZOIC DIAZO COMPONENTS, SALTS--Continued:	
Azoic diazo component 9, salt	: ALL, BUC.
Azoic diazo component 10, salt	: ALL, BUC.
Azoic diazo component 11, salt	: ALL.
Azoic diazo component 12, salt	: ALL, BUC.
Azoic diazo component 13, salt	: ALL, BUC.
Azoic diazo component 14, salt	: ALL, BUC.
Azoic diazo component 32, salt	: ALL.
Azoic diazo component 34, salt	: ALL.
Azoic diazo component 41, salt	: ALL.
Azoic diazo component 42, salt	: ALL.
Azoic diazo component 44, salt	: ALL, BUC.
Azoic diazo component 49, salt	: ALL, BUC.
Azoic diazo components, salt, all other--	: ALL.
AZOIC COUPLING COMPONENTS:	
Azoic coupling component 2	: BUC, PCW, SDB.
Azoic coupling component 3	: BUC, PCW.
Azoic coupling component 7	: BUC, PCW, X.
Azoic coupling component 8	: BUC, PCW.
Azoic coupling component 10	: PCW.
Azoic coupling component 11	: BUC, PCW.
Azoic coupling component 12	: PCW.
Azoic coupling component 13	: HET.
Azoic coupling component 14	: BUC, PCW.
Azoic coupling component 15	: BUC, GAF.
Azoic coupling component 17	: BUC, PCW.
Azoic coupling component 18	: BUC, PCW.
Azoic coupling component 19	: PCW.
Azoic coupling component 20	: BUC, PCW.
Azoic coupling component 21	: BUC, PCW.
Azoic coupling component 24	: BUC, PCW.
Azoic coupling component 28	: BUC, PCW.
Azoic coupling component 35	: PCW.
Azoic coupling component 43	: ALL, ATL, BUC, GAP.
Azoic coupling components, all other	: ATL.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
B A S I C D Y E S	
*BASIC YELLOW DYES:	
Basic Yellow 1	DUP.
Basic Yellow 2	ACY.
*Basic Yellow 11	ATL, DUP, GAF, TRC, VFC.
*Basic Yellow 13	ATL, DUP, GAF, VFC.
Basic Yellow 15	DUP.
Basic Yellow 21	VFC.
Basic Yellow 23	BAS.
Basic Yellow 25	GAF.
Basic Yellow 26	ATL, GAF, VFC.
Basic Yellow 28	ATL, DUP, VFC.
Basic Yellow 29	DUP.
Basic Yellow 31	ACY, GAF.
Basic Yellow 37	ACY.
Basic Yellow 41	BAS.
Basic Yellow 45	DUP.
Basic Yellow 52	DUP.
Basic Yellow 53	DUP.
Basic Yellow 58	ACY.
Basic Yellow 78	DUP.
Basic Yellow 83	ACY, DUP, VFC, X.
Basic yellow dyes, all other,	ACY, DUP, VFC, X.
*BASIC ORANGE DYES:	
Basic Orange 1	PSC, TRC.
Basic Orange 11	ACY, ATL, DUP, GAF, PSC, TRC.
Basic Orange 12	GAF.
*Basic Orange 21	ATL, DUP, GAF, TRC, VFC.
Basic Orange 24	DUP.
Basic Orange 25	DUP.
Basic Orange 26	DUP.
Basic Orange 28	VFC.
Basic Orange 31	ACY.
Basic Orange 35	DUP.
Basic Orange 40	BAS.
Basic Orange dyes, all other,	ALT, DUP, VFC.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
BASIC RED DYES:	
Basic Red 1	BAS, DUP, GAF.
Basic Red 2	DUP.
Basic Red 12	ACI, DUP, VPC.
Basic Red 13	ACI.
Basic Red 14	ACI, ATL, DUP, GAF, VPC.
Basic Red 15	ATL, DUP, GAF.
Basic Red 17	DUP.
Basic Red 18	ATL, DUP, GAF, VPC.
Basic Red 22	TRC.
Basic Red 23	VPC.
Basic Red 29	VPC.
Basic Red 30	BAS.
Basic Red 49	DUP.
Basic Red 51	BAS, GAF, TRC, VPC.
Basic Red 73	DUP.
Basic Red dyes, all other	DUP, VPC, X.
BASIC VIOLET DYES:	
Basic Violet 1	ACS, ACY, BAS, BCC, DSC.
Basic Violet 3	DSC, DUP, SDH.
Basic Violet 4	DSC, DUP.
Basic Violet 7	ATL.
Basic Violet 10	ACY, DUP.
Basic Violet 14	VPC.
Basic Violet 15	DUP.
Basic Violet 16	ATL, DUP, GAF, TRC.
Basic Violet 35	BAS.
Basic Violet dyes, all other	ACY, BCC, DUP, VPC.
BASIC BLUE DYES:	
Basic Blue 1	DSC, GAF, SDH, VPC.
Basic Blue 2	DSC.
Basic Blue 3	DUP, GAF, HST, TRC.
Basic Blue 5	DSC.
Basic Blue 6	ACY.
Basic Blue 7	DSC, DUP, SDH.
Basic Blue 9	ACY, SDH.
Basic Blue 11	SDH.
Basic Blue 21	DUP.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
B A S I C D Y E S--Continued	
*BASIC BLUE DYES-- Continued	
Basic Blue 22	: DUF, VPC
Basic Blue 26	: DSC, SDH
Basic Blue 35	: DUF
Basic Blue 41	: ATL, BAS, GAF, TRC
Basic Blue 45	: VPC
Basic Blue 47	: VPC
Basic Blue 54	: ACY, ATL, BAS
Basic Blue 69	: VPC
Basic Blue 75	: EKT
Basic Blue 76	: ACY
Basic Blue 77	: DUF
Basic Blue 78	: BAS
Basic Blue 87	: DUF
Basic Blue 94	: DUF
Basic Blue dyes, all other	: ACS, DUF, EKT, VPC, X
*BASIC GREEN DYES:	
Basic Green 1	: DSC
Basic Green 4	: ACY, DSC
*BASIC BROWN DYES:	
Basic Brown 1	: GAF, DUF, PSC, TRC
Basic Brown 2	: GAF
Basic Brown 4	: GAF, PSC, TRC
Basic Brown dyes, all other	: DUF
*BASIC BLACK DYES:	
Basic Black dyes, all other	: ALT, VPC
D I R E C T D Y E S	
*DIRECT YELLOW DYES:	
Direct Yellow 4	: AC, ACY, ATL, DUF, GAF, TRC, VPC
Direct Yellow 5	: ACI, GAF
Direct Yellow 6	: ATL, ACY, DUF, GAF, TRC
Direct Yellow 8	: ACI, ACY, DUF, GAF, SDH, TRC
Direct Yellow 11	: ACI, ATL, TRC
Direct Yellow 12	: ACI, ATL, TRC



TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/DR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*DIRECT YELLOW DYES--Continued:	
Direct Yellow 26	ATL
Direct Yellow 27	ATL
*Direct Yellow 28	ATL, DUF, GAF, PDC, TRC.
Direct Yellow 29	GAF.
*Direct Yellow 34	AC, ALT, ATL, TRC.
Direct Yellow 39	TRC.
*Direct Yellow 44	AC, ATL, DUP, GAF, HSH, TRC.
*Direct Yellow 50	AC, ATL, DUF, FAB, GAF, HSH, TRC.
Direct Yellow 51	FAB.
Direct Yellow 59	ATL.
Direct Yellow 81	ATL.
*Direct Yellow 84	AC, ATL, GAF, TRC.
*Direct Yellow 105	AC, ALT, TRC.
*Direct Yellow 106	AC, ALT, GAF, TRC.
Direct Yellow 107	ATL, GAF, TRC.
Direct Yellow 114	TCI.
Direct Yellow 118	TRC.
Direct Yellow 119	DUF.
Direct Yellow 120	DUF.
Direct Yellow 121	DUF, TRC.
Direct Yellow 131	DUF.
Direct Yellow 137	TRC.
Direct Yellow 137	DUP.
Direct Yellow 139	DUP.
Direct Yellow 147	DUP.
Direct Yellow 314	AC, DUP.
Direct yellow dyes, all other--	ALT, ATL, TRC.
*DIRECT ORANGE DYES:	
Direct Orange 6	ATL.
Direct Orange 8	FAB.
*Direct Orange 15	AC, ACY, DUP, GAF, TRC.
Direct Orange 26	ATL, TRC.
Direct Orange 29	TRC.
Direct Orange 34	ATL, DUP, GAF.
Direct Orange 37	ATL, GAF.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
D I R E C T D Y E S--Continued	
* DIRECT ORANGE DYES --Continued	
*Direct Orange 39	: AC, ACY, ALT, FAB, GAF.
Direct Orange 59	: DUP, GAF.
Direct Orange 61	: TRC.
*Direct Orange 72	: AC, ATL, FAB, HSH, TRC.
Direct Orange 73	: TRC.
Direct Orange 74	: DUP.
Direct Orange 78	: VPC.
Direct Orange 80	: ATL.
Direct Orange 83	: GRE.
Direct Orange 86	: DUF.
*Direct Orange 102	: ACY, ATL, DUP, GAF.
Direct Orange 118	: TRC.
Direct Orange 119	: AC, ALT.
*DIRECT RED DYES, all other--	
*DIRECT RED DYES:	
*Direct Red 1	: FAB, GAF.
Direct Red 2	: AC, ATL, TRC.
Direct Red 4	: ATL, TRC.
Direct Red 16	: ATL, TRC.
*Direct Red 23	: AC, ACY, ATL, DUP, GAF, HSH, TRC, VPC.
*Direct Red 24	: AC, ATL, HSH, TRC, VPC.
Direct Red 26	: AC, ATL, GAF.
Direct Red 28	: FAB.
Direct Red 31	: ATL, GAF.
Direct Red 37	: GAF.
Direct Red 39	: ATL, GAF, TRC.
Direct Red 62	: ATL, TRC.
*Direct Red 72	: ATL, DUP, GAF, TRC.
Direct Red 73	: AC, ATL.
Direct Red 75	: ATL.
Direct Red 76	: GAF.
Direct Red 79	: TRC.
*Direct Red 80	: AC, ALT, ATL, HSH, SDH, TRC, VPC.
*Direct Red 81	: AC, ATL, FMG, DUP, GAF, HSH, SDH, TRC, VPC.
Direct Red 83	: AC, ALT, ATL, FAB.
Direct Red 95	: GAF.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
D I R E C T D Y E S--Continued	
*DIRECT RED DYES--Continued	
Direct Red 117	: DUF.
Direct Red 122	: TRC.
Direct Red 149	: ATL, CMG.
Direct Red 152	: CMG.
Direct Red 153	: TRC.
Direct Red 209	: TRC.
Direct Red 212	: VPC.
Direct Red 236	: DUF.
Direct Red 238	: DUF.
Direct Red 239	: TRC.
Direct Red dyes, all other	: AC, ACY, ATL, ATL, VPC.
*DIRECT VIOLET DYES:	
Direct Violet 7	: ATL.
Direct Violet 9	: ATL, GAP, TRC.
Direct Violet 66	: ATL, DUP, TRC.
*DIRECT BLUE DYES:	
Direct Blue 1	: AC, ACY, ATL, GAP, TRC.
Direct Blue 2	: PAB, GAP.
Direct Blue 6	: PAB, GAP.
Direct Blue 8	: ATL.
Direct Blue 14	: ATL, TRC.
Direct Blue 15	: AC, ATL, DUP, GAP, VPC.
Direct Blue 25	: ATL, TRC.
Direct Blue 67	: ATL.
Direct Blue 71	: TRC.
Direct Blue 75	: AC, ATL, ALL, GAP.
Direct Blue 76	: AC, CMG.
Direct Blue 78	: AC, ATL, ALL, PAB, GAP, TRC.
Direct Blue 80	: AC, ATL, ALL, DUP, PAB, TRC, VPC.
Direct Blue 91	: TRC.
Direct Blue 98	: ATL, ATL, PAB, GAP, TRC.
Direct Blue 100-	: ATL.
Direct Blue 120-	: AC, ATL, TRC.
Direct Blue 126-	: ATL, HSH.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
D I R E C T D Y E S--Continued	
*DIRECT BLUE DYES--Continued	
Direct Blue 143	DUP.
Direct Blue 151	ATL, TBC.
Direct Blue 160	ALT, TRC, VPC.
Direct Blue 189	TBC.
Direct Blue 191	ALT, GAF.
Direct Blue 199	DUP.
*Direct Blue 218	AC, ATL, DUP, GAF, TRC.
Direct Blue 260	DUP.
Direct Blue 263	DUP.
Direct Blue dyes, all other	AC, ALT, ATL, HSH, TRC.
*DIRECT GREEN DYES:	
Direct Green 1	FAB, GAF.
Direct Green 6	FAB, GAF.
Direct Green 26	TBC.
Direct Green 27	TBC.
Direct Green 28	TBC.
Direct Green 47	DUP.
Direct Green 51	TRC.
Direct Green 69	TRC.
Direct green dyes, all other	ACY, DUP, TBC.
*DIRECT BROWN DYES:	
Direct Brown 2	FAB, GAF.
Direct Brown 6	FAE.
Direct Brown 31	FAB, GAF.
Direct Brown 44	FAB.
Direct Brown 74	FAB.
Direct Brown 95	BCC, FAB, GAF.
Direct Brown 154	FAE.
Direct Brown dyes, all other	AC, ALT, ATL, VPC.
*DIRECT BLACK DYES:	
Direct Black 4	FAB, GAF.
Direct Black 19	ATL, TRC.
*Direct Black 22	FAE, ALT.
Direct Black 38	FAB, GAF.
Direct Black 78	AC.
Direct Black 80	AC, ATL, FAB.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
D I R E C T D Y E S--Continued	
*DIRECT BLACK DYES--Continued	
Direct Black 190	AC, ATL, FAB.
Direct black dyes, all other	AC, ACS, ALT, ATL, FAB, TRC.
D I S P E R S E D Y E S	
*DISPERSE YELLOW DYES	
Disperse Yellow 1	GAF.
Disperse Yellow 3	AC, GAF, HSH, TRC, VFC.
Disperse Yellow 5	ATL, GAF.
*Disperse Yellow 23	AC, ALT, ATL, DUP, EXT, HSH, TRC.
Disperse Yellow 31	GAF.
Disperse Yellow 33	AC, EXT, TRC.
Disperse Yellow 3u	AC, EXT.
*Disperse Yellow 42	AC, ALT, DUP, EXT, SDC, TRC.
*Disperse Yellow 54	AC, BAS, DUP, GAF, SDC, TRC, VFC.
Disperse Yellow 56	BAS.
Disperse Yellow 58	HST.
Disperse Yellow 64	BAS, DUP.
Disperse Yellow 67	DUP, GAF, VFC.
Disperse Yellow 68	HST.
Disperse Yellow 74	VFC.
Disperse Yellow 77	VFC.
Disperse Yellow 85	EXT.
Disperse Yellow 86	AC, EXT.
Disperse Yellow 88	ALT, EXT.
Disperse Yellow 93	VFC.
Disperse Yellow 96	VFC.
Disperse Yellow 108	VFC.
Disperse Yellow 118	EXT.
Disperse Yellow 125	AC.
Disperse Yellow 126	SDC.
Disperse Yellow 131	ICI.
Disperse Yellow 136	DUP.
Disperse Yellow 137	DUP.
Disperse Yellow 138	DUP.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
D I S P E R S E D Y E S--Continued	
*DISPERSE YELLOW DYES--Continued	
Disperse Yellow 198	BAS.
Disperse Yellow dyes, all other	EXT, HST, MAY, SDC, VPC.
*DISPERSE ORANGE DYES:	
Disperse Orange 3	AC, ATL, GAP, HSH, TRC.
Disperse Orange 5	ATL, BUC, EXT, SDC.
Disperse Orange 17	AC, EXT, GAP, HSH.
Disperse Orange 21	TRC.
Disperse Orange 25	ALT, ATL, DUP, EXT, TRC, VPC.
Disperse Orange 29	TRC.
Disperse Orange 30	AC, ATL, GAP, HSH, VPC.
Disperse Orange 31	BAS.
Disperse Orange 33	BAS.
Disperse Orange 37	AC, ATL, EXT.
Disperse Orange 38	TRC.
Disperse Orange 41	AC, DUP.
Disperse Orange 44	DUP, TRC.
Disperse Orange 53	TRC.
Disperse Orange 55	HSH.
Disperse Orange 56	TRC.
Disperse Orange 57	EXT.
Disperse Orange 58	EXT.
Disperse Orange 59	HSH.
Disperse Orange 62	BUC, DUP.
Disperse Orange 66	VPC.
Disperse Orange 75	DUP.
Disperse Orange 77	MAL.
Disperse Orange 78	MAL.
Disperse Orange 79	MAL.
Disperse Orange 89	AC.
Disperse Orange 90	SC.
Disperse Orange 94	DUP.
Disperse Orange 98	DUP.
Disperse Orange 125	DUP.
Disperse Orange dyes, all other	AC, ALT, BUC, DUP, EXT, HSH, SDC, VPC.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES		MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
DISPERSE DYES		
*DISPERSE RED DYES:		
Disperse Red 1		AC, ATL, DUP, EKT, GAF, HSH, TRC.
Disperse Red 4		GAF, TRC.
*Disperse Red 5		AC, EKT, HSH.
Disperse Red 7		AC.
Disperse Red 11		AC, DUP.
Disperse Red 13		ATL, GAF.
*Disperse Red 15		GAF, HSH, TRC.
Disperse Red 17		AC, ATL, EKT, GAF, HSH, TRC.
Disperse Red 20		EKT.
Disperse Red 30		EKT.
Disperse Red 35		EKT.
Disperse Red 50		AIT, GAF, TRC.
Disperse Red 54		BAS.
Disperse Red 54-		DUP, TRC, VPC.
*Disperse Red 55-		DUP, GAF, TRC, VPC.
*Disperse Red 60-		AC, DUP, GAF, TRC, VPC.
Disperse Red 65-		AIT, DUP, EKT, TRC.
Disperse Red 71-		TRC.
Disperse Red 76-		BAS.
Disperse Red 82-		VPC.
Disperse Red 86-		EKT.
Disperse Red 88-		EKT, HSH, TRC.
Disperse Red 90-		VPC.
Disperse Red 91-		BAS.
Disperse Red 96-		ACY.
Disperse Red 105		VPC.
Disperse Red 106		VPC.
Disperse Red 108		VPC.
Disperse Red 109		VPC.
Disperse Red 115		MAY.
Disperse Red 117		EKT.
Disperse Red 118		BAS.
Disperse Red 128		DUP.
Disperse Red 133		VPC.
Disperse Red 135		AIT, DUP.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
DISPERSE DYES--Continued	
*DISPERSE RED DYES--Continued	
Disperse Red 136	EKT.
Disperse Red 137	EKT.
Disperse Red 138	EKT.
Disperse Red 140	DUP.
Disperse Red 159	VPC.
Disperse Red 161	DUP.
Disperse Red 162	DUP.
Disperse Red 163	DUP.
* Disperse Red 163	EKT.
Disperse Red 177	ALT, SDC, TRC, VPC.
Disperse Red 178	TRC.
Disperse Red 179	GAF.
Disperse Red 211	TRC.
Disperse Red 217	DUP.
Disperse Red 219	DUP.
Disperse Red 220	DUP.
Disperse Red 271	DUP.
Disperse Red 313	SDC.
Disperse Red 319	ALT.
Disperse Red dyes, all other	AC, BUC, EKT, HSH, HST, MAY, SDC, TRC, VPC.
*DISPERSE VIOLET DYES:	
Disperse Violet 17	AC, HSH, TRC.
Disperse Violet 26	DUP, VPC.
* Disperse Violet 26	DUP.
Disperse Violet 27	AC, AGY, DUP, EKT, TRC.
Disperse Violet 28	DUP, TRC.
Disperse Violet 33	ICI.
Disperse Violet 40	VPC.
Disperse Violet 41	EKT.
Disperse Violet 43	EKT.
Disperse Violet 64	DUP.
Disperse Violet dyes, all other	EKT, MAY, SDC.
*DISPERSE BLUE DYES:	
*Disperse Blue 3	AC, EKT, HSH, TRC.
Disperse Blue 7	AC, TRC.
Disperse Blue 9	BAS.



TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
D I S P E R S E D Y E S--Continued	
*DISPERSE BLUE DYES--Continued	
Disperse Blue 27	: EKT.
Disperse Blue 35	: ICI.
Disperse Blue 55	: TBC.
Disperse Blue 56	: VFC.
Disperse Blue 60	: VFC.
Disperse Blue 61	: DUP.
Disperse Blue 62	: VFC.
*Disperse Blue 64	: DUP, EKT.
Disperse Blue 73	: AC, DUP, EKT, TBC.
Disperse Blue 77	: ACT, TRC.
*Disperse Blue 79	: EKT, GAF, HST.
Disperse Blue 81	: ATL, AEL, EKT, HSH, MAY, TRC.
Disperse Blue 87	: BAS, VFC.
Disperse Blue 94	: BAS, HST.
Disperse Blue 95	: HST.
Disperse Blue 102	: EKT.
Disperse Blue 109	: DUP.
Disperse Blue 112	: EKT.
Disperse Blue 118	: EKT.
Disperse Blue 122	: ICI.
Disperse Blue 123	: EKT.
Disperse Blue 125	: TBC.
Disperse Blue 138	: VFC.
Disperse Blue 139	: VFC.
Disperse Blue 148	: BAS.
Disperse Blue 152	: HST.
Disperse Blue 165	: DUP, HST, VFC.
Disperse Blue 174	: AC.
Disperse Blue 192	: DUP.
Disperse Blue 194	: DUP.
Disperse Blue 203	: DUP.
DISPERSE GREEN DYES:	
Disperse Green 7	: AC, ATL, BUC, DUP, EKT, HSH, HST, MAY, SDC, TBC, VFC.
	: DUP.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
DISPERSE BROWN DYES:	
Disperse Brown 2	AC, ALT, ATL, GAP, HST, ICI, SDC, TRC.
Disperse Brown 3	EKT.
Disperse Brown 4	DUP.
Disperse Brown dyes, all other	SDC, TRC.
*DISPERSE BLACK DYES:	
Disperse Black 1	GAF.
Disperse Black 9	AC, EKT.
Disperse Black 11	AC, EKT.
Disperse Black dyes, all other	AC, ALT, DUP, EKT, SDC, VPC.
FIBER-REACTIVE DYES	
*REACTIVE YELLOW DYES:	
Reactive Yellow 1	ICI.
Reactive Yellow 2	TRC.
Reactive Yellow 3	TRC.
Reactive Yellow 4	ICI.
Reactive Yellow 6	TRC.
Reactive Yellow 7	ICI.
Reactive Yellow 13	HST.
Reactive Yellow 15	HST.
Reactive Yellow 17	HST.
Reactive Yellow 18	ICI.
Reactive Yellow 22	ICI.
Reactive Yellow 24	HST.
Reactive Yellow 25	VPC.
Reactive Yellow 27	VPC.
Reactive Yellow 37	HST.
Reactive Yellow 42	HST.
Reactive Yellow 56	ICI.
Reactive Yellow dyes, all other	HST, ICI.
*REACTIVE ORANGE DYES:	
Reactive Orange 1	PAB, ICI.
Reactive Orange 4	ICI.
Reactive Orange 11	TRC.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
F I B E R - R E A C T I V E D Y E S--Continued	
REACTIVE ORANGE DYES--Continued:	
Reactive Orange 17	: ICI.
Reactive Orange 18	: ICI.
Reactive Orange 19	: ICI.
Reactive Orange 16	: HST.
Reactive Orange 18	: HST.
Reactive Orange 80	: ICI.
Reactive Orange 80	: ICI.
REACTIVE RED DYES:	
Reactive Red 1	: ICI.
Reactive Red 2	: PAB, ICI.
Reactive Red 4	: TRC.
Reactive Red 5	: ICI.
Reactive Red 8	: ICI.
Reactive Red 11	: ICI.
Reactive Red 21	: HST.
Reactive Red 29	: ICI.
Reactive Red 31	: ICI.
Reactive Red 33	: ICI.
Reactive Red 40	: WFC.
Reactive Red 41	: ICI, TRC.
Reactive Red 43	: TRC.
Reactive Red 55	: ICI.
Reactive Red 58	: TRC.
Reactive Red 86	: TRC.
Reactive Red 94	: HST.
Reactive Red 120	: ICI, TRC.
Reactive Red dyes, all other	: HST, WFC.
REACTIVE VIOLET DYES:	
Reactive Violet 1	: ICI.
Reactive Violet 2	: HST.
Reactive Violet 3	: HST.
Reactive Violet dyes, all other	: HST.
REACTIVE BLUE DYES:	
Reactive Blue 3	: ICI.
Reactive Blue 4	: ICI.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
F I B E R - R E A C T I V E D Y E S--Continued	
REACTIVE BLUE DYES--Continued:	
Reactive Blue 5	ICI.
Reactive Blue 7	TRC.
Reactive Blue 19	HST.
Reactive Blue 21	HST.
Reactive Blue 25	ICI.
Reactive Blue 29	VFC.
Reactive Blue 38	HST.
Reactive Blue 71	ICI.
Reactive Blue 89	HST.
Reactive Blue 109	ICI.
Reactive Blue dyes, all other	HST, ICI.
REACTIVE GREEN DYES:	
Reactive Green 19	ICI.
REACTIVE BROWN DYES:	
Reactive Brown 9	ICI.
Reactive Brown 10	ICI.
Reactive Brown 17	ICI.
Reactive Brown 19	HST.
REACTIVE BLACK DYES:	
Reactive Black 5	HST.
Reactive Black 9	ICI.
Reactive Black dyes, all other	HST.
F L U O R E S C E N T B R I G H T E N E R S :	
Fluorescent brightener 9	X.
Fluorescent brightener 22	CGW.
Fluorescent brightener 24	CGW.
Fluorescent brightener 25	CGW.
Fluorescent brightener 28	CGW, CGY, VFC, X.
Fluorescent brightener 46	CGY.
Fluorescent brightener 49	S.
Fluorescent brightener 52	S.
Fluorescent brightener 59	CGY.
Fluorescent brightener 61	ACY, CCW, DGO, GAP.
Fluorescent brightener 68	FCW.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
FLUORESCENT BRIGHTENERS--Continued:	
Fluorescent brightener 71-	ACY, CGY.
Fluorescent brightener 75-	GAF.
Fluorescent brightener 126	X.
Fluorescent brightener 128	X.
Fluorescent brightener 134	CGY.
Fluorescent brightener 135	CGY.
Fluorescent brightener 148	VPC.
Fluorescent brightener 159	ACY.
Fluorescent brightener 191	VPC.
Fluorescent brightener 200	VPC.
Fluorescent brighteners, all other	ACY, CCW, DGO, S, VPC.
FOOD, DRUG, AND COSMETIC COLORS:	
FOOD, DRUG, AND COSMETIC DYES:	
*Food, drug, and cosmetic Blue 1-	ACS, ALT, BCC, KON, SDH, MJ.
*Food, drug, and cosmetic Blue 2-	ACS, ALT, BCC, KON, SDH, MJ.
*Food, drug, and cosmetic Green 1-	WJ.
*Food, drug, and cosmetic Red 1-	BCC, KON, SDH.
*Food, drug, and cosmetic Red 2-	ALT, BDO, KON, STG, WJ, X.
*Food, drug, and cosmetic Red 4-	ALT, KON.
*Food, drug, and cosmetic Red 40-	ACS, ALT, BCC, KON, SDH, MJ.
*Food, drug, and cosmetic Yellow 5-	ACS, ALT, BCC, KON, SDH, STG, WJ.
*Food, drug, and cosmetic Yellow 6-	ACS, ALT, BCC, KON, SDH, STG, WJ.
*Food, drug, and cosmetic dyes, all other	STG.
DRUG AND COSMETIC DYES:	
Drug and cosmetic Blue 6	ACS, BCC.
Drug and cosmetic Green 5-	BCC, KON.
Drug and cosmetic Green 6-	KON.
Drug and cosmetic Green 8-	KON, X.
Drug and cosmetic Orange 4-	ACS, KON.
Drug and cosmetic Orange 5-	SDH, SNA, TMS.
Drug and cosmetic Orange 17-	KON, SDH, SNA, TMS.
*Drug and cosmetic Red 6-	KON, SDH, SNA, TMS.
*Drug and cosmetic Red 7-	KON, SDH, SNA, TMS.
Drug and cosmetic Red 8-	SNA.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES		MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
FOOD, DRUG, AND COSMETIC COLORS--		
Continued		
DRUG AND COSMETIC DYES--Continued		
Drug and cosmetic Red 9		KON, MRX, SDH, SNA, TMS.
Drug and cosmetic Red 10		KON, SNA.
Drug and cosmetic Red 11		SNA.
Drug and cosmetic Red 12		SNA.
Drug and cosmetic Red 13		SNA.
Drug and cosmetic Red 14		KON.
Drug and cosmetic Red 17		KON, SNA, TMS.
Drug and cosmetic Red 19		KON.
Drug and cosmetic Red 21		SDH, SNA.
Drug and cosmetic Red 22		SDH.
Drug and cosmetic Red 27		TMS.
Drug and cosmetic Red 30		KCH, SNA.
Drug and cosmetic Red 33		BCC, KON.
Drug and cosmetic Red 36		ALT, KON, SDH, SNA, TMS.
Drug and cosmetic Red 37		ACS, BCC.
Drug and cosmetic Violet 2		BCC.
Drug and cosmetic Yellow 5		KCH.
Drug and cosmetic Yellow 6		KON.
Drug and cosmetic Yellow 10		KON.
Drug and cosmetic Yellow 11		ACS, BCC, KON.
DRUG AND COSMETIC DYES, EXTERNAL:		
External drug and cosmetic Violet 2		KON.
External drug and cosmetic Yellow 1		ACS, BCC, CMG, KON.
External drug and cosmetic Yellow 7		KON.
MORDANT DYES		
MORDANT YELLOW DYES:		
Mordant Yellow 1		PDC.
Mordant Yellow 8		PDC.
Mordant Yellow 20		PDC.
Mordant Yellow 26		PDC.
Mordant Yellow 30		TRC.
Mordant Yellow dyes, all other		ATL.
MORDANT ORANGE DYES:		
Mordant Orange 1		ACY, PDC, TRC.
Mordant Orange 6		ATL, GAP, PDC, TRC.

TABLE 2.--DYES FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
M O R D A N T D Y E S--Continued	
*MORDANT ORANGE DYES--Continued:	
Mordant Orange 8	: TRC.
MORDANT RED DYES	
Mordant Red 7-	: ACY, ATL, BDO, PDC.
Mordant Red 9-	: MRK.
Mordant Red 11	: ACY.
Mordant Red 60-	: SDH.
MORDANT BROWN DYES:	
Mordant Brown 1-	: PDC, TRC.
Mordant Brown 18	: PDC.
Mordant Brown 19	: GAE.
Mordant Brown 33	: GAF, PDC, TRC.
Mordant Brown 70	: PDC.
Mordant Brown 70-	: PDC.
MORDANT BLACK DYES:	
Mordant Black 11	: VPC.
Mordant Black 13	: GAF, TRC.
Mordant Black 17	: HSH.
Mordant Black 17-	: GAF, TRC.
S O L V E N T D Y E S	
*SOLVENT YELLOW DYES:	
Solvent Yellow 1	: HSH.
Solvent Yellow 3	: PSC.
Solvent Yellow 13-	: ACY, GAF.
Solvent Yellow 14-	: ACY, ATL, DUP, GAF, MRI, PSC, VPC.
Solvent Yellow 19-	: GAF.
Solvent Yellow 29-	: PSC.
Solvent Yellow 30-	: PSC.
Solvent Yellow 31-	: MRT.
Solvent Yellow 33-	: AC, ACS, ACY, BCC.
Solvent Yellow 40-	: ACS, BCC.
Solvent Yellow 42-	: ACS, ATL, BCC.
Solvent Yellow 43-	: DGC, MRT.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
S O L V E N T D Y E S--Continued	
*SOLVENT YELLOW DYES--Continued:	
Solvent Yellow 44-	DGO.
Solvent Yellow 47-	ACY, DUP.
Solvent Yellow 56-	ACY, PSC.
Solvent Yellow 71-	ACY.
Solvent Yellow 72-	AC, ACY.
Solvent Yellow 77-	MRT.
Solvent Yellow 87-	ACY.
Solvent Yellow 107	MRT.
Solvent Yellow 109	MRT.
Solvent Yellow 131	DGO.
Solvent Yellow 132	AC.
*SOLVENT ORANGE DYES, all other - - -	
Solvent Orange 7	ACY, BCC.
Solvent Orange 20	ACY, GAF, PSC.
Solvent Orange 23	ACY, GIE.
Solvent Orange 25	ACS, ATI, BCC.
Solvent Orange 31-	ACY, DUP.
Solvent Orange 51-	PSC.
Solvent Orange 74-	ACY.
Solvent Orange dyes, all other	MRT.
* SOLVENT RED DYES:	
Solvent Red 1-	AC, BCC, DUP.
Solvent Red 8-	PSC.
Solvent Red 11	GAF.
Solvent Red 19	VPC.
Solvent Red 22	MRT.
Solvent Red 24	GAF.
Solvent Red 26	AC, ACY, ATL, MRT, PSC.
Solvent Red 27	AC, ACY, MRT, PSC.
Solvent Red 33	PSC.
Solvent Red 49	DUP, GAF.
Solvent Red 68	ACY, DUP, GAF.
Solvent Red 74	ACS, BCC.
Solvent Red 105-	BCC.
Solvent Red 108-	ACY.



TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
S O L V E N T D Y E S--Continued	
*SOLVENT RED DYES--Continued	
Solvent Red 111	AC, ACY.
Solvent Red 115	ACY.
Solvent Red 120	ACY.
Solvent Red 164	MRT.
Solvent Red 165	MRT.
Solvent Red 169	MRT.
Solvent Red 171	MRT.
Solvent Red dyes, all other	AC, ACY, VEC.
SOLVENT VIOLET DYES:	
Solvent Violet 8	ACY, DSC.
Solvent Violet 9	DSC.
Solvent Violet 13	AC, HSH.
Solvent Violet 26	AC.
*SOLVENT BLUE DYES:	
Solvent Blue 3	ACY, SW.
Solvent Blue 4	DSC, DUP, SDH.
Solvent Blue 5	DSC.
Solvent Blue 7	ACI.
Solvent Blue 14	ACI.
Solvent Blue 16	HSC.
Solvent Blue 23	MRT.
Solvent Blue 35	AC, DDP, MRT.
Solvent Blue 36	DUP.
Solvent Blue 37	ACY, DUP.
Solvent Blue 38	ACY, GAP.
Solvent Blue 58	AC, ACY.
Solvent Blue 59	MRT.
Solvent Blue 98	MRT.
Solvent Blue 99	MRT.
Solvent Blue 100	MRT.
Solvent Blue 101	MRT.
Solvent Blue dyes, all other	AC, DDP, X.
SOLVENT GREEN DYES:	
Solvent Green 1	AC, ACY, DSC.
Solvent Green 3	AC, HSH.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 1)
S O L V E N T D Y E S -- C O N T I N U E D	
S O L V E N T B R O W N D Y E S:	
Solvent Brown 11	GNP.
Solvent Brown 12	PSC.
Solvent Brown 19	DUP.
Solvent Brown 20	ACY, DUP.
Solvent Brown 21	PSC.
Solvent Brown 24	ACY.
Solvent Brown 38	ACY.
S O L V E N T B L A C K D Y E S:	
Solvent Black 5	ACY.
Solvent Black 7	ACY, PSC.
Solvent Black 13	ACS, BCC.
Solvent Black 26	ACY.
Solvent Black dyes, all other	ATL, PSC.
S U L F U R D Y E S	
S U L F U R Y E L L O W D Y E S:	
Leuco sulfur Yellow 1	SDC.
Leuco sulfur Yellow 2	ACY, SDC.
Leuco sulfur Yellow 4	SDC.
Sulfur Yellow dyes, all other	SDC.
S U L F U R R E D D Y E S:	
Sulfur Red dyes, all other	SDC.
S U L F U R B L U E D Y E S:	
Leuco sulfur Blue 7	SDC.
Leuco sulfur Blue 8	SDC.
Leuco sulfur Blue 13	ACY.
Sulfur Blue 7	ACY.
S U L F U R G R E E N D Y E S:	
Leuco sulfur Green 2	SDC.
Leuco sulfur Green 3	SDC.
Leuco sulfur Green 14	SDC.
Leuco sulfur Green 16	SDC.
Sulfur Green dyes, all other	SDC.
S U L F U R B R O W N D Y E S:	
Leuco sulfur Brown 3	SDC, SDH.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
S U L F U R D Y E S--Continued	
SULFUR BROWN DYES--Continued:	
Leuco sulfur Brown 10	SDC.
Leuco sulfur Brown 14	SDC.
Sulfur brown dyes, all other	ACY, SDC.
SULFUR BLACK DYES:	
Leuco sulfur Black 1	SDC.
Leuco sulfur Black 2	SDC.
Leuco sulfur Black 10	ACY.
Leuco sulfur Black 11	SDC.
Solubilized sulfur Black 2	SDC.
Sulfur Black 1	ACY, SDC.
Sulfur Black 2	SDC.
Sulfur Black 11	SDC.
Sulfur Black dyes, all other	SDC.
V A T D Y E S	
*VAT YELLOW DYES:	
Vat Yellow 2, 8-1/2%	AC, TRC, VPC.
Vat Yellow 3, 12-1/2%	HST.
Vat Yellow 14, 12-1/2%	TRC.
Vat Yellow 15, 11-1/2%	ACY.
Vat Yellow 22, 10%	DUP.
Vat Yellow 33, 15%	TRC.
Vat Yellow dyes, all other	VPC.
*VAT ORANGE DYES:	
Vat Orange 1, 20%	HST, TRC, VPC.
Vat Orange 2, 12%	ACY, DUP, TBC.
Vat Orange 3, 13-1/2%	HST.
Vat Orange 4, 6%	DUP.
Vat Orange 5, 10%	HST.
Vat Orange 7, 11%	HST, TRC.
Vat Orange 9, 12%	ACY, TRC.
Vat Orange 15, 10%	ACY, TRC, VPC.
Vat Orange dyes, all other	SDC.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
V A T D Y E S--Continued	
*VAT RED DYES:	
Vat Red 1, 13%	ACV.
Vat Red 10, 18%	DUP.
Vat Red 13, 11%	DUP, TRC.
Vat Red 14, 10%	HST.
Vat Red 15, 10%	HST, TRC.
Vat Red 32, 20%	DUP.
Vat Red 41, 20%	HST.
Vat Red 52, 10%	DUP.
*VAT VIOLET DYES:	
Vat Violet 1, 11%	DUP, TRC.
Vat Violet 2, 20%	ACV, HST.
Vat Violet 3, 15%	HST.
Vat Violet 9, 12%	TRC.
Vat Violet 13, 6-1/4%	BAS, TRC.
Vat Violet 21, 1%	DUP, VPC.
VAT BLUE DYES:	
Vat Blue 1, 20%	ACS, BCC.
Vat Blue 2, 16%	ALU, HST.
Vat Blue 7, 8-1/3%	BAS, TRC.
Vat Blue 9, 1%	ACV, TRC.
Vat Blue 18, 13%	ACV, TRC.
Vat Blue 20, 1%	SDC, TRC.
Vat Blue 43, 1%	HST.
Vat Blue 67, 1%	BAS, BCC.
Vat Blue dyes, all other	
*VAT GREEN DYES:	
Vat Green 1, 6%	ACV, DUP.
*Vat Green 3, 10%	AC, ACV, BAS, DUP, TRC.
Vat Green 8, 8-1/2%	DUP.
Vat Green 9, 12-1/2%	ACV, BAS, TRC.
Vat Green 32, 1%	VPC.
Vat Green dyes, all other	ACV, SDC.
VAT BROWN DYES:	
Vat Brown 1, 11%	ACV, DUP, TRC.
Vat Brown 3, 11%	AC, ACV, TRC, VPC.

TABLE 2.--DYES FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

DYES	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
V A T D Y E S--Continued	
VAT BROWN DYES--Continued:	
Vat Brown 5, 13X	: ACY.
Vat Brown 6	: AC.
Vat Brown 11, 12X	: TRC.
Vat Brown 13, 17X	: TRC.
Vat Brown 14, 12X	: AC.
Vat Brown 57, 12-8X	: HST, TBC.
Vat Brown dyes, all other	: AC, ACY, SDC, VPC.
*VAT BLACK DYES:	
Vat Black 16	: ACS, BCC.
Vat Black 2, 18-1/2X	: ACY.
Vat Black 3, 18-1/2X	: ACY, TRC.
*Vat Black 25, 12-1/2X	: AC, ACY, DUP, TRC.
Vat Black 27, 12-1/2X	: ACY, EDO, DU P, TRC.
Vat Black 49, all other	: AC, ACY, SDC.
MISCELLANEOUS DYES, ALL OTHER--	
	: DUF, SDC, WRI.

TABLE 3.--DYES: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of dyes to the U.S. International Trade Commission for 1977 are listed below in order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
AC	American Color & Chemical Corp.	ICI	ICI United States, Inc., Chemical Specialties Co.
ACS	Allied Chemical Corp., Specialty Chemical Div.	KON	H. Kohnstamm & Co., Inc.
ACY	American Cyanamid Co.	MAY	Otto B. May Co. Div. of Cone Mills Corp.
ALL	Alliance Chemical Corp.	MRT	Morton Norwich Products, Morton Chemical Co. Div.
ALT	Crompton & Knowles Corp., Dyes & Chemical Div.	MRX	Max Marx Color & Chemical Co.
ATL	Atlantic Chemical Corp.	PCW	Pfister Chemical Works
BAS	BASF Wyandotte Corp.	PDC	Berncolors-Poughkeepsie, Inc.
BCC	Buffalo Color Corp.	PSC	Passaic Color & Chemical Co.
BDO	Benzenoid Organics, Inc.	S	Sandoz, Inc.
BUC	Synalloy Corp., Blackman-Uhler Chemical Div.	SDC	Martin-Marietta Corp., Sodyeco Div.
CCW	Cincinnati Milacron Chemicals, Inc.	SDH	Sterling Drug, Inc., Hilton-Davis Chemical Co. Div.
CGY	Ciba-Geigy Corp.	SNA	Sun Chemical Corp., Pigments Div.
CMG	Nyanza, Inc.	STG	Stange Co.
DGO	Day-Glo Color Corp.	SW	Sherwin-Williams Co.
DSC	Dye Specialties, Inc.	TMS	Sterling Drug, Inc., Thomasset Colors Div.
DUP	E. I. duPont de Nemours & Co., Inc.	TRC	Toms River Chemical Corp.
EKT	Eastman Kodak Co., Tennessee Eastman Co. Div.	VPC	Mobay Chemical Corp, Verona Div.
FAB	Fabricolor Manufacturing Corp.	WAY	Philip A. Hunt Chemical Corp., Organic Chemical Div.
GAF	GAF Corp.	WJ	Warner-Jenkinson Manufacturing Co.
HSC	Chemetron Corp., Pigments Div. Sub. of Allegheny Ludlum Industries, Inc.		
HSR	Harshaw Chemical Co.		
HST	American Hoechst Corp. Industrial Chemicals Div.		

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.

Organic Pigments  
(Color Lakes & Toners)

Bonnie Noreen

Description and uses

An organic pigment is a concentrated form of minute particles of coloring matter which is substantially insoluble in the medium in which it is dispersed. The organic pigment differs from a dye in that a dye is generally soluble in the transport medium or in the final product. Pigments are used rather than dyes when the color required must be insoluble, or substantially so, in its vehicle. An example of this is in the area of printing inks where distinction of colors is required and dyes would "bleed," or spread into surrounding areas. Usually pigments, having more opacity than dyes, are less expensive to use in certain applications since more of the dye is required to achieve the same degree of coloration. For example, opacity, plus a greater resistance to heat, makes pigments more desirable as coloring agents in many plastics and industrial paints.

There are both organic and inorganic pigments. Organic pigments, in general, are more expensive and are available in brighter and more varied colors. They are usually transparent and are affected by organic solvents while inorganic pigments are usually opaque and insoluble in organic solvents. Although both pigment types have functional as well as decorative properties and can contribute to the durability and visibility of the end product, the inorganic pigments are more functional in that some add reinforcement and rust inhibition and generally are more heat resistant than organic pigments. Organic pigments comprise approximately 10 percent of the total volume and 30 percent of the total value of all pigments.<sup>1</sup> The volume of organic pigments as a percent of the total output is not expected to change drastically but their percent of the value is expected to increase in the next several years partly because of the increased costs of the petrochemical raw materials.

The largest use of organic pigments is in printing inks. The second largest use is in paints and other coatings. Lesser amounts are employed to color plastics, textiles, and many other products. When employed in inks and paints, pigments must be readily dispersible in such mediums as oils, organic solvents, varnishes, and resins.

Organic pigments can be derived from synthetic or natural dyestuffs. For economic reasons, the natural products have been almost completely replaced by synthetics. These pigments are generally prepared in one of two ways from dyes or pigment intermediates closely related to dyes. Color lakes are prepared by the precipitation of a water-soluble dye on an insoluble inorganic compound or substrate. In contrast, toners, or full strength colors, do not require a substrate or base. Toners are by far the more commercially important of the two pigments and are marketed either full strength or extended, i.e., diluted by

---

<sup>1</sup> Kirk-Othmer, Encyclopedia of Chemical Technology, Vol. 15, pp. 557-569; and Kline Guide to the Chemical Industry, 3rd Edition p. 151.

the addition of a solid diluent.<sup>1</sup> Over the past 10 years production of lakes has decreased by 59 percent while production of toners increased by 34 percent. The sales unit values of both have increased, toners by 71 percent in 10 years and lakes by 192 percent (table A).

#### Production and sales

In 1977, the pigment industry continued to recover from the economic setback of 1975. The production of organic pigments in 1977 was 68.7 million pounds or 980,000 pounds more than in 1976, which represents an increase of 1.4 percent. The sales quantity increased by 3.2 million pounds (6 percent) in 1977 to a total of 57.4 million pounds, but the sales unit value decreased by 15c to \$4.66 per pound (table A). The decrease in unit value could possibly be attributed to increased import competition.

#### Foreign trade

In 1977, U.S. exports of organic pigments registered a high in both quantity and value. The total quantity of exports, 14.7 million pounds, was 30,000 pounds greater than in 1974, the next highest year, and 242,000 pounds (1.7 percent) greater than in 1976. The total value of exports in 1977 was \$3.8 million more than the \$36.5 million recorded in 1976. This is an increase of 10 percent. Canada, Japan, the Netherlands, the United Kingdom, Belgium, West Germany, Italy, and Australia make up 57 percent of the quantity and 60 percent of the value of these exports (table B).

Imports of 7.6 million pounds in 1977 were less than the all-time high reached in 1974, but were 11 percent higher than the 6.9 million pounds in 1976 (table C). Imports of organic pigments to the United States come mostly from West Germany and Switzerland. These two countries accounted for 64 percent of the quantity and 76 percent of the value in 1977. Imports of Pigments Blue 15, Red 144, Yellow 92, Green 7, and Green 36 accounted for 56 percent of the total U.S. organic pigments imports in 1977.<sup>2</sup> Imports in 1977 accounted for 12.4 percent of the apparent U.S. consumption on a quantity basis, and 11.5 percent on a value basis (table D).

#### The domestic industry

Concentration in the pigments industry in 1977 was about the same as in 1976. In 1977, 5 of the 36 companies accounted for 59 percent of the sales and 10 companies accounted for 83 percent. In 1976, 5 companies accounted for 61 percent of total sales, and 10 companies 87 percent.

---

<sup>1</sup> Although extended toners are provided for under TSUS item 406.70, analysis of import data indicates that imports have also been entered under TSUS item 409.00 as mixtures.

<sup>2</sup> Imports of Benzenoid Chemicals and Products, 1977; USITC Publication #900, p. 73.



The number of domestic companies reporting production of organic pigments has not varied much in the past 10 years, but the number of companies partially or completely owned by foreign investors is increasing. In early 1977, Harmon Colors Corp., a subsidiary of Bayer A.G., acquired the organic pigment business of Allied Chemical Corp. In mid-1977, GAF offered for sale its dye and pigments business.<sup>1</sup> The purchase, by BASF Wyandotte, was concluded in early 1978. Recently there have been negotiations on the sale of yet another large producer to a Germany based company. The amount of foreign interest in the pigment industry is expected to continue to increase in the immediate future. Many U.S. producers have indicated that rising domestic costs are making it more difficult to compete with lower priced foreign pigments. Industry attributes the rising domestic costs to various U.S. pollution controls and safety regulations, increasing labor and overhead costs, and increasing costs of the pigment intermediates and dyestuffs. Foreign companies with U.S. subsidiaries can bypass many of these expenses by manufacturing semifinished dyestuffs abroad and providing them to the U.S. subsidiaries at prices below U.S. market prices.

The U.S. pigment industry is highly dependent upon imported pigment intermediates. According to some industry sources, this dependency has increased in the past several years to the point that approximately one-third of the domestic output of pigments is now based on imported pigment intermediates. These sources point out that many foreign intermediate suppliers are also producers of organic pigments. By increasing the prices of the intermediates to dependent U.S. producers, they could make their own pigments more competitive in the U.S. market. Further import penetration into the pigment intermediate market could, they believe, pose a threat to the domestic pigments industry. They argue that the current trade negotiations may have an adverse effect on the domestic industry in that import duties may be reduced beyond the point where the domestic manufacturers can compete on a price basis with imports.

---

<sup>1</sup> American Dyestuff Reporter, September 1977, pp. 17 and 18.

TABLE A.--Organic pigments (toners and lakes): U.S. production and sales, 1968-77

Year	Production	Sales		
		Quantity	Value	Unit Value <sup>1</sup>
		1,000 pounds	1,000 dollars	Per pound
<b>Toners:</b>				
1968-----	49,919	42,202	116,337	\$2.76
1969-----	57,310	47,375	129,310	2.73
1970-----	52,547	43,754	119,353	2.73
1971-----	55,086	44,247	126,564	2.86
1972-----	62,878	50,506	145,941	2.89
1973-----	66,949	58,991	178,583	3.03
1974-----	67,464	56,318	222,805	3.96
1975-----	47,723	40,779	182,067	4.46
1976-----	66,020	52,818	256,707	4.86
1977-----	67,134	56,037	263,671	4.71
<b>Lakes:</b>				
1968-----	3,830	3,608	3,597	1.00
1969-----	3,701	3,419	3,839	1.12
1970-----	3,977	3,412	3,612	1.06
1971-----	3,240	2,805	3,449	1.23
1972-----	3,019	2,709	3,402	1.26
1973-----	2,446	2,473	3,583	1.45
1974-----	2,334	2,163	5,007	2.31
1975-----	1,930	1,593	3,923	2.46
1976-----	1,707	1,393	4,382	3.15
1977-----	1,573	1,397	4,076	2.92
<b>Total:</b>				
1968-----	53,749	45,810	119,934	2.62
1969-----	61,011	50,794	133,149	2.62
1970-----	56,524	47,166	122,965	2.61
1971-----	58,326	47,052	130,013	2.76
1972-----	65,897	53,215	149,343	2.81
1973-----	69,395	61,464	182,166	2.96
1974-----	69,798	58,481	227,812	3.90
1975-----	49,653	42,372	185,990	4.39
1976-----	67,727	54,211	261,089	4.81
1977-----	68,707	57,434	267,747	4.66

<sup>1</sup> Calculated from rounded figures.

Source: U.S. International Trade Commission, Synthetic Organic Chemicals, United States Production and Sales.

TABLE B.--Organic pigments: U.S. exports, 1973-77

Market	1973	1974	1975	1976	1977
	Quantity (1,000 pounds)				
Canada-----	1,894	2,736	2,624	2,696	1,873
Japan-----	860	719	655	1,391	1,058
Netherlands-----	875	969	1,063	1,309	1,474
United Kingdom-----	962	1,132	756	720	1,157
Belgium-----	329	398	250	595	807
West Germany-----	383	492	508	366	827
Italy-----	1,019	1,089	577	1,200	829
Australia-----	337	675	580	708	413
All other-----	4,083	6,586	5,107	5,519	6,308
Total-----	10,743	14,716	12,120	14,504	14,746
	Value (1,000 dollars)				
Canada-----	3,434	6,037	5,007	6,839	5,199
Japan-----	3,187	4,215	2,637	4,952	4,015
Netherlands-----	1,107	1,643	1,738	3,218	3,817
United Kingdom-----	1,612	3,253	1,878	2,071	3,284
Belgium-----	791	1,236	933	1,904	2,570
West Germany-----	952	1,190	889	1,208	2,251
Italy-----	1,663	2,431	1,430	2,877	1,840
Australia-----	780	1,400	985	1,341	1,293
All other-----	5,997	8,642	9,565	12,087	15,986
Total-----	19,515	33,147	25,062	36,497	40,255

Source: Compiled from official statistics of the U.S. Department of Commerce.

TABLE C.--Organic pigments: U.S. imports, 1973-77

Source	1973	1974	1975	1976	1977
	Quantity (1,000 pounds)				
West Germany-----	2,105	3,225	2,009	2,407	2,722
Switzerland-----	2,226	2,891	1,243	2,326	2,135
Japan-----	177	437	527	819	738
Canada-----	862	395	796	527	709
Italy-----	51	224	126	300	524
United Kingdom-----	360	269	299	204	205
All other-----	273	701	319	305	612
Total-----	6,054	8,142	5,319	6,888	7,645
	Value (1,000 dollars)				
West Germany-----	7,206	12,553	8,281	13,488	16,246
Switzerland-----	6,003	9,179	6,303	12,618	11,409
Japan-----	448	1,500	1,422	2,330	2,604
Canada-----	1,147	835	981	1,343	1,621
Italy-----	192	741	404	800	1,452
United Kingdom-----	1,166	1,056	1,789	700	1,041
All other-----	485	1,441	1,098	1,067	2,064
Total-----	16,647	27,305	20,278	32,346	36,437

Source: Compiled from official statistics of the U.S. Department of Commerce.

TABLE D.--Organic pigments: U.S. production, imports, exports, and apparent consumption, 1968-77

Year	Production <sup>1/</sup>	Imports	Exports	Apparent consumption	Ratio (percent) of imports to consumption
Quantity (1,000 pounds)					
1968-----	53,749	1,653	4,921	50,481	3.3
1969-----	61,011	3,447	4,408	60,050	5.7
1970-----	56,524	3,617	5,632	54,509	6.6
1971-----	58,326	5,764	6,222	57,868	10.0
1972-----	65,897	4,612	7,094	63,415	7.3
1973-----	69,395	6,054	10,743	64,706	9.4
1974-----	69,798	8,142	14,716	63,224	12.9
1975-----	49,653	5,319	12,120	42,852	12.4
1976-----	67,727	6,888	14,504	60,111	11.5
1977-----	68,707	7,645	14,746	61,606	12.4
Value (1,000 dollars)					
1968-----	140,985	4,940	8,366	137,559	3.6
1969-----	159,868	8,783	7,846	160,805	5.5
1970-----	146,806	10,622	9,575	147,853	7.2
1971-----	160,921	12,966	10,870	163,017	8.0
1972-----	183,826	12,017	12,867	182,976	6.6
1973-----	205,882	16,647	19,515	203,014	8.2
1974-----	272,212	27,305	33,147	266,370	10.3
1975-----	217,977	20,278	25,062	213,193	9.5
1976-----	325,767	32,346	36,497	321,616	10.1
1977-----	320,175	36,437	40,255	316,357	11.5

<sup>1/</sup> Value of production estimated, based on unit value of sales.

Source: Production, U.S. International Trade Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports compiled from official statistics of the U.S. Department of Commerce.

## ORGANIC PIGMENTS

Bonnie J. Noreen and Edmund Cappuccilli

Organic pigments are toners and lakes derived in whole or in part from benzenoid chemicals and colors.

Statistics on production and sales of all organic pigments in 1977 are given in table 1.<sup>1</sup> For a few important pigments already reported in table 1, supplemental data on sales by commercial forms are reported in table 1A. Individual toners and lakes are identified in this report by the names used in the third edition of the Colour Index.

Total production of organic pigments in 1977 was 68.7 million pounds--1.5 percent more than the 67.7 million pounds produced in 1976. Total sales of organic pigments in 1977 amounted to 57.4 million pounds, valued at \$267.7 million, compared with 54.2 million pounds, valued at \$261.1 million, in 1976. In terms of quantity, sales of organic pigments in 1977 were 5.9 percent greater than in 1976 in terms of value, sales in 1977 were 2.6 percent greater than in 1976.

Production of toners in 1977 amounted to 67.1 million pounds--1.7 percent more than the 66.0 million pounds reported in 1976. Sales in 1977 were 56.0 million pounds, valued at \$263.7 million, compared with 52.8 million pounds, valued at \$256.7 million, in 1976. Sales in 1977 were 6.1 percent greater than those of 1976 in terms of quantity, and 2.7 percent greater in terms of value. The individual toners listed in the report which were produced in the largest quantities in 1977 were Pigment Yellow 12, 8.7 million pounds; Pigment Blue 15:3, beta form, 6.7 million pounds; Pigment Red 49, barium toner, 5.1 million pounds; Pigment Blue 15, alpha form, 3.7 million pounds; and Pigment Red 53, barium toner, 3.7 million pounds.

Production of lakes totaled 1.6 million pounds in 1977--7.8 percent less than the 1.7 million pounds reported for 1976. Sales of lakes in 1977 amounted to 1.4 million pounds, valued at \$4.1 million, almost identical to the sales reported in 1976 of 1.4 million pounds, valued at \$4.4 million.

For each of 6 selected pigments, or groups of pigments, table 1A gives data on sales by commercial forms. Pigment Green 7, Pigment Red 3, and Pigment Blue 15, alpha form, were sold principally in the dry full-strength form. The remaining 2 pigments and group of pigments for which statistics are published were sold principally in the flushed form.

---

<sup>1</sup> See also table 2 which lists these products and identifies the manufacturers by codes. These codes are listed in table 3.

TABLE 1.--ORGANIC PIGMENTS: U.S. PRODUCTION AND SALES, 1977

[Listed below are all organic pigments for which any reported data on production or sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published.) Table 2 lists separately all organic pigments for which data on production or sales were reported and identifies the manufacturers of each]

ORGANIC PIGMENTS	PRODUCTION	SALES		
		QUANTITY	VALUE <sup>1</sup>	UNIT VALUE <sup>2</sup>
	1,000 pounds dry basis <sup>3</sup>	1,000 pounds dry basis <sup>3</sup>	1,000 dollars	Per pound
Grand total-----	68,707	57,434	267,747	\$4.66
TONERS				
Total-----	67,134	56,037	263,671	4.71
Yellow toners, total-----	18,495	12,837	52,903	4.12
Acetoacetylride yellows:				
Pigment Yellow 1, C.I. 11 680-----	422	362	1,505	4.16
Pigment Yellow 3, C.I. 11 710-----	156	150	634	4.23
Pigment Yellow 73, C.I. 11 738-----	455	448	1,785	3.99
Pigment Yellow 74, C.I. 11 741-----	1,463	1,249	7,508	6.01
Diarylride yellows:				
Pigment Yellow 12, C.I. 21 090-----	8,670	5,768	19,072	3.31
Pigment Yellow 13, C.I. 21 100-----	367	300	1,191	3.97
Pigment Yellow 14, C.I. 21 095-----	3,248	2,323	7,616	3.28
Pigment Yellow 17, C.I. 21 105-----	1,002	612	2,536	4.14
All other-----	2,712	1,625	11,056	6.80
Orange toners, total-----	1,923	1,549	8,289	5.35
Pigment Orange 5, C.I. 12 075-----	663	520	1,880	3.62
Pigment Orange 13, C.I. 21 110-----	230	186	981	5.28
Pigment Orange 16, C.I. 21 160-----	439	441	1,996	4.52
Pigment Orange 34, C.I. 21 115-----	75	75	380	5.06
All other-----	516	327	3,052	9.33
Red toners, total-----	25,267	21,847	98,069	4.49
Naphthol reds, total-----	970	798	5,654	7.09
Pigment Red 2, C.I. 12 310-----	36	38	230	6.03
Pigment Red 5, C.I. 12 490-----	41	43	329	7.58
Pigment Red 9, C.I. 12 460-----	7	...	...	...
Pigment Red 17, C.I. 12 390-----	84	39	267	6.84
Pigment Red 22, C.I. 12 315-----	94	82	582	7.11
Pigment Red 23, C.I. 12 355-----	255	242	1,780	7.36
All other naphthol reds-----	453	354	2,466	6.97
Pigment Red 3, C.I. 12 120-----	1,583	1,313	5,045	3.84
Pigment Red 4, C.I. 12 085-----	172	150	506	3.37
Pigment Red 38, C.I. 21 120-----	205	161	1,328	8.25
Pigment Red 48, C.I. 15 865, barium toner-----	517	485	2,202	4.54
Pigment Red 48, C.I. 15 865, calcium toner-----	1,525	1,529	6,908	4.52
Pigment Red 48, C.I. 15 865, manganese toner-----	271	168	786	4.67
Pigment Red 49, C.I. 15 630, barium toner-----	5,077	4,602	11,670	2.54
Pigment Red 49, C.I. 15 630, calcium toner-----	1,450	1,312	3,932	3.00
Pigment Red 52, C.I. 15 860, calcium toner-----	1,439	1,256	5,653	4.50
Pigment Red 52, C.I. 15 860, manganese toner-----	496	479	1,621	3.39
Pigment Red 53, C.I. 15 585, barium toner-----	3,651	2,736	8,572	3.13
Pigment Red 57, C.I. 15 850, calcium toner-----	2,984	2,278	10,433	4.58
Pigment Red 63, C.I. 15 880-----	39	35	164	4.63
Pigment Red 81, C.I. 45 160, PMA-----	489	462	4,324	9.35
Pigment Red 81, C.I. 45 160, PTA-----	47	44	533	12.14
All other-----	4,352	4,039	28,738	7.12
Violet toners, total-----	1,693	2,159	17,850	8.27
Pigment Violet 1, C.I. 45 170, PMA-----	65	58	563	9.62
Pigment Violet 1, C.I. 45 170, PTA-----	154	83	952	11.52
Pigment Violet 3, C.I. 42 535, fugitive-----	269	272	1,126	4.14
Pigment Violet 3, C.I. 42 535, PMA-----	447	380	2,157	5.67

See footnotes at end of table.

TABLE 1.--ORGANIC PIGMENTS: U.S. PRODUCTION AND SALES, 1977--CONTINUED

ORGANIC PIGMENTS	PRODUCTION	SALES		UNIT VALUE <sup>2</sup>
		QUANTITY	VALUE <sup>1</sup>	
	1,000 pounds dry basis <sup>3</sup>	1,000 pounds dry basis <sup>3</sup>	1,000 dollars	Per pound
TONERS--Continued				
Violet toners--Continued				
Pigment Violet 3, C.I. 42 535, PTA-----	24	29	275	\$9.58
Pigment Violet 23, C.I. 51 319-----	266	198	4,335	21.86
All other-----	468	1,139	8,442	7.41
Blue toners, total-----				
Pigment Blue 1, C.I. 42 595, PMA-----	92	114	1,133	9.90
Pigment Blue 15, C.I. 74 160, alpha form-----	3,674	2,855	16,541	5.79
Pigment Blue 15:1, C.I. 74 160, alpha form-----	331	266	1,865	7.01
Pigment Blue 15:3, C.I. 74 160, beta form-----	6,670	6,025	28,639	4.75
All other-----	5,088	4,796	15,836	3.30
Green toners, total-----				
Pigment Green 2, C.I. 42 040 and 49 005, PMA-----	24	23	236	10.34
Pigment Green 2, C.I. 42 040 and 49 005, PTA-----	36	36	456	12.54
Pigment Green 7, C.I. 74 260-----	2,974	2,745	17,638	6.43
Pigment Green 36, C.I. 74 265-----	211	179	1,405	7.85
All other-----	290	254	1,713	6.74
Brown and black toners, total-----				
Pigment Brown 5, C.I. 15 800-----	86	52	229	4.42
All other-----	280	300	869	2.90
LAKES				
Total-----	1,573	1,397	4,076	2.92
Red lakes:				
Pigment Red 60:1, C.I. 16 105-----	295	302	1,191	3.95
Pigment Red 83, C.I. 58 000-----	59	52	323	6.23
Violet lake: Pigment Violet 5:1, C.I. 58 055-----				
	80	85	424	4.98
Blue lakes-----				
	602	737	1,710	2.32
All other lakes-----				
	537	221	428	1.94

<sup>1</sup> The value of sales from toners are reported on a dry full-strength basis and the value of sales for lakes are reported on a dry form basis. All sales value data exclude the additional costs of processing or packaging in commercial forms other than the dry full-strength or dry form.

<sup>2</sup> "All other" unit values calculated from rounded figures.

<sup>3</sup> Quantities for toners are reported as dry-full strength toner content, excluding the weight of any dispersing agent, vehicle, or extender. Quantities for lakes are reported as dry lake content, excluding the weight of any dispersing agent or vehicle.

Note.--The C.I. (Colour Index) numbers shown in this report are the identifying numbers given in the third edition of the Colour Index.

The abbreviations PMA and PTA stand for phosphomolybdic and phosphotungstic (including phosphotungstomolybdic) acids, respectively.



TABLE 1A.--U.S. SALES OF SELECTED DRY FULL-STRENGTH COLORS, DRY EXTENDED COLORS, DRY DISPERSIONS, AQUEOUS DISPERSIONS, AND FLUSHED COLORS, 1977

[Listed below are supplemental sales data, by commercial forms, of selected pigments that have been reported in table 1]

SELECTED PIGMENTS BY COMMERCIAL FORMS	SALES <sup>1</sup>		
	QUANTITY	VALUE	UNIT VALUE <sup>2</sup>
	1,000 pounds dry basis <sup>3</sup>	1,000 dollars	Per pound
Pigment Yellow 12, C.I. 21 090 and Pigment Yellow 14, C.I. 21 095, total-----	8,091	28,026	\$3.46
Dry full-strength toner-----	2,961	9,833	3.32
Flushed color-----	3,976	14,278	3.59
Aqueous dispersion, <sup>4</sup> dry dispersions, and dry extended toner <sup>5</sup> -----	1,154	3,915	3.39
Pigment Red 3, C.I. 12 120, total-----	1,313	5,291	4.00
Dry full-strength toner-----	832	3,149	3.78
Dry extended toner, aqueous dispersions, <sup>4</sup> and flushed color <sup>5</sup> -----	481	2,142	4.45
Pigment Red 53:1, C.I. 15 585, barium toner, total-----	2,736	8,706	3.18
Flushed color-----	1,822	5,895	3.24
Dry dispersions, dry full-strength toner, and aqueous dispersions <sup>4,5</sup> -----	914	2,811	3.08
Pigment Red 57:1, calcium toner, C.I. 15 850, total-----	2,278	10,547	4.63
Flushed color-----	1,495	8,808	4.65
Dry full-strength toner and aqueous dispersions <sup>4,5</sup> -----	383	1,739	4.54
Pigment Blue 15, C.I. 74 160, alpha form, total-----	2,855	16,816	5.89
Dry full-strength toner-----	1,338	7,847	5.87
Aqueous dispersions <sup>4</sup> -----	512	2,633	5.14
Dry extended toner and flushed color <sup>5</sup> -----	1,005	6,336	6.30
Pigment Green 7, C.I. 74 260, total-----	2,745	17,947	6.55
Dry full-strength toner-----	1,456	9,528	6.57
Flushed color-----	438	3,139	7.16
Aqueous dispersions <sup>4</sup> -----	585	3,473	5.94
Dry extended toner and dry dispersions <sup>5</sup> -----	266	1,807	6.79

<sup>1</sup> Sales quantities are identical in table 1 and 1A; the sales value data in table 1A generally exceed the value in table 1 because table 1A includes the additional processing and packaging costs of the various commercial forms

<sup>2</sup> Calculated from unrounded figures.

<sup>3</sup> Quantity of the various commercial forms is given in terms of dry full-strength toner content.

<sup>4</sup> Includes presscake.

<sup>5</sup> Separate data on these commercial forms may not be published without revealing the operation of individual companies.

Note.--The C.I. (Color Index) numbers shown in this report are the identifying numbers given in the third edition of the Color Index.

The abbreviations PMA and PTA stand for phosphomolybdic and phosphotungstic (including phosphotungstomolybdic) acids respectively.

TABLE 2.--ORGANIC PIGMENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT]

ORGANIC PIGMENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
TONERS	
* YELLOW IONERS:	
ACETOACETARYLIDE YELLOWS:	
* Pigment Yellow 1	: ACY, AMS, DUP, GLX, HPC, HSC, HSH, HST, KCH, KON, S, SDH, SNA.
* Pigment Yellow 2	: KCH, SNA.
* Pigment Yellow 3	: BNS, HPC, HRC, HSC, HSH, HST, KCH, KON.
* Pigment Yellow 4	: HRC.
* Pigment Yellow 5	: HFC.
* Pigment Yellow 6	: HPC.
* Pigment Yellow 49	: S.
* Pigment Yellow 60	: HSH, HSH.
* Pigment Yellow 95	: HFC, HRC, HSH, HST, SNA.
* Pigment Yellow 75	: HPC.
* Pigment Yellow 76	: DUP, GLX, HPC, HRC, HSC, HSH, HST, ICC, SDH, SNA, VPC.
* Pigment Yellow 78	: HPC.
* Pigment Yellow 98	: HST.
Acetoacetarylide yellows, all others	: HPC, KCH, SNA.
DIARYLIDE YELLOWS:	
* Pigment Yellow 12	: AMS, APO, BOR, GLX, HPC, HRC, HSC, HSH, HST, ICC, IND, RCM, SDH, SNA.
* Pigment Yellow 13	: APO, BUC, GLX, HPC, HSC, HST, IND, ROM, SDH, SNA, USH.
* Pigment Yellow 14	: AMS, APO, BNS, BOR, BUC, GAZ, GLX, HPC, HRC, HSC, HSH, HST, ICC, IND, ROM, S, SDH, SNA, USM.
* Pigment Yellow 17	: AMS, APO, BOR, BUC, GLX, HPC, HSC, HSH, HST, ICC, IND, RCM, SDH, SNA.
* Pigment Yellow 55	: HPC, ICC.



TABLE 2.--ORGANIC PIGMENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

ORGANIC PIGMENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
-----	
ORGANIC PIGMENTS	
-----	
TONERS--Continued	
-----	
*RED TONERS--Continued	
*NAPHTHOL REDS--Continued	
Pigment Red 31	ROM.
Pigment Red 172	HPC, HST.
Naphthol reds, all other	ICC, IND, KCH, ROM, S, SDH, SNA, USM.
RED PIGMENTS, OTHER:	
Pigment Red 3	ACY, CIK, DUP, HPC, HSC, HSH, KCH, KON, SDH, SNA, UHL.
Pigment Red 4	ACY, AMS, HPC, HSC, KON, BRX, SDH, UHL.
Pigment Red 6	DUP, HSH, KCH, KON.
Pigment Red 36	HPC, HSH, SNA.
Pigment Red 41	HPC, ICC, SDH.
Pigment Red 48	DUP, HPC, SDH.
Pigment Red 58	DUP, HPC, SDH.
Pigment Red 63	HSC, HSH, KON, SNA.
Pigment Red 83	HPC, ICC, KON, SNA.
Pigment Red 90	AMS, BOR, ICC, SDH.
Pigment Red 122	AMS, BOR, ICC, SDH.
Pigment Red 123	HPC, HST, SNA.
Pigment Red 146	HPC, HSC.
Pigment Red 149	HST.
Pigment Red 168	HPC, HST.
Pigment Red 170	HST.
Pigment Red 179	HST.
Pigment Red 181	HST.
Pigment Red 190	HPC, HSC.
Pigment Red 202	DUP.
Pigment Red 206	HPC.
Pigment Red 207	DUP.
Pigment Red 224	HPC.
*Pigment Red 48:1, barium	ACY, AMS, BOR, DUP, HPC, HSC, HSH, S, SNA.
*Pigment Red 49:1, barium	ACY, AMS, BNS, BOR, CIK, HSC, ICC, KON, MXX, SDH, SNA, UHL.
*Pigment Red 53:1, barium	ACY, AMS, BOR, CIK, HSC, HSH, ICC, KON, MGR, MXX, SDH, SNA.
*Pigment Red 48:2, calcium	ACY, AMS, BOR, DUP, HPC, HSC, HSH, MGR, MXX, SNA.
*Pigment Red 49:2, calcium	ACY, AMS, BNS, BOR, CIK, HSC, SDH.
*Pigment Red 52:1, calcium	ACY, AMS, HPC, HSC, MGR, SNA, UHL.
*Pigment Red 53:2, calcium	APD.

TABLE 2.--ORGANIC PIGMENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

ORGANIC PIGMENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
-----	
TONERS--Continued	
*RED TONERS--Continued	
RED PIGMENTS, OTHER--Continued	
Pigment Red 4	HSB, SDH.
*Pigment Red 5:1, calcium	ACI, AMS, APO, BMS, BOB, CIK, DUP, HFC, HSC, HSH, ICC,
	KON, MGB, SDH, SNA, UHL.
Pigment Red 1, dark	HPC, HSH.
Pigment Red 1, light	HPC, HSH, SDH.
*Pigment Red 49:4, manganese	ACI, DUP, HFC, HEC, HSH.
*Pigment Red 52:2, manganese	ACI, HFC, HSC, HSH.
*Pigment Red 81, PTA	DUP, HFC, KON, MGR, MBX, SMA, UHL.
*Pigment Red 81, PTA	DUP, HFC, HSC, KON, MGR, MBX, UHL.
Pigment Red 49, sodium	BMS, KON, SDH.
Pigment Red 49:3, strontium	HFC, HSC, HST, IND, X.
Pigment Red toners, all other	DUP, HFC, SMA.
*VIOLET TONERS:	
Pigment Violet 19--	DUP, HFC, SMA.
Pigment Violet 23--	BUC, HFC, HSC, HST, SOC, SNA.
Pigment Violet 31--	DUP.
Pigment Violet 36--	HST.
Pigment Violet 42--	DUP.
Pigment Violet 1, fugitive	KCH, UHL.
Pigment Violet 3, fugitive	ACY, HSC, KON, MGB, UHL.
Pigment Violet 4, fugitive	KCW.
*Pigment Violet 1, PMA	HFC, MGR, MBX, SMA, UHL.
*Pigment Violet 3, PMA	AMS, DUP, HFC, HSC, KON, LVB, MGR, MBX, SDH, UHL.
*Pigment Violet 1, PTA	DUP, HFC, HSC, MGR, MBX, SMA.
*Pigment Violet 3, PTA	ACY, HFC, HSC, KON, MBX.
Pigment Violet toners, all other	ACY, BUC, HFC, ROM.
*BLUE TONERS:	
Pigment Blue 19--	SM.
Pigment Blue 22--	DUP.
Pigment Blue 25--	GLX, ICC, IND.
Pigment Blue 27--	BOR.
Pigment Blue 61--	BSC.
*Pigment Blue 15, alpha form	ACY, DUP, HFC, HSC, HST, ICC, SDH, TMS, USM.
*Pigment Blue 15:1, alpha form	HFC, HSC, HST, SNA.
*Pigment Blue 15:2, alpha form	HFC, HSC, SMA.
*Pigment Blue 15:3, beta form	ACY, AMS, APO, BAS, BUC, DUP, HFC, HSC, ICC, POP, ROM,
	SNA.

TABLE 2.--ORGANIC PIGMENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

ORGANIC PIGMENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
ORGANIC PIGMENTS	
*BLUE TONERS--Continued	
Pigment Blue 15-4, Beta form	HSC, SNA
Pigment Blue 9, PMA	BHS, DUP, HPC, KON, MGR, MBX, UHL
Pigment Blue 10	SH
Pigment Blue 1, PMA	SH
Pigment Blue 10, PMA	DUP
Pigment Blue 1, PMA	GAP
Pigment Blue 1, PTA	MBX
Pigment Blue 2, PTA	KON
Pigment Blue toners, all other	IND, LYB, SDH, TNI, UHL, VFC
*GREEN TONERS:	
Pigment Green 7	ACY, BAS, CLK, DUP, HPC, HRC, HSC, HST, POP, SDH, SNA, TMS
Pigment Green 8	HPC, KCM
Pigment Green 10	DUP, HPC
Pigment Green 36	ACY, DUP, HRC, HST, SNA
Pigment Green 1, PMA	MBX, UHL
Pigment Green 2, PMA	MGR, MBX, S, UHL
Pigment Green 4, PMA	MGR
Pigment Green 2, PTA	ACY, HPC, KON, MBX, S, UHL
Pigment Green 4, PTA	ACY
Pigment Green toners, all other	HST, UHL, VFC
BROWN TONERS:	
Pigment Brown 1	S
Pigment Brown 5	BHC, BRC, ICC, ROM
Pigment Brown 3, PMA	KON
Pigment Brown toners, all other	HRC, LYB, SDH
BLACK TONERS:	
Pigment Black 7	HST
Pigment Black toners, all other	DUP, HST, LYB, UHL
LAKES	
*YELLOW LAKES:	
(Acid Yellow 11)	KCM
(Acid Yellow 23)	KON, MBX
(Basic Yellow 37)	BHS
(Direct Yellow 29)	KCM
ORANGE LAKES:	
Pigment Orange 17	KCM, KON

TABLE 2.--ORGANIC PIGMENTS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

ORGANIC PIGMENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
LAKES--Continued	
RED LAKES:	
(Acid Red 17) - - - - -	KCM.
(Acid Red 26) - - - - -	HPC, KCM.
(Basic Red 1) - - - - -	BNS.
* Pigment Red 60:1 - - - - -	HSH, KON, MRX, SDH, SMA.
* Pigment Red 83 - - - - -	HPC, HSH, KON, MRX, UHL.
Pigment Red lakes, all other - - - - -	LVR.
VIOLET LAKES:	
* Pigment Violet 5:1 - - - - -	DUP, HEC, HSH, KON, MRX, S, UHL.
(Basic Violet 1) - - - - -	BNS.
(Basic Violet 4) - - - - -	BNS.
(Basic Violet 10) - - - - -	BNS.
* BLUE LAKES:	
(Basic Blue 7) - - - - -	BNS.
Pigment Blue 17:1 - - - - -	GAF, SDH.
Pigment Blue 28 - - - - -	BOR, KON.
Pigment Blue lakes, all other - - - - -	LVR.
GREEN LAKES:	
Pigment Green lakes, all other - - - - -	LVR.
BROWN LAKES:	
Pigment Brown lakes, all other - - - - -	KON.
BLACK LAKES:	
(Acid Black 2) - - - - -	KCM.
Pigment Black lakes, all other - - - - -	KON.

TABLE 3.--ORGANIC PIGMENTS: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of organic pigments to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
ACY	American Cyanamid Co.	KCW	Keystone Color Works, Inc.
AMS	Ridgway Color & Chemicals	KON	H. Kohnstamm & Co., Inc.
APO	Apollo Colors, Inc.		
		LVR	C. Lever Co., Inc.
BAS	BASF Wyandotte Corp.		
BNS	Binney and Smith, Inc.	MGR	Magruder Color Co., Inc.
BOR	Borden, Inc., Printing Ink Div.	MRX	Max Marx Color & Chemical Co.
BUC	Synalloy Corp., Blackman-Uhler Chemical Div.		
		POP	Pope Chemical Corp.
CIK	Flint Ink Corp., Cal/Ink Div.		
		ROM	United Merchants & Manufacturers, Inc., Roma Chemical Div.
DUP	E. I. duPont de Nemours & Co., Inc.		
		S	Sandoz, Inc., Colors & Chemicals Div.
GAF	GAF Corp.	SDC	Martin-Marietta Corp., Sodyeco Div.
GLX	Galaxie Chemical Corp.	SDH	Sterling Drug, Inc., Hilton-Davis Chemical Co. Div.
		SNA	Sun Chemical Corp., Pigments Div.
HPC	Hercules, Inc.	SW	Sherwin-Williams Co.
HRC	Harmon Colors Corp.		
HSC	Chemetron Corp., Pigments Div. Sub. of Allegheny Ludlum Industries, Inc.	TMS	Sterling Drug, Inc., Thomasset Colors Div.
HSB	Harshaw Chemical Co.	TNI	Gillette Co., Chemical Div.
HST	American Hoechst Corp., Industrial Chemicals Div.		
		UHL	Paul Uhlich & Co., Inc.
ICC	Inmont Corp.	USM	USM Corp., Bostik Div.
IND	Indol Chemical Co., Inc.	VPC	Mobay Chemical Corp., Verona Div.

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.



## Medicinal Chemicals

Tedford C. Briggs

The most important new developments during 1977 were significant Government actions affecting consumers and producers of medicinal chemicals. The Department of Health, Education, and Welfare (HEW) ordered a drug removed from the market, proposed restrictions on antibiotics and some other anti-infective agents used as growth promoters in animal feeds, and drafted legislation that may change drug approval and regulatory procedures.

Also, several significant new drugs were marketed in 1977. An indepth analysis of the anti-infective sulfonamides is provided below, as a case study, pointing out trends in that important group of medicinal chemicals. The market for sulfonamides may be affected by HEW restrictions on the use of medicinals in animal feeds.

Government Actions

In an unprecedented move, HEW banned sales of the antidiabetic drug phenformin on the basis that it presented an imminent hazard to the public. An estimated 385,000 patients were using the drug to control some type of diabetes. The Secretary of HEW acted to remove phenformin because of evidence that the drug had an incidence rate of fatalities associated with its general use that was far higher than has been regarded as acceptable for any other drug approved for use in the United States for a broad patient population. HEW estimated that the risk of death from phenformin use ranged from 5 to 80 times greater than for other drugs known to produce life-threatening side effects.

In another Government action, with likely significant economic effects, the Food and Drug Administration (FDA) decided to restrict the use of antibiotics as growth promoters routinely added to cattle and poultry feeds. The FDA proposal would virtually eliminate the use of the penicillins, oxytetracycline, and chlortetracycline in animal feeds. The sales value of antibiotics consumed in animal feeds has been estimated at \$170 million.

Farm groups have opposed the proposed restrictions on antibiotic feed additives, and they have estimated that implementation of the proposal could cost from \$2 billion to \$5 billion annually in increased feed costs, lower feed efficiency, and higher animal mortality rates.

According to the FDA, the use of subtherapeutic doses of antibiotics in animal feeds promotes the growth of antibiotic-resistant bacteria in the animals' intestines. These bacteria contain plasmids (small lengths of genetic material), which can be transferred among various types of bacteria. A single plasmid can confer bacterial resistance against several antibiotics. Also, the plasmids can supposedly be transferred from nonpathogenic bacteria to pathogenic bacteria, thus creating a new group of drug-resistant harmful bacteria that could infect both animals and humans.

There is little agreement with the FDA assessment from the antibiotic producers or the cattle and poultry producers. These groups argue that the FDA reasoning is speculative and that there is little or no actual evidence supporting the FDA position. Thus, before the FDA plan to restrict the use of antibiotics in feeds can be implemented, the agency must go through a process of hearings to receive public comment.

During 1977, pressure mounted for major changes in the law regulating the testing, approval, and marketing of medicinal chemicals in the United States. The basic legislation which now controls these procedures is set forth in the 1906 Pure Food and Drug Act, as amended. Major changes in the 1906 Act have occurred only twice, in 1938 and 1962. In those instances the amendments were direct congressional responses to specific drug-related disasters. In 1938, the Congress passed drug safety rules in the wake of more than 100 deaths caused by a preparation of sulfanilamide. In 1962, drug efficacy rules were enacted into law after congressional hearings on the thalidomide disaster in Germany which left a number of deformed infants whose mothers took the drug while pregnant.

As the result of both consumer and industry dissatisfaction with the current law, a number of bills were drafted in 1977 which, if enacted, would significantly alter the regulation and marketing of drugs in the United States. According to the Secretary of HEW, the present law highlights irrelevant historical distinctions and perpetuates time-consuming repetitive processes that are closed to effective public review. Under the present system, an application for approval of a new drug averages 34 volumes of paperwork, takes years to process, and costs millions of dollars.

Among the features included in some of the proposed legislation are provisions to speed up the approval process for new drugs and to make it easier to remove a drug from the market if it has an unusually high incidence of harmful side effects. Other proposals would require that drug packets include messages to patients spelling out the proper use and adverse effects of a drug and, thus, make industry information on drug safety easily available to the public for the first time. Another provision would specify that patent protection for a drug would begin on the day of FDA approval. Drug patents now take effect when a drug is first submitted to the FDA for approval, a process that can take years. FDA reportedly is seeking legislation that would articulate more precisely the responsibilities of the agency, thus easing the differences of opinion about its role in regulating drugs.

#### New drugs

Several new drugs were introduced into the prescription market in 1977, and others entered clinical trials which are steps in the testing procedures required for FDA approval for marketing.

The drugs mentioned below do not constitute an exhaustive list of new products and the information is based upon recent reports in various trade journals.

Cimetidine.--This new drug for treating duodenal ulcers received FDA approval for marketing. Cimetidine has been available for use in the United Kingdom for about a year, and it is now being marketed worldwide. The drug was developed in the United Kingdom and belongs to a new class of compounds that reduce or block excess acid secretions in the gastrointestinal tract, thus promoting the healing of duodenal ulcers.

Disopyramide phosphate.--This new drug for treating ventricular arrhythmias is now being marketed in the United States. The drug has been available for some time in several European countries and reportedly has fewer side effects than some of the other antiarrhythmic agents.

Sodium valporate.--This drug for treating epilepsy received FDA approval for marketing in early 1978. Sodium valporate was developed in France and has been in use there since 1967.

Probucol.--This drug for lowering blood cholesterol levels was approved by the FDA in early 1977. The domestic market for cholesterol reducing agents has been estimated at \$35 million.

Adenine arabinoside.--This antiviral drug demonstrated clinical effectiveness against a virulent form of encephalitis caused by a herpes virus. Presently the drug is approved for treatment of eye infections caused by herpes simplex virus.

#### The Anti-Infective Sulfonamides

The anti-infective sulfonamides are an important group of drugs to examine for market factors affecting domestic production because these drugs are, for the most part, mature products that have passed through the stages of discovery, development, extensive use, the development of competing products, expiration of many basic patents, reductions of tariffs on imported sulfonamides, and yet they continue to be an important group of domestically produced medicinal chemicals.

#### Development of sulfonamides as medicinal chemicals

The anti-infective sulfonamides, or sulfa drugs, are derivatives of sulfanilamide which was first synthesized in 1908 by Gelmo as a step in obtaining a better synthetic red dye. In 1935 Gerhard Domagk reported that a red dye called Prontosil protected mice against lethal doses of infective streptococci.

Studies by workers in the Pasteur Institute in France led to the important discovery in late 1935 by Trefouel, Trefouel, Nitti, and Bovet, that the dye Prontosil was altered by the metabolism of the host to give sulfanilamide as the bacteriostatic agent. These discoveries stimulated research throughout the world on the therapeutic properties of derivatives of sulfanilamide, and it was soon discovered that nitrogen-containing heterocyclic-substituted sulfanilamides were more effective anti-infective agents than the parent compound.

The discovery and development of the anti-infective sulfonamides were major milestones in the development of synthetic medicinal chemicals, and the effectiveness of these compounds was demonstrated soon after the discovery of their bacteriostatic properties. Sulfanilamide and its derivatives were the "miracle" drugs of World War II, and in 1942 the War Department announced that every U.S. soldier going into a combat zone would be equipped with a container of sulfa drugs. The results were dramatic in controlling infections resulting from wounds and in curing and preventing infectious diseases.

By 1945, about 5,500 sulfonamides had been described in the literature, and because of the intensive research in this area many of the compounds were developed independently leading to many patent interferences.

In recent years the importance of sulfonamides has diminished in the treatment of infectious diseases of man, as bacterial resistance to the sulfonamides has increased, and as the frequently more effective and less toxic antibiotics have been developed. Nevertheless, the anti-infective sulfonamides continue to be the drugs of choice in the treatment of certain urinary tract and systemic infections in humans and, because of their relatively low cost and demonstrated effectiveness, are frequently-used anti-infective agents in veterinary medicine. About 25 different anti-infective sulfonamides were produced in the United States in 1977.

#### Methods of production

Acetanilide is the basic chemical used to produce most anti-infective sulfonamides. Acetanilide is treated with chlorosulfonic acid to obtain n-acetylsulfanilyl chloride which can be reacted with ammonia and then an alkali to obtain sulfanilamide, or n-acetylsulfanilyl chloride can be used to produce a multitude of other sulfonamides.

#### Production

Production data for sulfanilamide drugs were first published in United States International Trade Commission statistics in 1937 and are summarized in the table on the following page.

Sulfanilamide and related anti-infective sulfonamides:  
U.S. Production, 1937-77

(In thousands of pounds)

Year	Production	Year	Production	Year	Production
1937-----	355	:1951-----	6,411	:1965-----	4,728
1938-----	339	:1952-----	5,786	:1966-----	5,450
1939-----	709	:1953-----	4,672	:1967-----	5,046
1940-----	646	:1954-----	4,157	:1968-----	4,794
1941-----	2,091	:1955-----	2,767	:1969-----	4,916
1942-----	5,436	:1956-----	3,817	:1970-----	5,943
1943-----	10,006	:1957-----	3,843	:1971-----	6,063
1944-----	4,514	:1958-----	3,725	:1972-----	6,078
1945-----	5,912	:1959-----	5,835	:1973-----	6,781
1946-----	5,104	:1960-----	5,080	:1974-----	7,104
1947-----	6,142	:1961-----	4,181	:1975-----	4,677
1948-----	2,660	:1962-----	4,257	:1976-----	4,015
1949-----	4,895	:1963-----	4,639	:1977-----	4,435
1950-----	4,967	:1964-----	4,964	:	:
:	:	:	:	:	:

Source: U.S. International Trade Commission, Synthetic Organic Chemicals, United States Production and Sales, 1937-77.

Production of the anti-infective sulfonamides peaked in 1943 at 10 million pounds at the height of World War II. At that time, the sulfonamides were the only widely effective anti-infective drugs, and the United States was supplying these drugs for most of the Allied Forces. Some market analysts predicted that the anti-infective sulfonamides would largely be replaced by the antibiotics, but a glance at the production statistics reveals that this has not been the case. Production has varied widely from a post-World War II low of 2.7 million pounds in 1948 to a high of 7.1 million pounds in 1974.

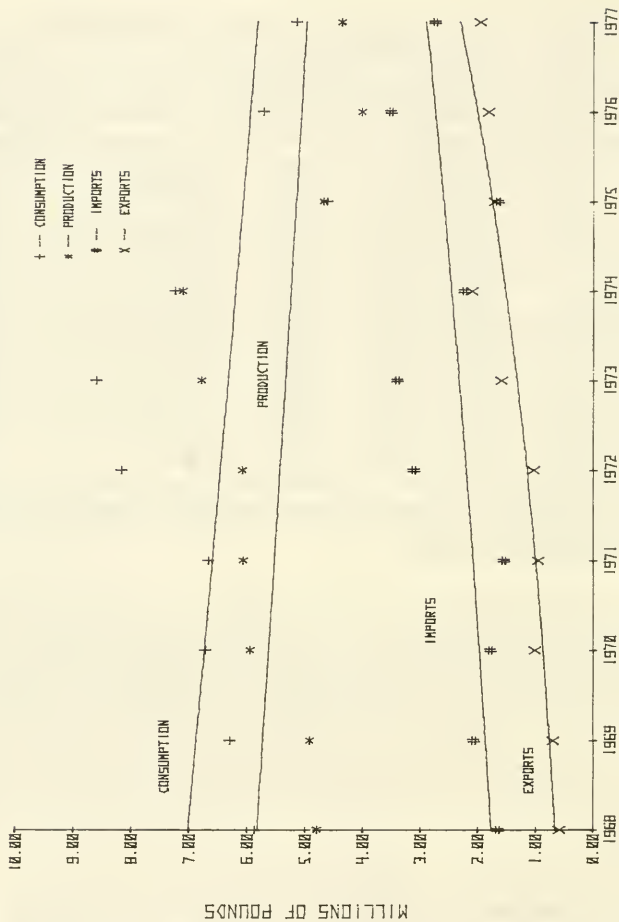
#### Trade Statistics:

Statistics for production, imports, exports, and consumption of anti-infective sulfonamides for a 10-year period, 1968-77, are shown graphically in the following illustration. A non-linear regression analysis was used to establish trend lines for the data.

The chart shows a gradual decline in the trend for both production and consumption. The declines are probably due to loss of markets to competing anti-infective agents such as the antibiotics. Consumption and production could drop sharply, as would imports, if the FDA places strong restrictions on the use of anti-infective sulfonamides in animal feeds.

Both exports and imports showed increasing trends during 1968-77, with exports increasing somewhat more rapidly than imports. Imports of some individual anti-infective sulfonamides, such as sulfamethazine, have shown large increases. There may be some correlation between imports of sulfamethazine, as shown in the following table, and its U.S. patent protection which expired about 1963.

THREE STATISTICS FOR ANTI-INFECTIVE SULFONAMIDES



## Sulfamethazine and its sodium salt: U.S. imports, 1958-77

(In thousands of pounds)

Year	Imports	Year	Imports	Year	Imports
1958-----	3	1965-----	121	1972-----	679
1959-----	9	1966-----	225	1973-----	861
1960-----	7	1967-----	343	1974-----	1,010
1961-----	5	1968-----	479	1975-----	683
1962-----	63	1969-----	783	1976-----	1,434
1963-----	107	1970-----	773	1977-----	1,064
1964-----	175	1971-----	482		

Source: U.S. International Trade Commission, Imports of Benzenoid Chemicals and Products, 1958-77.





## Medicinal Chemicals

Tedford C. Briggs

Medicinal chemicals include the medicinal and feed grades of all organic chemicals having therapeutic value, whether obtained by chemical synthesis, by fermentation, by extraction from naturally occurring plant or animal substances, or by refining a technical grade product. They include antibiotics and other anti-infective agents, antihistamines, autonomic drugs, cardiovascular agents, central nervous system depressants and stimulants, hormones and synthetic substitutes, vitamins, and other therapeutic agents for human or veterinary use and for animal feed supplements.

The table shows statistics for production and sales of medicinal chemicals grouped by pharmacological class. The statistics shown are for bulk chemicals only. Finished pharmaceutical preparations and products put up in pills, capsules, tablets, or other measured doses are excluded.<sup>1</sup> The difference between production and sales reflects inventory changes, processing losses, and captive consumption of medicinal chemicals processed into ethical and proprietary pharmaceutical products by the primary manufacturer. In some instances, the difference may also include quantities of medicinal grade products used as intermediates, for example, penicillin G salts used as intermediates in the manufacture of semi-synthetic penicillins. All quantities are given in terms of 100-percent content of the pure bulk drug.

Total U.S. production of bulk medicinal chemicals in 1977 amounted to 240.7 million pounds, or 2.1 percent more than the 235.8 million pounds produced in 1976 and 15.5 percent more than the 208.4 million pounds produced in 1975. Total sales of bulk medicinal chemicals in 1977 amounted to 162.4 million pounds, valued at \$794.0 million, compared with sales in 1976 of 160.8 million pounds, valued at \$741.5 million, and sales in 1975 of 148.8 million pounds, valued at \$772.1 million. In terms of quantity, sales in 1977 were 1.0 percent more than in 1976 and 9.1 percent more than in 1975. In terms of value, sales in 1977 were 7.1 percent more than in 1976 and 2.8 percent more than in 1975.

Production of the more important groups of medicinal chemicals in 1977 was as follows: Antibiotics, 23.1 million pounds (12.9 percent more than in 1976), of which 14.0 million pounds was for medicinal use and 9.1 million pounds was

---

<sup>1</sup> Complementary statistics on the dollar value of manufacturers' shipments of finished pharmaceutical preparations, except biologicals, are published annually by the U.S. Department of Commerce, Bureau of the Census, in Current Industrial Reports, Series MA-28G. Many pharmaceutical manufacturers who report to the Bureau of the Census are excluded from the U.S. International Trade Commission report because they are not primary producers of medicinal chemicals, that is, they do not themselves produce the bulk drugs which go into their pharmaceutical products but purchase their drug requirements from domestic or foreign producers.

for other uses; anti-infective agents other than antibiotics, 28.0 million pounds (1.2 percent more than in 1976); central nervous system depressants and stimulants, 52.5 million pounds (0.4 percent less); and vitamins, 37.1 million pounds (11.4 percent more).

Production of some of the more important individual products listed in the table was as follows: Choline chloride, 48.2 million pounds (2.5 percent larger than in 1976); aspirin, 31.4 million pounds (11.1 percent more); penicillins (except semi-synthetic), 7.5 million pounds (4.6 percent more); tetracyclines, 5.6 million pounds (1.3 percent less); and vitamin E, 5.3 million pounds (15.1 percent more).

TABLE 1.--MEDICINAL CHEMICALS: U.S. PRODUCTION AND SALES, 1977

[Listed below are all synthetic organic medicinal chemicals for which any reported data on production or sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists all medicinal chemicals for which data on production and/or sales were reported and identifies the manufacturers of each]

MEDICINAL CHEMICALS	SALES <sup>1</sup>			
	PRODUCTION <sup>1</sup>	QUANTITY	VALUE	UNIT VALUE <sup>2</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	240,733	162,384	794,018	\$4.89
Acyclic-----	86,811	78,798	75,626	.96
Benzenoid <sup>3</sup> -----	109,143	57,943	380,521	6.57
Cyclic nonbenzenoid <sup>4</sup> -----	44,779	25,643	337,871	13.18
Antibiotics, total <sup>5</sup> -----	23,120	7,407	255,867	34.54
Cephalosporins-----	806	...	...	...
Penicillins, semisynthetic, total-----	2,034	443	38,380	86.64
Amoxicillin-----	305	...	...	...
Ampicillin-----	1,167	...	...	...
All other (semisynthetic) <sup>6</sup> -----	562	443	38,380	86.64
Penicillins (except semisynthetic), total-----	7,460	2,915	35,862	12.30
Penicillin G, potassium, for medicinal use-----	2,712	...	...	...
All other, for all uses-----	4,748	2,915	35,862	12.30
Tetracyclines, for all uses-----	5,615	...	...	...
Other antibiotics, total-----	7,205	4,049	181,625	44.86
For medicinal use <sup>7</sup> -----	3,474	1,096	136,183	124.25
For nonmedicinal uses <sup>8</sup> -----	3,731	2,953	45,442	15.39
Antihistamines, total-----	454	249	6,914	27.77
Chlorpheniramine maleate-----	37	...	...	...
All other-----	417	249	6,914	27.77
Anti-infective agents (except antibiotics), total-----	27,977	11,140	42,166	3.79
Anthelmintics, total-----	10,932	4,856	15,964	3.29
Piperazine dihydrochloride-----	1,464	1,279	1,777	1.39
All other-----	9,468	3,577	14,187	3.97
Antifungal agents-----	776	735	1,189	1.62
Antiprotozoan agents-----	8,233	...	...	...
Sulfonamides-----	4,435	731	4,680	6.40
Urinary antiseptics-----	327	392	1,180	3.01
Other anti-infective agents <sup>9</sup> -----	3,274	4,426	19,153	4.33
Autonomic drugs, total-----	1,194	834	15,885	19.05
Sympathomimetic (adrenergic) agents, total-----	1,085	771	12,255	15.89
Phenylpropanolamine hydrochloride-----	433	359	2,952	8.22
All other-----	652	412	9,303	22.58
Other autonomic drugs-----	109	63	3,630	57.62
Central depressants and stimulants, total-----	52,479	38,340	134,275	3.50
Analgesics, antipyretics, and nonhormonal anti-inflammatory agents, total-----	45,857	33,520	63,293	1.90
Aspirin-----	31,415	...	...	...
All other <sup>10</sup> -----	14,442	33,520	63,293	1.90
Anticonvulsants, hypnotics, and sedatives-----	1,426	505	3,996	7.91
Antidepressants-----	162	...	...	...
Antitussives-----	200	151	39,263	260.02
Skeletal muscle relaxants-----	417	422	3,817	9.05
Tranquilizers-----	556	...	...	...
Other central depressants and stimulants <sup>11</sup> -----	3,861	3,742	23,906	6.39
Dermatological agents and local anesthetics, total-----	2,139	1,975	3,032	1.54
Lidocaine-----	46	20	258	12.90
All other-----	2,093	1,955	2,774	1.42

See footnotes at end of table.

TABLE 1.--MEDICINAL CHEMICALS: U.S. PRODUCTION AND SALES, 1977--CONTINUED

MEDICINAL CHEMICALS	PRODUCTION <sup>1</sup>		SALES <sup>1</sup>	
	QUANTITY	VALUE	QUANTITY	UNIT VALUE <sup>2</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Expectorants and mucolytic agents, total-----	2,302	1,862	7,258	\$3.90
Ethylenediamine dihydriodide-----	1,300	1,180	4,050	3.43
All other-----	1,002	682	3,208	4.70
Hematological agents, total-----	28	23	2,862	124.43
Sodium heparin-----	5	2	1,843	921.50
All other-----	23	21	1,019	48.52
Hormones and synthetic substitutes, total-----	1,103	160	81,503	509.39
Synthetic hypoglycemic agents-----	942	...	...	...
All other <sup>12</sup> -----	161	160	81,503	509.39
Renal-acting and edema-reducing agents, total-----	1,754	275	6,400	23.27
Theophylline derivatives-----	113	...	...	...
All other <sup>13</sup> -----	1,641	275	6,400	23.27
Vitamins, total-----	37,128	22,726	164,430	7.24
Vitamin D-----	12	9	3,226	358.44
Vitamin E-----	5,289	3,466	51,059	14.73
All other vitamins <sup>14</sup> -----	31,827	19,251	110,145	5.72
Miscellaneous medicinal chemicals, total-----	91,055	77,393	73,426	.95
Choline chloride (all grades)-----	48,167	42,556	16,970	.40
All other <sup>15</sup> -----	42,888	34,837	56,456	1.62

<sup>1</sup> The data on production and sales are for bulk medicinal chemicals only.

<sup>2</sup> Calculated from rounded figures.

<sup>3</sup> Benzenoid, as used in this report, describes any cyclic medicinal chemical whose molecule contains either a six-membered carbocyclic ring with conjugated double bonds or a six-membered heterocyclic ring with 1 or 2 hetero atoms and conjugated double bonds, except the pyrimidine ring.

<sup>4</sup> Includes antibiotics of unknown structure.

<sup>5</sup> Production of all antibiotics for medicinal use amounted to 13,992,000 pounds, and sales amounted to 3,198,000 pounds, valued at \$205,523,000. Production of all antibiotics for animal feed and other nonmedicinal uses amounted to 9,128,000 pounds, and sales amounted to 4,209,000 pounds, valued at \$50,344,000.

<sup>6</sup> Includes sales quantity and value of amoxicillin and ampicillin.

<sup>7</sup> Includes production and sales of antifungal and antitubercular antibiotics and sales of cephalosporins.

<sup>8</sup> Includes sales quantity and value of tetracyclines.

<sup>9</sup> Includes sales quantity and value of antiprotozoan agents.

<sup>10</sup> Includes sales quantity and value of aspirin.

<sup>11</sup> Includes sales quantity and value of antidepressants and tranquilizers. Also includes production and sales of amphetamines, general anesthetics, and respiratory and cerebral stimulants.

<sup>12</sup> Includes sales quantity and value of synthetic hypoglycemic agents.

<sup>13</sup> Includes sales quantity and value of theophylline derivatives.

<sup>14</sup> Includes production and sales of vitamin A, vitamin B, vitamin C, and vitamin K.

<sup>15</sup> Includes production and sales of antineoplastic agents, cardiovascular agents, diagnostic agents, gastrointestinal agents (except choline chloride), therapeutic nutrients, smooth muscle relaxants, and unclassified medicinal chemicals.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS, OR GROUPS OF CHEMICALS, FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); OTHER CHEMICALS DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT]

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
<b>*ANTIBIOTICS:</b>	
<b>*PENICILLINS, SEMI-SYNTHETIC:</b>	
*Amoxicillin - - - - -	BEE, BOC, BRS.
*Ampicillin - - - - -	BEE, BOC, BRS.
Ampicillin, sodium - - - - -	BEE, BRS, TRD, WYT.
Carbenicillin, disodium - - - - -	BEE, BRS, WYT.
Carbenicillin indanyl, sodium - - - - -	PEZ.
Clorxacillin, sodium - - - - -	BEE, BRS.
Dicloxacillin, sodium - - - - -	BEE, BRS, WYT.
Metacillin - - - - -	BRS.
Metacillin, potassium - - - - -	BRS.
Nafcillin, sodium - - - - -	BEE, BRS.
Oxacillin, sodium - - - - -	BRS, WYT.
Ticarcillin, sodium - - - - -	BEE, BRS.
<b>*PENICILLINS, EXCEPT SEMI-SYNTHETIC:</b>	
FOR MEDICINAL USE:	
Penicillin V (Phenoxymethylpenicillin) - - - - -	BRS, LIL, PFZ.
Penicillin G, benzathine - - - - -	WYT.
*Penicillin G, potassium - - - - -	BRS, LIL, OMS, PFZ, WYT.
Penicillin V, potassium - - - - -	BRS, LIL.
Penicillin G, procaine (Medicinal grade) - - - - -	LIL, PFZ, WYT.
Penicillin G, sodium - - - - -	PFZ.
FOR NONMEDICINAL USE:	
Penicillin G, Procaine (Animal feed grade) - - - - -	MRK, OMS, PFZ.
<b>*TETRACYCLINES:</b>	
FOR MEDICINAL USE:	

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*ANTIBIOTICS--Continued	
*TETRACYCLINES--Continued	
FOR MEDICINAL USE--Continued	
Chlortetracycline (Medicinal grade)-	ACY.
Desacetylcycline--	ACY.
Doxycycline--	PFZ.
Methacycline--	PFZ.
Minoocycline--	ACY.
Oxytetracycline (Medicinal grade)-	PFZ.
Tetracycline--	ACY, BBS, PFZ, UPJ.
FOR NONMEDICINAL USES:	
Chlortetracycline (Animal feed grade)-	ACY, RLS.
Oxytetracycline (Animal feed grade)-	PFZ.
*OTHER ANTIBIOTICS:	
*FOR MEDICINAL USE:	
ANTIFUNGAL ANTIBIOTICS:	
Amphotericin B--	OMS, TBD.
Candidin--	PER.
Nystatin (Medicinal grade)--	ACY, OMS, TRD.
ANTITUBERCULAR ANTIBIOTICS:	
Dihydrostreptomycin--	MRK, PFZ.
Streptomycin (Medicinal grade)--	LLI, MRK, PFZ.
*CEPHALOSPORINS:	
Cefazolin--	LLI, SK.
Cefoxitin--	MRK.
Cephalexin--	LLI.
Cephalexidine--	LLI.
Cephaloridine--	LLI.
Cephalothin--	LLI.
Cephapirin--	BES.
Cephapirin, sodium--	BKS.
Cephadrine--	SK, TRD.
OTHER ANTIBIOTICS FOR MEDICINAL USE:	
Amikacin sulfate--	BBS.
Bactracin (Medicinal grade)--	IC.
Chloramphenicol--	PD, RLS.
Clindamycin--	UPJ.
Erythrocytin--	ABB, LLI, UPJ.
Erythrocytin estolate--	LLI.
Erythromycin stearate--	UPJ.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*ANTIBIOTICS--Continued	
*OTHER ANTIBIOTICS--Continued	
*FOR MEDICAL USE--Continued	
OTHER ANTIBIOTICS FOR MEDICAL USE--Continued	
Gentamycin	SCH.
Kanamycin	BFS.
Lincosycin	UPJ.
Neomycin (Medicinal grade)	ONS, PEN, PFZ, UPJ.
Norbiocin (Medicinal grade)	UPJ.
Polyoxin B	PFZ.
Spectinomycin (Medicinal grade)	ABB, UPJ.
Thiostrepton	ONS.
Tyrothricin	PEN.
Vancosycin	LIL.
*FOR NONMEDICINAL USES:	
Bacitracin (Animal feed grade)	MC, PEN.
Cycloheximide	UPJ.
Hydroxyin B	LIL.
Lasalocid	HOF.
Lincosycin (Animal feed grade)	LV.
Monensin, sodium	UPJ.
Neosycin (Animal feed grade)	PFZ, UPJ.
Norbiocin (Animal feed grade)	UPJ.
Nystatin (Animal feed grade)	ONS.
Spectinomycin (Animal feed grade)	UPJ.
Tylosin	MRK, PFZ.
*ANTIHISTAMINES:	
ANTIHAUSEANTS:	
Cyclizine hydrochloride	BUR.
Dimenhydrinate	GAN, SBL.
Meclizine hydrochloride	PFZ.
Trimethobenzamide hydrochloride	HOF.
OTHER ANTIHISTAMINES:	
Bromodiphenhydramine hydrochloride	PD.
Brompheniramine maleate	HEX, SCH.
Chlorcyclizine hydrochloride	BUR.
Chlorpheniramine maleate	HEX, SCH, SK.
Chlorpheniramine tannate	MAL.
Cyproheptadine hydrochloride	MRK.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS* IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*ANTHISTAMINES--Continued	
OTHER ANTIHISTAMINES--Continued	
DESOBUPRENORAMINE maleate	: SCH.
DESOBUPRENORAMINE maleate	: SCH.
DESOBUPRENORAMINE maleate	: CGY.
DIPHENHYDRAMINE hydrochloride	: B.J.L. GAN, PD.
DOXYLAMINE succinate	: B.J.L. BKC.
METHAPYRILENE fumarate	: ABB, MON.
METHAPYRILENE hydrochloride	: B.J.L.
METHILAZINE hydrochloride	: HOF.
PHENIDAMINE tartrate	: HEX.
PHENYLOXAMINE citrate	: BBS, GAN, Y.
PRILAMINE maleate	: HEX.
PRILAMINE resin adsorbate	: MKK.
PRILAMINE tannate	: MAL.
TRIPROUTAMINE phosphate	: LIL.
TRIPLENNAMINE citrate	: CGY.
TRIPLENNAMINE hydrochloride	: CGY.
TRIPROCLIDINE hydrochloride	: BDR.
*ANTI-INFECTION AGENTS (EXCEPT ANTIPIROTIKS):	
*ANTHELMINTICS:	
DICHLORVOS	: SBC.
DIETHYLCARBAZINE citrate	: ACY.
GENTIAN VIOLET	: SDH.
HEXYLRESORCINOL	: MKK.
PHENOTHIAZINE (Medicinal grade)	: MAG.
PIPERAZINE	: DOM, JCC.
Piperazine citrate	: BUR, JCC.
*Piperazine dihydrochloride	: DOM, FLN, JCC, WEL.
Piperazine hexahydrate	: JCC.
Piperazine phosphate	: DOM, FLN, JCC, LEM.
Pyrantel pamoate	: PFZ.
Pyvinius pamoate	: PB.
Rafloxamide	: RFA.



TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*ANTI-INFECTION AGENTS (EXCEPT ANTIBIOTICS)--Continued	
*ANTHELMINTICS--Continued	
Thabendazole	MRK.
Dredefos	TNA.
*ANTIPROTOZOAN AGENTS:	
ARSENIC AND BISRUITH COMPOUNDS:	
Arsanilic acid	ABB, PLM, WHL.
Bismuth subsalicylate	MAL, NOR, PEN.
Carbarsone	SIL, MHL.
Glycotharsol	SDW, X.
Nitarsone	SDW.
Roxarsone	SAL.
OTHER ANTIPROTOZOAN AGENTS:	
Alcicide	SAL.
Amoebicidal	PD.
Amoebicidal hydrochloride	MRK.
Amoebicide	MRK.
Chloroquine phosphate	SDW.
Cloridol	DOM.
Diacetohydroxyquin	BSA.
Dimetridazole	RDA.
Ethopabate	MRK.
Parazolidone	NOR.
Hydroxychloroquine sulfate	SDW.
Iodochlorhydroxyquin	CGY.
Metronidazole	RDA.
Nifuroxime	NOR.
Nitroamide	SAL.
Nitrophenide	ACY.
Priaquine phosphate	SDW.
Pyrimethamine	BSR.
Ronidazole	MRK.
*SULFONAMIDES:	
Acetyl sulfisoxazole	HOZ.
Dinsed	SAL.
Mafenide acetate	SDW.
Mafenide hydrochloride	SDW.
Phthalylsulfacetamide	LEN.
Sulfabenzamide	ACY.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*ANTI-INFECTIVE AGENTS (EXCEPT ANTI-BIOTICS)--Continued	
*SULFONAMIDES--Continued	
Sulfabenzamide, sodium	ACY.
Sulfacetamide	LEM.
Sulfacetamide, sodium	LEM.
Sulfachloropyridazine, sodium	ACY.
Sulfachloropyridazine, sodium	ACY.
Sulfacyline	ACY.
Sulfadiazine	ACY.
Sulfadiazine	HOF.
Sulfadiazine	HOF.
Sulfadiazine, sodium	MRK.
Sulfadiazine, sodium	MRK.
Sulfadiazine	ACY.
Sulfadiazine	ACY.
Sulfamethazine, sodium	ACY.
Sulfamethazine, sodium	ACY, LEM, RLS.
Sulfamethazine, sodium	LEM, SAL.
Sulfamethazole	ACY.
Sulfamethazole	HCF.
Sulfamethazole	SAL.
Sulfamitran	SAL.
Sulfapyridine	ACY, LEM.
Sulfapyridine	MRK.
Sulfapyridine (Salicylazosulfapyridine)	SAL.
Sulfathiazole	MRK.
Sulfathiazole, sodium	MRK, SAL.
Sulfisoxazole	HOF.
Sulfisoxazole, sodium	HOF.
OTHER ANTI-INFECTIVE AGENTS:	
* ANTI-FUNGAL AGENTS:	
Benzoic acid	MRK.
Calcium undecylenate	WTL.
Sodium caprylate	LEM.
Zinc undecylenate	NTL, WTL.
ANTI-LEPROTIC AND ANTITUBERCULAR AGENTS:	
Aminosalicilic acid	MLS.
Sodium aminosalicylate	MLS.
Sodium sulfoxone	ABB.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*ANTI-INFECTION AGENTS (EXCEPT ANTIBIOTICS)--Continued	:
*OTHER ANTI-INFECTION AGENTS--Continued	:
MERCURY COMPOUNDS:	:
Merbromin	: HYN.
Thimerosal	: LIL.
*URINARY ANTISEPTICS:	:
Methenamine hippurate	: RIK.
Methenamine mandelate	: ARN.
Nitrofurantoin	: NOR.
Phenazopyridine hydrochloride	: NEP.
GENERAL ANTISEPTICS AND ANTIBACTERIAL AGENTS:	:
Aminacrine	: SDW.
Aminacrine hydrochloride	: SDW.
Benzalkonium chloride	: SDW.
Betanaphthol	: ACY.
Bromoform	: DOW.
Camphor, monobromated	: PEN.
Carbadox	: PFZ.
Cetalkonium chloride	: FIN, SDW.
Cetylpyridinium chloride	: FIN, HEK.
Chlorobutanol	: SFS.
Chlorothymol	: OPC.
D-cresyl acetate	: ADC, PEN.
Iodofors	: BAL.
Lactic acid	: SCH.
Nitrofurazone	: WEP.
Nitrofurazone	: WEP.
Oxolinic acid	: WEP.
Oxyquinoline benzoate	: ASH, MKK.
Oxyquinoline citrate	: ASH, LEM.
Oxyquinoline sulfate	: ASH, MKK.
Oxyquinoline zinc	: ASH, LEM.
Povidone-iodine complex	: MKK, LEM.
Resorcinol	: GAP.
Thymol	: KFT.
Thymol iodide	: GIV.
Trimethoprim	: MAL.
	: BUB.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*AUTONOMIC DRUGS:	
*SYMPATHOMIMETIC AGENTS:	
Cinnasoline hydrochloride	SDW.
Cyclopentamine hydrochloride	LIL.
Ephedrine	UPJ.
Isotarine hydrochloride	SDW.
Isoproterenol hydrochloride	SDW.
Levaterenol bitartrate	SDW.
Nepentamine	ARA.
Nepentamine sulfate	ARA.
Methoxyphenamine hydrochloride	RLS.
Naphazoline hydrochloride	CGI.
Norefirin hydrochloride	SDW.
Phenylephrine	SDW.
Phenylephrine bitartrate	GAN.
Phenylephrine hydrochloride	GAN, HEX, SDR.
Phenylpropanolamine hydrochloride	ARS, GAN, NEP, ORT, X.
Pseudoephedrine hydrochloride	SK, GAN, UPJ.
Pseudoephedrine hydrochloride	BUR, GAN, UPJ.
Pseudoephedrine sulfate	GAN.
Tetrahydrozoline hydrochloride	PPZ.
Synthabisetic (adrenergic) agents, all other	CGY.
*OTHER AUTONOMIC DRUGS:	
GAMMLONIC BLOCKING AGENTS:	
Tetraethylammonium chloride	RSA.
PARASYMPATHOLYTIC QUATERNARY AMMONIUM COMPOUNDS (EXCEPT TROPANE DERIVATIVES):	
Diphenamil methylsulfate	SCH.
Isopropane iodide	SK.
Mepanzolate bromide	LKL.
Methantheline bromide	SRL.
Pipenzolate bromide	LKL.
Propantheline bromide	SRL.
Tidibhexethyl iodide	ACL.
PARASYMPATHOLYTIC TERTIARY AMINES (EXCEPT TROPANE DERIVATIVES):	

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*AUTONOMIC DRUGS--Continued	
*OTHER AUTONOMIC DRUGS CONTAINED PARAPARIC DERIVATIVES: TROPANE AMINES (EXCEPT TROPANE DERIVATIVES) C. Continued	
Atropine hydrochloride	: CGV.
Ephedrine hydrochloride	: LIL.
Dicyclanil hydrochloride	: BKC.
Oxphenadine citrate	: BIK.
Orbutyrin chloride	: X.
Oxyphenycycline hydrochloride	: PFZ.
Piperidolate hydrochloride	: LKL.
Thiophenacil hydrochloride	: BJL.
Trihexyphenidyl hydrochloride	: ACT, SD W.
PARASYMPATHOLYTIC TROPANE DERIVATIVES:	
Anisotropine methylobromide	: ARA.
Benztropine mesylate	: ARA.
Homatropine hydrobromide	: ARA.
Homatropine methylobromide	: ARA.
PARASYMPATHOMIMETIC AGENTS:	
Bethanechol chloride	: MRK.
Carbachol	: MRK.
Neostigmine bromide	: HEX, HOF.
Neostigmine methylsulfate	: HOF.
Pyridostigmine bromide	: HOF.
SYMPATHOLYTIC AGENTS:	
Ergonovine maleate	: LIL.
Tibolol maleate	: MRK.
*CENTRAL DEPRESSANTS AND STIMULANTS:	
*ANALGESICS, ANTIPIRETTICS, AND NONHORMONAL ANTI- INFLAMMATORY AGENTS:	
*SALICYLIC ACID DERIVATIVES:	
*Aspirin (Acetylsalicylic acid)	: DOM, MON, NOR, SDG.
Diflunisal	: MRK.
Phenyl salicylate (Salol)	: DOM.
Potassium salicylate	: HN.
Salicylamide	: PEN.
Salicylsalicylic acid	: PD.
Sodium salicylate	: HN.
OTHER ANALGESICS AND ANTIPIRETTICS:	
Acetaminophen	: ARA, MAL, MON, NEP, NOR, PEN.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS* IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*CENTRAL DEPRESSANTS AND STIMULANTS--Continued	
*ANALGESICS, ANTIPIRETTICS, AND NONHORMONAL	
ANTI-INFLAMMATORY AGENTS--Continued	
*OTHER ANALGESICS AND ANTIPIRETTICS--Continued	
Aspirin acid	: GAN.
Aspirin	: MRK.
Allevudine hydrochloride	: SCH.
Acetaminophen	: WYT.
Etioheptazine citrate	: X.
Ibuprofen	: MRK.
Indomethacin	: PD.
Meclofenamic acid, sodium salt	: PD.
Mefenamic acid	: PEN, SDW, WYT.
Meperidine hydrochloride	: LIL, MAL, PEN.
Methadone hydrochloride	: MRK.
Morphine sulfate	: ARA.
Naproxen	: EN.
Oxycodone hydrochloride	: CGY.
Oxyphenbutazone	: MGN.
Phenacetin	: CGY.
Phenylbutazone	: GAN.
Potassium aminobenzoate	: GAN, RLS.
Propoxyphene hydrochloride	: GAN.
Sodium aminobenzoate	: MRK.
Sulindac	: MRK.
* ANTI CONVULSANTS, HYPNOTICS, AND SEDATIVES:	
ANTICONSULSANTS (EXCEPT BARBITURATES):	
Ethosuximide	: PD.
Ethotoin	: ABB.
Methsuximide	: PD.
Phensuximide	: PD.
Phenytoin, sodium	: PD.
Anticovulsants (Except barbiturates), all other	: CGY.
BARBITURATES:	
Amobarbital	: GAN, LIL.
Amobarbital, sodium	: GAN.
Barbital	: GAN.
Barbital, sodium	: GAN.
Butabarbital	: ABB, GAN.
Butabarbital, sodium	: ABB, GAN.
Etalbarbital	: GAN.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*CENTRAL DEPRESSANTS AND STIMULANTS--Continued	
*ANCIQONVULSANTS, HYPNOTICS, AND SEDATIVES--Continued	
BARBITURATES--Continued	
Butalbital, sodium	: GAN.
Hexobarbital	: GAN.
Mephobarbital	: SDM.
Methohexital, sodium	: LIL.
Pentobarbital	: ABB, GAN.
Pentobarbital, sodium	: ABB, GAN.
Phenobarbital	: GAN.
Phenobarbital, sodium	: GAN.
Secobarbital	: GAN.
Talbutal	: SDM.
Thiaylal, sodium	: PD.
Thiopental, sodium	: ABB.
HYPNOTICS AND SEDATIVES (EXCEPT BARBITURATES):	
Carbromal	: PD.
Ethchlorvynol	: ABB.
Ethinamate	: LIL.
Flurazepam hydrochloride	: HCF.
Glutethimide	: BKL, CGY, GAN.
Methaqualone	: X.
Methaqualone hydrochloride	: X.
Methyprylon	: HOP.
Thichloral, sodium	: LIL.
PSYCHOPRESSANTS	
*ANALGESICS	
Asitriptiline hydrochloride	: MRK, PD.
Desipramine hydrochloride	: LKL.
Toxepin hydrochloride	: PFZ, SK.
Imipramine hydrochloride	: CGY.
Nortriptyline	: LIL.
*TRANQUILIZERS:	
PHENOTHIAZINE DERIVATIVES:	
Acetophenazine maleate	: SCB.
Chlorpromazine hydrochloride	: SK.
Fluphenazine hydrochloride	: OMS, SCH.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*CENTRAL DEPRESSANTS AND STIMULANTS--Continued	
PSYCHOTROPIC AGENTS--Continued	
*TRANQUILIZERS--Continued	
PHENOTHIAZINE DERIVATIVES--Continued	
Perphenazine	SCH.
Prochlorperazine edisylate	SK.
Prochlorperazine maleate	SK.
Promazine hydrochloride	WYT.
Prothazine hydrochloride	WIT.
Trifluoperazine hydrochloride	SK.
OTHER TRANQUILIZERS:	
Meclozine hydrochloride	PFZ.
Chlorazepoxide hydrochloride	HCF, PD.
Chlorthalidone	DDV.
Clonazepam	ABB.
Diazepam	HOP.
Ethoxybutamoxane	LIL.
Hydroxyzine hydrochloride	PFZ.
Hydroxyzine pamoate	PFZ.
Meprobarbital	BKI.
Molindone hydrochloride	X.
Oxazepam	WYT.
Theohivene hydrochloride	PFZ.
*OTHER CENTRAL DEPRESSANTS AND STIMULANTS:	
AMPHETAMINES:	
Amphetamine (Racemic)	ARN, SK.
Amphetamine sulfate (Racemic)	ARN, SK.
Dextroamphetamine	ARN, SK.
Dextroamphetamine sulfate	ARN, SK.
Methamphetamine (Levo)	ARN.
Methamphetamine hydrochloride (Dextro)	ARN.
Amphetamine, all other	ARN.
*ANTIEMETICS:	
Benzonate	CGY.
Carambiphen edisylate	SK.
Carbetapentane Citrate	PFZ.
Codeine	HRK, PEN.
Dextroethorphan hydrobromide	ROP.
Ethylmorphine hydrochloride	HRK.
Hydrocodone bitartrate	WAL, HRK, PEN.



TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*CENTRAL DEPRESSANTS AND STIMULANTS--Continued	
*OTHER CENTRAL DEPRESSANTS AND STIMULANTS--Continued	
*ANTIEMETICS--Continued	
Noscapine	MRK.
Thebaine	MRK, PEN.
GENERAL ANESTHETICS:	
Ketamine hydrochloride	PD.
RESPIRATORY AND CEREBRAL STIMULANTS:	
Benzphetamine hydrochloride	UPJ.
Caffeine, citrated	MAL.
Caffeine, natural	CPR, GNF.
Caffeine, synthetic	PFZ.
Deanol acetamidobenzoate	R.K.
Methypropion hydrochloride	BRC, GAN.
Methylphenidate hydrochloride	BRC.
Mkethamide	CGY.
Phendimetrazine	CGY.
Phendimetrazine tartrate	GAN.
Pentobarbital	HEA.
*SKELETAL MUSCLE RELAXANTS:	
Chlorfodol	BKL.
Chlorfodol	UPJ.
Chlorhexin carbamate	MRK.
Cyclobenzaprine hydrochloride	HEK, PEN.
Methocarbamol	ABB, BUR.
Succinylcholine chloride	ABB.
Tubocurarine	ABB.
*DERMATOLOGICAL AGENTS AND LOCAL ANESTHETICS:	
DERMATOLOGICAL AGENTS:	
Allantoin	HFT.
Aluminum phenolsulfonate	SAL.
Asonium phenolsulfonate	SAL.
Bismuth subgallate	MAL, PEN.
Glycol salicylate	RDA.
Podophyllum resin	PEN.
Salicylic acid	DOW.
Sodium phenolsulfonate	SAL.
Zinc phenolsulfonate	MAL, SAL.
LOCAL ANESTHETICS:	
Cocaine	MRK.
Dibucaine	CGY.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS, IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*DERMATOLOGICAL AGENTS AND LOCAL ANESTHETICS--Continued	
LOCAL ANESTHETICS--Continued	
Dibucaine hydrochloride	CGI.
Dyclonine hydrochloride	BJL.
Ethyl aminobenzoate (Benzocaine)	PD.
*Isobutyl aminobenzoate	ASA.
*Lidocaine (diethylaminoacetoxylidide)	SLI, LEH, HLS, SDH.
Lidocaine hydrochloride	ABM, WYT.
Omethazine	SDM.
Phenacaine hydrochloride	ABR.
Prilocaine hydrochloride	ABR.
Procaine hydrochloride	ABR, PPZ.
Tetracaine hydrochloride	OMS.
Tetracaine hydrochloride	SDM.
*EXPECTORANTS AND MUCOLYTIC AGENTS:	
*Ethylene diamine dihydroiodide	HPT, MAL, WAG, WHL.
Guaiacol	PEN.
Iodinated glycerol	GAN, HEX, PEN.
Potassium guaiacolsulfonate	X.
*HEMATOLOGICAL AGENTS:	
Amonium heparin	RIK, WIL.
Anisindione	SCH.
Cellulose, oxidized	EKT.
Dextran (Plasma expander)	PHR.
Diphenadione	UPJ.
Lithium heparin	ABB, RIK, WIL.
Potassium warfarin	ASA.
*Sodium heparin	ABB, RIK, SPR, WIL.
Sodium warfarin	PEN.
Warfarin	SDM.
*HORMONES AND SYNTHETIC SUBSTITUTES:	
ANABOLIC AGENTS AND ANDROGENS:	
Fluoxymesterone	UPJ.
Testosterone cypionate	UPJ.
Zeranol	PFC.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*HORMONES AND SYNTHETIC SUBSTITUTES--Continued	
CORTICOSTEROIDS:	
Betamethasone	SCH.
Betamethasone dipropionate	SCH.
Betamethasone sodium phosphate	SCH.
Betamethasone valerate	SCH.
Cortisone	UPJ.
Cortisone acetate	UPJ.
Dexamethasone	MRK, SCH.
Dexamethasone sodium phosphate	MRK
Fludrocortisone acetate	UPJ.
Fluorometholone	UPJ.
9- $\alpha$ -Fluoroprednisolone acetate	UPJ.
Fluprednisolone	UPJ.
Halcinonide	TRD.
Hydrocortisone	UPJ.
Hydrocortisone acetate	UPJ.
Medrysone	UPJ.
Methylprednisolone	UPJ.
Prednisolone	UPJ.
Prednisolone acetate	UPJ.
Prednisone	UPJ.
Triamcinolone	TRD, X.
Triamcinolone acetonide	OMS, TRD.
Triamcinolone diacetate	TRD.
ESTROGENS AND PROGESTOGENS:	
Chlortrianiisene	BKC.
Diethylstilbestrol	DLI.
Diethylstilbestrol diposphate	ARA.
Estradiol cypionate	UPJ.
Estrogenic substances, conjugated	ORG.
Estrogenic substances	ORG.
PROGESTOGENS:	
Dibutyltinone	X.
Hydroxyprogesterone caproate	UPJ.
Methoxyprogesterone acetate	UPJ.
Megestrol acetate	UPJ.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*HORMONES AND SYNTHETIC SUBSTITUTES--Continued	
ESTROGENS AND PROGESTOGENS--Continued	
PROGESTOGENS--Continued	
Melenestrol acetate	: U.F.J.
Norethindrone acetate	: PD.
Norgestrel	: WY.
Progesterone	: U.F.J.
*SYNTHETIC HYPGLYCEMIC AGENTS:	
Acetohexamide	: LIL
Chlorpropamide	: LIL
Phenpropamide	: PFZ.
Tolazamide	: CBI.
Tolbutamide	: U.F.J.
Tolbutamide	: U.F.J.
THYROID HORMONE AND ANTITHYROID AGENTS:	
Methimazole	: LIL
Propylthiouracil	: ABA.
2-Thiouracil	: ACY.
Thyroglobulin	: NFP.
Thyroid	: LIL.
OTHER HORMONES AND SYNTHETIC SUBSTITUTES:	
Corticotropin	: ARP.
Damazol (pituitary)	: SDW.
Epinephrine bitartrate	: SDW.
Glucagon	: LIL.
Insulin	: ARP.
Insulin (Levo), sodium (thyroid hormone)	: BAY.
*RENAL-ACTING AND EDEMA-REDUCING AGENTS:	
BENZOTHIADIAZINE DERIVATIVES:	
Benzthiazide	: PFZ.
Chlorothiazide	: MBK.
Hydrochlorothiazide	: ABB.
Hydroflumethiazide	: X.
Methylclothiazide	: ABB.
Polythiazide	: PFZ.
Ticloflumethiazide	: SCH.
*THEOPHYLLINE AND THEOPHYLLINE DERIVATIVES:	
Aminophylline	: GAN.
Oxtriphylline	: NFP.
Theophylline sodium glycinate	: CHT.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*RENAL-ACTING AND EDEMA-REDUCING AGENTS--Continued	
OTHER RENAL-ACTING AND EDEMA-REDUCING AGENTS:	
Acetazolamide--	ACY,
Amloride--	MRK,
Dichlorphenamide--	MRK,
Ethacrynic acid--	MRK,
Frobenecid--	MRK,
Spironolactone--	SRL,
Triasterene--	ACY, SK,
*VITAMINS:	
VITAMIN A:	
B-Carotene (Provitamin A)--	HOF,
Tretinoin (Vitamin A acid)--	EK, HOF,
Vitamin A acetate (Animal feed grade)--	HCK,
Vitamin A acetate (Medicinal grade)--	HOF,
Vitamin A alcohol--	EK, HOF,
Vitamin A palmitate (Animal feed grade)--	HOF,
Vitamin A palmitate (Medicinal grade)--	HOF,
Vitamin A propionate (Animal feed grade)--	HOF,
VITAMIN B-COMPLEX:	
NICOTINIC ACID AND DERIVATIVES:	
Nicacin (Nicotinic acid) (Animal feed grade)--	MRK, NEP, RIL,
Nicacin (Nicotinic acid) (Medicinal grade)--	MRK, RIL,
Nicotinamide (Nicotinamide)--	MRK, NEP, RIL,
PANTOTHENIC ACID AND DERIVATIVES:	
Calcium pantothenate (Racemic) (Animal feed grade)	HFT,
Calcium pantothenate (Racemic) (Medicinal grade)	HFT,
Calcium pantothenate (Racemic) - calcium chloride	
Dexpanthenol (Animal feed grade)--	HFT,
Dexpanthenol (Racemic)--	HOF,
Panthenol (Racemic)--	HOF, PD,
Sodium pantothenate--	PD,
OTHER B-COMPLEX VITAMINS:	
Biotin--	HOF,
Cyanocobalamin (Animal feed grade)	MRK,
Cyanocobalamin (Medicinal grade)	MRK,
Cyanocobalamin (U.S.P. Crystalline)--	MRK,

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*VITAMINS--Continued	
VITAMIN B-COMPLEX--Continued	
OTHER B-COMPLEX VITAMINS--Continued	
Inositol	STA.
Pyridoxine	HOP.
Riboflavin (Medicinal grade)	HOP, MRK.
Riboflavin (feed grade)	HOP, MRK.
Riboflavin-5-phosphate, sodium	HCF.
Thiamine hydrochloride	HOF.
Thiamine mononitrate	HOP.
VITAMIN C:	
Ascorbic acid	HOP, PFZ.
Calcium ascorbate	PFZ.
Sodium ascorbate	HOP, PFZ.
*VITAMIN D:	
Cholecalciferol (Vitamin D <sub>3</sub> )	DA, ICH, VTH.
*VITAMIN E:	
d- $\alpha$ Tocopherol	EKT, GNM.
dl- $\alpha$ Tocopherol	HOF.
d- $\alpha$ Tocopheryl acetate	EKT, GNM.
dl- $\alpha$ Tocopheryl acetate (feed grade)	DA, GBT, HCF.
d- $\alpha$ Tocopheryl acetate (Medicinal grade)	GNH, HOF.
d- $\alpha$ Tocopheryl acid succinate	EKT, GNM.
VITAMIN K:	
Menadiolone sodium bisulfite	ABE, HET, HFT.
Phytonadione	RRF.
OTHER MEDICINAL CHEMICALS:	
ANTIEMETIC AGENTS:	
Azathioprine	BUR.
O-Araucidine	PD.
Cisapride	UPJ.
Clastidine	UPJ.
Morapromazine	BUR.
Methotrexate	PFN.
Symptocin	PFN, DPJ.
Vinblastine sulfate	LIL.
Vincristine sulfate	LIL.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
OTHER MEDICINAL CHEMICALS--Continued	
CARDIOVASCULAR AGENTS:	
ANTIHYPERTENSIVE AGENTS:	
Diazoxide	SCB.
Guanethidine sulfate	CGF.
Hydralazine hydrochloride	CGF.
Methyldopa	MRK.
Prazosin hydrochloride	PFZ.
Rauwolfia serpentina	PEW.
Reserpine	PEW.
BIOFLAVONOIDS:	
Hesperidin	SKG.
Lemon bioflavonoid complex	SKG.
Naringin	SKG.
VASODILATORS:	
Amyl nitrite	MAL.
Dioxyline phosphate	LIL.
Nicotyl alcohol tartrate	HOF.
OTHER CARDIOVASCULAR AGENTS:	
Disopyramide	SRL.
Procaineamide hydrochloride	OMS, PD.
DIAGNOSTIC AGENTS:	
ROENTGENOGRAPHIC CONTRAST MEDIA:	
Diatrizoate, meglumine	SDW.
Diatrizoate, sodium	SDW.
Iodipamide, meglumine	OMS.
Iodipamide, sodium	OMS.
Iodohippurate, sodium	OMS.
Iopanoic acid	SDW.
Iothalamate, meglumine	MAL.
Iothalamate, sodium	MAL.
Iothalamic acid	MAL.
Methiodal, sodium	SDW.
Tyropanoate, sodium	SDW.
ROENTGENOGRAPHIC CONTRAST MEDIA, all other	OMS.
OTHER DIAGNOSTIC AGENTS:	
Benzocaine hydrochloride (gastric secretion indicator)	LIL.
Indocyanine green (cardiac output test)	EK.

TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*OTHER MEDICINAL CHEMICALS--Continued	
DIAGNOSTIC AGENTS--Continued	
OTHER DIAGNOSTIC AGENTS--Continued	
Inulin (kidney function test) - - - - -	PFN.
Metyrapone (pituitary function test) - - - - -	CGY.
Phenolsulfonphthalein (kidney function test) - - - - -	HYN.
Xylose (intestinal malabsorption test) - - - - -	PFN.
GASTROINTESTINAL AGENTS AND THERAPEUTIC NUTRIENTS:	
GASTROINTESTINAL AGENTS:	
*CHOLINE CHLORIDE (ALL GRADES):	
Choline chloride (Animal feed grade) - - - - -	DA, DON, HPT, IMC, TMH.
Choline chloride (Medicinal grade) - - - - -	HFT.
OTHER GASTROINTESTINAL AGENTS:	
Apoorphane hydrochloride - - - - -	MR.
Betaine hydrochloride - - - - -	HFT.
Bile acids, oxidized - - - - -	SRL, WIL.
Biscodyl - - - - -	PD.
Choline bicarbonate - - - - -	IEC.
Choline bitartrate - - - - -	HFT.
Choline citrate (Tricholine citrate) - - - - -	HFT.
Choline hydrogen citrate - - - - -	HFT.
Colistipol hydrochloride - - - - -	AL.
Dehydrocholic acid - - - - -	WIL.
Ethacrynic acid, sodium - - - - -	SRL.
Floratol salts - - - - -	WIL.
Iron bile salts - - - - -	WIL.
Magnesium citrate - - - - -	MAI.
Metionine hydroxy analogue, calcium salt - - - - -	DUP, MON.
Ox bile extract - - - - -	ABB, WIL.
Pectin - - - - -	SKG.
Phenolphthalein - - - - -	SCH.
Sitosterols - - - - -	UPJ.
Sodium dehydrocholate - - - - -	WIL.
Sodium tartrate - - - - -	MAI.
THERAPEUTIC NUTRIENTS:	
AMINO ACIDS AND SALTS:	
Amino acid mixtures - - - - -	BBS, CHI, MDJ.
Glutaamic acid - - - - -	LEM.



TABLE 2.--MEDICINAL CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

MEDICINAL CHEMICALS  
 MANUFACTURERS' IDENTIFICATION CODES  
 (ACCORDING TO LIST IN TABLE 3)

\*OTHER MEDICINAL CHEMICALS--Continued  
 GASTROINTESTINAL AGENTS AND THERAPEUTIC NUTRIENTS--Con.  
 THERAPEUTIC NUTRIENTS--Continued  
 AMINO ACIDS AND SALTS--Continued  
 Glutamic acid hydrochloride-- LEM.  
 Potassium glutamate-- LEM.  
 Tyrosine-- BRS, MDJ.  
 OTHER THERAPEUTIC NUTRIENTS:  
 Calcium gluceptate-- PFN.  
 Calcium glucoheptonate-- PFN.  
 Copper gluconate-- PFZ.  
 Ferrous gluconate-- PFZ, SDW.  
 Magnesium gluconate-- PFZ.  
 Manganese gluconate-- PFZ.  
 Potassium gluconate-- PFZ.  
 Tolidinos, sodium-- RSM.  
 Zinc glucoheptonate-- PFN.  
 Zinc gluconate-- PFZ.  
 SMOOTH MUSCLE RELAXANTS:  
 Alverine citrate-- AR4.  
 Alverine hydrochloride-- AR4.  
 Flavoxate hydrochloride-- SK.  
 Papaverine hydrochloride-- LIL.  
 UNCLASSIFIED MEDICINAL CHEMICALS:  
 Allopurinol-- BUR.  
 Carbidoqa-- MRK.  
 Dopamine hydrochloride-- SDW.  
 Ethorazolamide (Carbonic anhydrase inhibitor)-- AR4.

TABLE 3.--MEDICINAL CHEMICALS: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of medicinal chemicals to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
ABB	Abbott Laboratories	MAL	Mallinckrodt Chemical Works
ACY	American Cyanamid Co.	MDJ	Mead Johnson & Co.
ADC	Anderson Development Co.	MLS	Miles Laboratories, Inc. Sumner Div.
ARA	Arapahoe Chemicals, Inc. Sub/Syntex Corp., (U.S.A.)	MON	Monsanto Co.
ARN	Arenol Chemical Corp.	MRK	Merck & Co., Inc.
ARP	Armour Pharmaceutical Co.	NEP	Nepera Chemical Co., Inc.
ARS	Arsynco, Inc.	NOR	Morton-Norwich Products, Inc., Norwich Eaton Pharmaceutical Div.
ASH	Ashland Oil, Inc., Ashland Chemical Co.	NTL	NL Industries, Inc.
AST	Astra Pharmaceutical Products, Inc.	OMS	E.R. Squibb & Sons, Inc.
BAX	Baxter/Travenol Laboratories, Inc.	OPC	Orbis Products Corp.
BEE	Beecham, Inc.	ORG	Organics, Inc.
BJL	Burdick & Jackson Laboratories, Inc.	ORT	Roehr Chemicals, Inc.
BKC	J.T. Baker Chemical Co.	PD	Parke, Davis & Co. Sub of Warner-Lambert Co.
BKL	Kewanee Industries, Inc., Millmaster Chemical Co. Div.	PEN	CPC International, Inc., Penick Corp.
BOC	Biocraft Laboratories, Inc.	PFN	Pfanzstiel Laboratories, Inc.
BRS	Bristol-Myers Co.	PFZ	Pfizer, Inc. and Pfizer Pharmaceuticals, Inc.
BUR	Burroughs-Wellcome Co.	PHR	Pharmachem Corp.
CGY	Ciba-Geigy Corp. and Ciba Pharmaceutical Co.	RDA	Rhodia, Inc.
CHT	Chatten Drug & Chemical Co.	RIK	Riker Laboratories, Inc. Sub. of 3M Co.
CPR	Certified Processing Corp.	RIL	Reilly Tar & Chemical Corp.
DA	Diamond Shamrock Corp.	RLS	Rachelle Laboratories, Inc.
DLI	Dawe's Laboratories, Inc.	RSA	R.S.A. Corp.
DOW	Dow Chemical Co.	SAL	Salsbury Laboratories
DUP	E.I. duPont de Nemours & Co., Inc.	SCH	Schering Corp. Sterling Drug Corp.:
EK	Eastman Kodak Co.:	SDC	Glenbrook Laboratories Div.
EKT	Tennessee Eastman Co. Div.	SDW	Winthrop Laboratories Div.
EN	Endo Laboratories, Inc.	SFS	Stauffer Chemical Co., Specialty Div.
FIN	Hexcel Corp., Hexcel Specialty Chemicals	SHC	Shell Oil Co., Shell Chemical Co. Div.
FLM	Fleming Laboratories, Inc.	SK	SmithKline Chemicals
GAF	GAF Corp.	SKG	Sunkist Growers, Inc.
GAN	Game's Chemical Inc.	SFR	Scientific Protein Laboratories, Inc.
GIV	Givaudan Corp.	SRL	G.D. Searle & Co.
GNF	General Foods Corp., Maxwell House Div.	STA	A.E. Staley Manufacturing Co.
GNM	General Mills Chemicals, Inc.	THH	Thompson-Hayward Chemical Co.
HET	Heterochemical Corp.	TNA	Ethyl Corp.
HEX	Hexagon Laboratories, Inc.	TRD	Manufacturing Enterprises, Inc., Squibb Manufacturing Inc., Trade Enterprises, Inc., Ersana, Inc.
HFT	Syntex Agribusiness, Inc.	UPJ	Upjohn Co.
HW	Temaco Chemicals, Inc.	VTM	Vitamins, Inc.
HOF	Hoffmann-LaRoche, Inc.	WAG	West Agro-Chemicals, Inc.
HYN	Hynson, Westcott & Dunning, Inc.	WHL	Whitmoyer Laboratories, Inc.
IMC	IMC Chemical Group, Inc.	WIL	Incolex Corp., Incolex Pharmaceutical Div.
JCC	Jefferson Chemical Co., Inc.	WTL	Pennwalt Corp., Lucidol Div.
KPT	Koppers Co., Inc.	WYT	Wyeth Laboratories, Inc., Wyeth Laboratories Div. of American Home Products Corp.
LEM	Napp Chemicals, Inc.		
LLL	Eli Lilly & Co.		
LKL	Richardson-Merrell, Inc., Merrell-National Laboratories Div.		

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.

## The Flavor and Perfume Chemical Industry - an Overview

Anne Klein

The flavor and perfume<sup>1</sup> chemicals considered here are important as raw materials in the production of food flavors, perfumery, cosmetics, and toiletries. Important flavor and perfume products not included here are flavor and perfume oil blends, and "synthetic essential oils" which are artificial mixtures.

U.S. production, sales, and consumption

Production of flavor and perfume chemicals in the United States in 1977 continued its significant annual rate of growth begun the previous year as it recovered from the depressed level of 1975. Production by domestic firms increased to 150.4 million pounds, valued at an estimated \$290.3 million,<sup>2</sup> an increase over 1976 of 16.8 percent and 28.1 percent, respectively.

In 1977, acyclic compounds constituted 61.2 percent of total output of flavor and perfume chemicals, benzenoid cyclic, 30.9 percent, and other cyclic, 7.9 percent.<sup>3</sup> Based on value of sales the top ranking single chemical in 1977, as in 1976 and 1975, was monosodium glutamate (MSG). Following MSG in value of sales were vanillin, saccharin, anethole, methyl salicylate, and coumarin. The aggregate value of shipments of these chemicals amounted to \$84.3 million or 40.7 percent of the total.

MSG is the leading flavor enhancer. Vanillin is one of the most widely used chemicals, both in perfume formulations and in flavors. Saccharin remains the only artificial sweetener whose use is permitted in the United States. P-propenylanisole (anethole) is extensively used in low-cost fragrances, particularly in soap and household products, and in flavor compositions for chewing gums and anisette-type alcoholic beverages. Methyl salicylate has long had diverse large volume uses varying from an industrial masking odor to a popular chemical flavoring agent for candy and soft drinks. Coumarin has long been extensively used in perfumery and as a masking agent.

U.S. apparent consumption<sup>4</sup> of flavor and aroma chemicals in 1977 increased by 22.9 percent over the level in 1976 to about 159 million pounds. MSG consumption, which rose, slightly, accounted again in 1977, as in 1976, for a significant share of the total consumption of all flavor and perfume chemicals. The following factors suggest that the rise in demand for flavor and aroma chemicals will continue, although slower than the rise from 1976 to 1977.

---

<sup>1</sup> Also known as aroma chemicals; the terms "perfume," "fragrance," and "aroma" are used interchangeably here.

<sup>2</sup> The value of production is estimated by applying the unit value of sales to quantity of production.

<sup>3</sup> The benzenoid, other cyclic, and acyclic breakdowns of the flavor and aroma chemicals tables accommodate tariff classification requirements rather than industry practices.

<sup>4</sup> Apparent consumption is estimated here by adding U.S. imports to and subtracting U.S. exports from U.S. production.

<sup>o</sup>Observable changing tastes among both men and women purchasers of toiletries, according to an industry periodical,<sup>1</sup> may have important and differing implications for sales of toiletries in the next several years. These changing tastes may have secondary implications for aroma chemicals as raw materials for these products. There is an expected growth of demand, the industry believes, in the so-called "treatment cosmetics," for women, or products that cleanse and moisturize the skin. On the other hand, significant growth of demand is not expected for fragrances for women, which are believed to have reached a plateau. The industry believes, however, that the demand for men's toiletries, particularly fragrances, is rapidly rising. According to an industry educational group,<sup>2</sup> retail sales of men's fragrances in 1976 amounted to \$650 million and in 1977 exceeded \$800 million. The group believes that the accelerated growth of demand for men's fragrances which began in 1976, will reach 10 to 12 percent annually through 1983.

<sup>o</sup>There continues to be, particularly in perfume bases, a public acceptance of the substitution of aroma chemicals for natural oils which are subject to high prices and/or supply problems. This acceptance would tend to enhance consumption of synthetic aroma chemicals considered here.

<sup>o</sup>U.S. disposable personal incomes in terms of constant 1972 dollars increased by about 25 percent during the 1970-77 period.<sup>3</sup> This pattern will probably continue through the 1978-83 period. Increased disposable income for individuals and families tends to increase their consumption of prepared food, cosmetics, and toilet preparations--products in which flavor and aroma chemicals are raw materials.

#### International trade

Because of the traditionally international orientation of the flavor and aroma chemical industry and the relatively low freight costs for the products, foreign trade is relatively important for flavor and fragrance chemicals. In 1977, imports, for example, represented about 25.8 percent of U.S. apparent consumption while exports amounted to 20.5 percent of U.S. production.

---

<sup>1</sup> Chemical Marketing Reporter, June 26, 1978.

<sup>2</sup> The Fragrance Foundation of New York, NY.

<sup>3</sup> Based on official statistics of the Bureau of Economic Analysis, U.S. Department of Commerce.

Imports.--Imports of all natural and synthetic flavor and aroma chemicals in 1977 amounted to 34.6 million pounds, valued at \$81.6 million--32 percent in terms of quantity and 24 percent in terms of value over the 1976 level. Imports of monosodium glutamate, principally from Korea, Japan, and Taiwan, alone amounted to 18 million pounds, valued at \$9.6 million.

Other flavor and aroma chemicals imported during 1977 in significant quantities were vanillin, saccharin, and menthol. These items came principally from Canada, Japan, and Brazil.

In 1977, the sole domestic producer of saccharin filed a complaint that imports of saccharin from Japan and the Republic of Korea were allegedly being dumped in the United States and causing injury to the U.S. saccharin industry. In December 1977, the U.S. International Trade Commission reported its negative findings in this case to the Secretary of the Treasury in connection with Investigation Nos. AA-1921-174 and 175.

Exports.--Exports amounted to 26 million pounds valued at \$52 million, a slight increase over 1976 both in terms of quantity and value. The negative trade balance observed for most years during 1970-76 was again observed in 1977. The ratio of exports to imports was 74.2 percent in 1977, showing a further steep decline of this ratio when compared with the 1976 level of 96.7 percent. There has been no evidence that the multinational orientation of the principal firms of this industry will change in the next several years. These firms typically tend to import aroma chemicals from their foreign affiliates rather than initiate production in the United States when it is mere cost-efficient to do so. One can thus anticipate a continuation of this negative balance of trade into the early 1980's for the flavor and aroma chemical industry.

### The industry

The traditionally international orientation of the flavor and aroma chemical industry will probably continue. Of all companies reporting sales of aroma chemicals to the Commission in 1977, those companies having affiliates in one to four foreign countries accounted for about 42 percent of the total sales value of these products and were represented among the top members of the flavor and aroma chemical industry when ranked by sales values. During early 1978, Haarman and Reimer of West Germany, which maintains operations in 13 countries, and whose total sales annually exceed \$130 million, has opened a new production facility in Bushy Park, S.C., for the manufacture of synthetic menthol.

The concentration profile of producers of flavor and perfume chemicals changed to a small extent in 1977 from that observed in 1976. In 1977, the four largest companies in terms of value of sales together accounted for 43 percent of total sales value compared with 49 percent in 1976. In 1977, 14 companies accounted for almost 75 percent of total sales value; in 1976, that share was accounted for by 9 companies.

Regulation--an update

The flavor and perfume chemicals included here are widely used in food products or in cosmetics and toiletries. The regulation of these chemicals continues to be more important when an ingredient is used in foods than in cosmetics. Labeling requirements by the FDA, begun in 1976, have been in place since the beginning of 1977. These Federal regulations require that cosmetic containers must include on their labels, in addition to the name and address of the manufacturer, packer, or distributor, and net quantity of contents, a list of ingredients in descending order of predominance. Fragrance and flavor ingredients may be listed as such.

The flavor enhancer monosodium glutamate, which early in the decade (1970) had been removed by the Food and Drug Administration (FDA) from baby foods but not from its Generally Regarded as Safe (GRAS) list, has been produced and consumed during the decade in increasing quantities. Consumption of MSG in the United States, is estimated to have reached 56 million pounds in 1977. The industry estimates that demand for MSG in 1978 amounted to nearly 60 million pounds.<sup>1</sup>

During 1978 it became mandatory for stores selling products containing saccharin to display a poster warning of health hazards inherent in using saccharin-containing products, as required by the FDA.

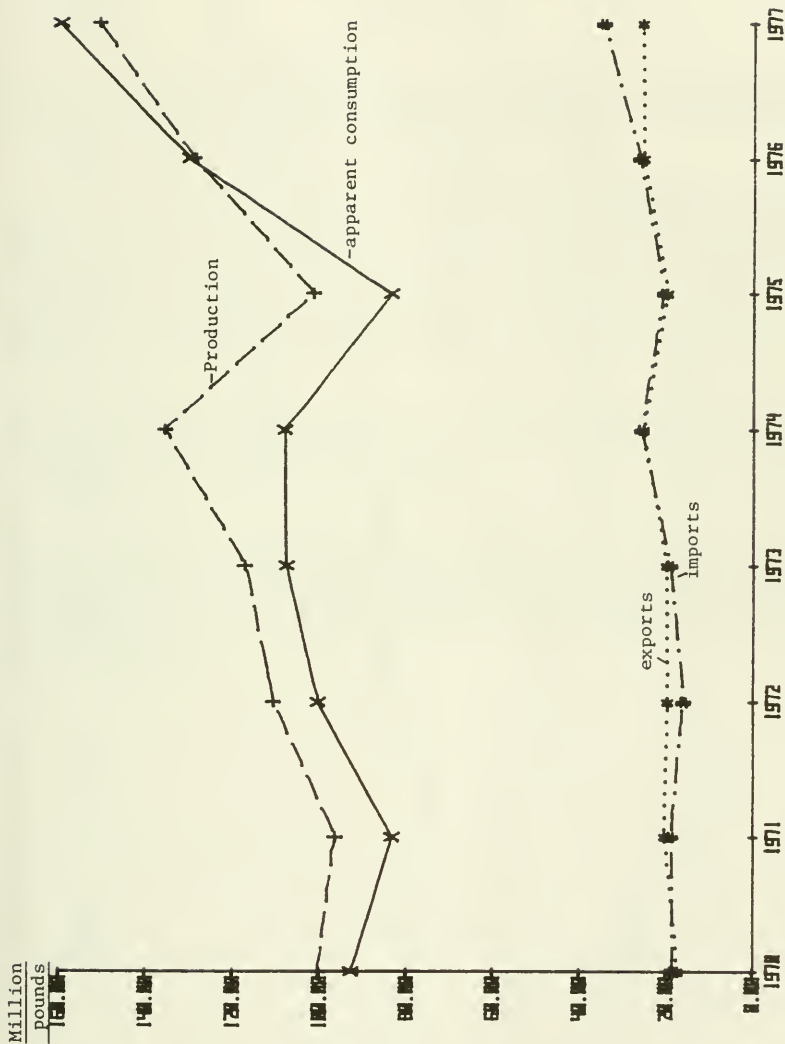
The Cosmetic, Toiletry, and Fragrance Association, a trade association comprised of more than 90 members, has expanded work in 1977 on its intra-industry Cosmetic Ingredient Review which would review the safety of some 2700 ingredients in products which are applied to the eyes or to the skin. The industry believes that initiatives on its part will probably tend to retard any government regulation initiatives in this area during the next few years.

Regulation has traditionally been minimal in the home markets of our principal trading partners. Actions by governments increasing regulation have been rare. In Canada, cosmetic containers are subject to labeling requirements of the Consumers' Packaging and Labelling Act and Regulations. This probably has negligible affect on U.S. trade with Canada which produces 96 percent of all cosmetic products consumed by Canadians. In Japan, cosmetics, along with drugs, "quasidrugs" and medical devices are controlled with respect to sale, labeling, and advertisement by the Pharmaceutical Affairs Law of Japan. In West Germany as in other countries of the European Community a Cosmetic Directive is in effect which contains a list of "generally prohibited substances" and a list of substances allowed but to a restricted extent. These 35 or 40 agents are generally regarded, in most countries including the United States, as poisonous or damaging to health.

---

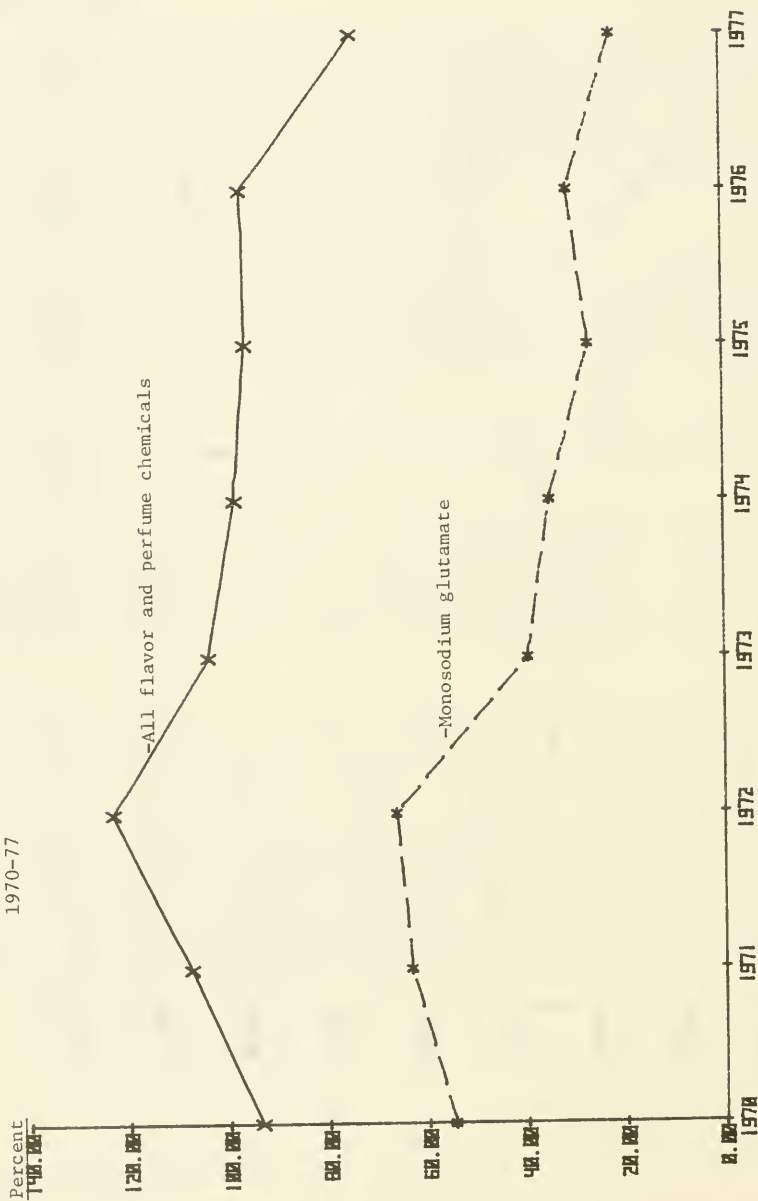
<sup>1</sup> Chemical Marketing Reporter, July 31, 1978.

Flavor and perfume chemicals: U.S. production, imports, exports, and apparent consumption, 1970-77



Source: Production, compiled from official statistics of the U.S. International Trade Commission; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Flavor and perfume chemicals and monosodium glutamate: U.S. balance of trade as a ratio of quantity of exports to quantity of imports, 1970-77



Source: Compiled from official statistics of the U.S. Department of Commerce.



## FLAVOR AND PERFUME MATERIALS

Anne Klein

Flavor and perfume materials are organic chemicals used to impart flavors and aromas to foods, beverages, cosmetics, and soaps. These aroma chemicals are also utilized to neutralize or mask unpleasant odors in industrial processes and products as well as in consumer products.

Total domestic production of flavor and perfume materials in 1977 amounted to 150.4 million pounds (table 1). Sales of these materials in 1977 amounted to 107.6 million pounds, valued at \$207.1 million, compared with 110.9 million pounds, valued at \$195.3 million, in 1976. These totals do not include benzyl alcohol, which, before 1973, was included in flavor and perfume materials but is now shown in the miscellaneous cyclic section of this series. U.S. production of flavor and perfume materials in 1977 increased 16.8 percent from the level in 1976 but the quantity of sales decreased slightly, by 3 percent.

Production of cyclic flavor and perfume materials in 1977 amounted to 58.5 million pounds; sales amounted to 46.8 million pounds, valued at \$134.6 million. Individual publishable chemicals in the cyclic group produced in the greatest volume in 1977 were  $\alpha$ -terpineol, anethole, cinnamaldehyde, benzyl acetate, and isopentyl salicylate.

U.S. output of acyclic flavor and perfume materials in 1977 amounted to 92.0 million pounds; sales of these materials amounted to 60.8 million pounds, valued at \$72.5 million. Monosodium glutamate was by far the most important of the acyclic chemicals in 1976, although the data are not publishable. Other important acyclic compounds included linalyl alcohol, citronellol, and hydroxycitronellal.



TABLE 1.--FLAVOR AND PERFUME MATERIALS: U.S. PRODUCTION AND SALES, 1977

[Listed below are all synthetic organic flavor and perfume materials for which any reported data on production or sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists separately all flavor and perfume materials for which data on production and/or sales were reported and identifies the manufacturers of each]

FLAVOR AND PERFUME MATERIALS	SALES			
	PRODUCTION	QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	150,416	107,565	207,101	\$1.93
CYCLIC				
Total-----	58,452	46,809	134,628	2.88
<i>Benzenoid and Naphthalenoid</i>				
Total-----	46,491	37,970	106,617	2.81
4-Allyl-2-methoxyphenol (Eugenol)-----	299	277	1,188	4.30
4-Allyl-2-methoxyphenol acetate-----	4	7	34	5.02
Anisyl acetate-----	...	4	27	6.31
Benzophenone <sup>2</sup> -----	973	569	1,112	1.95
Benzyl acetate-----	1,542	1,396	1,370	.98
Benzyl benzoate-----	...	725	643	.89
Benzyl propionate-----	28	26	45	1.71
Cinnamaldehyde-----	2,010	1,219	1,634	1.34
Cinnamyl acetate-----	32	14	70	4.92
Cinnamyl anthranilate-----	...	1	20	18.85
Cinnamyl propionate-----	...	3	16	6.17
2-Ethylhexyl salicylate-----	...	69	130	1.87
Isobutyl phenylacetate-----	...	23	55	2.39
Isobutyl salicylate-----	...	10	19	1.83
Isopentyl salicylate-----	1,052	796	958	1.20
4'-Methoxyacetophenone-----	22	...	...	...
2-Methoxy-4-propenylphenol (Isoeugenol)-----	127	130	896	6.89
p-Methylanisole-----	23	25	50	2.01
Methyl anthranilate-----	...	223	401	1.80
α-Methylcinnamaldehyde-----	...	7	16	2.33
Methyl phenylacetate-----	28	...	...	...
2-Phenethyl phenylacetate-----	30	15	70	4.73
Phenethyl propionate-----	22	...	...	...
3-Phenyl-1-propanol (Hydrocinnamic alcohol)-----	52	...	...	...
3-Phenylpropyl acetate-----	7	...	...	...
p-Propenylanisole (Anethole)-----	2,423	2,310	8,603	3.72
p-Tolaldehyde-----	28	...	...	...
All other benzenoid and naphthalenoid materials-----	37,789	30,121	89,260	2.96
<i>Terpenoid, heterocyclic, and Alicyclic</i>				
Total-----	11,961	8,839	28,011	3.17
Cedrol-----	35	30	196	6.46
Cedryl acetate-----	320	172	728	4.24
Dihydronordicyclopentadienyl acetate-----	87	53	72	1.36
Dihydronordicyclopentadienyl propionate (Cyclaprop)-----	...	89	130	1.46
Dihydroterpinyl acetate-----	136	78	144	1.83
Guaiacwood acetate-----	...	45	199	4.47
α-Ionone-----	72	59	494	8.41
Ionone (α- and β-)-----	27	22	131	6.05
Isobornyl propionate-----	...	3	8	2.56
α-Methylionone-----	22	...	...	...
Methylionone (α- and β-)-----	628	444	2,482	5.59
α-Terpineol-----	2,570	2,393	1,161	.49
α-Terpinyl acetate-----	1,004	899	903	1.00
Vetivenyl acetate-----	37	...	...	...
All other terpenoid, heterocyclic, and alicyclic materials-----	7,023	4,552	21,363	4.69

See footnotes at end of table.

TABLE 1.--FLAVOR AND PERFUME MATERIALS: U.S. PRODUCTION AND SALES, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
		1,000 pounds	1,000 pounds	1,000 dollars
Total	91,964	60,756	72,473	\$1.19
Allyl heptanoate	2	2	10	4.37
Butyl butyryl lactate	45	44	192	4.33
Butyl undecylenate	23	...	...	...
Citral dimethyl acetal	39	...	...	...
Citronellyl acetate	53	28	103	3.64
Citronellyl formate	21	18	89	5.05
Citronellyl isobutyrate	7	...	...	...
Citronellyl propionate	5	2	12	4.89
3,7-Dimethyl-cis-2,6-octadien-1-ol (Nerol)	...	320	293	.92
3,7-Dimethyl-trans-2,6-octadiene-1-ol (Geraniol)	...	1,783	4,553	2.55
3,7-Dimethyl-cis-2,6-octadien-1-ol acetate (Neryl acetate)	10	...	...	...
3,7-Dimethyl-1,6-octadien-3-ol (Linalool; Linalyl alcohol)	3,273	2,703	5,139	1.90
3,7-Dimethyl-1,6-octadien-3-ol acetate (Linalyl acetate)	910	942	2,546	2.70
3,7-Dimethyl-6-octen-1-ol (Citronellal)	1,013	...	...	...
3,7-Dimethyl-6-octen-1-ol (Citronellol)	2,508	1,337	3,690	2.76
Ethyl heptanoate	5	6	17	2.90
Ethyl hexanoate (Ethyl caproate)	14	8	23	2.86
Ethyl isovalerate	12	...	...	...
Ethyl myristate	20	...	...	...
Ethyl propionate	...	124	155	1.26
Geranyl acetate	...	95	331	3.47
Geranyl butyrate	5	...	...	...
Geranyl formate	18	18	88	4.93
Geranyl propionate	...	1	7	7.35
2-Hexanal	3	1	21	20.45
7-Hydroxy-3,7-dimethyl-1-octanal (Hydroxy-citronellal)	1,690	623	3,889	6.24
Isopentyl butyrate	129	106	152	1.43
Isopentyl formate	7	7	17	2.45
Isopentyl isovalerate	25	...	...	...
Rhodinol	13	...	...	...
All other acyclic materials	82,114	52,588	51,146	.97

<sup>1</sup> Calculated from the unrounded figures.<sup>2</sup> Includes significant quantities having other end uses.

TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURER IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT]

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C L I C	
BENZENOID AND NAPHTHALENOID:	
Acetaldehyde, diphenethyl acetal (Phenylethyl acetal)	: GIV.
2*-Acetonaphthone ( $\beta$ -Methyl naphthyl ketone)	: GIV.
1-Acetoxy-2-sec-butyl-1-ethenylcyclohexane	: GIV, SCH, I.
p-Allylanisole	: RT.
Allyl anthranilate	: CI, FB, GIV, UOP.
4-Allyl-1,2-dimethoxybenzene (4-Allylveratrole)	: CI, FB, GIV, IFF, NEO, PEN, UNG.
*4-Allyl-2-methoxyphenol (Eugenol)	: CI, FB, GIV, IFF, NEO, PEN, UNG.
*4-Allyl-2-methoxyphenol acetate (Eugenol acetate)	: CI, ELN, GIV, UMS.
4-Allyl-1,2-(methylenedioxy)-benzene (Safrole)	: FB, GIV.
Allyl phenoxyacetate	: GIV.
$\alpha$ -Amyl cinnamic aldehyde	: IFF.
tert-Amyl cycene	: PFM.
p-Anisaldehyde	: OFC, SH, UOP.
Anisole (Methoxybenzene) (Methyl phenyl ether)	: OFC.
*Anisyl acetate	: ELN, GIV, OFC, UOP.
Anisyl butyrate	: RT.
Anisyl caproate	: RT.
Auranoeol (Hydroxycitronellidene methyl anthranilate)	: BT.
Benzaldehyde glyceryl acetal	: FB.
*Benzophenone	: CMN, GA, NEO, PD, UOP.
*Benzyl acetate	: FB, GIV, FCN, OFC, UOP.
*Benzyl benzoate	: MON, PFZ, UOP, VEL.
Benzyl butyrate	: ELN, FB, GIV.

TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C I C--Continued	
BENZENOID AND NAPHTHALENOID--Continued	
Benzyl cinnamate	FB, UOP, VEL.
Benzyl ether	FB, UOP, VEL.
Benzyl formate	GIV.
Benzyl glyceryl acetal	CI.
Benzyl isobutyrate	ELN, GIV.
Benzyl isopentyl ether	GIV.
Benzyl isovalerate	ELN.
Benzyl laurate	GIV.
1-(Benzylloxy)-2-methoxy-4-propenylbenzene (Benzyl isoeugenyl ether)	ELN, GIV.
Benzyl phenylacetate	ELN, GIV.
*Benzyl propionate	ELN, FB, GIV, OPC.
Benzyl salicylate	FB, GIV, MON, UOP.
4-tert-Butyl-2,6'-dimethyl-3,5'-dinitroacetophenone (Musk ketone)	GIV.
6-tert-Butyl-3-methyl-2,4-dinitroanisole (Musk ambrette)	GIV.
p-tert-Butyl- $\alpha$ -methylhydrocinnamalehyde	GIV, UOP.
Butyl phenyl acetate	GIV.
1-tert-Butyl-3,4,5-trimethyl-2,6-dinitrobenzene (Musk tibetene)	GIV.
5-tert-Butyl-2,4,6-trinitro-m-xylene (Musk xylol)	GIV, UOP.
Carvacrol	GIV.
*Cinnamaldehyde	CI, FB, UOP.
Cinnamic aldehyde dimethyl acetal	IFF.
*Cinnamyl acetate	ELN, FB, GIV.
Cinnamyl alcohol	FB, UOP.
*Cinnamyl anthranilate	FEL, GIV, RT.
Cinnamyl butyrate	FB.
*Cinnamyl cinnamate	FB.
*Cinnamyl propionate	ELN, FB, GIV.
Cinnamyl tiglate	FB.
Coumarin	ROA.
Cusaniyl acetate	IFF.
Cusaniyl alcohol	GIV, IFF.
Cusaniyl formate	IFF.

TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
BENZENOID AND NAPHTHALENOID--Continued	
trans-Decahydro- <i>p</i> -naphthol	IFF.
2-Dibromo-6-nitro- <i>m</i> -cresyl methyl ether	GIV.
3,4-Dimethoxybenzaldehyde (tetraldehyde)	GIV, SDH, SLV.
1,2-Dimethoxy-4-propenylbenzene (4-propenylver-	
1,2-trial)	FB, GIV.
3,7-Dimethyl-2,6-octadienyl phenylacetate (Geranyl	
phenylacetate)	GIV.
<i>α,α</i> -Dimethylphenethyl acetate	IFF.
<i>α,α</i> -Dimethylphenethyl alcohol	IFF.
<i>α,α</i> -Dimethylphenethyl butyrate	IFF.
Dimethyl phenylethyl carbonyl	IFF.
Dimethyl phenylethyl carbonyl acetate	IFF.
Diphenylacethane (Benzenylbenzene)	UOP.
1,3-Diphenyl-2-propanone (Dibenzylketone)	GIV.
2-Ethoxybenzaldehyde	GIV.
2-Ethoxynaphthalene	FB, SM.
Ethyl anthranilate	ELN.
Ethyl benzoate	ELN, GIV.
Ethyl cinnamate	ELN.
Ethyl- <i>α,β</i> -epoxy- <i>β</i> -methyhyrocinnamate	FEL, HON, NEO.
*2-Ethyl hexyl salicylate	GIV, OPC.
Ethyl phenylacetate	ELN, GIV.
Ethyl phenylglycidate	FB.
Ethyl salicylate	GIV, UOP.
3-Ethyl-5',6',7',8'-tetrahydro-5',8',8'-tetra-	
methyl-2'-acetoneaphthone	GIV.
Geranyl benzoate	PFM.
Hexyl benzoate	CI, IFF.
<i>α</i> -Hexylcinnamaldehyde	NEC.
Homomenthyl salicylate	GIV, IFF.
Hydratropaldehyde	GIV, IFF.
Hydratropaldehyde, dimethyl acetal	ARS.
Hydrocinnamic acid	ARS.
Hydroquinone	GIV, DOP.
Hydroxycitronellal methyl anthranilate	GIV.
4-Hydroxy-3-ethoxy benzaldehyde (Ethylvanillin)	HON, SDH, SLV.

TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C L I C--Continued	
BENZENOID AND NAPHTHALENOID--Continued	
3-Hydroxy-4-methoxybenzaldehyde (Iso-vanillin)	SDH, SLV.
4-Hydroxy-3-methoxybenzaldehyde (Vanillin)	MON, SLV.
4-(4-Hydroxy-3-methoxyphenyl)-2-butanone (Vanillyl-acetone)	GIV.
Indole	GIV.
Isoamyl phenylacetate	ELN, FB.
Isobutyl benzoate	ELN, FB.
Isobutyl phenylacetate	ELN, FB, GIV, OPC.
Isobutylquinoline	IFF.
*Isobutyl salicylate	FB, GIV, UOP.
Isohexenyl tetrahydrobenzaldehyde (Nyrac aldehyde)	IFF.
*Isopentyl benzoate	GIV.
*Isopentyl salicylate	FB, GIV, MON, UOP.
Isopropylbenzaldehyde (Cusaaldehyde)	GIV.
P-isopropyl- $\alpha$ -methylhydrocinnamaldehyde (Cyclamenaldehyde)	GIV, RDA.
P-isopropyl- $\alpha$ -methylhydrocinnamyl alcohol	GIV.
Linallyl anthranilate	FMT.
linalyl benzoate	GIV, MOF.
p-Menthyl-1,8-diene (Limonene)	RI, SKG.
*Menthyl anthranilate	FFN.
q-Methoxyacetophenone	OPC, OPC, UOP.
o-Methoxybenzyl alcohol (Anisyl alcohol)	ELC, GIV, OPC, UOP.
o-Methoxybenzyl aldehyde	ELN, GIV, OPC, UOP.
o-Methoxy cinnamic aldehyde crystals	CI, FB, OPC.
2-Methoxynaphthalene	GIV.
P-Methoxyphenyl methylglycidate	OPC.
1-p-Methoxyphenyl pentan-1-one-3 (a-Methyl-anisalacetone)	GIV.
*2-Methoxy-4-propenylphenol (Isoeugenol)	CI, FB, GIV, IFF, NEO, UOP.
2-Methoxy-4-propenylphenol, acetate	CI.
4'-Methylacetophenone	OPC, UOP.
*p-Methylanisole	GIV, OPC, SW, UOP.
*Methyl anthranilate	FB, SW, UNG.
Methyl benzoate	HN.



TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
BENZENOID AND NAPHTHALENOID--Continued	
α-Methylbenzyl acetate (Styralyl acetate)	: CI, FB, GIV.
*α-Methylcinnamaldehide	: CI, FB, GIV.
Methyl cinnamate	: FB.
6-Methylcoumarin	: GIV.
3,4-Methylenedioxyphenyl-2-butanone	: PF.
1,2-(Methylenedioxy)-4-propenylbenzene ferol	: GIV.
4-Methyl-7-ethoxycoumarin	: GIV.
p-Methyl ethyl phenyl glycidate	: PF.
p-Methylhydratropaldehide	: GIV.
1-Methyl-isoheptyl-hexahydro benzaldehide	: GIV.
Methyl N-methylantranilate	: GIV, OPC, SH.
*Methyl phenylacetate	: ELM, GIV, OPC.
Methyl salicylate	: HB, MON.
Musk 89	: IFF.
1,3,5-Pentamethyl-6-dinitroindan (noskeme)	: GIV.
α-Pentylcinnamaldehide	: FB, UOP.
Phenethyl acetate	: GIV, IFF, OPC.
Phenethyl alcohol	: IFF, OPC.
Phenethyl isobutylate	: ELM, IFF.
Phenethyl isobutyrate	: ELM, GIV, IFF.
Phenethyl isovalerate	: ELM, FB, RT.
Phenethyl methacrylate	: NEO.
*2-Phenethyl phenylacetate	: CI, ELM, GIV, IFF, NEO.
*Phenethyl salicylate	: ELM, GIV, IFF, OPC, PF.
2-Phenethyl isobutylate	: GIV, NEO.
Phenoxyethyl propionate	: ELM, GIV, OPC.
Phenylacetaldehyde	: IFF.
Phenylacetaldehyde, dimethyl acetal	: ELM, GIV.
Phenylacetic acid	: GIV.
Phenylacetic acid isopentyl ester	: GIV.
α-Phenylanisole	: GIV.
4-Phenyl-3-buten-2-one	: FB, NEO.
Phenylethyl antranilate	: OPC, RT.
Phenylethyl triolate	: FB.

C Y C L I C--Continued

TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
BENZENOID AND NAPHTHALENOID--Continued	
*3-Phenyl-1-propanol (Hydrocinnamic alcohol)-	ELN, FB, GIV.
*3-Phenylpropyl acetate -	ELN, FB, GIV.
3-Phenylpropyl aldehyde -	CI, FB, GIV.
3-Phenylpropyl cinnamate -	FB, RT.
Piperonal (Heliotropin)-	AMB, GIV.
*p-Propenylanisole (Anethole) -	ABZ, FB, HPC, MCI, SCM.
*4-Propenyl-1,2-dimethoxybenzene (Methyl isoeugenol)-	CI.
p-Propylanisol (Dihydroanethole) -	FB, GIV.
N-Propyl phenyl ethyl alcohol -	GIV.
SWEETENERS, SYNTHETIC:	
Cyclohexanesulfamic acid -	ABB.
Cyclohexanesulfamic acid, calcium salt -	ABB.
Cyclohexanesulfamic acid, sodium salt -	ABB.
Saccharin (1,2-Benzisothiazolin-3-one,-1,1-dioxide) -	SW.
Saccharin, sodium salt -	SW.
Saccharin solution -	SW.
*p-Tolualdehyde -	FB, GIV, TCC.
p-Tolylacetalddehyde -	GIV.
p-Tolyl acetate -	ELN, GIV.
*Tolyl phenylacetate -	GIV.
*-(Trichloromethyl)benzyl acetate (Rosetone) -	NEO.
Triethanolamine salicylate -	NEO.
Trimethylcyclohexyl salicylate -	ARS.
all other Benzenoid or naphthalenoid chemicals -	SCM.
TERPENOID, HETEROCYCLIC, AND ALICYCLIC:	
Acetyl-n-butyl (2,3-Hexanedione) -	FB.
Acetyl cedrene (Vertoflex) -	OFB.
Acetyl isovaleryl (5-Methyl-2,3-hexanedione) -	FB.
Acetyl propionyl (2,3-Pentanedione) -	FB.
Alliocinene -	GIV, IFF, X.
Allyl cyclohexyl Propionate -	GIV.
Allyl acetate -	GIV.
Bornyl isovalerate -	FB, RT.
p-Tert-Butylcyclohexyl acetate (Verbemix) -	CI, IFF.

TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
TERPENOID, HETEROCYCLIC, AND ALICYCLIC--Continued	
p-tert-Butylcyclohexanone	IFF,
2-tert-Butylcyclohexanone	GIV,
2-sec-Butylcyclohexanone	IFF,
o-tert-Butylcyclohexyl acetate	FB,
Cadinene	NEO,
Carvone oxide	CI, FB, GIV,
B-Caryophyllene	CI,
Caryophyllene acetate	GIV,
Caryophyllene oxide	NEO,
α-Cedrene	IFF,
α-Cedrene epoxide (Andrane)	GIV, IFF, NEO,
Cedrenol	ELN, GIV, IFF, NEO,
*Cedryl acetate	ELN, GIV, IFF, NEO, UNG,
Cedryl acetate	IFF, OPC,
Cedryl acetate	RT,
Cyclohexyl acetate	RT,
Cyclohexyl butyrate	CI,
Cyclohexyl cyclohexanol	GIV,
2-Cyclohexylcyclohexanone	GIV,
Cyclohexyl isovalerate	RT,
Dihydro-iso-jasmonone	FB,
*Dihydronordicyclopentadienyl acetate (Cyclacet)	CI, GIV, IFF, OPC,
Dihydronordicyclopentadienyl isobutyrate	IFF, OPC,
Dihydronordicyclopentadienyl methyl ether	OPC,
*Dihydronordicyclopentadienyl propionate (Cyclac-prop) (Verdyl propionate extra)	CI, GIV, IFF, OPC,
Dihydro terpineol	ACI,
*Dihydroterpinyll acetate	GIV, NCI, OPC,
3,5-Dimethyl-3-cyclohexen-1-carboxaldehyde	IFF,
3-5 Dimethyl cyclopentadione	PFM,
2,5-Dimethyl-4-hydroxy-3-(2H)-furanone	PFM,
Ethylene brassylate	NEO,
Ethyl furoate	RT,
Furfural acetone	RT,
Furfural acrolein	RT,
Galaxolide (1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexa-methyl-cyclohepta-γ-2-beazopyran)	IFF,



TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
T E R P E N O I D , H E T E R O C Y C L I C , A N D A L I C Y C L I C--Continued	
1-1-p-menthen-6-yl-1-propanone	: GIV.
Menthyl, synthetic, U.S.P.	: SCM.
Menthyl, synthetic, tech.	: GIV, NCI.
Menthyl acetate	: PF, GIV, SCM.
3-Methyl cyclohexanediene-1,2	: PFM.
Methyl furate	: RT.
$\alpha$ -Methyl- $\beta$ -furyl acrolein	: GIV, IFF, NEO, BDA, STP.
*Methylionone ( $\alpha$ and $\beta$ )	: GIV, NEO, UNG.
*Methylionone	: GIV.
6-Methyl- $\alpha$ -ionone	: NCI.
Nopol	: FEL, NCI, OPC, ET.
Nopol acetate	: IFF.
3-Pentyl tetrahydro-4-pyridine	: PFM.
Rose oxide	: GIV.
$\alpha$ -Santalol	: GIV.
$\alpha$ -Santalyl acetate	: GIV.
Sassafras oil, hydrogenated	: GIV.
Terpineol ( $\alpha$ and $\beta$ )	: HFC, NCI, SCM.
*Terpineol	: GIV, NCI, NEO, PFM, RDA, SCM, UNG.
$\alpha$ -Terpinyl acetate	: ELN, GIV.
$\alpha$ -Terpinyl propionate	: HFC.
[4,4',4'',4'''-Tetraaadinophthalocyanina(2-)]-copper	: RT.
Tetrahydrofuryl-n-butylate	: ABS, NEO.
Tetrahydrofuryl propionate	: ABS, NEO.
3,3-Trimethyl cyclohexanone (n-Homeomenthol)	: IFF.
1-(2,6,6-trimethyl-7-cyclohexen-1-yl)-1,6-heptadien-3-one (Allilceton)	: GIV.
2,6,10-Trimethyl-9-undecen-1-al	: GIV.
*Terpinol acetate	: PF, GIV, IFF, NEO, PFM, UNG.
All other terpenoid, heterocyclic, or alicyclic flavor and perfume chemicals	: SCM, VIK.

TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Allyl disulfide	RT.
*Allyl heptanoate	ELN, PB, RT.
*Allyl hexanoate	ELN, PB, GIV, PFW.
*Allyl isothiocyanate (Synthetic mustard oil)	OPC.
*Allyl isovaleate	RT.
*Allyl mercaptan	RT.
*Allyl sulfide	RT.
*Allyl sulfide (Allyl caprylate)	RT.
Asomius isovalerate	RT.
*Amyl propionate	8SA.
*Amyl propionate	GIV.
Butter acids	RT.
Butter esters	RT.
*Butyl butyrate	PB.
*Butyl butyryl lactate	BJL, ELN, RT.
*Butyl undecylenate	CI, PB, GIV, IFF.
*Citral diethyl acetal	CI, GIV, IFF, RDA.
*Citronellal acid	PFW.
*Citronellal acetate	ELN, GIV, IFF, MCI, SCM.
*Citronellal butyrate	ELN, GIV.
*Citronellal formate	ELN, GIV, IFF, MEO.
*Citronellal isobutyrate	ELN, GIV, IFF.
*Citronellal oxycetaldehyde	IFF, OPC.
*Citronellal propionate	ELN, GIV, IFF.
Crude acetate mixture (Linalyl, neryl, geranyl acetates, main components)	X.
2,4-becadienal	PFW.
Decanal (Capraldehyde)	CI, GIV.
Decyl acetate	GIV.
Diethyl acetal	PB.
Diethyl glutarate	PFW.
Diethyl sebacate	ELN, UOP.
Diethyl succinate	ELN.
Dihydro myrcenol	IFF.
2,6-Dimethyl-5-hepten-1-ol	GIV.
Dimethyl hexanediole	X.
Dimethyl hexanediole	RDA, X.
3,7-Dimethyl-2,3,6-nonadienenitrile	GIV.

TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
3,7-Dimethyl-trans-2,6-octadienal (Citral A geraniol)-	FB, FEL, GIV, SCM.
*3,7-Dimethyl-cis-2,6-octadien-1-ol (Nerol) -	ELN, FB, GIV, IFF, MCI, SCM.
*3,7-Dimethyl-trans-2,6-octadien-1-ol (Geraniol) -	CI, ELN, FB, FEL, GIV, IFF, MCI, SCM, UOP.
*3,7-Dimethyl-1,6-octadien-3-ol (Linalyl alcohol) -	ELN, FB, FEL, GIV, HOP, MCI, RDA, SCM.
*3,7-Dimethyl-cis-2,6-octadienol, acetate (Neryl acetate) -	CI, ELN, FB, GIV, IFF.
*3,7-Dimethyl-1,6-octadien-3-ol, acetate (Linalyl acetate) -	ELN, FB, GIV, HOP, MCI, RDA, SCM, UNG.
3,7-Dimethyl-1,6-octadien-3-yl isobutyrate (Linalyl isobutyrate) -	ELN, HOP.
3,7-Dimethyl-1,6-octadien-3-yl propionate (Linalyl propionate) -	ELN, GIV, HOP.
3,7-Dimethyloctanol-1 [Tetrahydroamial] -	GIV, MCI.
D,7-Dimethyl-5-octanol -	IFF, SCM.
*Dimethylacetyl acetate -	IFF.
*2,6-Dimethyl-2-octenal (Citronellal) -	CI, FB, GIV, RDA, SCM, UOP.
2,6-Dimethyl-2-octene-7-yne-6-ol -	RDA, X.
*3,7-Dimethyl-6-octen-1-ol (Citronellol) -	CI, ELN, FB, GIV, IFF, MCI, SCM.
3,7-Dimethyl-7-octenol, 6-octenol isomer 30pct	: IFF.
Diylacetol -	FB, NW.
Ethyl butyrate -	ELN, FB.
Ethyl caprate -	BT.
Ethyl crotonate -	OPC.
Ethylene glycol acetal of heptaldehyde -	FB.
Ethyl formate -	ELN, FB, FEL, BT.
Ethyl heptanoate -	HOP.
*Ethyl hexanoate -	ELN, FB, NW, PFW, BT.
Ethyl isobutyrate -	FB.
*Ethyl isovalerate -	ELN, FB, PFW.
Ethyl laurate -	ELN, FB, PFW.
Ethyl levulinate -	PFW.
Ethyl linalool (3,7-Dimethyl-1,6-nonadien-3-ol) -	HCF.
Ethyl linalyl acetate (3,7-Dimethyl-1,6-nonadien-3-ol, acetate) -	HOP.

A C Y C L I C--Continued

TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Ethyl-2-methyl butyrate-	PFM, SCM.
*Ethyl-2-methyl-2-pentenoate-	PFM.
*Ethyl myristate-	ELN, PFM, RT.
Ethyl nonanoate-	ELN, FB.
Ethyl octanoate-	ELN, FB.
*Ethyl oxyhydrate-	FLO, RT.
*Ethyl propionate-	FB, NW, UOP.
Ethyl valerate-	ELN.
Geranic acid-	FB.
*Geranyl acetate-	CI, ELN, FB, FEL, GIV, IFF, NCI, PFM, SCM.
*Geranyl butyrate-	ELN, FB, GIV.
*Geranyl crotonate-	FB.
*Geranyl formate-	CI, ELN, GIV.
Geranyl isobutyrate-	IFF.
Geranyl isovalerate-	FB.
Geranyl nitrile (Geranyl nitrile) (Citralva)-	CI, IFF.
*Geranyl propionate-	ELN, FB, IFF.
Geranyl tiglate-	FB.
Glutamic acid, monosodium salt (monosodium glutamate)	GTL, SFF.
Heptanamide-	FB.
2,4-Hexadieneal-	PFM.
Hexadeceneol-	PFM.
*2-Hexenal-	FB, GIV, SCM.
CIS-3-Hexen-1-ol-	GIV, SW.
2-Hexenol-	FB.
CIS-3-Hexen-1-yl acetate	GIV.
CIS-3-Hexenyl butyrate-	OPC.
CIS-3-Hexenyl tiglate-	OPC.
Hexyl caproate-	OPC.
*Hexyl-2-butanone (Acetol)-	HOP, SW.
*3-Hydroxy-2-butanone (Acetol)-	PMI.
*7-Hydroxy-3,7-dimethyl-1-octanal (Hydroxycitronellal)-	CI, GIV, IFF, BDA, SCM, UOP.
7-Hydroxy-3,7-dimethyl octanal, dimethyl acetal (Hydroxycitronellal, dimethyl acetal)-	GIV.
Hydroxy-2-propanone (Acetol)-	FB.

A C Y C L I C-- Continued



TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Isosavyl caproate	: FB.
Isosavyl caprylate	: FB.
Isosavyl geranate	: FB.
Isosavyl propionate	: FB.
Isobutyl acetate	: FB.
Isobutyl butyrate	: FB.
Isodihydro lavandulol	: FB.
Isodihydro lavandulylacetate	: FB.
Isodihydro lavandulylaldehyde	: FB.
Isononyl acetate	: CI, OPC.
Isooctyl acetate (Isosavyl acetate)	: FB, NW, PFW.
Isooctyl butyrate	: FB, GIV, NW, PFW, UOP.
Isooctyl formate	: ELN, FB, GIV, RT.
Isooctyl isovalerate	: ELN, FB, PFW.
Lauraldehyde	: GIV.
Linalool oxide	: HOF.
Linolyl formate	: HOF.
Methyl citronellal	: SCM.
Methyl eugenol	: X.
Methyl pivalic acid	: PFW.
3-Methyl butylaldehyde	: X.
Methyl crotonate	: FB.
Methyl heptadienone	: HUF.
3-Methyl-5-heptanone oxime	: HCF, BDA.
Methyl heptenone	: PFA.
Methyl isobutyrate	: FB.
Methyl isovalerate	: PFA.
Methyl mercaptopropylamine	: PFW.
3-Methyl-2-f and 3 nonene nitrile	: GIV.
Methylol methyl hexyl ketone	: GIV, PFW.
4-Methyl pentanoic acid	: PFA.
Methyl pentylol	: X.
Methyl propionate	: FB.
β-Methyl thiopropionaldehyde	: RT.

A C Y C L I C--Continued

TABLE 2.--FLAVOR AND PERFUME MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

FLAVOR AND PERFUME MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
2-Methylundecanal	: GIV.
Mycenyl acetate	: IFF.
Myristaldehyde	: GIV.
Myrolidol (3,7,11-Trimethyl-1,6,10-dodecatrien-3-ol)	: HOF.
Nonanal	: GIV.
Nonane diacetate	: CI.
1,3-Nonanediol acetate	: CI, GIV.
Nonanol	: GIV.
$\beta$ -Nonanone	: HOF.
Nonyl acetate	: ELN, GIV.
Ocimenyl acetate	: IFF.
2-trans-6-cis-Octadienal	: PFM.
Octanal	: CI, GIV.
3-Octanol	: GIV, SCH.
3-Octanone (Ethyl amyl ketone)	: GIV.
N-Octyl acetate	: ELN.
N-Octyl alcohol	: GIV.
Pentyl acetate	: DOP.
n-Propyl n-butyrate	: PFM.
* Pseudo linallyl acetate (Neobergamate)	: IFF.
Rhodnyl	: FB, FEL, GIV, IFF.
Rhodnyl acetate	: GIV, IFF.
Tepyl acetate	: ELM, UOF.
Tetrahydro allo-ocimene	: IFF.
Tetrahydro pseudolimonene	: CI.
Undecanal	: GIV.
9-Undecenal	: GIV.
All other acyclic flavor and perfume materials	: SCH, X, Y.

A C Y C L I C--Continued

TABLE 3.--FLAVOR AND PERFUME MATERIALS: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of flavor and perfume materials to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of Company	Code	Name of Company
ABB	Abbott Laboratories	OPC	Orbis Products Corp.
AIP	Air Products & Chemicals, Inc.	PD	Parke, Davis & Co. Sub. of Warner-Lambert Co.
AMB	American Bio-Synthetics Corp.	PEN	CPC International, Inc., Penick Div.
ARS	Arsynco, Inc.	PFW	Polak's Frutal Works, Inc.
ARZ	Arizona Chemical Co.	PFZ	Pfizer, Inc.
BJL	Burdick & Jackson Labs., Inc.	RDA	Rhodia, Inc.
CI	Chem-Fleur, Inc.	RSA	R.S.A. Corp.
CWN	Upjohn Co., Fine Chemical Div.	RT	Ritter International
ELN	Elan Chemical Co.	SCM	SCM Corp.
FB	Fritzsche, Dodge & Olcott, Inc.	SDH	Sterling Drug, Inc., Hilton-Davis Chemical Co. Div.
FEL	Felton International, Inc.	SFF	Stauffer Chemical Co., Food Ingredients Div.
FLO	Florasynt, Inc.	SKG	Sunkist Growers, Inc.
FMT	Fairmount Chemical Co., Inc.	SLV	Sterwin Chemicals, Inc.
GAF	GAF Corp.	STP	Stepan Chemical Co.
GIV	Givaudan Corp.	SW	Sherwin-Williams Co.
GRW	Great Western Sugar Co.	TCC	Tanatex Chemical Corp.
HN	Tenneco Chemicals, Inc.	UNG	Ungerer & Co.
HOF	Hoffman-LaRoche, Inc.	UOP	UOP, Inc., Chemical Div.
HPC	Hercules, Inc.	VEL	Velsicol Chemical Corp.
IFF	International Flavors & Fragrances, Inc.	VIK	Viking Chemical Co.
MON	Monsanto Co.		
NCI	Union Carb Corp.		
NEO	Norda Inc.		
NW	Northwestern Chemical Co.		

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.



## Synthetic Resins and Plastics Materials

Edward J. Taylor

The synthetic resins and plastics materials 1/ industry is a major user of many of the synthetic organic chemicals covered in this report. These plastic materials are in turn sold in the fabrication of consumer products such as automobile instrument panels and soft drink bottles. This paper discusses the industry in general, certain end-use markets, foreign trade, new product areas and the impact of government regulations on the industry.

Production, sales, and major markets

The U.S. production, consumption, and sales of synthetic resins and plastics materials reached an all-time high in 1977; production amounted to 35 billion pounds, consumption reached 32 billion pounds, and sales, 30 billion pounds. These quantities represent gains of 15 percent, 18 percent, and 19 percent, respectively, above what it was in 1976. The average unit value of sales for all plastics materials in 1977 was double the level of the early 1970's (i.e., 37 cents per pound in 1977 compared to about 19 cents per pound during 1970-72).

The principal markets for plastics materials include building/construction, packaging, and automotive applications. These three markets have accounted for over half the annual consumption of all plastics materials in recent years. Industry sources 2/ estimate that building/construction applications represented 27 percent of domestic synthetic resins consumption in 1976; packaging represented 25 percent; and the automotive industry represented about 6 percent of synthetic resins demand during the same year.

Building/construction.--Major synthetic plastics products used in the building and construction trade include pipe, siding, and insulation. The chief plastics beneficiary of the rise in building starts are the thermo-setting resins, 3/ of which about 40 percent are consumed in this market.

Insulation applications have made important strides as a result of the energy crisis. Polyurethane foam and polystyrene foam are two of the principal materials used in insulation. Other important plastics applications in the building/construction sector are glazing, panels, ducts, and tanks.

---

1/ Unless otherwise stated, the term "plastics materials" as used in this paper is synonymous with "synthetic resins and plastics materials."

2/ Charles Genest (Arthur D. Little) "Plastics Industry to Grow at Triple the Rate of GNP through 1981," a paper presented at the Third Annual Conference on Contingency Planning, New York, fall 1977.

3/ A plastic material that cures by heat, catalyst, or other chemical means, and, when cured, cannot be resoftened by heating.

Plastics products now account for only about 5 percent of all the materials used in building and construction. Thus the building and construction industry offers great market potential for plastics. A surge in this market usually has a multiplier effect on other important markets for plastics such as appliances, furniture, and housewares. These increase although interior applications usually lag behind the building boom.

Packaging.--A highly diversified market, packaging constitutes the single most important use for thermoplastic resins. 1/ At the present time, packaging uses comprise about 30 percent of all the thermoplastic resins consumed. Packaging materials includes both rigid and flexible plastics items such as shrink wrap, blister containers, bottles, disposable cups, boxes, and trays, all of which are familiar consumer items. The value of U.S. shipments for the total packaging industry was \$38 billion in 1977, 9 percent above the 1976 level of \$35 billion. 2/ The quantity of plastics materials used by the packaging industry increased to 7.1 billion pounds in 1977, up 11 percent from 6.4 billion pounds in 1976. 3/

Plastics materials currently constitute about 10 percent of all material used in packaging. The growth of plastics in packaging has been at the expense of both traditional materials (glass, paper products, and nonferrous metals) and older plastics (e.g., cellulosic plastics).

The preference for newer plastics materials over other materials is due primarily to cost/performance factors. For example, plastics materials, when compared with glass or metal, may be formed into a great variety of shapes, with lower temperatures and energy requirements. Also, plastics products (cups, bottles, and so forth) are typically lighter in weight per given volume than those of glass or metal which results in lower shipping costs.

Automotive industry.--Although plastics materials are used in all forms of transportation, the automobile represents the most important end use for plastics in the transportation industry. The increase in consumption of plastics in the automotive industry is the result of an absolute gain in the number of new car sales as well as Federal regulations governing fuel consumption (i.e., the Energy Policy and Conservation Act of 1975). The act specifies that all 1985 model autos must meet a standard of 27.5 miles per gallon (mpg) on a production-weighted average basis, which is an increase of 53 percent over the federally mandated standard of 18 mpg that must be met by the 1978 model autos. In order to attain this increased fuel efficiency, it will be necessary to reduce the weight and size of automobiles. The substitution of plastics and other lighter weight materials must take place.

---

1/ A plastic material that will repeatedly soften when heated, and harden when cooled.

2/ U.S. Department of Commerce, U.S. Industrial Outlook 1978.

3/ Modern Plastics, Jan. 1978, p. 43.

Industry sources 1/ report that the average 1977 auto contained 166 pounds of plastics as compared with 20 pounds in the typical 1960 automobile. It has been forecast 2/ that the typical 1985 auto will contain 350 to 500 pounds of plastics. This means that as a share of total vehicle weight, plastics will increase from 5 percent in 1977 to about 20 percent in 1985, with a reduction in the the overall weight of the automobile.

### Foreign trade

The plastic materials industry is export-competitive and should maintain a positive trade balance in the coming years. It may, however, be unfavorably impacted by the export plants being built in the oil-rich countries.

Exports.--In 1977, exports accounted for about 8 percent of U.S. production of plastics materials, a level consistent with that of recent years. The quantity of exports of plastics materials amounted to 2,770 million pounds in 1977, a 5 percent decline from the 2,913 million pounds estimated for 1976. However, the value of exports increased in 1977 to \$1,197 million, a 3.7 percent gain above what it was in 1976; this increase in value was due mostly to inflationary reasons rather than any shift in product lines. Thermoplastic commodity resins 3/ accounted for about two-thirds of the total volume and 45 percent of the value in both 1976 and 1977. Large U.S. exports of plastics, particularly the commodity resins, are indicative of the inability of the plastics materials industries of developing countries to keep pace with the growth of the local plastics materials fabrication and processing industries. One reason given for the decline in the quantity of U.S. plastics materials exports in 1977 was the excess production capacity for these materials in Europe and Japan. 4/

Canada was the leading market for U.S. exports of plastics materials in 1977, as it has been for at least the last decade. Other important U.S. markets in the Western Hemisphere during 1977 include Brazil, Colombia, Ecuador, Guatemala, Mexico, and Venezuela--nations whose fabrication industries have outpaced their local plastics production capabilities. The major Asian markets in 1977 included Hong Kong, Japan, Korea, New Zealand, the Philippines, Singapore, and Taiwan. The leading markets in Europe, on the other hand, were all developed nations--Belgium, the Netherlands, France, and West Germany. A significant share of these exports are believed to represent shipments by U.S. producers to their European subsidiaries.

---

1/ The Society of the Plastics Industry, Inc., 1977 Facts and Figures of the Plastics Industry.

2/ Du Pont's Annual Report 1977, p. 19. Several independent marketing research firms have made similar forecasts. Included among these are: Predicasts, Inc. (Cleveland, Ohio), and Springborn Laboratory (Enfield, Conn.).

3/ Low-density polyethylene, high-density polyethylene, polypropylene, polystyrene and its copolymers and terpolymers, and polyvinyl chloride and its copolymers.

4/ Chemical Week, Dec. 7, 1977, pp. 57, 58 and 63.

Imports.--Except for 1974, imports have not exceeded 1 percent of consumption in any year during the period 1950-77; in 1977 the ratios of imports to consumption were 0.7 percent (quantity) and 0.9 percent (value). Imports of plastics materials in 1977 amounted to 207 million pounds valued at \$112 million, an increase of 8.4 percent and 8.7 percent, respectively, over 1976.

Traditionally, the capital-intensive, technology-oriented manufacture of plastics materials has given the United States a competitive edge over its foreign competition, but that advantage appears to be diminishing. In addition, the U.S. plastic manufacturers have recently had a cost advantage in both raw materials and energy over Western Europe and Japan. Should the proposed National Energy Plan 1/ become enacted, the energy cost advantage may also disappear.

The leading sources of imports of plastics materials in 1977 included Canada, France, Japan, the United Kingdom, and West Germany; together they accounted for three-fourths of the volume of plastics imports that year, up from two-thirds of the total in 1976. West Germany was the major source in 1977, a position that Japan held in earlier years. Since most foreign plastics materials do not compete with domestic plastics in the U.S. market, imports are usually sought for one of three reasons: (1) A shortage of a particular resin exists in the United States; (2) the imported plastic is a new product not yet made domestically; or (3) foreign firms are supplying their U.S. affiliates or subsidiaries to make up a short-fall for a given resin or resins.

The pattern of U.S. imports of plastics materials is not expected to change significantly until at least the mid-1980's. At that time, the oil-rich nations of the Middle East are expected to attain a capacity for plastics materials which will allow substantial export. 2/

#### New areas of growth

The plastics materials industry continues to be a leader in the development of technology and of applications for its products. This leadership has resulted in continued new areas of growth which have contributed greatly to the health of the industry.

---

1/ Executive Office of the President, Energy and Policy Planning, The National Energy Plan, Apr. 29, 1977.

2/ Chemical Week, Mar. 23, 1977, pp. 29-40.



Polyethylene terephthalate.--The thermoplastic polyester resin, polyethylene terephthalate (PET), is making rapid inroads into the disposable (one-way) soft drink bottle field as a replacement for glass. This market grew from zero consumption of PET in 1976 to 51 million pounds in 1977, and is forecast to reach 176 million pounds in 1978 and to climb to 309 million pounds by 1980. 1/ This penetration has been most pronounced in the "family size" bottles (32 ounce and 64 ounce), where PET now accounts for an estimated 25 percent of the Coca Cola and Pepsi Cola family-size containers.

PET bottles offer certain advantages over glass containers (lighter weight, safety), as discussed earlier. Future markets for PET bottles include containers for such diverse products as cooking oils, salad dressing, fruit juice, and shampoos.

Engineering thermoplastics.--The engineering thermoplastic resins comprise a family of high-performance resins which have mechanical, chemical, and thermal properties suitable for use in construction, transportation equipment, machine components, and chemical processing equipment. 2/ Industry sources forecast that by the mid-1980's the domestic demand for engineering resins will have reached 2 billion pounds, about 3 1/2 times the reported 1976 level of 600 million pounds. 3/ These materials enjoy a cost-benefit advantage over die-cast metals. They also have considerably lower production energy requirements than the metals they compete with and offer improved fuel economy in automobiles through reduced weight.

The engineering resins are closely tied to the durable goods economy. For example, automotive applications (e.g., distributor caps), together with electrical/electronics uses (e.g., coil bobbins) and home appliance applications (e.g., dishwasher pump parts) are the three leading markets for these engineering resins, and together account for about three-fourths of the domestic consumption.

#### Government regulations

A high degree of concern has been expressed in many segments of the U.S. Government about how specific chemicals might adversely affect the health of individuals who come into contact with them. This concern has resulted in various laws and regulations designed to control industry actions.

---

1/ Modern Plastics, April 1978, pp. 48 and 49.

2/ Whittington's Dictionary of Plastics, First edition. These engineering resins include polyacetal resins, polycarbonate resins, polyimide and amide-imide polymers, polyphenylene oxide, polyphenylene sulfide, and polysulfone. Whittington's also lists ABS resins and nylon resins in this category.

3/ Chemical Marketing Reporter, Sept. 19, 1977, p. 38.

Occupational Safety and Health Administration (OSHA).--Since 1974, polyvinyl chloride (PVC) resins have been subjected to closer government scrutiny (for safety) than any of the other plastics materials; so far the PVC resin industry has not only survived but output has increased under these conditions (4,744 million pounds in 1974 versus 5,153 million pounds in 1977). Because of a worker health problem, OSHA in October 1974 imposed strict rules governing the level of vinyl chloride monomer (VCM, the raw material for PVC) to which workers may be exposed. These rules specify a maximum exposure of 1 part per million (ppm) during an 8-hour period, and 5 ppm for any 15-minute period. Prior to the OSHA ruling the exposure level to VCM was 500 ppm for an 8-hour period.

An independent marketing research firm estimated that the OSHA regulations lowering worker exposure levels to VCM have added 0.3 cent to 1 cent per pound to the manufacturing cost of VCM and from 1 cent to 3 cents per pound to costs for PVC resins. 1/ Since 1974, five producers of PVC resins have left the market while four new producers have entered this field.

Environmental Protection Agency (EPA).--It has been estimated that to meet proposed standards under the Clean Air Act (limiting the emission level of VCM in the atmosphere to 10 ppm) the initial industry outlay will be \$183 million with an annual upkeep expenditure of \$70 million. 2/ In addition, EPA's new water effluent guideline will become effective in 1983. The total capital cost for existing plants to meet these guidelines has been estimated by EPA at an aggregate of \$83 million, with an annual maintenance of \$17 million for all existing plants. Thus, in order for industry to maintain precontrol profits and also to recover the annual control costs for meeting both the air and water standards, EPA estimates that it will be necessary to increase the price of PVC resins by at least 7 percent. 3/

The Toxic Substances Control Act (TSCA).--This law, which became effective on January 1, 1977, may be the most significant legislation ever to impact the plastics materials industry. 4/ It empowers the EPA to ban or restrict the use of chemicals to protect public health. EPA's new regulatory powers are being directed not only toward the production side of business through pollution standards, and so forth, but also on the marketing side through prescreening and testing for safety of new and existing products. TSCA could affect plastics materials either directly, or indirectly by impacting the ingredients of plastics materials (e.g., acrylonitrile, benzene). Many studies have already been made and are now being done to assess the probable economic effects that strict enforcement of the act could have on the plastics materials industry. The cost to industry of compliance with TSCA has been estimated by EPA at \$80 million to \$140 million, and by a business-consulting firm at \$360 million to \$1.3 billion. 5/

---

1/ Chemical and Engineering News, Nov. 10, 1975, pp. 13 and 14.

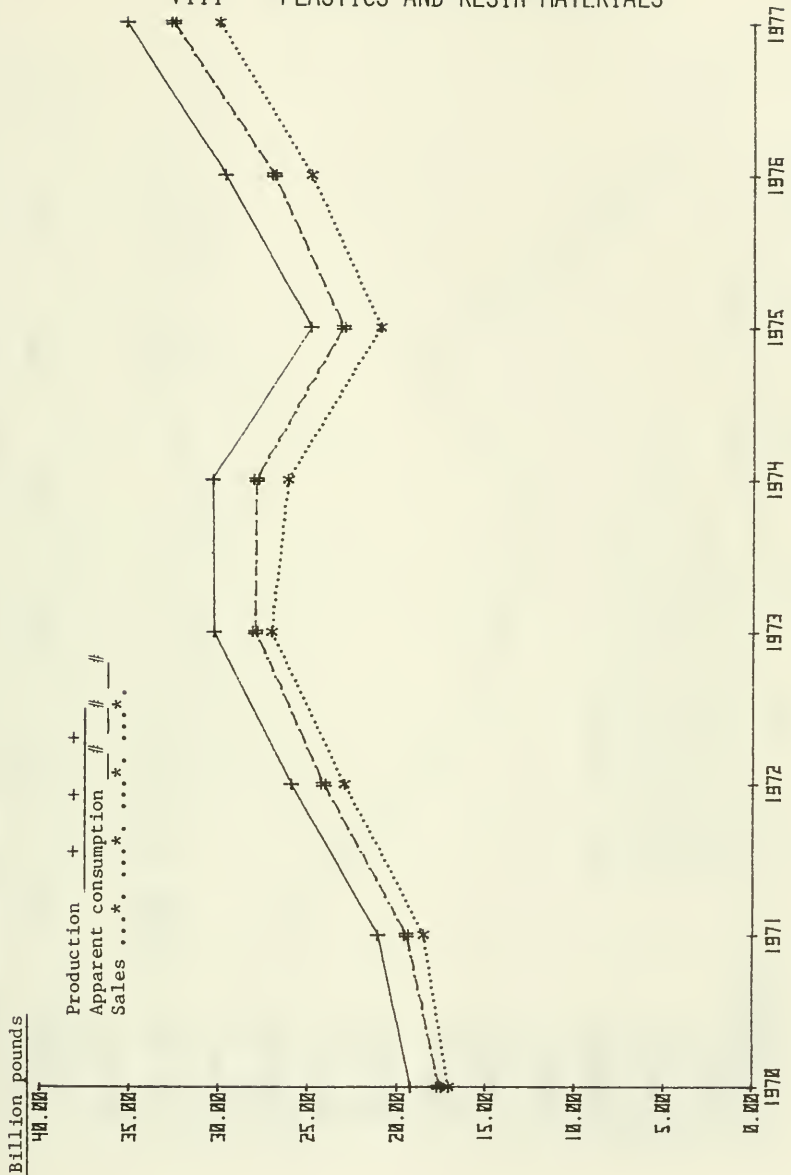
2/ Modern Plastics, February 1976, p. 16, also 41 F.R. 46561 and 42 F.R. 28154.

3/ Ibid.

4/ Salomon Brothers, an international investment banking house, "Government Regulations of Marketing will Lower Chemical Earnings Growth," July 6, 1977.

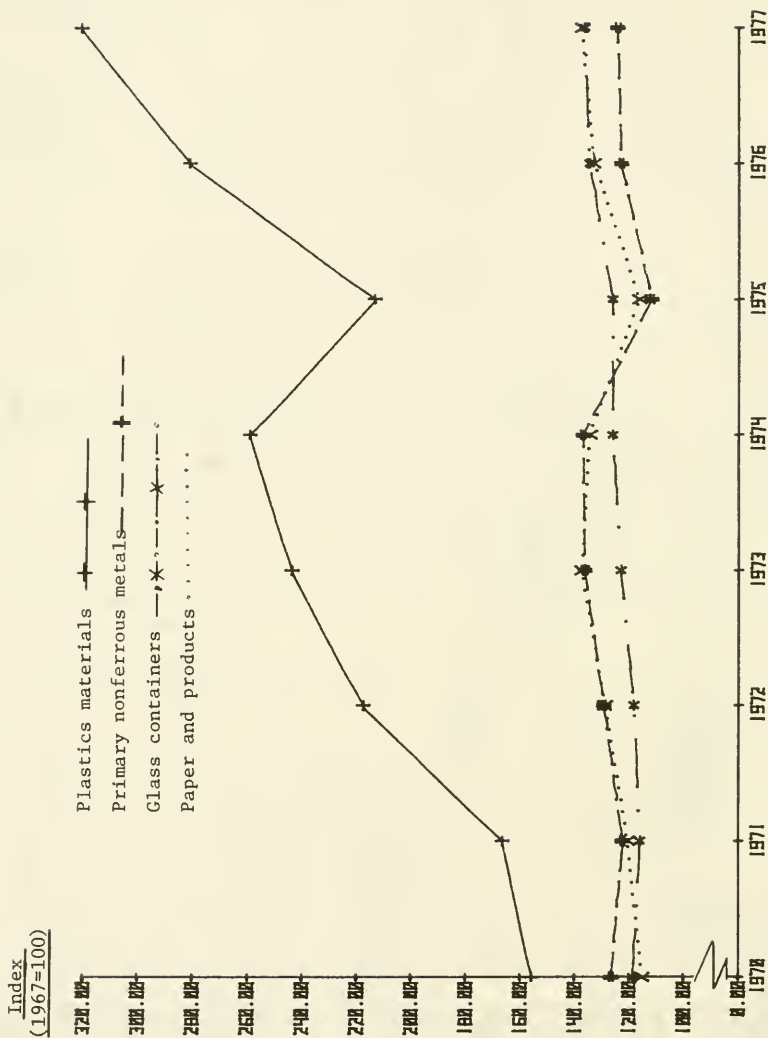
5/ U.S. Department of Commerce, U.S. Industrial Outlook 1978, p. 91.

VIII -- PLASTICS AND RESIN MATERIALS



Source: Production and sales, U.S. International Trade Commission, Synthetic Organic Chemicals, United States Production and Sales.

Indexes of industrial production 1/ of plastics and resins and selected competitive materials, 1970-77.





## PLASTICS AND RESIN MATERIALS

Edward Taylor

Plastics and resin materials are high molecular weight polymers which, at some stage in their manufacture, exist in such physical condition that they can be shaped or otherwise processed by the application of heat and pressure. The terms "plastics," "resin," and "polymers," can be (and often are) used interchangeably by the trade. Depending on the chemical composition, manufacturing process or intended use, the commercial products may contain plasticizers, fillers, extenders, stabilizers, coloring agents, or other additives. There are about 40 to 50 basic plastics and resins which are available commercially. These basic materials are available in literally thousands of individual compounds each with its distinct properties depending on the molecular weight of the resin and the types and amounts of the additives present. Plastics materials may be molded, cast, or extruded into semi-finished or finished solid forms. Resin materials may be in the form of solutions, pastes, or emulsions for applications such as protective coatings, adhesives, or paper and textile treatment.

Statistics on U.S. production and sales of synthetic plastics and resin materials for 1977 are given in table 1. U.S. production of plastics and resin materials in 1977 totaled 34,623 million pounds, or 15.5 percent more than the 29,989 million pounds<sup>1</sup> produced in 1976. Sales in 1977 totaled 29,799 million pounds, valued at \$10,882 million compared with 25,050 million pounds,<sup>1</sup> valued at \$8,785 million<sup>1</sup> in 1976.

Thermosetting materials are those which harden with a change in composition in the final treatment so that in their final state as finished articles they are substantially infusible and insoluble, that is, they cannot again be softened by heat or solvents. U.S. production of thermosetting materials totaled 7,129 million pounds in 1977 compared with 5,970 million pounds in 1976. Production of the most important products in 1977 included phenolic resins (1,797 million pounds), amino (or urea and melamine) resins (1,361 million pounds), polyester resins, (unsaturated) (1,018 million pounds) and alkyd resins (753 million pounds).

Thermoplastic materials are those which in their final states as finished articles can be repeatedly softened by heat and hardened by a decrease in temperature. U.S. production of thermoplastic materials totaled 27,494 million pounds in 1977 compared with 24,020 million pounds<sup>1</sup> in 1976. Production of the most important products in 1977 included polyethylene (10,100 million pounds), vinyl resins (6,438 million pounds), and styrene type materials (5,203 million pounds).

---

<sup>1</sup> Certain of the 1976 data have been revised. See footnote 1, table 1 for details.

TABLE 1.--PLASTICS AND RESIN MATERIALS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>

[Quantities and values are given in terms of the total weight of the materials (dry basis). Listed below are all plastics and resin materials, urethane type elastomers, and certain precursors for which any reported data on production or sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published or where no data were reported.] Table 2 lists all products for which data on production and/or sales were reported and identifies the manufacturers of each]

PLASTICS AND RESIN MATERIALS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>2</sup>
	1,000	1,000	1,000	
	pounds	pounds	dollars	Per
	dry basis <sup>3</sup>	dry basis <sup>3</sup>		pound
Grand total-----	34,623,041	29,799,004	10,881,823	\$0.37
Plastics and resin materials, benzenoid <sup>4</sup> -----	10,802,389	9,444,644	4,275,111	.45
Plastics and resin materials, nonbenzenoid-----	23,820,652	20,354,360	6,606,712	.32
THERMOSETTING RESINS				
Total-----	7,129,280	5,598,603	2,287,028	.41
Alkyd resins, total-----	753,363	434,347	189,499	.44
Phthalic anhydride type-----	637,222	374,974	163,023	.43
Polybasic acid type-----	54,820	33,163	14,940	.45
Styrenated-alkyds or copolymer alkyds-----	38,227	21,901	9,143	.42
Other copolymer alkyds-----	23,094	4,309	2,393	.56
Dicyandiamide resins-----	1,973	1,840	1,796	.98
Epoxy resins: <sup>5,6</sup>				
Unmodified-----	261,283	273,580	233,571	.85
Advanced-----	(79,311)	(52,286)	(54,621)	1.04
Melamine-formaldehyde resins (an amino resin)-----	198,119	162,938	93,968	.58
Phenolic and other tar acid resins-----	1,797,128	1,390,702	546,973	.39
Polyester resins, unsaturated <sup>7</sup> -----	1,017,970	866,434	351,476	.41
Polyether and polyester polyols for urethanes <sup>8</sup> -----	1,572,357	1,154,269	432,663	.37
Polyurethane elastomer and plastic products, total-----	255,006	188,116	187,837	1.00
Elastomers <sup>9</sup> -----	92,244	79,009	105,665	1.34
Plastics-----	162,762	109,107	82,172	.75
Silicone resins-----	18,348	11,348	31,403	2.77
Urea-formaldehyde resins (an amino resin)-----	1,162,853	1,045,287	169,994	.16
Other thermosetting resins <sup>10</sup> -----	90,880	69,742	47,848	.69
THERMOPLASTIC RESINS				
Total-----	27,493,761	24,200,401	8,594,795	.36
Acrylic resins, total <sup>11</sup> -----	967,155	...	...	...
Polymethyl methacrylate-----	355,137	...	...	...
Thermosetting acrylics-----	30,770	5,172	3,678	.71
Other acrylics-----	581,248	...	...	...
Cellulose plastics <sup>11</sup> -----	356,367	228,329	190,996	.84
Engineering plastics <sup>12</sup> -----	524,995	415,802	428,107	1.03
Petroleum hydrocarbon resins-----	333,540	332,257	78,477	.24
Polyamide resins, total-----	284,950	257,948	300,199	1.16
Nylon type <sup>11,13</sup> -----	244,365	218,285	246,905	1.13
Non-nylon type-----	40,585	39,663	53,294	1.34
Polyester resins, saturated <sup>11,14</sup> -----	384,054	216,010	272,246	1.26
Polyethylene resins, total-----	10,100,116	9,199,437	2,610,435	.28
Density 0.940 and below-----	6,494,273	5,804,039	1,660,254	.29
Density over 0.940-----	3,605,843	3,395,398	950,181	.28
Polypropylene resins-----	2,705,831	2,212,005	629,522	.28
Polyterpene resins-----	14,485	14,117	6,561	.46
Polytetrafluorethylene (PTFE)-----	18,459	14,242	54,735	3.84

See footnotes at end of table.

TABLE 1.--PLASTICS AND RESIN MATERIALS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>--CONTINUED

PLASTICS AND RESIN MATERIALS	PRODUCTION	SALES		
		QUANTITY	VALUE	PER VALUE <sup>2</sup>
	1,000 pounds	1,000 pounds	1,000	Per pound
	dry basis <sup>3</sup>	dry basis <sup>3</sup>	dollars	
THERMOPLASTIC RESINS--Continued				
Rosin modifications, total-----	46,925	47,081	19,833	\$0.42
Rosin esters, unmodified (ester gums)-----	20,829	21,485	8,222	.38
Rosin esters, modified-----	26,096	25,596	11,611	.45
Styrene plastics materials, total-----	5,203,024	5,031,021	1,752,096	.35
Acrylonitrile-butadiene-styrene terpolymer (ABS) resins-----	1,108,130	1,091,198	519,197	.48
Styrene-acrylonitrile copolymer (SAN) resins-----	141,424	...	...	...
Straight polystyrene-----	2,196,169	2,064,231	577,985	.28
Rubber modified polystyrene-----	1,013,776	1,007,776	270,098	.27
Styrene-butadiene latexes-----	481,603	473,215	169,646	.36
All other styrene latexes-----	46,990	46,102	14,530	.32
All other styrene plastics materials <sup>15</sup> -----	214,932	348,499	200,640	.58
Vinyl resins, total <sup>16</sup> -----	6,438,458	5,364,642	1,638,431	.31
Polyvinyl acetate <sup>17</sup> -----	768,563	686,196	254,555	.37
Polyvinyl alcohol <sup>18</sup> -----	138,717	116,933	78,117	.67
Polyvinyl chloride and copolymers-----	5,267,291	4,363,441	1,155,251	.26
Polyvinylidene chloride latex resins-----	20,686	...	...	...
Other vinyl and vinylidene resins-----	243,201	198,072	150,508	.76
All other thermoplastic resins <sup>19</sup> -----	115,402	862,338	609,479	.71

<sup>1</sup> Certain data have been revised for 1976. These revisions are summarized below:

PLASTICS AND RESIN MATERIALS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE
	1,000 pounds	1,000 pounds	1,000	Per pound
	dry basis	dry basis	dollars	
Grand total-----	29,989,431	25,050,206	8,784,700	\$0.35
Thermoplastic resins, total-----	24,019,587	20,369,586	6,906,238	.34
Engineering resins-----	378,226	290,716	239,471	.82
Polyester resins, saturated-----	131,585	84,185	90,697	1.08

<sup>2</sup> Calculated from rounded figures.

<sup>3</sup> Dry weight basis unless otherwise specified. Dry weight basis is the total weight of the materials including resin and coloring agents, extenders, fillers, plasticizers, and other additives, but excluding water and other liquid diluents unless they are an integral part of the materials.

<sup>4</sup> Includes benzenoid plastics and resin materials as defined in part 1 of schedule 4 of the Tariff Schedules of the United States; also includes urethane type elastomers which are not defined in part 1 of schedule 4 of the TSUS.

<sup>5</sup> Includes reactive diluents which are an integral part of the resin. Excludes the weight hardeners sold in association with the resin as part of a two-component system.

<sup>6</sup> Data shown for advanced epoxy resins are that part of the unmodified epoxy resins which is further processed; therefore, the totals in parentheses are not included in the grand total.

<sup>7</sup> Polyester resins are unsaturated alkyd resins, later to be copolymerized with a monomer (such as styrene or methyl methacrylate), and polyallyl resins (such as diallyl phthalate and diglycol carbonate). Data are on an "as sold" basis, including monomer if part of the resin system.

<sup>8</sup> In addition to the polyols, the other principal starting materials used in the production of urethane products are the isocyanic acid derivatives, mainly the 80/20 mixture of toluene-2,4- and 2,6-diisocyanate. Statistics for the isocyanic acid derivatives are reported in the "Cyclic Intermediates" section of the Synthetic Organic Chemicals report.

<sup>9</sup> The data on urethane elastomers are believed to be not fully representative of the total urethane market in view of the very large number of urethane elastomer producers.

<sup>10</sup> Includes acetone-formaldehyde resins, furfuryl type resins, polybutadiene resins and certain other thermo-setting resins.

<sup>11</sup> Does not include production or sales for fiber use.

<sup>12</sup> Engineering plastics: Includes acetal, polycarbonate, polyimide and amide-imide polymers, polysulfone, and polyphenylene oxide, and polyphenylene sulfide. Engineering plastics are defined in Whittington's Dictionary of Plastics, as "those [plastics] which have mechanical, chemical and thermal properties suitable for use in construction, machine components and chemical processing equipment." The above list of plastics (all of which are thermoplastic) was selected from a larger group in this source. The other plastics named in Whittington's Dictionary as engineering plastics, ABS resins and nylon resins, are not included in the above list as they are published separately.



## Footnotes--Continued

<sup>13</sup> Statistics for nylon 6 and nylon 6/6 which are used in plastic applications (e.g., molding, etc.) are included here.

<sup>14</sup> Statistics are included here for polyethylene terephthalate used in plastics applications (e.g., molding, etc.).

<sup>15</sup> Includes data for styrene-acrylonitrile copolymer (SAN) resins (sales only),  $\alpha$ -methyl styrene polymers, and all other styrene copolymers.

<sup>16</sup> Data are on the basis of dry resin content, excluding the weight of plasticizers, extenders, fillers, coloring agents, stabilizers, or impact modifiers, unless otherwise noted.

<sup>17</sup> Data for polyvinyl acetate produced and sold in latex form includes the weight of any protective colloids which are used as emulsion stabilizers and form an integral part of the resin system. Production and sales do not include polyvinyl acetate used as a reactive intermediate for polyvinyl alcohol or other vinyl resins.

<sup>18</sup> Production and sales do not include polyvinyl alcohol used as a reactive intermediate for polyvinyl butyral or other vinyl resins.

<sup>19</sup> Includes acrylic resins (sales only), coumarone-indene resins, fluorocarbon resins except PTFE, polybutylene type resins, polyphenyl aromatic ester resins, and other thermoplastics materials.

Note.--Data reported to the U.S. International Trade Commission do not necessarily coincide with that reported to the Society of the Plastics Industry (SPI) because of differences in both the reporting instructions and in the coverage of certain resins.

TABLE 2.--PLASTICS AND RESIN MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977

(CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (*). CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "M" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT. COMPANY IDENTIFICATION CODES WHICH ARE FOLLOWED BY AN "EY" ARE SO LABELED BECAUSE THE COMPANY FAILED TO SUPPLY THE U.S. INTERNATIONAL TRADE COMMISSION WITH THEIR DATA IN SUFFICIENT TIME FOR ITS INCLUSION IN THIS REPORT. THE COMPANY IS PRESUMED TO HAVE CONTINUED PRODUCTION OF THE COMPOUND IN QUESTION IN 1977 AND THE VOLUME OF PRODUCTION AND SALES HAS BEEN ESTIMATED BY THE USITC STAFF MEMBERS)	
PLASTICS AND RESIN MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Acetone-formaldehyde resins	ACY, AEP, PFG.
*ALKYD RESINS:	
*alkyd copolymers,all other	DCO, FLW, GEI, MCC, PFG, REL, SCM, STT, SW.
*phthalic anhydride type alkyd resins	ACS, AFT, ASH, AYS, BAL, BEN, BRU, CEL, CGL, CNE, CPV, DEG, DSO, DUP, EM, FAR, FLN, FOC, FRE, GEL, GIL, GRV, HAN, ICF, IHC, JOB, JSC(E), KMC, KRP, KPT, MCC, MID, HRP, NPV, OBC, PER, PFG, PFI, RCI, RED, REL, RH, BSI, SCB, SCM, SED, SKI, SB, STI, SW, X.
*polybasic acid type alkyd resins	ACI, ASH, AYS, BEN, CEL, CGL, DGO, EM, FAR, FOC, GEI, GRV, HAN, ICF, AUCI, OCP, RCI, SBT, SW.
*styrenated-alkyds, or copolymer alkyds	AP, ASH, CGL, CNE, CPV, DSO, EM, FLW, PFG, GRV, HAN, ICF, JOB, KPT, MCC, REL, SCM, SH, STI, SW.
AMINO RESINS:	
*melamine-formaldehyde resins	ACS, ACY, AMP, BOB, CBD, CEL, CGL, CNE, CPV, DAN, DGO, DSO, DUP, EM, GE, GRV, HAN, JSC(E), KPT, MID, MON, OCF, PFC, PFG, PFI, OCP, RCI, REL, RH, SCM, SED, S, SM, STC, USM, VAL, WBD.
*Urea-formaldehyde resins	ACS, ACY, AMP, APX, BOB, CBD, CBN, CEL, CGL, CMP, CNE, CPV, DAN, DSO, DUP, GAP, GOC, GR, HNC, HRT, IBI, JSC(E), KPT, MM, MON, NTC, PC, PFC, PPG, PPI, RCI, REL, RH, RPC, SAC, SCH, SM, SW, UNO, USM, USO, VAL, VPC, X, X.
*Dicyandiamide resins	APX, ECC, JSC(E), RPC, S, SM, STC, DSH, VAL, VPC.

TABLE 2.--PLASTICS AND RESIN MATERIALS FOR WHICH U.S. PRODUCTION AND/OB SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PLASTICS AND RESIN MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
THERMOSETTING RESINS--Continued	
EPoxy RESINS:	
*Epoxy resins, advanced--	ACS, ASH, AZS, BEN, CEL, CGY, CNI, DSO, EW, GE, GRV, HFC, ICF, MCC, MID, MME, MHT, APV, OCF, FCL, PFG, CEL, SCH, SCN, SH, STT, WM(E).
*Epoxy resins unmodified--	CEL, GGI, DA, DOM, ICF, JOB, BCI, SHC, SM, UCC.
Purified type resins--	AGR, BVG, SIC, UNO, MBD.
*Phenolic and other tar acid resins--	ABS, ACR, ACS, AME, ASH, BME, BOR, CBD, CBM, CGL, CLK, DN, DER, ENJ, EA, FAR, FOH, GEI, GEL, GLL, GOC, GP, HG, HER, HED, HFC, HVG, ICF, ENL, HRI, RFI, RGA, RAB, RCH, RCM, RE, BCI, OCF, ELS, PFG, EPL, PFC, BAB, SCN, CGY, BH, SCN, SHS, SKI, SH, SPL, STC, UCC, UNO, USR, PFC, YSI, YCA, YRD.
Polybutadiene resins--	ATR, CGL, CNT.
POLYESTER RESINS, UNSATURATED, AND ALLYL RESINS:	
*Polyester resins, unsaturated--	ACS, FMP(E), PPG. ACS, AW, APH, APT, ASH, AZS, CEL, CNE, CPV, DA, DOH, DSO, EW, FMP, FFE, GEI, GPG, ICF, ICI, IPC, KAC, KFT, MCC, MFG, MRB, MRO, OCP, POL, PPG, EPI, RCI, RH, BSC, SCN, SCN, SHC, SIL, SLC, SM, SH, ACI, RH, APT, ARK, BAS, CHC, CPV, DOM, DSO, FRE, GPM, HPC, ICF, ICI, UCC, MMH, MOB, WTL, OCF, OMC, PPG, RCI, SKT, UCC, UNO, UPJ, WTC.
*Polyether and polyester polyols for urethanes--	ACV, BAS, BFG, CNI, CWN, DNS, DUP, EPI, INP, MMM, MOB, MHT, PFP, PLN, PPG, PBC, PRT, BEZ, RUB, TKL, UPJ, USR, WTC.
*POLYURETHANE ELASTOMER AND ELASTIC PRODUCTS:	
*Polyurethane elastomers--	APJ, ASH, BAS, CGL, CPV, DSO, DUP, EW, FAR, ICF, ICI, JOB, KMC, MCC, MID, MNP, NTL, OMC, PFP, PCL, PPG, PVI, QUN, RCI, SCH, SCN, SLC, SW, TMO, UPJ, USM, USR, WLN(E), WTC.
*Silicone resins--	ASH, CGL, DCC, JOB, MID, RCI, SCN, SM, SPD, SWS.
Thermosetting resins,benzenoid,all other--	APX, SW, USO.
Thermosetting resins,benzenoid,all other--	GEI, MOB, MON, PPZ, S, SCH, SED, SM, VAL.

TABLE 2.--PLASTICS AND RESIN MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PLASTICS AND RESIN MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
-----	
THERMOPLASTIC RESINS	
-----	
*ACRYLIC RESINS:	
*Acrylic resins, all other--	ACY, AZS, CHF, CYR, DSO, DUP, EKH, GIC, GNM, GRD, ICF, SAG, PSC(E), MID, OBC, PPO, PRT, PVI, PIC, RH, SAR, SCS, SM, SW, TX, UBS, VPC.
Ethyl acrylate butyl acrylate copolymer--	QUB, VAL.
*Polymethyl methacrylate--	ASH, CNE, DSO, DUP, ICE, IOC, JOB, MRT, PFG, PVI, PIC, SM, SNA, SNW, SOR, SRE, SKL.
*Thermosetting acrylics--	CPY, DSO, GRV, ICF, MID, PFC, SCH, USM.
*CELLULOSE PLASTICS AND RESINS:	
Cellulose nitrate--	DUP, HPC.
Cellulose plastics, all other--	DCM, DUP, EKT, HPC, ICF, PPG.
Chlorinated polyolefins, thermoplastic--	EKK.
Conmarone-indene resins--	DUP, HPC, NEV, VEL.
*ENGINEERING PLASTICS:	
Acetal resins--	CEL, DUP, FLH.
Polycarbonate resins--	GE, MOB.
Polyimides and amide-imide polymers--	ACC, DUP, EM, MON, PDI.
Polyphenylene oxide type resins--	GE.
Polyphenylene sulfide resins--	PLC.
Poly sulfone resins--	UCC.
FLUOROCARBON RESINS:	
Chlorotrifluoroethylene resins--	ACS.
*Polytetrafluoroethylene (PTFE)--	ACS, DUP, ICL.
Fluorocarbon resins, all other--	DUP, PAS.
*Petroleum hydrocarbon resins--	EKK, ENJ, GRV, GYR, HPC, ICF, NEV, NPV, BCI, SCM, SM, VEL, ZGL.
*POLYAMIDE RESINS:	
*Non-nylon type, polyamide resins--	AMP, AZS, CBV, COO, DEG, EHR, GNM, HAL, RSN, SM, SNA, USM.
*Nylon type, polyamide resins--	ALF, BCM, CEL, CTR, DGO, DUP, FG, FR, GNM, MON, POL, USM.
Polybutylene type resins--	ENJ, WTC.
*Polyester resins, saturated--	CEL, COO, DEG, DGO, DSO, DUP, EKT, GAF, G5, GRV, GYR, ICF, ICI, MCC, MID, MMH, MRT, RUB, SCH, SED, STT, SW, USM.
*POLYETHYLENE AND COPOLYMERS RESINS:	
*Polyethylene resins, high density (density over 0.940)--	ACC, ACS, CPX, DOM, DUP, GOC, HPC, KPP, MON, PLC, SLT, UCC, USI.
*Polyethylene resins, low density (density of 0.940 and below)--	ACS, CBN, CPX, DON, DUP, EKK, ENJ, GOC, KPP, NWP, PLC, ACC, RH, UCC, UOI.

TABLE 2.--PLASTICS AND RESIN MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PLASTICS AND RESIN MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
THERMOPLASTIC RESINS--Continued	
Polyphehyl aromatic ester resins	HFC.
*Polypropylene polymer and copolymer resins	ACC, ERX, ENJ, HPC, KPP, NVT, PLC, RCC, SHC.
*Polycarbonate resins	CBY, HPC, SCN.
*ROBIN MODIFICATIONS:	
Modified resin (unesterified)	DPP.
*Resin esters, unmodified (ester gums)	ASH, CBY, DPP, EM, FCD, FRP, GBV, ICF, MCC, RCI, SCM, SH, STC, SW, T-L.
*STYRENE TYPE PLASTICS MATERIALS:	
*Acrylonitrile-butadiene-styrene (ABS) Terpolymer	BFG, CSD, DOM, FRS, GRD, GYR, MCB, MON, RCC, USB.
*Methyl styrene polymers	ACC, DOM.
*Styrene-acrylonitrile copolymer resins (SAN)	BFG, CSD, DOM, MON, SKT, DCC.
POLYSTYRENE:	
*Rubber modified polystyrene	DOM, GOR, KPP, MON, SHC, SOL, USS.
*Straight polystyrene	ACC, REF, ASI, BAS, CSD, DOM, FG, GAF, GOR, JSC(E), KPP, MON, RAC, RCD, SHC, SOL, UCC, USS.
Styrene copolymers, all other	ATP, BFG, CO, DAD, DOM, DSO, DUP, GRD, GYR, HPC, IOC, JMS, MM, ON, PERI, UBC, FLC, FVI, FCC, RCD, SH, SED, SKT, SW, TRL, UBS.
STYRENE LATEXES:	
*Styrene-butadiene latexes	BOR, CEL, DOM, DSO, GAF, GNT, GRD, GYR, KPP, UOC, USB.
*all other Styrene latexes	BFG, DOM, FIR, GM, GRD, MON, UCC.
*VINYL RESINS:	
*Polyvinyl acetate resins	AIP, AZS, BAL, BEN, BLS, BOR, CEL, CME, DAN, FAR, FLH, FILM, GLC, GRD, JOE, JSC(E), KMC, KME, KNE, MCE, MON, NSC, OBC, OCP, RCI, RPC, SCH, SCO, SED, SW, UBS, UCC, X.
*Polyvinyl alcohol resins	AIP, DUP, MON.
Polyvinyl butyral resins	DUP, MON, UBS, UCC.
*Polyvinyl chloride and copolymer resins	AIP, BFG, BOR, CO, CPR, DA, FIR, GNT, GP, GRA, GYR, HN, KYS, NSC, PNT, RBT, RCO, RUB, SPP, SHT, TWA, UCC.
Polyvinyl formal resin	MON.

TABLE 2.--PLASTICS AND RESIN MATERIALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PLASTICS AND RESIN MATERIALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
THERMOPLASTIC RESINS--Continued	
*VINYL RESINS--Continued	
Vinyl acetate-acrylate copolymers--	: DSO, FLW, NFW.
Polyvinylidene chloride latex type resins--	: BGS, DM, GMD, HRT.
Vinyl and vinylidene resins, all other--	: DGS, DPF, EW, RH, UCC.
Thermoplastic resins, nonbenzoid, all other--	: DSB, SW.
Thermoplastic resins, benzoid, all other--	: DGO, RPC.

TABLE 3.--PLASTICS AND RESIN MATERIALS: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of plastics and resin materials to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
ABS	Abex Corp., Friction Products Group	DOW	Dow Chemical Co.
ACC	Amoco Chemicals Corp.	DPP	Dixie Pine Chemicals, Inc.
ACR	CPC International, Inc., Acme Resin Corp.	DSO	DeSoto, Inc.
ACS	Allied Chemical Corp., Specialty Chemical Div.	DUP	E.I. duPont de Nemours & Co., Inc.
ACY	American Cyanamid Co.		
AEP	A & E Plastics Pak Co., Inc.	ECC	Eastern Color & Chemical Co.
AIP	Air Products & Chemicals, Inc.	EFH	E.F. Houghton & Co.
ALF	Allied Chemical Corp., Fibers Div.		Eastman Kodak Co.:
AMR	Pacific Resins & Chemical Co.	EKT	Tennessee Eastman Co. Div.
APT	Whittaker Corp., Whittaker Coatings & Chemical, Mol Rez Resins	EKX	Texas Eastman Co. Div.
APX	Apex Chemical Co., Inc.	EMR	Emery Industries, Inc.
ARK	Armstrong Cork Co.	ENJ	Exxon Chemical Co. U.S.A.
ASH	Ashland Oil, Inc., Ashland Chemical Co. Div.	EPI	Eagel Pitcher Industries, Inc., Ohio Rubber Co.
ASY	American Synthetic Rubber Corp.	EW	Westinghouse Electric Corp., Industrial Materials Div.
ATR	Atlantic Richfield Co.		
AZS	AZS Corp.:		
	AZ Products Co. Div.	FAR	Syncon, Inc.
	AZS Chemical Co.	PCD	Synres Chemical Corp.
BAL	Baltimore Paint & Chemical Corp.	FG	Foster Grant Co., Inc.
BAS	BASF Wyandotte Corp.	FIR	Firestone Tire & Rubber Co., Firestone Plastics Co. Div.
BCM	Belding Chemical Industries		
BEN	Bennett's	FLH	H.B. Fuller Co.
BFG	B.F. Goodrich Co., B.F. Goodrich Chemical Co. Div.	FLN	Franklin Chemical Corp.
BLS	Life Savers, Inc.	FLW	O'Brien Corp., Fuller-O'Brien Div.
BME	Bendix Corp., FMD Div.	FMC	FMC Corp., Industrial Chemical Div.
BOR	Borden Co., Borden Chemical Co. Div.	FMP	Handschy Chemical Co., Farac Oil & Chemical Co. Div.
BRU	M.A. Bruder & Sons, Inc.	FOC	Formica Corp.
		FOM	Freeman Chemical Corp.
		FRF	Firestone Tire & Rubber Co., Firestone Synthetic Fibers Co.
CBD	Chembond Corp.	FRP	FRP Company
CBM	Carborundum Co.	FRS	Firestone Tire & Rubber Co., Firestone Synthetic Rubber & Latex Co. Div.
CBN	Cities Service Co., Petrochemicals Div.		
CBY	Crosby Chemicals, Inc.	CAF	CAF Corp..
CEL	Calanese Corp.:	GE	General Electric Co.:
	Calanese Plastics Co.	CEI	Insulating Materials Products Sec.
	Calanese Polymer Specialties Co.	CIL	Gilman Paint & Varnish Co.
CGL	Cargill, Inc.	GLC	General Latex & Chemical Corp.
CCY	Ciba-Geigy Corp., Resins Dept.	CNM	General Mills Chemicals, Inc.
CHC	Carpenter Chemical Co.	GNT	General Tire & Rubber Co., Chemical Plastics Div.
CHP	C.H. Patrick & Co., Inc.	COC	Gulf Oil Corp., Gulf Oil Chemicals Co.-U.S.
CLK	Clark Chemical Corp.	COR	Carl Gordon Industries, Inc.
CMP	Commercial Products Co., Inc.	CP	Georgia-Pacific Corp.:
CNE	Conchemco, Inc.		Plaquemine Div.
CNI	Conap, Inc.		Resins Operations
CNT	Certainteed Corp.	GPM	General Plastics Manufacturing Co.
CO	Continental Oil Co.	GRA	Great American Chemical Corp.
COO	The Tarrell Corp.	GRD	W.R. Grace & Co., Polymers Chemicals Div.
CPV	Cook Paint & Varnish Co.	GRG	P.D. George Co.
CPX	Chemplex Co.	GRV	Guardman Chemicals, Inc.
CSD	Cosden Oil & Chemical Co.	GYR	Goodyear Tire & Rubber Co.
CTR	Customs Resins, Inc.		
CWN	Upjohn Co., Fine Chemical Div.	HAL	C.P. Hall Co.
CYR	CY/RO Industries, Inc.	HAN	Hanna Chemical Coating Corp.
		HER	Heresite & Chemical Co.
DA	Diamond Shamrock Corp.	HKD	Hooker Chemicals & Plastics Corp, Durez Div.
DAN	Dan River, Inc., Chemical Products Dept.		
DCC	Dow Corning Corp.		
DEG	Degan Oil & Chemical Co.		
DGO	Day-Glo Color Corp.		
DNS	Dennis Chemical Co.		

TABLE 3.--PLASTICS AND RESIN MATERIALS: DIRECTORY OF MANUFACTURERS, 1977--CONTINUED

Code	Name of company	Code	Name of company
HN	Tenneco Chemicals, Inc.	PhR	Perry & Derrick Co.
HNC	H & N Chemical Co.	PPF	Midwest Manufacturing Corp.
HPC	Hercules, Inc.	PLC	Phillips Petroleum Co.
HRT	Hart Products Corp.	PLN	Disogrin Industries Corp.
HVG	Haveg Industries, Inc. Sub of Hercules, Inc.	PLR	Polysar Resins, Inc.
HYC	Dexter Corp., Hysol Co. Div.	PLS	Plastics Engineering Co.
ICF	Inmont Corp.	PMC	Plastics Manufacturing Co.
ICI	ICI United States, Inc.: Plastics Div. Chemical Specialties Co.	PNT	Pantasote Co.
IMC	IMC Chemical Group, Inc., McWorther Resins	POL	Polymer Corp.
INL	Inland Steel Co., Inland Steel Container Co. Div.	PPG	PPG Industries, Inc.
INP	Indopol, Inc.	PPL	Pioneer Plastics Div. of LOF Plastics, Inc.
IOC	Ionac Chemical Co. Div. of Sybron Corp.	PRC	Products Research & Chemical Corp.
IPC	Interplastic Corp.	PRT	Pratt & Lambert, Inc.
IRI	Ironsides Resins, Inc.	PVI	Polyvinyl Chemical Ind.
JCC	Jefferson Chemical Co.	PYC	Polycast Technology Corp.
JNS	S.C. Johnson & Sons, Inc.	PYZ	Polyrez Co., Inc.
JOB	Jones-Blair Paint Co.	QCP	Quaker Chemical Corp.
JSC	Jersey State Chemical Co.	QUN	K.J. Quinn & Co., Inc.
JWC	J.W. Carroll & Sons Div. of U.S. Industries, Inc.	RAB	Raybestos-Manhattan, Inc., RM Friction Materials Co. Div.
KMC	Kohler-McLister Paint Co.	RBT	Robintech, Inc.
KMP	Kelly-Moore Paint Co.	RCC	Rexene Polyolefins Co.
KPP	Arco/Polymers, Inc.	RCC	Rexene Styrenics Co.
KPT	Koppers Co.	RCD	Richardson Co., Polymeric Systems Div.
KYS	Keysor Corp.	RCI	Reichhold Chemicals Inc. and Reichhold Polymers Inc.
MCA	Masonite Corp., Alpine Div.	RCO	Rico Chemical Corp.
MCB	Borg-Warner Corp., Borg-Warner Chemicals	RED	Red Spot Paint and Varnish Co., Inc.
MCC	McCloskey Varnish Co.	REL	Reliance Universal, Inc., Louisville Resins Operations
MCC	McCloskey Varnish Co. of the Northwest	REZ	Hexcel Corp.
MCC	McCloskey Varnish Co. of the West	RGC	Rogers Corp.
MFC	Rockwell International Corp.	RH	Rohm & Haas Co.
MID	Dexter Corp., Midland Div.	RPC	A. Kewanee Industry, Millmaster Onyx Group, Refined-Onyx Co. Div.
MMV	Minnesota Mining & Manufacturing Co.	RSC	Resinous Chemicals Corp.
MSP	The Valspar Corp.	RSN	Rilsan Corp.
MOB	Mobay Chemical Co.	RSY	Resyn Corp.
MON	Monsanto Corp.	RUB	Hooker Chemical Corp., Ruco Div.
MRB	Marlette Co.	S	Sandoz, Inc.
MRO	W.R. Grace & Co., Hatco Polyester Div.	SAC	Southeastern Adhesives Co., Inc.
MRT	Morton Chemical Co. Div. of Horton Norwich Products, Inc.	SAR	Sartomer Industries, Inc.
NCI	Union Camp Corp.	SCH	SCM Corp.
NEV	Neville Chemical Co.	SCN	Schenectady Chemicals, Inc.
NPV	Norris Paint & Varnish Co., Inc.	SCO	Scholler Bros., Inc.
NSC	National Starch & Chemical Corp.	SED	Conchemco, Inc.
NTC	National Casein Co.	SFP	Stauffer Chemical Co., Plastics Div.
NTL	NL Industries, Inc.	SHC	Shell Oil Co., Shell Chemical Co. Div.
NVT	Novamont Corp.	SHT	Shintech, Inc.
NWP	Northern Petrochemical Co.	SIC	Vistron Corp., Silmar Div.
OBC	O'Brien Corp.	SIM	Simpson Timber Co., Chemicals Div.
OCF	Owens-Corning Fiberglas Corp.	SKT	Textron Inc., Spencer Kellogg Div.
OMC	Olin Corp.	SLC	Soluol Chemical Co., Inc.
PAS	Pennwalt Corp.	SLT	Soltex Polymer Corp.
PC	Proctor Chemical Co., Inc.	SM	Mobil Oil Corp., Mobil Chemical Co., Chemical Coatings Div.
PDI	Phelps Dodge Industries, Inc., Phelps Dodge Magnet Wire Co. Div.	SNW	Sun Chemical Corp., Chemicals Div.
		SOR	MW Manufacturers, Southern Resin Div.
		SPC	Insilco Corp., Sinclair Paint Co. Div.
		SPD	General Electric Co., Silicone Products Dept.
		SPL	Spaulding Fibre Co., Inc.



TABLE 3.--PLASTICS AND RESIN MATERIALS: DIRECTORY OF MANUFACTURERS, 1977--CONTINUED

Code	Name of company	Code	Name of company
STC	American Hoechst Corp., Sou-Tex Works	USM	USM Corp., Bostik Div.
STT	Standard T Chemical Co.	USO	U.S. Oil Co.
SW	Sherwin-Williams Co.	USR	Uniroyal, Inc., Uniroyal Chemical Div.
SWE	Swedcast Corp.	USS	USS Chemicals Div. of U.S. Steel Corp.
SWS	Stauffer Chemical Co., SWS Silicones Div.	VAL	Valchem Div. of United Merchants & Manufacturers, Inc.
TKL	Thiokol Corp.	VEL	Veliscol Chemical Corp.
TNA	Ethyl Corp.	VPC	Hobay Chemical Corp., Verona Div.
TNO	Trancoa Chemical Corp.	VSV	Valentine Sugars, Inc., Valite Div.
TX	Texaco, Inc.		
UBS	A.E. Staley Manufacturing Co., Chemicals Specialties Div.	WCA	West Coast Adhesives Co., Inc.
UCC	Union Carbide Corp.	WLN	Wilmington Chemical Corp.
UNO	United-Erie, Inc.	WRD	Weyerhaeuser Co.
UOC	Union Oil Co. of California	WTC	Witco Chemical Corp.
UPJ	Upjohn Co.		
USI	U.S. Industrial Chemicals Co.: National Distillers & Chemical Corp. National Petro Chemical Corp.	ZGL	Carolina Processing Corp.

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.



## RUBBER-PROCESSING CHEMICALS

David B. Beck

Rubber-processing chemicals are organic compounds that are added to natural and synthetic rubber to give them qualities necessary for their conversion into finished rubber goods. In this report, statistics are given for cyclic and acyclic compounds by use--such as accelerators, antioxidants, blowing agents, and peptizers. Data on production and sales of rubber-processing chemicals in 1977 are given in table 1.<sup>1</sup>

Production of rubber-processing chemicals as a group in 1977 amounted to 402 million pounds, or 4.7 percent more than the 384 million pounds in 1976. Sales of rubber-processing chemicals in 1977 amounted to 238 million pounds, valued at \$278 million, compared with 224 million pounds, valued at \$247 million, in 1976.

The production of cyclic rubber-processing chemicals in 1977 amounted to 356 million pounds, or 6.3 percent more than the 335 million pounds in 1976. Sales in 1977 were 202 million pounds, valued at \$249 million, compared with 186 million pounds, valued at \$218 million, in 1976. Of the total production of cyclic rubber-processing chemicals in 1977, accelerators, activators, and vulcanizing agents accounted for 39.8 percent and antioxidants, antiozonants, and stabilizers for 55.9 percent. Production of antioxidants, antiozonants, and stabilizers, which amounted to 198.7 million pounds in 1977, included 132.0 million pounds of amino compounds and 66.7 million pounds of phenolic and phosphite compounds. Sales of amino antioxidants, antiozonants, and stabilizers in 1977 amounted to 79.1 million pounds, valued at \$99.1 million; sales of phenolic and phosphite antioxidant, antiozonants, and stabilizers, were 38.2 million pounds, valued at \$43.6 million.

Production of acyclic rubber-processing chemicals in 1977 amounted to 46.5 million pounds, or 6.4 percent less than the 49.7 million pounds reported for 1976. Sales in 1977 totaled 35.8 million pounds, valued at \$29.0 million, compared with 37.9 million pounds, valued at \$28.6 million, in 1976. Dithiocarbamic acid derivatives accounted for 15.9 percent of sales (based on quantity) of acyclic rubber-processing chemicals in 1977 and bis-(dimethylthiocarbamoyl) disulfide accounted for 10.4 percent.

---

<sup>1</sup> See also table 2 which lists these producers and identifies the manufacturers by codes. These codes are given in table 3.



TABLE 1.--RUBBER-PROCESSING CHEMICALS: U.S. PRODUCTION AND SALES, 1977

[Listed below are all rubber-processing chemicals for which any reported data on production or sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published or where no data were reported.] Table 2 lists separately all rubber-processing chemicals for which data on production and/or sales were reported and identifies the manufacturers of each]

RUBBER-PROCESSING CHEMICALS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	402,013	238,084	277,765	\$1.17
CYCLIC				
Total-----	355,549	202,251	248,756	1.23
Accelerators, activators, and vulcanizing agents, total-----	141,354	71,794	82,465	1.15
Aldehyde-amine reaction products-----	732	620	1,041	1.68
Dithiocarbamic acid derivatives-----	243	162	547	3.37
Thiazole derivatives, total-----	132,107	62,307	64,937	1.04
N-Cyclohexyl-2-benzothiazolesulfenamide-----	...	2,315	3,041	1.31
2,2'-Dithiobis(benzothiazole)-----	19,530	7,353	6,847	.93
2-Mercaptobenzothiazole-----	...	5,994	3,828	.64
All other thiazole derivatives-----	109,035	46,645	51,221	1.10
All other accelerators, activators, and vulcan- izing agents <sup>2</sup> -----	8,272	8,705	15,940	1.83
Antioxidants, antiozonants, and stabilizers, total-----	198,664	117,292	142,673	1.22
Amino compounds, total-----	131,957	79,054	99,065	1.25
Aldehyde- and acetone-amine reaction products-----	77,007	5,518	5,713	1.04
Substituted p-phenylenediamines-----	54,955	31,382	31,024	.99
All other amino compounds-----	66,707	38,238	43,608	1.15
Phenolic and phosphite compounds, total-----	20,482	15,985	28,749	1.80
Polyphenolics (including bisphenols)-----	13,080	12,455	24,449	1.86
Phenol, alkylated-----	3,778	1,416	1,147	.81
Phenol, styrenated-----	...	855	502	.59
Other-----	3,624	1,259	2,651	2.11
Phosphite compounds-----	46,224	22,253	14,859	.67
Peptizers-----	2,222	...	...	...
Retarder: N-Nitrosodiphenylamine-----	1,469	679	722	1.06
All other cyclic rubber-processing chemicals <sup>4</sup> -----	11,840	12,486	22,896	1.83
ACYCLIC				
Total-----	46,464	35,833	29,009	.81
Dithiocarbamic acid derivatives, total <sup>5</sup> -----	8,302	5,687	8,559	1.50
Dimethyldithiocarbamic acid, zinc salt-----	502	440	356	.81
Dimethyldithiocarbamic acid, zinc salt-----	1,710	1,570	1,466	.93
All other dithiocarbamic acid derivatives-----	6,090	3,677	6,737	1.83
Bis(diethylcarbamoyl)disulfide-----	2,373	1,998	1,890	.95
Bis(dimethylthiocarbamoyl)disulfide-----	...	3,716	2,816	.76
Shortstops: Dimethyldithiocarbamic acid, sodium salt-----	3,455	1,420	596	.42
All other acyclic rubber-processing chemicals <sup>6</sup> -----	32,334	23,012	15,148	.66

<sup>1</sup> Calculated from rounded figures.

<sup>2</sup> Includes guanidines and other uses not separately shown.

<sup>3</sup> Includes aldehyde- and acetone-amine reactions products (production only).

<sup>4</sup> Includes blowing agents and other uses not separately shown.

<sup>5</sup> Data on dithiocarbamates included in this table are for materials used chiefly in the processing of natural and synthetic rubber. Data on dithiocarbamates which are used chiefly as fungicides are included in the report on "Pesticides and Related Products".

<sup>6</sup> Includes "other" thiurams, xanthates, sulfides, conditioning and lubricating agents, polymerization regulators, shortstops, and other uses not separately shown.

TABLE 2.---RUBBER-PROCESSING CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT.]

RUBBER-PROCESSING CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*ACCELERATORS, ACTIVATORS AND VULCANIZING AGENTS:	
*ALDERHYDE-MKWE REACTION PRODUCTS:	
Bis(cinnamylidene)hexamethylenediamine	DUP.
n-Butyraldehyde-aniline condensate	DUP, RCD.
Heptaldehyde-aniline condensate	USR.
Triethyltrimethylenetriamine	USR.
*DIETHOCARBAMIC ACID DERIVATIVES:	
Dibenzylidithiocarbamic acid, sodium salt	USR.
Dibenzylidithiocarbamic acid, zinc salt	USR.
Dibutylidithiocarbamic acid, N,N-dimethylcyclohexyl amine salt	REC.
Piperidinecarbonyldithioic acid, piperidinium potassium salts, mixed	DUP.
GUANIDINES:	
Dicacethol borate, di-o-tolylguanidine salt	DUP.
1,3-Diphenylguanidine	ACY.
1,3-Di-o-tolylguanidine	ACY.
*THIAZOLE DERIVATIVES:	
2-Benzothiazyl N,N-diethylthiocarbonyl sulfide	PAS.
1,3-Bis(2-benzothiazolyl)sercaptomethyl urea	LAF.
N-tert-butyl-2-benzothiazolesulfonamide	ACY, BFG, MON, USR.
*N-Cyclohexyl-2-benzothiazolesulfenamide	ACY.
N,N-disopropyl-2-benzothiazolesulfenamide	ACY.
2,5-Dimercapto-1,3,4-thiadiazole	VNC.
N-(2,4,6-Dimethylmorpholino)-2-benzothiazolesulfenamide	MON.

C Y C L I C

TABLE 2.--RUBBER-PROCESSING CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

RUBBER-PROCESSING CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C I C--Continued	
*ACCELERATORS, ACTIVATORS AND VULCANIZING AGENTS--	
Continued	
*THIAZOLE DERIVATIVES--Continued	
* 2, 2'-Dithiobis (Benzothiazole)	ACY, BFG, GYR, MON, USR.
* 2-Mercaptobenzothiazole	ACY, BFG, GYR, MON, USR.
2-Mercaptobenzothiazole, copper salt	ACY, BFG, GYR, MON, USR.
2-Mercaptobenzothiazole, zinc chloride	DUP.
2-Mercaptobenzothiazole, zinc salt	ACY, GYR, USR.
4-Morpholinyl 2-benzothiazyl disulfide	GYR.
N-Oxydiethylene-2-benzothiazolesulfenamide	ACY, BFG.
ALL OTHER CYCLIC ACCELERATORS, ACTIVATORS AND VULCANIZING AGENTS:	
Bis(morpholinothiocarbonyl) disulfide	ACY.
Di benzylamine	USR.
Dimethyl ethanolamine, toluene-2,4-diisocyanate adduct	DUP.
DI-, N'-Pentamethylenethiuram tetrasulfide	DUP, VMC.
4,4'-dithiodimorpholine	MON.
2-Isodazolidenethione (1,3-Ethylene-2-thiourea)	DUP, RBC.
8-Phenylensibisaleamide	DUP.
Poly-P-dinitrosobenzene	DUP.
tetramethylthiuram disulfide	DUP.
tetramethylthiuram tetrasulfide	GYR.
p-Toluenesulfonic acid, zinc salt	USR.
Accelerators, activators, and vulcanizing agents, cyclic, other	PAS.
*ANTIOXIDANTS, ANTIDEGRANTS AND STABILIZERS:	
*AMALDEHYDES:	
*ALDEHYDES AND ACETONE-AMINE REACTION PRODUCTS:	
Bisacryldehyde-aniline condensate	DUP.
Bisacryldehyde-amine condensate	ACY, BFG, USR.
Phenyl-2-saminacetone condensate	USR.
*SUBSTITUTED p-PHENYLENEDIAMINES:	
Alkylaryl-p-phenylenediamines	MON.
N,N'-Bis(1,4-dimethylphenyl)-p-phenylenediamine	MON, UFM, USR.
N,N'-Bis(1-ethyl-3-methylphenyl)-p-phenylenediamine	MON, UFM, USR.
N,N'-Bis(1-methylphenyl)-p-phenylenediamine	UFM.
N-Cyclohexyl-1-N-phenyl-p-phenylenediamine	BFG, UFM.
N-Cyclohexyl-1-N-phenyl-p-phenylenediamine	UFM, USR.

TABLE 2.--RUBBER-PROCESSING CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

RUBBER-PROCESSING CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C L C--Continued	
*ANTIOXIDANTS, ANTIOZONANTS, AND STABILIZERS--Continued	
*AMINO COMPOUNDS--Continued	
*SUBSTITUTED P-PHENYLENEDIAMINES--Continued	
Diarylenediamines, mixed	GYR.
N,N-Dicyclohexyl-p-phenylenediamine	UPM.
N-(1,3-Dimethylbutyl)-N-phenyl-p-phenylenediamine	GYR, UPM, USR.
N,N-Di-2-naphthyl-p-phenylenediamine	BFG.
N,N-Diphenyl-p-phenylenediamine	BFG, DUP, USR.
N-Isopropyl-N-phenyl-p-phenylenediamine	UPM.
N-(1-Ethylheptyl)-N-phenyl-p-phenylenediamine	UPM.
N-(1-Methylpentyl)-N-phenyl-p-phenylenediamine	UPM.
OTHER AMINES:	
p-Aminophenol	BFG.
1,2-Dihydro-6-dodecyl-2,2,4-trimethylquinoline	X.
1,2-Dihydro-6-stoxy-2,2,4-trimethylquinoline	X.
1,2-Dihydro-2,2,4-trimethylquinoline	BFG, X.
Diphenylamine, streated	GYR.
Diphenylamine, substituted	USR.
Diisopropylidiphenylamine	BFG.
4,4'-Methyldiphenylamine	USR.
Nonyldiphenylamine mixture (Mono-, di-, and tri-)	USR.
Octyldiphenylamine	USR.
Octyldiphenylamine, alkylated	ACL, USR.
Octyldiphenylamine mixtures (Mono-, nonyl-, and di-)	BFG.
N-Phenyl-1-naphthylamine	DUP.
N-Phenyl-2-naphthylamine	DUP, USR.
Toluenediamine (Mixed isomers)	BFG, DUP.
P-(p-Toluenesulfonamido)diphenylamine	USR.
*PHENOLIC AND PHOSPHITE COMPOUNDS:	
*POLYMERIC COMPOUNDS:	
*PHENOLENOLICS (INCLUDING BISPHENOLS):	
Bisphenol, hindered	GYR, USR.
4,4'-Butylidenebis(6-tert-butyl-m-cresol)	MON.
2,5-Di-sec-butylidicyclohexanone	USR.
2,5-Di-(1,1-dimethylpropyl)hydroquinone	X.
2,2'-Methylenebis(6-tert-butyl-p-cresol)	ACY.
2,2'-Methylenebis[6-tert-butyl-4-ethylphenol]	ACY.
2,2'-Methylenebis[6-(1-methylcyclohexyl)-p-cresol]	ACY, ICI.



TABLE 2.--RUBBER-PROCESSING CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED IDENTIFIED BY MANUFACTURER, 1977--Continued

RUBBER-PROCESSING CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C I C--Continued	
*ANTIOXIDANTS, ANTIIONOMANTS, AND STABILIZERS--Continued	
*PHENOLIC AND PHOSPHITE COMPOUNDS--Continued	
*PHENOLIC COMPOUNDS--Continued	
*POLYPHENOLICS (INCLUDING BISPHENOLS)--Continued	
4,4'-Thiobis(6-tert-butyl-m-cresol) - - - - -	X.
Thioisphenol, alkylated - - - - -	USR, X.
1,1,3-Tri(2-methyl-4-hydroxy-5-tert-butylphenyl)butane - - - - -	ICI.
ALL OTHER PHENOLIC	
o-Cresol, alkylated - - - - -	PIT.
*Phenol, alkylated - - - - -	ACY, BFG, GYR, NEV, RCI.
*Phenol, hindered - - - - -	DUP, USR.
*Phenol, styrenated, mixtures - - - - -	GYR, NEV, USR.
N-Stearoyl-p-aminophenol - - - - -	MLS.
Tris-(3,5-di-tert-butyl-4-hydroxybenzyl)iso-	
cyanurate - - - - -	X.
PHOSPHITE COMPOUNDS:	
Alkylaryl phosphites mixed - - - - -	MCB, X.
Nonylphenyl phosphites, mixed - - - - -	MCB, NPL, USR, X.
Polymeric phosphites - - - - -	MCB, NPL.
Polyphenolic phosphite, polyalkylated - - - - -	BFG, MCB.
Triaryl phosphites - - - - -	MCB.
ALL OTHER ANTIIONOMANTS, ANTIIONOMANTS, AND STABILIZERS:	
2-Mercaptobenzimidazole - - - - -	USR.
2-Mercaptobenzimidazole, zinc salt - - - - -	USR.
BLOWING AGENTS:	
Dinitrosopentamethylenetetramine - - - - -	NPL.
p,p'-Oxybis(benzenesulfonhydrazide) - - - - -	USR.
p-Toluenesulfonylsemicarbazide - - - - -	USR.
*PEPTIZERS:	
2,2',2''-Dithiobis(benzanilide) - - - - -	ACY.
Dialkyl disulfides, mixed - - - - -	PIT.
Xylenethiol - - - - -	DUP.
ALL OTHER CYCLIC RUBBER-PROCESSING CHEMICALS:	
p-tert-Amylphenol sulfide (Tackifier) - - - - -	PAS.
4-Chloro-2,6-bis(2,4-dihydroxybenzyl)phenol - - - - -	ICL.
N-(Cyclohexylthio)phthalimide - - - - -	X.
Diphenyl-4,4'-diphenylmethylenedicarbamate - - - - -	USR.

TABLE 2.--RUBBER-PROCESSING CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED IDENTIFIED BY MANUFACTURER, 1977--Continued

MANUFACTURERS' IDENTIFICATION CODES  
(ACCORDING TO LIST IN TABLE 3)

RUBBER-PROCESSING CHEMICALS

C Y C L I C--Continued

ALL OTHER CYCLIC RUBBER-PROCESSING CHEMICALS--

Continued

N-(2-Methyl-2-nitropropyl)-4-nitrosoaniline - - - - - MOM.  
 \*Nitrosodiphenylamine (Retarder) - - - - - ALC, BFG, GYR, USR.

A C Y C L I C

ACCELERATORS, ACTIVATORS AND VULCANIZING AGENTS:

\*DITHIOCARBAMIC ACID DERIVATIVES:  
 Dibutylthiocarbamic acid, nickel salt - - - - - DUP, USR.  
 Dibutylthiocarbamic acid, sodium salt - - - - - ALC, DUP, USR, VNC.  
 Dibutylthiocarbamic acid, zinc salt - - - - - ALC, PAS, VNC.  
 Dibutylthiocarbamic acid, zinc salt and bis-(diethylthiocarbamoyl) disulfide mixture - - - - - VNC.  
 Diethylthiocarbamic acid, selenium salt - - - - - PAS.  
 Diethylthiocarbamic acid, sodium salt - - - - - VNC.  
 Diethylthiocarbamic acid, tellurium salt - - - - - VNC.  
 Diethylthiocarbamic acid, zinc salt - - - - - ALC, GYR, VNC.  
 \*Dimethylammonium-dimethylthiocarbamate  
 Dimethylthiocarbamic acid, bismuth salt - - - - - USR.  
 Dimethylthiocarbamic acid, copper salt - - - - - VNC.  
 Dimethylthiocarbamic acid, lead salt - - - - - VNC.  
 Dimethylthiocarbamic acid, selenium salt - - - - - VNC.  
 Dimethylthiocarbamic acid, sodium salt and sodium polysulfide - - - - - BFG.  
 \*Dimethylthiocarbamic acid, zinc salt - - - - - ALC, FMN, GYR, PAS, USR, VNC.

THIURAMS:

\*Bis(diethylthiocarbamoyl) disulfide - - - - - DUP, GYR, PAS.  
 \*Bis(dimethylthiocarbamoyl) disulfide - - - - - DUP, GYR, PAS, VNC.  
 Bis(dimethylthiocarbamoyl) sulfide - - - - - DUP, GYR, USR.  
 N,N'-Diocetadecyl-N,N'-diisopropyl thiuram disulfide - - - - - USR.  
 Methyl-ethyl thiurams, mixed - - - - - PAS.  
 XANTHATES AND SULFIDES:  
 Di-n-butylxantho disulfide - - - - - USR.  
 Diisopropylxantho disulfide - - - - - BFG, BBC.  
 Zinc diisopropyl xanthate - - - - - VNC.

TABLE 2.--RUBBER-PROCESSING CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED IDENTIFIED BY MANUFACTURER, 1977--Continued

RUBBER-PROCESSING CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
ALL OTHER ACYCLIC ACCELERATORS, ACTIVATORS AND VULCANIZING AGENTS:	
p-Aminocyclohexylmethane carbonate	DUP.
n-Butylaldehyde-butylamine condensate	DUP.
Di-n-butylammonium oleate	DUP.
3-Ethyl-1,1-dimethyl-2-thiourea	VNC.
Ethylene diamine carbamate	DUP.
Metacrylic acid, zinc salt	USR.
Tetraethylthiourea	RBC.
1,13-Trimethyl-2-thiourea	RBC.
CONDITIONING AND LUBRICATING AGENTS:	
Alkyl alcohols, mixed	DUP.
Sono- and dialkyl phosphate ammonium salts, mixed	DUP.
SODIUM ALKYL SULFATES	DUP.
POLYMERIZATION REGULATORS:	
Alkyl mercaptans, mixed	PLC.
Alkyl mercaptans	PAS, PLC.
tert-Butyl mercaptan	PLC.
n-Hexyl mercaptan	PAS, PLC.
n-Octyl mercaptan	PAS, PLC.
tert-Octyl mercaptan	PAS, PLC.
Tetradecyl mercaptan	PLC.
Tridecyl mercaptan	PAS.
SHORTSTOPS:	
Dimethyldithiocarbamic acid, potassium salt	USR.
*Dimethyldithiocarbamic acid, sodium salt	ALC, DUP, GYR, PAS, USR.
ALL OTHER ACYCLIC RUBBER-PROCESSING CHEMICALS:	
3,7-Dioctylphenothiazine	USR.
Waxes and paraffinic products	DUP, RCI.
Zinc laurate (Activator, physical property improver and processing auxiliary)	USR.

TABLE 3.--RUBBER-PROCESSING CHEMICALS: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of rubber-processing chemicals to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
ACY	American Cyanamid Co.	MCB	Borg-Warner Corp., Borg-Warner Chemicals Div.
ALC	Alco Chemical Corp.	MLS	Miles Laboratories, Inc., Summer Div.
ASH	Ashland Oil, Inc., Ashland Chemical Co.	MON	Monsanto Co.
BFG	B. F. Goodrich Co., B. F. Goodrich Chemical Co. Div.	NEV	Neville Chemical Co.
DUP	E. I. duPont de Nemours & Co., Inc.	NPI	Stepan Chemical Co., Polychem Dept.
FMN	FMC Corp., Agricultural Chemical Div.	PAS	Pennwalt Chemicals Corp.
CYR	Goodyear Tire & Rubber Co.	PIT	Pitt-Consol Chemical Co.
ICI	ICI United States, Inc., Chemical Specialties Co.	PLC	Phillips Petroleum Co.
LAK	Bofors Lakeway, Inc.	RBC	Fike Chemicals, Inc.
		RCD	Richardson Co.
		RCI	Reichhold Chemicals, Inc.
		UPM	UOP, Inc.
		USR	Uniroyal, Inc., Uniroyal Chemical Div.
		VNC	Vanderbilt Chemical Corp.

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.

## Synthetic Elastomers: Role of U.S. Imports

David B. Beck

Synthetic elastomers (also referred to as synthetic rubber) comprise part of a large group of materials called polymers (which encompasses all plastics as well as elastomers). An elastomer is any polymer material that is capable of recovering quickly and forcibly from large deformations such as stretching, bending, or twisting. Generally, a cured elastomer (1) can be stretched to at least three times its original length at room temperature and (2) after being held at twice its original length for 1 minute, will return to 1.5 times its original length within 5 minutes.

U.S. consumption of synthetic elastomers was estimated at 5.6 billion pounds in 1977. More than half of the synthetic elastomers consumed in the United States are used in the manufacture of tires and tire products. The remainder are consumed in a wide variety of industrial end uses, chiefly nontire automotive components; latex applications (carpet and drape backing, dipped goods, adhesives, molded products); impact modifiers for plastics; hoses and belting; footwear; gaskets and seals; and wire and cable insulation. U.S. production in 1977 amounted to more than 5.7 billion pounds, an increase of 7.5 percent over 1976. U.S. exports accounted for 9.7 percent of 1977 production, and were 1.5 times as large as U.S. imports that year.

U.S. consumption

Total annual U.S. consumption of synthetic elastomers for the 6-year period from 1972 to 1977, along with domestic production, imports, and exports, is shown in the table below.

Synthetic elastomers: U.S. production, imports,  
exports, and consumption, 1972-77

(In millions of pounds)

Year	Production	Imports	Exports	Consumption	Ratio (percent) of imports to consumption
1972-----	5,154.4	249.8	602.8	5,133.0	4.9
1973-----	6,185.9	304.0	657.2	5,379.8	5.7
1974-----	5,823.5	249.5	631.2	4,872.5	5.1
1975-----	4,631.7	203.9	510.2	4,329.3	4.7
1976-----	5,441.1	273.5	623.3	4,687.3	5.8
1977-----	5,749.9	367.0	559.1	5,600.0	6.5

1/ Compiled from estimates of the U.S. International Trade Commission.

Source: Production data compiled from U.S. International Trade Commission, Synthetic Organic Chemicals, United States Production and Sales; import, export, and consumption data compiled from official statistics of the U.S. Department of Commerce.

Consumption in 1977 reached an estimated all-time high of 5.6 billion pounds; the previous record was 5.38 billion pounds in 1973. Styrene-butadiene rubber (SBR) accounted for about 55 percent of the total in 1977; polybutadiene accounted for about 15 percent; butyl, polychloroprene (neoprene), ethylene-propylene, nitrile, and isoprene elastomers, less than 6 percent each. As with many commodities, consumption of synthetic elastomers dropped in 1974 as a result of the Arab oil embargo. The continuing recession in 1975 kept consumption down. Although the national economy began to recover in 1976, the United Rubber Workers' Union went on strike against the major tire producers, effecting a slackening of demand for elastomers during the summer of that year. Later in 1976 and through most of 1977, U.S. tire producers stepped up tire production for two reasons: (1) to replenish inventories that had dropped to near-critical levels during the 1976 strike; and (2) to meet increasing demand brought about by the improving economy; hence, the large jump in synthetic elastomers consumption in 1977.

Consumption (quantity basis) of the larger volume synthetic elastomers, except polychloroprene (neoprene), increased in 1977 over 1976, as shown below:

<u>Elastomer type</u>	<u>Change in U.S.</u>
	<u>consumption from</u> <u>1976 to 1977</u> (Percent)
Styrene-butadiene-----	+14
Butyl-----	+23
Nitrile-----	+12
Polybutadiene-----	+22
Polyisoprene-----	+16
Polychloroprene-----	-4
Ethylene-propylene-----	+25

The larger increases in consumption of butyl and polybutadiene elastomers were accounted for at least in part by a 31-percent increase in demand for truck and bus tires: butyl, because it has superior air retention for inner tubes, which are still commonly used in truck and bus tires; and polybutadiene, because an average of 7 pounds of it are used in the production of every truck and bus tire.

The 25-percent increase in ethylene-propylene elastomer consumption in 1977 over 1976 was a continuation of rising growth equaling an average compounded rate of 15 percent per year since 1972. While declines in consumption of other types of elastomers ranged from 7.5 percent to 27 percent in 1975 (overall synthetic decline was 11 percent), ethylene-propylene elastomer consumption declined only 7.5 percent in 1975 but rebounded quickly in 1976. Although consumption of ethylene-propylene elastomers in tires never burgeoned to producers' initial great expectations, that group of elastomers has been found to be suitable for a growing number of nontire applications.

Similarly, the decline in polychloroprene consumption in 1977 was a continuation of a downward trend. Polychloroprene will continue to be best suited for industrial applications where good weathering and water resistance (e.g., in bridge mounts) are important; in less demanding end uses, polychloroprene has yielded to less expensive substitutes (i.e., other elastomers and plastics materials).

U.S. imports

Imports of synthetic elastomers during 1972-77 fluctuated in the same pattern as U.S. consumption, accounting, on the average, for 5.4 percent of total consumption. The chief sources each year during 1972-77 were Canada and Japan. On the average, Canada accounted for 54 percent of the total (52 percent in 1977); Japan, for 25 percent (23 percent in 1977). The bulk of the remainder came from West European countries.

Effective August 3, 1975,<sup>1</sup> imports of synthetic elastomers from Romania became eligible for duty-free treatment under the Generalized System of Preferences provided for in title V of the Trade Act of 1974 (Public Law 93-618). The share of U.S. imports originating in Romania rose from virtually nil before 1975 to 2.2 percent in 1976 and 1.2 percent in 1977.

Total U.S. imports of synthetic elastomers increased irregularly from 249 million pounds in 1972 to 367 million pounds in 1977. For the 6-year period, styrene-butadiene rubber accounted for about one-third of the total; polybutadiene accounted for about one-fourth; and butyl rubber, about 15 percent. For the first time, the level of polybutadiene imports, accounting for 34 percent of the U.S. synthetic elastomers import total in 1977, jumped above the import level of the perennial leader styrene-butadiene rubber, which accounted for 24 percent of the total in 1977. The figure on the following page is a graphic illustration of U.S. imports of the three large-volume elastomers (with respect to imports), which together accounted for 74 percent of total U.S. imports of synthetic elastomers in 1977.

The ratio of total synthetic elastomer imports to consumption reached a record 6.4 percent in 1977. The following tabulation indicates by types of elastomers the changes which occurred in the import/consumption ratios from 1976 to 1977:

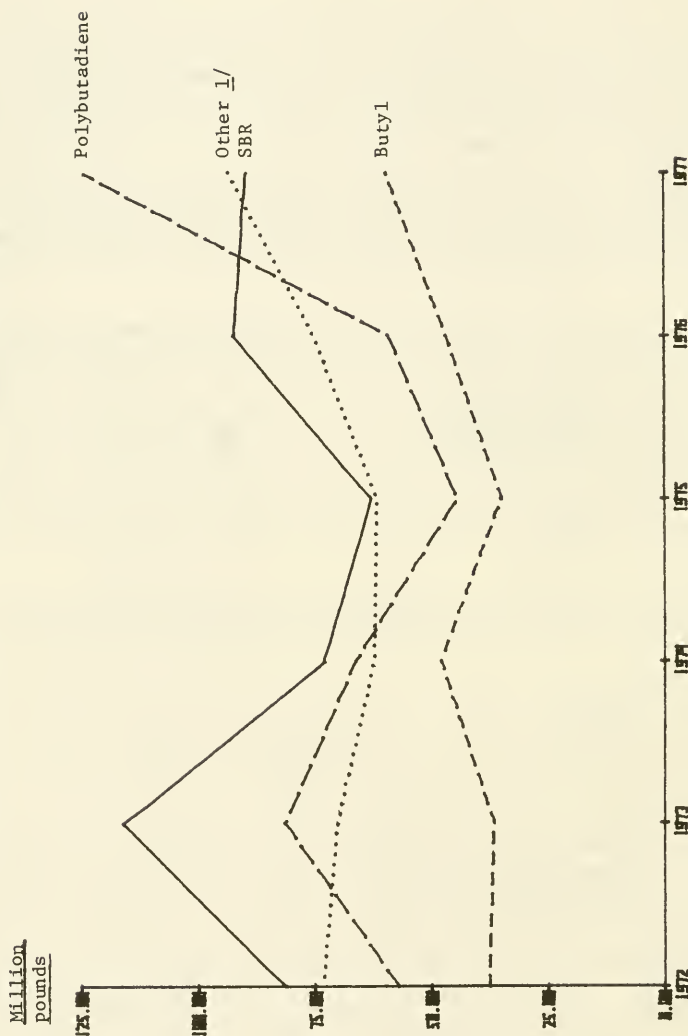
<u>Type of elastomer</u>	<u>1976</u>	<u>1977</u>
Styrene-butadiene-----	3.3	2.8
Butyl-----	18.4	19.1
Nitrile-----	11.5	10.9
Polybutadiene-----	7.8	13.5
Polyisoprene-----	.8	4.8
Polychloroprene-----	2.6	2.7
Ethylene-propylene-----	1/	1.0

1/ Less than 0.05.

The most significant change in import/consumption ratios from 1976 to 1977 was for polybutadiene. Production of polybutadiene in 1977 is estimated to have increased only about 5 percent over 1976, while demand strengthened with the increase in truck and bus tire production. Since the domestic polybutadiene industry as a

<sup>1</sup> Presidential Proclamation 4369, dated Apr. 24, 1975.

Synthetic elastomers: U.S. imports, by types, 1972-77



1/ Includes nitrile rubber (5 percent of 1977 total), polyisoprene (2 percent), polychloroprene (2 percent), ethylene-propylene elastomers (1 percent), and other specialty elastomers (16 percent).

Source: Compiled from official statistics of the U.S. Department of Commerce.



whole operated at or near capacity in 1977, imports served to meet the temporarily increased demand; however, import statistics for the first four months of 1978 indicate that by yearend, the polybutadiene import level will be 18 percent below the 1977 level.

#### Competitiveness of imports in U.S. market

Imported synthetic elastomers are generally comparable in quality to U.S. products. The average unit value of imports (including insurance and shipping costs) was 1 to 4 cents lower than the average unit value of U.S. sales during 1972-77. However, there are three factors which offset the effect of unit value differences between domestic product and imported material. First, the overall U.S. product mix is different from that of imports. Many imported specialty elastomers are not produced in volume in the United States. Furthermore, the proportion of each type of elastomer comprising imports may differ from that for U.S. production. Secondly, the proximity of U.S. producers to industrial consumers, rapid response to those consumers' needs, and steady availability of supply all contributed to the competitive edge held by domestic producers despite price differences. Finally, many imports from Western Europe and elsewhere, are intracompany transfers, some of which are valued below the domestic market price.

Those importers which did account for a significant part of the U.S. market during 1972-77 included Polysar, Inc. and the larger Japanese trading companies. Polysar, Inc., a wholly owned subsidiary of Polysar, Ltd. (the largest producer of synthetic elastomers in Canada), was the major importer of synthetic elastomers into the United States during 1972-77. The larger Japanese importing firms are wholly owned subsidiaries of large Japanese chemical companies and include, among others, JSR America, Inc.; Mitsubishi International Corp.; Mitsui & Co., U.S.A.; Nichimen Company, Inc.; and Marubeni America Corp. Significant as imports were during 1972-1977, exports continued to outpace imports during the period.

The United States was a net exporter of most types of synthetic elastomers throughout 1972-77. On the average, U.S. export quantity each year was 2.2 times that for imports.

#### Trade outlook for 1978

Based upon preliminary import data for 1978, the quantity of U.S. imports of synthetic elastomers is projected to return to about the 1976 level. The push by U.S. tiremakers to replenish depleted inventories is beyond the crisis stage, and near-term demand growth is not expected to top 3 or 4 percent for the year. The domestic industry is expected to operate at or near practical production capacity, with no impending strike threats or the like.

Exports, on the other hand, are expected to approach the 600 million pound level in 1978. As a result, the export/import ratio will climb from 1.5 (in 1977) to about 2.0 (compared with the 1972-77 average of 2.2).

## ELASTOMERS

David B. Beck

Elastomers (synthetic rubber) are high polymeric materials with properties similar to those of natural rubber. The term "elastomers" as used in this report, means a substance, whether in bale, crumb, powder, latex, and other crude form, which can be vulcanized or similarly processed into a material that can be stretched to at least twice its original length and, after having been so stretched and the stress removed, will return with force to approximately its original length. U.S. production and sales of elastomers in 1977 are shown in table 1.<sup>1</sup>

Total U.S. production<sup>2</sup> of synthetic rubber in 1977 amounted to 5,813 million pounds, an increase of 7.9 percent from that produced in 1976. Total sales<sup>2</sup> of elastomers in 1977 amounted to 4,177 million pounds, an increase of 12.6 percent from that sold in 1976.

Styrene-butadiene rubber (SBR, or S-type rubber) in 1977 continued to be elastomer produced in the greatest quantity as it has been for more than a quarter of a century. U.S. production of S-type rubber, including 34 million pounds of its vinylpyridine sub-type, amounted to 3,288 million pounds in 1977, an increase of 9 percent from that reported for 1976. Solution polymerized butadiene rubber, a stereo type elastomer, was produced domestically in 1977 in the next largest amount--758 million pounds; production of isoprene the other major stereoelastomer, amounted to 137 million pounds.<sup>3</sup> Total U.S. production of these stereo type elastomers amounted to 896 million pounds in 1977--a decrease of 2 percent from 1976.<sup>4</sup> Other principal types of synthetic elastomers for which U.S. production data are reported separately are ethylene-propylene rubber, production of which was 348 million pounds in 1977, isobutylene-isoprene (butyl) rubber, production of which was 329 million pounds,<sup>3</sup> acrylonitrile butadiene (N-type) rubber, production of which was 161 million pounds, and polychloroprene (Neoprene) rubber, production of which was 365 million pounds.<sup>3</sup>

Sales of S-type rubber by U.S. producers in 1977 (including its vinylpyridine sub-type) amounted to 1,946 million pounds, an increase of 9 percent over sales reported for 1976. Sales of solution polymerized butadiene rubber amounted to 544 million pounds, and those of ethylene-propylene rubber to 298 million pounds. Sales of N-type rubber in 1977 amounted to 135 million pounds. Sales of solution polymerized butadiene rubber in 1977 increased from sales in 1976 by 32 percent, and sales of ethylene-propylene rubber increased 22 percent. Sales of N-type rubber in 1977 were 4 percent above those in 1976.

---

<sup>1</sup> See also Table 2 which lists these products and indicates the manufacturers of each by code. The codes are identified by company name in table 3.

<sup>2</sup> Does not include urethane type elastomers.

<sup>3</sup> Reported by the Rubber Manufacturers' Association.

<sup>4</sup> The 1976 totals for stereorubber erroneously included production and sales of ethylene-propylene rubber; the revised production total for stereorubber in 1976 is 915.6 million pounds.

TABLE 1.--ELASTOMERS (SYNTHETIC RUBBER):<sup>1</sup> U.S. PRODUCTION AND SALES, 1977

[Listed below are all elastomers (synthetic rubber) for which reported data on production or sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists all elastomers for which data on production and/or sales were reported and identifies the manufacturers of each]

ELASTOMERS	SALES			
	PRODUCTION <sup>2</sup>	QUANTITY <sup>2</sup>		UNIT VALUE <sup>3</sup>
		VALUE	VALUE	
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	5,813,236	4,177,429	1,940,260	\$0.46
Cyclic-----	3,449,123	2,157,680	760,128	.35
Acyclic-----	2,364,113	2,019,749	1,180,132	.58
Acrylonitrile-butadiene type (N-type)-----	161,280	134,563	87,813	.65
Butadiene (emulsion polymerized) type-----	37,397	27,848	8,290	.30
Chloroprene type (Neoprene)-----	(4)	...	...	...
Ethylene-propylene type-----	348,534	298,391	147,804	.50
Isobutylene-isoprene type (Butyl)-----	(5)	...	...	...
Silicone type-----	52,563	43,340	127,020	2.93
Stereo elastomers:				
Butadiene (solution polymerized) type-----	758,429	544,117	182,669	.34
Isoprene type-----	(6)	...	...	...
Styrene-butadiene type (S-type)-----	3,254,079	1,924,576	643,680	.33
Styrene-butadiene-vinylpyridine type-----	33,967	21,536	15,898	.74
Urethane type-----	(7)	...	...	...
All other elastomers <sup>8</sup> -----	1,166,987	1,183,058	727,086	.61

<sup>1</sup> The term "elastomers" is defined as substances in bale, crumb, powder, latex, and other crude forms which can be vulcanized or similarly processed into materials that can be stretched at 68° F. to at least twice their original length and, after having been stretched and the stress removed, will return with force to approximately their original length.

<sup>2</sup> Includes oil content of oil-extended elastomers.

<sup>3</sup> Calculated from rounded figures.

<sup>4</sup> Included in "All other elastomers". The production of polychloroprene rubber in 1977 was reported by the Rubber Manufacturers' Association to be 165,388 metric tons (364,614,400 pounds).

<sup>5</sup> Included in "All other elastomers". The production of butyl rubber in 1977 was reported by the Rubber Manufacturers' Association to be 149,455 metric tons (329,488,500 pounds).

<sup>6</sup> Included in "All other elastomers". The production of polyisoprene rubber in 1977 was reported by the Rubber Manufacturers' Association to be 62,260 metric tons (137,258,400 pounds).

<sup>7</sup> The data on production and sales of urethane elastomers are reported in the section "Plastics and Resin Materials" with urethane plastics and polyols.

<sup>8</sup> Includes production and sales data for acrylic ester, butyl, chloroprene, epichlorohydrin, fluorinated, isobutylene, isoprenes, and polysulfide elastomers, certain solution elastomers, chlorinated rubber, chlorosulfonated polyethylene, thermoplastic rubber, miscellaneous elastomers.

TABLE 2.--ELASTOMERS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT]

ELASTOMERS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
CYCLIC	
Butadiene-styrene type:	
*Butadiene-styrene (S-Type)-----	: ASH, ASY, BFG, BOR, CPY, FIR, FRS, GNT, CRD, CYR, PLC, : PLR, RCI, SWL, TUS, USR.
Butadiene-styrene-itaconic acid-----	: ASY.
*Butadiene-styrene-vinylpyridine-----	: BFG, FIR, FRS, GNT, CYR, MIL, USR.
Polyester elastomer-----	: DUP.
Thermoplastic elastomers, cyclic-----	: PLC, SHC, USR.
ACYCLIC	
Butadiene-acrylic acid-acrylonitrile-----	: ASY.
*Butadiene-acrylonitrile type (N-Type)-----	: BFG, CPY, FRS, CYR, RCI, USR.
Depolymerized butyl rubber-----	: HDM.
Epichlorohydrin rubber-----	: BFG.
*Ethylene-propylene rubber-----	: BFG, CPY, DUP, ENJ, ORO, USR.
Fluoroelastomers-----	: DUP, MMM.
Isobutylene-isoprene type (Butyl)-----	: CBN, ENJ.
Polyacrylate ester, type elastomers-----	: ACY, BFC, DUP.
Polyalkalene oxide-----	: PRC.
Polyalkalene sulfide, type elastomers-----	: TKL.
*Polybutadiene type (Emulsion)-----	: BFG, FRS, CYR, TKL, TUS.
Polychloroprene type (Neoprene)-----	: DKA, DUP, PTT.
Polyethylene, chlorosulfonated-----	: DUP.
Polyisobutylene, type elastomers-----	: ENJ.
Products of natural rubber:	
Depolymerized natural rubber-----	: HDM.
Polymerized chlorinated rubber-----	: ICI, X.
*Silicone type elastomers-----	: DCC, SPD, SWS.
Stereoisomer type:	
Depolymerized isoprene-----	: HDM.
*Polybutadiene (Solution polymerized)-----	: ASY, BFG, FRS, CNT, CYR, PLC.
Polyisoprene (Solution polymerized)-----	: BFG, CYR.
Stereoisomer type, all other-----	: WAY.

TABLE 3.--ELASTOMERS (SYNTHETIC RUBBER): DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of elastomers to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
ACY	American Cyanamid Co.	ICI	ICI United States, Inc., Chemical Specialties Co.
ASH	Ashland Oil, Inc.		
ASY	American Synthetic Rubber Corp.		
BFG	B. F. Goodrich Co., B. F. Goodrich Chemical Co. Div.	MIL	Milliken & Co., Milliken Chemical Div.
BOR	Borden, Inc., Borden Chemical Div.	MMM	Minnesota Mining and Manufacturing Co.
CBN	Cities Service Co., Columbian Group		
CHP	C. H. Patrick & Co. Inc.	ORO	Chevron Chemical Co.
CPY	Copolymer Rubber & Chemical Corp.	PLC	Phillips Petroleum Co.
DCC	Dow Corning Corp.	PLR	Polysar Resins, Inc., Polysar Latex Div.
DKA	Denka Chemical Corp.	PRC	Products Research & Chemical Corp.
DUP	E. I. duPont de Nemours & Co., Inc.	PTT	Petro-Tex Chemical Corp.
ENJ	Exxon Chemical Co., U.S.A.	RCI	Reichhold Chemicals, Inc., Reichhold Polymers, Inc.
FIR	Firestone Tire & Rubber Co.:	SHC	Shell Oil Co., Shell Chemical Co. Div.
FRS	Firestone Plastics Co. Div.	SPD	General Electric Co., Silicone Products Dept.
	Firestone Synthetic Rubber & Latex Co. Div.	SWL	Southwest Latex Corp.
		SWS	Stauffer Chemical Co., SWS Silicones Div.
GNT	General Tire & Rubber Co., Chemical/Plastics Div.	TKL	Thiokol Chemical Corp.
GRD	W. R. Grace & Co., Polymers & Chemicals Div.	TUS	Texas-U.S. Chemical Co.
CYR	Goodyear Tire & Rubber Co.	USR	Uniroyal, Inc., Chemical Div.
HDM	Hardman, Inc.	WAY	Philip A. Hunt Chemical Corp., Organic Chemical Div.
HPC	Hercules, Inc.		

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.



## Plasticizers

J. Lawrence Johnson

Plasticizers are organic chemical substances that are added to synthetic plastics and resin materials to (1) improve workability during fabrication, (2) extend or modify the natural properties of these materials, or (3) develop new, improved properties not present in the original material. Plasticizers are not final products of themselves but rather components of other materials which, in turn, are formed into final products.

Roughly 85 percent of total annual plasticizer shipments are consumed in the manufacture of plastics materials, with elastomer production accounting for the remainder. Polyvinyl chloride (PVC) resins used in flexible applications (e.g., shower curtains, wall coverings, tablecloths, and window shades) now account for about two-thirds of all plasticizers consumed in the United States. Plasticizers convert this brittle PVC material, which decomposes when heated, into a flexible workable polymer.

U.S. Production and sales

In 1977, plasticizer production reached 1.8 billion pounds; consumption was 1.5 billion pounds and sales 1.7 billion pounds. These increases over 1976 of 5.5 percent, 12.2 percent, and 13.8 percent respectively, reflect the continuing recovery of the flexible PVC resin markets from the 1974 and 1975 recession.

Industry sources <sup>1/</sup> forecast demand growth for plasticizers at an average rate of 6.3 percent per year from 1976 to 1981. This is in line with a projected average annual growth rate for flexible PVC applications of 6.4 percent per year during this period.

The phthalic anhydride esters (i.e., phthalates) were again the leading plasticizers in 1977, accounting for about 67 percent of the total production quantity. The phthalic anhydride esters have dominated the plasticizer market for over 25 years mainly because these materials are unequaled on a cost/performance basis for general-purpose plasticizer applications.

The most important phthalate plasticizer is di(2-ethylhexyl) phthalate, accounting for an estimated 22 percent of all plasticizer sales. It is the standard PVC plasticizer and properties of other plasticizers are usually reported relative to it. Di(2-ethylhexyl) phthalate has good compatibility properties with PVC resins and is available at a price (31 cents per pound in mid-1978) generally below that of the other common phthalates.

---

<sup>1/</sup> Chemical and Engineering News, Nov. 27, 1976, p. 12.

Consumption of the trimellitates (esters of trimellitic anhydride) is forecast to grow at a faster rate (10.7 percent) between 1976 and 1981 than any other class of plasticizers <sup>1/</sup>. These trimellitates have relatively low volatility at higher temperatures which makes them choice plasticizers for PVC used to coat wire and cable for electrical applications.

#### Major PVC markets

The chief uses for plasticizers in PVC applications are, in descending order of importance: flooring, wire and cable insulation, meat and produce films, and furniture upholstery. Together, they account for about 50 percent of the total plasticizers consumed annually in flexible PVC applications; flooring alone represents about 18 percent of the total.

Flooring.--In flooring, the trend away from vinyl asbestos tile to the more highly plasticized coated types of resilient vinyl flooring is expected to continue. This should lead to increased uses of plasticizers in the flooring market, which has already captured a primary share of consumption.

Wire and cable insulation.--Most plasticizers used in extruded, flexible PVC applications in this field are in the low voltage range (500 volts and below) where building wire accounts for the greatest share. These are wires suitable for appliances and communications (90° C-rated wire) as well as for use on equipment and machinery (105° C-rated wire). Thus the insulation market for plasticizers as might be expected, is closely tied to the growth of the construction industry. Over the past 2 years the construction industry has been particularly healthy, and plasticizer growth in wire and cable insulation grew about 7 percent more in 1977 than in 1976. Plasticizer growth in this market is forecast at about 8 percent per year during 1976-81 <sup>2/</sup>.

Furniture coverings.--The market for plasticizers used in furniture coverings is cyclical and generally follows the pattern of new home construction. Since furniture sales are closely related to the level of disposable personal income, changes in the business cycle are a good indication of market performance. When the level of disposable personal income is high, furniture sales tend to climb at a faster rate than construction in general, thereby accelerating plasticizer usage in this market.

#### Foreign trade

The United States is the world's leading producer of plasticizers and is highly export competitive. The pattern of U.S. foreign trade in plasticizers has remained relatively unchanged during the 1970's in terms of export markets, import sources, and relative levels of trade.

---

<sup>1/</sup> Chemical and Engineering News, Nov. 27, 1976, p. 12.

<sup>2/</sup> Hydrocarbon Processing, January 1978, p. 155 and 156.



U.S. exports.--Exports of plasticizers in 1977 amounted to 152.5 million pounds, representing a 36 percent increase over the amount in 1976. This gain is indicative of the continuing recovery being made in the foreign plastics markets from the worldwide recession of 1974 and 1975. Exports in 1977 accounted for 9 percent of production, an annual level typical of the level during 1970-76.

Canada has been the single most important export market for plasticizer materials during the past decade, and in 1977 accounted for 18 percent of the quantity exported. Other major export markets for plasticizers in 1977 included Belgium, France, Italy, and the Netherlands in Europe, and Hong Kong, Japan, and Singapore in the Far East. These seven markets, together with Canada, accounted for 80 percent of the quantity of U.S. plasticizer exports in 1977.

Most of the exports of large-volume, low-priced phthalic anhydride ester plasticizers have gone to the developing nations in recent years. These developing areas tend to manufacture flexible PVC products (shower curtains, tablecloths) for which low price takes precedence over quality. Exports of the higher priced, specialty type plasticizers usually go to the more advanced economies which tend to produce higher quality PVC products that require a good deal of sophisticated technology.

U.S. imports.--Imports of plasticizers continue to be negligible and amounted to only 6.2 million pounds in 1977, or about 0.4 percent of domestic consumption. Since 1970, annual imports of plasticizers have not exceeded 11.6 million pounds. Most imports represent specialty items or shipments from a foreign manufacturer to its U.S. subsidiary.

Canada, Japan, and the United Kingdom accounted for more than 70 percent of the U.S. imports of plasticizers by quantity in 1977; these countries have been among the leading suppliers since the mid-1960's.

The Generalized System of Preferences (GSP).--The GSP has had a negligible impact on the source of plasticizers imports since its implementation in January 1976. Imports of plasticizers from GSP sources in 1977 amounted to 1.2 million pounds, or about 19 percent of total imports. This compares to 1.9 million pounds, or about 16 percent in 1974. The Republic of Korea was the leading source of GSP plasticizer imports in 1977, supplying 886,000 pounds.

### Recent developments

Certain changes have occurred recently which have altered the makeup of the plasticizer industry. Most important of these is the trend towards plasticizers based on linear alcohols. Also of importance is the increased use of trimellitates as plasticizers. The most recent development of note is the use of materials (e.g., ethylene vinyl acetate) which impart flexibility into PVC resins, but are not the typical ester type plasticizers.

Linear alcohols.--Industry sources 1/ claim that production of phthalic anhydride esters derived from linear (straight-chain) alcohols have increased from less than 8 percent of all phthalate esters plasticizers in 1966 to 25 percent or more a decade later. A major reason for this rapid growth is that linear type plasticizers offer improved low-temperature flexibility over phthalate plasticizers made from branched-chain alcohols. Also, the linear derived products are less volatile than those made from branched-chain alcohols. Both of these are important qualities in the prevention of fogging 2/ in automobiles, which is caused in part by volatile plasticizers incorporated in the vinyl products (e.g., upholstery, ceiling, and side panels) used in automobiles. Presently, linear phthalates are the major plasticizers used by automotive vinyl makers 3/ to reduce this condition.

Trimellitates.--Plasticizers derived from trimellitic anhydride have antifogging properties which are superior to all other plasticizers. However, price is a prohibiting factor. Trimellitic anhydride is a relatively expensive starting material (49 cents per pound) when compared with phthalic anhydride (26 cents per pound in mid-1978). Therefore, trimellitate plasticizers are used primarily in those applications where quality is paramount (e.g., wire and cable coatings).

Plasticizer substitutes.--High molecular weight materials such as polymers of ethylene vinyl acetate (EVA) are being employed as plasticizer substitutes. 4/ These materials add about 20 percent to the cost of the vinyl product over the standard phthalate type plasticizers. However they enhance the product's effective life as well as improve its resistance to heat, wear, and chemical attack. These new permanent plasticizers have nearly zero extraction, volatility, migration and exudation properties. 5/ These qualities are essential in applications such as vinyl roofing on automobiles and vinyl wrap for wharf piling where materials are subject to extreme climatic changes.

---

1/ Plastics World, July 19, 1976, pp. 54 and 55.

2/ "Fog" is the film formed on auto windshields when car interiors are shut in hot weather.

3/ Plastics Technology, May 1978, pp. 65-70.

4/ Modern Plastics, June 1978, pp. 42 and 43.

5/ Plastics World, July 19, 1976, pp. 54 and 55.

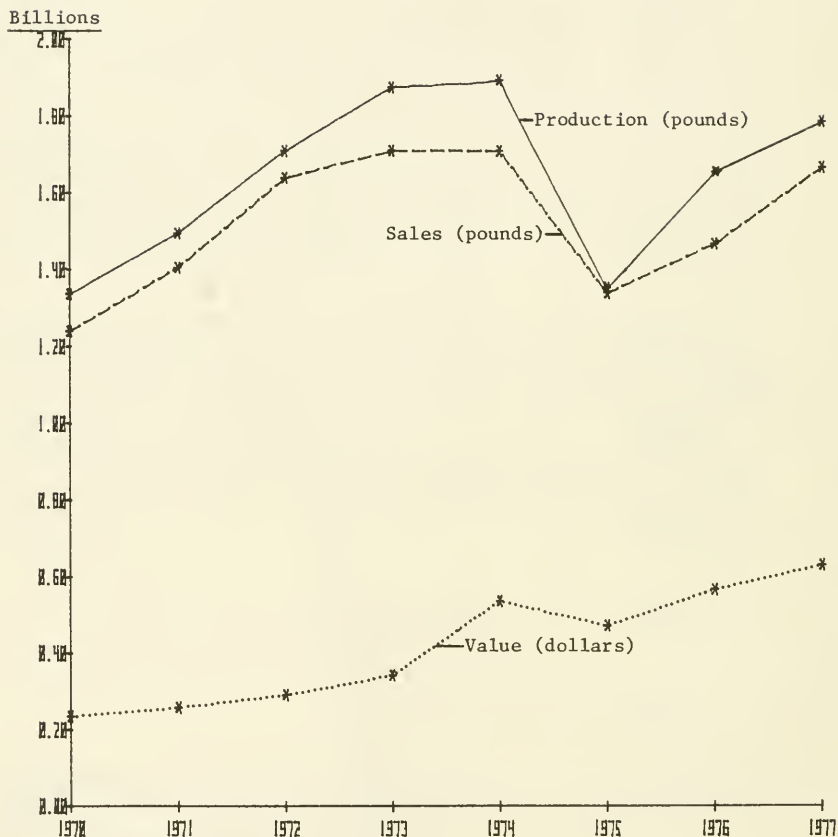
TABLE A.--Plasticizers: U.S. production, imports, exports, and sales, 1970-77

Year	Production			Sales			Exports			Imports			
	1,000 Pounds	Quantity 1,000 Pounds	Value 1,000 dollars	Unit value 1/ Per pound	Quantity 1,000 Pounds	Value 1,000 dollars	Unit value 1/ Per pound	Quantity 1,000 Pounds	Value 1,000 dollars	Unit value 1/ Per pound	Quantity 1,000 Pounds	Value 1,000 dollars	Unit value 1/ Per pound
1970-----	1,336,072	1,239,116	234,836	\$0.19	104,909	20,788	\$0.20	1,427	638	\$0.45			
1971-----	1,494,038	1,404,096	257,765	.18	105,321	18,893	.18	1,543	698	.45			
1972-----	1,708,313	1,637,497	290,564	.18	169,274	24,274	.14	939	432	.46			
1973-----	1,873,383	1,708,413	341,385	.20	161,944	32,672	.20	4,729	1,407	.30			
1974-----	1,891,685	1,707,125	535,247	.31	196,338	57,758	.29	11,620	4,524	.39			
1975-----	1,351,702	1,338,317	470,390	.35	163,486	34,749	.21	2,267	1,113	.49			
1976-----	1,698,887	1,465,623	566,114	.39	111,681	50,452	.45	2,504	1,407	.56			
1977-----	1,797,040	1,667,627	632,330	.38	152,504	50,830	.33	6,166	3,798	.66			

1/ Calculated from rounded figures.

Source: Production, U.S. International Trade Commission, Synthetic Organic Chemicals, United States Production and Sales; Imports and exports compiled from official statistics of the U.S. Department of Commerce.

Plasticizers: U.S. production and sales, 1970-77. 1/

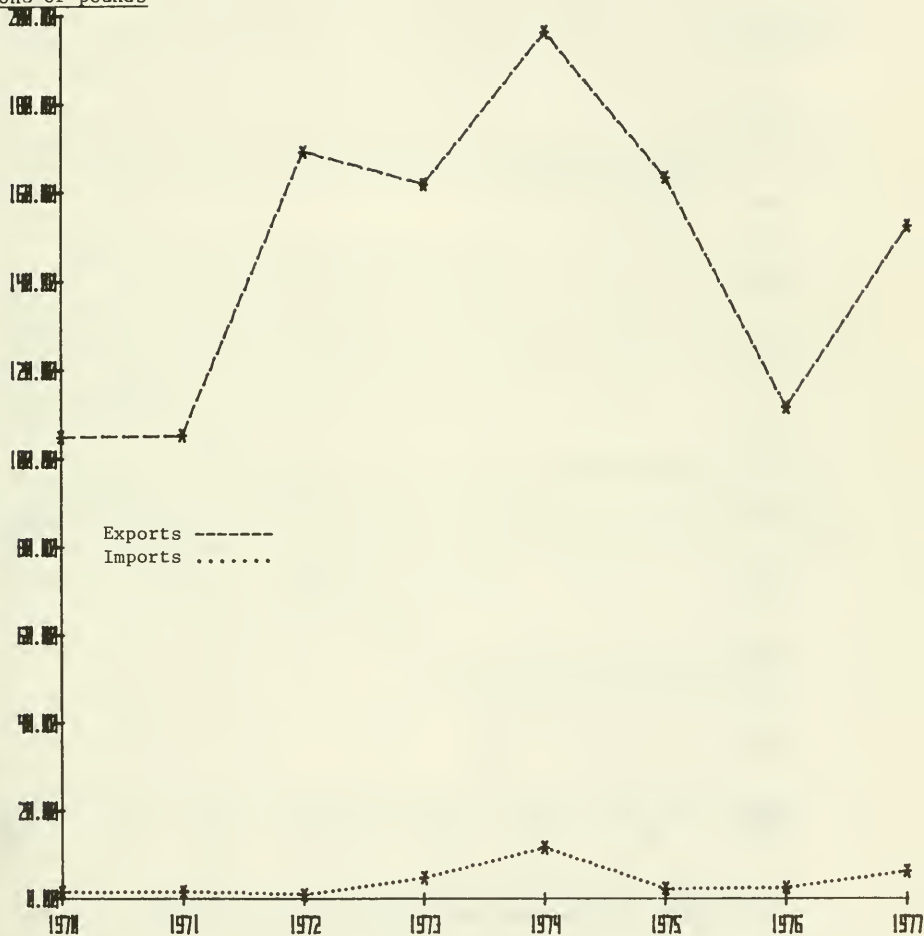


1/ 1977 figures are estimates.

Source: Compiled from official statistics of the U.S. International Trade Commission.

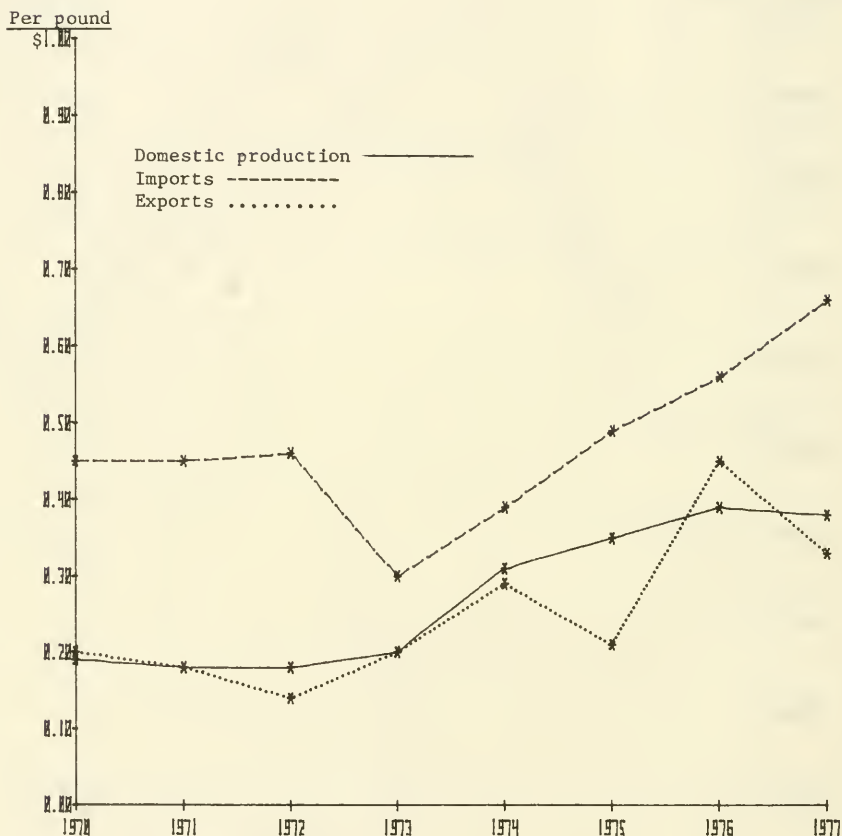
Plasticizers: U.S. imports and exports, 1970-77.

Millions of pounds



Source: Compiled from official statistics of the U.S. Department of Commerce.

Plasticizers: U.S. imports, exports, and domestic production, 1970-77.



Sources: Compiled from official statistics of the U.S. International Trade Commission and the U.S. Department of Commerce.

## PLASTICIZERS

J. Lawrence Johnson

Plasticizers are organic chemicals that are added to synthetic plastics and resin materials to (1) improve workability during fabrication, (2) extend or modify the natural properties of these materials, or (3) develop new improved properties not present in the original material. Table 1 presents statistics on U.S. production and sales of plasticizers in as great a detail as is possible without revealing the operations of individual producers.

U.S. production of plasticizers totaled 1,792 million pounds in 1977, an increase of 5.5 percent from the 1,699 million pounds<sup>1</sup> reported for 1976. Sales of plasticizers totaled 1,668 million pounds, valued at \$632 million, in 1977 compared with 1,466 million pounds,<sup>1</sup> valued at \$566 million,<sup>1</sup> in 1976.

Production of cyclic plasticizers in 1977, which consisted chiefly of the esters of phthalic anhydride, phosphoric acid, and trimellitic acid, amounted to 1,375 million pounds, an increase of 14.9 percent from the 1,197 million pounds<sup>1</sup> reported for 1976. Sales of cyclic plasticizers in 1977 totaled 1,302 million pounds, valued at \$425 million, compared with 1,111 million pounds,<sup>1</sup> valued at \$360 million,<sup>1</sup> in 1976. The most important cyclic plasticizer was di(2-ethylhexyl) phthalate, with production of 389 million pounds, in 1977.

Production of acyclic plasticizers in 1977 totaled 417 million pounds, an increase of 3.7 percent from the 402 million pounds reported for 1976. Sales of acyclic plasticizers totaled 366 million pounds, valued at \$208 million, in 1977, compared with 355 million pounds, valued at \$206 million, in 1976. Epoxidized soya oils were the most important acyclic plasticizer in 1977 with production of 93 million pounds.

---

<sup>1</sup> Some data for 1976 has been revised as shown in footnote 2 on Table 1.





TABLE 1.--PLASTICIZERS:<sup>1</sup> U.S. PRODUCTION AND SALES, 1977<sup>2</sup>

[Listed below are plasticizers for which any reported data on production or sales may be published. (Leaders (...) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists separately all plasticizer chemicals for which data on production and/or sales were reported and identifies the manufacturers of each]

PLASTICIZERS	SALES			
	PRODUCTION	UNIT VALUE <sup>3</sup>		
		QUANTITY	VALUE	UNIT VALUE <sup>3</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	1,792,040	1,667,627	632,330	\$0.38
Benzenoid <sup>4</sup> -----	1,407,084	1,390,319	474,781	.34
Nonbenzenoid-----	384,956	277,308	157,549	.57
CYCLIC				
Total-----	1,374,908	1,301,912	424,651	.33
Phosphoric acid esters <sup>5</sup> -----	92,013	74,769	51,344	.69
Phthalic anhydride esters, total-----	1,202,413	1,156,159	341,110	.30
Dibutyl phthalate-----	16,592	19,348	7,215	.37
Diethyl phthalate-----	17,471	13,496	5,796	.43
Disodecyl phthalate-----	160,567	149,408	43,941	.29
Dimethyl phthalate-----	9,887	8,309	3,272	.39
Diocetyl phthalates, total-----	400,207	391,782	109,097	.28
Di(2-ethylhexyl) phthalate-----	388,543	381,982	105,839	.28
Other dioctyl phthalates-----	11,664	9,800	3,258	.33
Di-tridecyl phthalate-----	23,278	16,267	5,952	.37
n-Hexyl n-decyl phthalate-----	15,182	...	...	...
All other phthalic anhydride esters-----	559,229	557,549	165,837	.30
Trimellitic acid esters, total-----	27,278	25,729	12,418	.48
Tri-n-octyl n-decyl trimellitate-----	1,213	1,037	610	.59
Trioctyl trimellitate-----	12,510	10,637	5,052	.48
All other trimellitic acid esters-----	13,555	14,055	6,756	.48
All other cyclic plasticizers <sup>6</sup> -----	53,204	45,255	19,779	.44
ACYCLIC				
Total-----	417,132	365,715	207,679	.57
Adipic acid esters, total-----	68,910	65,404	31,846	.49
Di(2-ethylhexyl) adipate-----	42,561	40,607	17,854	.44
Disodecyl adipate-----	2,527	2,228	1,138	.51
All other adipic acid esters-----	23,822	22,569	12,854	.57
Complex linear polyesters and polymeric plasticizers, total-----	47,995	37,455	35,928	.96
Adipic acid type-----	10,482	...	...	...
All other-----	37,513	37,455	35,928	.96
Epoxidized esters, total-----	120,482	114,892	53,917	.47
Epoxidized linseed oils-----	5,207	5,139	3,538	.69
Epoxidized soya oils-----	92,503	89,343	40,343	.45
All other epoxidized esters-----	22,772	20,410	10,036	.49
Isopropyl myristate-----	3,139	3,245	2,307	.71
Oleic acid esters, total-----	11,785	9,950	4,525	.45
Butyl oleate-----	2,575	1,435	725	.51
Methyl oleate-----	4,333	4,208	1,642	.39

See footnotes at end of table.

TABLE 1.--PLASTICIZERS:<sup>1</sup> U.S. PRODUCTION AND SALES, 1977<sup>2</sup>--CONTINUED

PLASTICIZERS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>3</sup>
		1,000 pounds	1,000 pounds	1,000 dollars Per pound
ACYCLIC--Continued				
Oleic acid esters--Continued				
n-Propyl oleate-----	326	202	93	\$0.46
All other oleic acid esters-----	4,551	4,105	2,065	.50
Palmatic acid esters-----	4,987	3,649	2,001	.55
Phosphoric acid esters-----	17,313	13,035	10,008	.77
Ricinoleic and acetylricinoleic acid esters-----	...	875	695	.79
Sebacic acid esters-----	4,482	3,594	4,011	1.12
Stearic acid esters, total-----	14,186	13,411	7,211	.54
n-Butyl stearate-----	8,059	7,460	2,989	.40
All other stearic acid esters-----	6,127	5,951	4,222	.71
All other acyclic plasticizers <sup>7</sup> -----	123,853	100,205	55,230	.55

<sup>1</sup> Includes data for compounds used principally (but not exclusively) as primary plasticizers. Does not include clearly defined extenders of secondary plasticizers.

<sup>2</sup> Certain 1976 data are revised as shown below:

PLASTICIZERS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE
		1,000 pounds	1,000 pounds	1,000 dollars Per pound
Grand total-----	1,698,587	1,465,623	566,114	\$0.39
Benzenoid-----	1,414,925	1,207,137	416,232	.34
Plasticizers, cyclic, total-----	1,197,062	1,110,781	360,302	.32
Phthalic anhydride esters, total-----	1,154,086	986,472	292,867	.30
Diocyl phthalates, total-----	413,952	393,454	102,989	.26
Di(2-ethylhexyl) phthalate-----	396,739	380,293	99,266	.26
Ditridecyl phthalate-----	21,625	14,224	4,924	.35

<sup>3</sup> Calculated from unrounded figures.

<sup>4</sup> Includes benzenoid products as defined in part 1 of schedule 4 of the Tariff Schedules of the United States Annotated.

<sup>5</sup> Includes data for cresyl diphenyl phosphate, dibutyl phenyl phosphate, diphenyl octyl phosphate, tricresyl phosphate, triphenyl phosphate, and other cyclic phosphoric acid esters.

<sup>6</sup> Includes data for glycol dibenzoates, toluenesulfonamides, tetrahydrofurfuryl oleate, and other cyclic plasticizers.

<sup>7</sup> Includes data for azelaic, citric and acetylcitric, myristic, pelargonic, ricinoleic (production only), acetylricinoleic (production only), glyceryl, and glycol esters, and other acyclic plasticizers.

TABLE 2.---PLASTICIZERS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT]

PLASTICIZERS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C L I C	
Diethylene glycol dibenzoate	VEL
Dipropandiol dibenzoate (Dipropylene glycol dibenzoate)	VEL
N-Ethyl-p-toluenesulfonamide	MON
Isopropylidenediphenoxypropanol-	MON
*PHOSPHORIC ACID ESTERS:	DOW
Cresyl diphenyl phosphate	FMP, IMC, MON, SPS
Dibutyl phenyl phosphate	FMP, MON
Diphenyl octyl phosphate	MON
Tricresyl phosphate	FMP, IMC, SPS
Triphenyl phosphate	EK, MON
Phosphoric acid esters, all other-	SFS
*PHTHALIC ANHYDRIDE ESTERS:	
Alkyl benzyl phthalates	MON
Bis (2-Ethylhexyl)Terephthalate	EKT
Butyl benzyl phthalate	MON
Butyl cyclohexyl phthalate	CPS
Butyl octyl phthalates	RCI, USS
Di(2-butoxyethyl) phthalate	HAL
*Dibutyl phthalate (Including diisobutyl phthalate)	BAS, EKT, GBH, RCI, SW, UCC, USS, WTH
Dicyclohexyl 2-ethylhexyl phthalate	GRH
Dicyclohexyl phthalate	MON, PFZ
Diethyl isophthalate	PFZ
*Diethyl phthalate	EKT, KP, MON, PFZ
Di-n-hexyl phthalate	USS
*Diisodecyl phthalate	BAS, CO, ENJ, GRH, HN, RCI, TEK, USS
Diisononyl phthalate	ENJ

TABLE 2.--PLASTICIZERS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

PLASTICIZERS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C L I C--Continued	
*PHTHALIC ANHYDRIDE ESTERS--Continued	
Di(2-methoxyethyl) phthalate	: EKT.
Dimethyl phthalate	: EKT, KP, MON, PFZ, TCC.
*DIOCTYL PHTHALATES:	
*Di(2-ethylhexyl) phthalate	: BAS, BFG, CO, EKT, GRH, HN, MON, RCI, TEK, USS.
Diiso-octyl phthalate	: BCI, USS.
Dioctyl phthalates, all other	: PFZ, USS, WTH.
Diononyl phthalate	: ENJ.
Diphenyl phthalate	: ENJ.
*Di-tridecyl phthalate	: EBJ, GRH, HN, RCI, RUB, SM, TEK, USS.
Diundecyl phthalate	: MON.
GLYCOL PHTHALATE ESTERS:	
Glycol phthalate	: MON.
Glycol dibutyl sebacate, glycolate	: SCP.
*Hexa-4-phtalate, all others	: CO, HN, TEK.
Heptyl iso-octyl phthalate	: PFZ.
n-Octyl n-decyl phthalate	: BCI, TEK, USS.
Phthalic anhydride esters, all other	: BAS, GRH, HN, MON.
Tetrahydrofurfuryl oleate	: ENR.
Toluenesulfonamide o-, p-mixtures	: MGN.
*TRIMELLITIC ACID ESTERS:	
Tri(2-ethylhexyl) trimellitate	: GRH, PFZ, PPL.
Tri-n-hexyl n-decyl trimellitate	: GRH.
Trisooctyl trimellitate	: PFZ, RCI, RUB, USS.
*Tri-n-octyl n-decyl trimellitate	: PFZ, RCI, RUB.
*Trioctyl trimellitate	: EKT, HN, RCI, RUB, USS, WTH.
all other trimellitic acid esters	: ENJ, MON, PFZ, TEK, WTH, X.
*Cyclic plasticizers, all other	: HAL, HN, NEV.
A C Y C L I C	
*ADIPIC ACID ESTERS:	
Di(2-(2-butoxyethoxy)ethyl) adipate	: RCI, TKL.
*Di(2-ethylhexyl) adipate	: BAS, GRH, HN, MON, PFZ, PPL, RCI, RH, RUB, USS, WM,
	: WTH.
Diisobutyl adipate	: GRH, HAL.
Disodecyl adipate	: GRH, HN, PFZ, RCI, RH, SM, USS.
*Diiso-octyl adipate	: HN, RCI, RH.
Diisopropyl adipate	: WTH.

TABLE 2.--PLASTICIZERS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

PLASTICIZERS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I O--Continued	
*Adipic acid esters--Continued	
Dinonyl adipate--	WTH.
Di-n-octyl adipate--	TEK.
Di-tridecyl adipate--	EMR, GRH, RUB.
n-hexyl n-decyl adipate--	DA, USS.
iso-octyl isodecyl adipate--	GER.
n-octyl n-decyl adipate--	MON, RCI, RH, USS.
adipic acid esters, all others	MON, SH.
AZELAIIC ACID ESTERS:	
Di(2-ethylhexyl) azelate--	EMR, PFZ, RCI, WE.
n-octyl azelate--	EMR.
Adipic acid esters, all others--	EMR, PFZ.
CITRIC AND ACETYLCITRIC ACID ESTERS:	
Tributyl acetylcitrate--	PFZ.
Tributyl citrate--	PFZ.
Triethyl citrate--	ICI.
Tristearyl citrate--	ICI.
Citric and acetylcitric acid esters, all other	PFZ.
*COMPLEX LINEAR POLYESTERS AND POLYMERIC PLASTICIZERS:	
*Adipic acid type complex linear polyesters and polymeric plasticizers--	ASH, DUP, GRH, HAL, TEK, WTH.
Complex linear polyesters and polymeric plasticizers, all other--	EMR, EKH, ENR, HAL, HN, HPC, MON, RCI, RH.
Di(2-(2-butoxyethoxy)methyl) methane-	TKL.
Dibutyl tartrate--	ARC.
Diiso-octyl diglycolate--	CCA.
*EPOXIDIZED ESTERS:	
Butyl epoxystearates--	UCC, WTC.
*Epoxidized linseed oils--	ASH, SWF, VIK, WTC.
*Epoxidized soya oils--	ASH, PMP, RH, UCC, VIK, WTC.
Epoxy oleates, mixed--	RH.
2-Ethylhexyl epoxytalates--	UCC.
Octyl epoxystearates--	WTC.
Octyl epoxytalates--	RH, WTC.
Epoxidized esters, all other	UCC.
Glyceryl tripropionate--	EKT.

TABLE 2.--PLASTICIZERS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED,  
IDENTIFIED BY MANUFACTURER, 1977--Continued

PLASTICIZERS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
MYRISTIC ACID ESTERS:	
* Isopropyl myristate--	ARC, TCH, WH, WTH.
* Isopropyl palmitate-isopropyl myristate mixture--	WTH.
* Myristyl ethoxy myristate--	SCP.
*OLEIC ACID ESTERS:	
*Butyl oleate--	ARC, EIC, EHR, GRO, HAL, HH, WTH.
*Decyl oleate--	SCP, VND.
*Glyceryl trioleate (Triolein)--	EHR, GLY, GRO, TCH.
*Isobutyl oleate--	DA.
*Methyl oleate--	EHR, GRO, HUN, TCH.
PROPYL OLATES:	
* Isopropyl oleate--	SCP, WH.
*n-Propyl oleate--	CHL, EHR, GRO, TCH, WH.
*Oleic acid esters, all other--	EHR, HAL.
*PALMITIC ACID ESTERS:	
* 2-Ethylhexyl palmitate--	WTH.
* Isobutyl palmitate--	ASC.
* Isopropyl palmitate--	ASC.
* Palmitic acid esters, all other--	ARC, TCH, WH, WTH.
PHENAN C ACID ESTERS, all other--	SCP.
Diethyl acetyl glycol dipelargonate (Diethylene glycol dipelargonate)	EHR.
Glycol pelargonate--	EHR.
Isododecyl pelargonate--	EHR.
*PHOSPHORIC ACID ESTERS:	
Tri(2-butoxyethyl) phosphate	FMP.
Tributyl phosphate--	MON.
Triethyl phosphate--	EKT.
Trioctyl phosphate--	HH, UCC.
*RICINOLEIC AND ACETYLRICINOLEIC ACID ESTERS:	
n-Butyl acetylricinoleate--	NIL.
Butyl ricinoleate--	NIL.
Glyceryl monoricinoleate--	NIL.
Glyceryl tri(acetylricinoleate)--	NIL.
Methyl acetylricinoleate--	RH.
Methyl ricinoleate--	NIL, TCH.

TABLE 2.--PLASTICIZERS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--Continued

PLASTICIZERS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*Ricinoleic and acetylricinoleic acid esters--Continued:	
Ricinoleic acid esters, all other--	NIL.
*SEBACIC ACID ESTERS:	
Dibutoxyethyl sebacate	HAL.
Diethyl sebacate	EXT, HAL.
Di(2-ethylhexyl) sebacate	RH.
Diiso-octyl sebacate	GRH.
Sebacic acid esters, all other	X, X.
*STEARIC ACID ESTERS:	
n-Butyl stearate	ARC, ASH, CHL, EBR, GRO, TCH, WM, WTH.
Diethylammonium stearate	RH.
2-Ethylhexyl stearate	SCR.
Glyceryl triacetyl stearate	NIL.
Hexadecyl stearate	WM.
Isobutyl stearate	DA, WM, WTH.
Isopropyl stearate	WTH.
Methyl stearate	HDR.
Polyglycol stearates	WTH.
Stearic acid esters, all other	ARC, HPC, SCR, TCH, VND, WM, WTH.
Sucrose acetate isobutyrate	ARC, EXT.
Triethylene glycol di(caprylate-caprate)	HAL, PYO, WM.
Triethylene glycol di(2-ethylbutyrate)	UCC.
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	EKA.
Acyclic plasticizers, all other	EMR, HPC, PPZ, PYO, SM, TCH, USS, WM, WTH.

TABLE 3.--PLASTICIZERS: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of plasticizers to the U.S. International Trade Commission of 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of Company
ARC	Armak Co.	NEV	Neville Chemical Co.
ASH	Ashland Oil, Inc., Ashland Chemical Co.	NTL	NL Industries, Inc.
BAS	BASF Wyandotte Corp.	PFZ	Pfizer, Inc.
BFG	B. F. Goodrich Co., B. F. Goodrich Chemical Co. Div.	PPL	Pioneer Plastics Div. of LOF Plastics, Inc.
CCA	Interstab Chemical, Inc.	PVO	PVO International, Inc.
CHL	Chemol, Inc.		
CO	Continental Oil Co.		
CPS	CPS Chemical Co.	RCI	Reichhold Chemicals, Inc.
DA	Diamond Shamrock Corp.	RH	Rohm & Haas Co.
DOW	Dow Chemical Co.	RUB	Hooker Chemical Corp., Ruco Div.
DUP	E. I. duPont de Nemours & Co., Inc.	SCP	Hankel, Inc.
EK	Eastman Kodak Co.:	SFS	Stauffer Chemical Co., Specialty Chemical Div.
EKT	Tennessee Eastman Co. Div.	SM	Mobil Oil Corp., Mobil Chemical Co. Div., Chemical Coatings Div.
EKX	Texas Eastman Co. Div.	SW	Sherwin-Williams Co.
ELC	Elco Corp. Sub of Detrex Chemical Industries, Inc.	SWT	Unitech Chemical, Inc.
EMR	Emery Industries, Inc.		
ENJ	Exxon Chemical Co. U.S.A.	TCC	Tanatex Chemical Corp.
FMP	FMC Corp., Industrial Chemical Group	TCH	Emory Industries, Inc., Trylon Div.
GLY	Glyco Chemicals, Inc.	TEK	Teknor Apex Co.
GRH	W. R. Grace & Co., Hatco Chemical Div.	TKL	Thiokol Chemical Corp.
GRO	A. Cross & Co., Millmaster Onyx Group, Kewanee Industries, Inc.	UCC	Union Carbide Corp.
HAL	C. P. Hall Co.	USS	USS Chemicals Div. of U.S. Steel Corp.
HN	Tenneco Chemicals, Inc.		
HPC	Hercules, Inc.	VEL	Velsicol Chemical Corp.
HUM	Kraft Inc., Humko Plastics Div.	VIK	Viking Chemical Co.
ICI	ICI United States, Inc., Chemical Specialties Co.	VND	Van Dyk & Co., Inc.
IMC	IMC Chemical Group, Inc.	WM	Inolex Corp.
KF	Kay-Fries Chemicals, Inc.	WTC	Witco Chemical Corp.
MON	Monsanto Co.	WTH	Union Camp Corp., Chemical Div.,

Note.—Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.



## Surface-Active Agents

Anne Klein

This paper covers surface-active agents or surfactants which are organic chemicals that reduce the surface tension of water or other solvents. They are used in packaged soaps and detergents for household and industrial use, in the processing of textiles and leather, by the mining industry in ore flotation fluids, and in petroleum production. Additional applications are in the manufacture of sprays, cosmetics, elastomers, food, lubricants, paints, and pharmaceuticals.

U.S. production and demand

U.S. production of surface-active agents amounted to 4.7 billion pounds in 1977 and was valued at \$1.7 billion. It had declined slightly, by 1.6 percent in terms of quantity, from the level in 1976, as shown in the following tabulation:

<u>Year</u>	<u>Annual change in production quantity (Percent)</u>
1971-----	(-1.5)
1972-----	5.5
1973-----	8.3
1974-----	7.4
1975-----	(-7.4)
1976-----	9.9
1977-----	(-1.6)

The slight decline in the level of production in 1977 may be attributed to a slackening in demand for household detergents, the principal market for surface-active agents. The synthetic detergent industry believes that the rate of growth of household detergents may continue to be lower than in the past. They expect a probable slowing of population growth rates in the 1975-85 decade compared to the previous decade (caused by smaller membered households). Women, at present, spend more time in activities outside the home, including jobs. This reduces the amount of family laundering and other household cleaning chores.

Whether the slowing of demand for household detergents will continue to affect the overall market for surface-active chemicals will depend on the growth of industrial uses of the latter. It is possible that the increased use of surface-active chemicals in secondary and tertiary oil recovery operations in the United States will compensate for any reduced demand by household detergent manufacturers.

Surfactants, including ligninsulfonates, are used increasingly in petroleum enhanced recovery procedures termed "microemulsions" or "micellar dispersions" which use surfactant solutions of various concentrations in the flooding of old wells in secondary or tertiary oil recovery. The Energy Research and Development Administration (ERDA) presently contributes to a significant part of the cost of industry research in a number of enhanced oil and gas recovery projects. Also, the petroleum industry conducts over 150 other enhanced oil recovery projects in the United States and, in 10 to 15 percent of the projects, surfactants are used for chemical flooding. Continued development and eventual commercialization of chemical flooding methods are probable. This could result in an accelerated demand in the early 1980's for sulfonated surface-active agents.

There was a significant increase in production of ligninsulfonates during 1970-77 from 491 million pounds to 1,160 million pounds, a more rapid change than that shown for any other group of surfactants. In addition to the continued use of ferrochrome ligninsulfonates in the secondary and tertiary oil recovery research mentioned above, additional expanding demand for ligninsulfonates has stemmed for such diverse uses as: an extender in the manufacture of phenolic resins; in air pollution control programs in which ligninsulfonates act as a binder for the recovery of polluting materials (such as dust caused by wind-erosion or fly-ash from industrial plants); and in certain other uses, including dispersants in water treatment formulations and in the increasing production of gypsum board used in housing. In addition, ligninsulfonates are used as a binder for such items as charcoal briquets and carbon black.

#### U.S. exports and foreign markets

During 1970-77, annual U.S. exports<sup>1</sup> of surfactants increased from 134 million pounds, valued at \$41 million to 157 million pounds, valued at \$83 million. Exports ranged from 3.3 to 4.2 percent by quantity of U.S. production as shown in the following tabulation:

<u>Year</u>	<u>Previous Year</u> <u>(Percent)</u>	<u>Rate of</u> <u>exports to production</u> <sup>1</sup> <u>(Percent)</u>
1970-----	-	3.4
1971-----	6.0	3.7
1972-----	6.3	3.7
1973-----	15.2	4.0
1974-----	13.8	4.2
1975-----	(-23.7)	3.5
1976-----	7.9	3.4
1977-----	(-3.7)	3.3

<sup>1</sup> U.S. exports are partly estimated.

Principal export markets are in Canada, Japan, the Netherlands, Belgium, the United Kingdom, France, and other European countries. In terms of value the largest group of exports specified in 1977 were nonionic surface-active agents (\$21 million), which reflects the ascendancy of the linear alcohols, alkoxyated, as the choice for the surfactant constituent in household detergent products in European markets as well as in U.S. markets.

The volume of U.S. exports is not expected to exceed 173 million pounds in 1982, and will probably continue the erratic pattern of growth of the previous decade. High shipping costs, relative to the low unit prices of surfactants, may tend to render exports of these items to overseas markets less profitable. In addition, according to industry data, significant overseas production of surfactants takes place in Germany, France, Italy, and the United Kingdom, all of which are large markets for actual or potential U.S. exports.

#### U.S. imports

U.S. imports<sup>1</sup> of surface-active agents totaled 98 million pounds in 1977, an increase over 1976 of 11 percent. Imports represented only 2.1 percent of U.S. consumption in 1977, as shown in the following tabulation.

<u>Year</u>	<u>Change from previous year (Percent)</u>	<u>Ratio of imports to consumption (Percent)</u>
1970-----	-	1.7
1971-----	(-24.3)	1.5
1972-----	(-25.0)	1.1
1973-----	47.6	1.5
1974-----	17.7	1.6
1975-----	2.7	1.8
1976-----	17.3	1.9
1977-----	11.4	2.1

In 1977, imports consisted principally of non-benzenoid surface-active agents which included 28.5 million pounds of ligninsulfonates and 29 million pounds of other surface-active agents, the predominant part of which consisted of linear alcohols, alkoxyated.

It is anticipated that by 1982 total imports will exceed 150 million pounds and will consist of a relatively unchanged product mix. The U.S. industry will probably continue to supply nearly all of the domestic market demand of synthetic detergents at strongly competitive prices and supply the bulk of the U.S. demand in other surface-active agents. It is believed that substantially increased U.S. productive capacity for lignin-sulfonate surfactants, which came on stream in Illinois in 1977, will supply a considerable part of the expected increased U.S. demand for these surfactants.

<sup>1</sup> U.S. imports are partly estimated.

### Synthetic detergent constituents - problems and regulations

Whole synthetic detergent formulated products are not included in the analysis in this paper, but only their surface-active components. Nevertheless, the problems and regulations surrounding synthetic detergent formulations as a whole are discussed in the following sections since the formulated products manufacturers are important users of surface-active agents.

Marketable synthetic detergents used for laundering are formulations containing surface-active agents as essential ingredients along with subsidiary constituents such as builders, boosters, anti-soil-redepositing agents, optical brighteners, perfume, and other auxiliary constituents. The function of the "builder" is as a sequestering agent, which binds up the calcium and magnesium ions of "hard" water which would otherwise cause a troublesome precipitate. The use of two groups of synthetic detergent constituents, the surface-active agents and the builders, has historically spawned problems for the environment which has stimulated both legislation and industry research for substitute chemicals and reformulation.

### Surface-active agents

Prior to 1965, a serious foaming problem in rivers and sewage treatment plants was caused by the preeminent use of the surfactant component alkylbenzenesulfonate (ABS). This ingredient exhibits delayed biodegradability because of the branched chain structure of its molecules. In 1965, detergent manufacturers substituted linear alkylbenzenesulfonate (LAS) for ABS in their formulations, and thus helped alleviate the foaming sewage problem. Today LAS remain an important surfactant, although production has declined from 715 million pounds in 1970 to 633 million pounds in 1977.

Meanwhile, the use in synthetic detergent formulations of linear alcohol ethoxylates (LAE) of molecular length of  $C_{10}$  or higher chains (e.g., dodecyl) has increased. The increased use of synthetic polyester blends in clothes fabrics, which are characterized by a tendency to retain oily soil deposits, has spurred the increased use in laundry detergent formulations of linear alcohol ethoxylates, which are superior in removing oily deposits. In addition, the laundry detergent manufacturers increased their consumption of linear alcohol ethoxylates as synthetic detergent surfactants in order to compensate for the lower levels of phosphate builders now allowed in laundry detergent formulations. The lower phosphate levels, they believed, lowered the overall cleaning performance of their products, and thus more surfactant was needed. Production of linear alcohol ethoxylates rose from 328 million pounds in 1970 to about 577 million pounds in 1977, thus rivaling the prominence that LAS had formerly held.

### Builders

Coping with water hardness, the builders role was a more complex problem than reducing foaming. Sodium tripolyphosphate (STPP), the most effective builder, is still the principal builder used in synthetic detergent

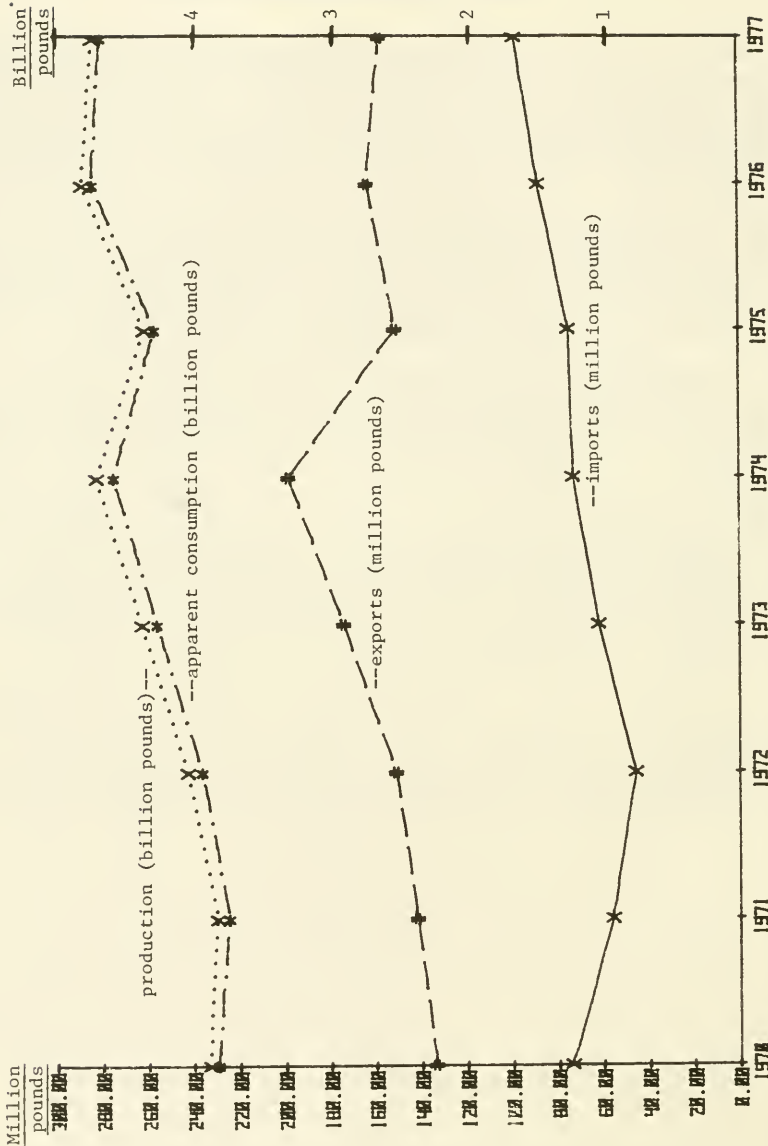
formulations, although the percent of phosphorus content has been reduced since 1970, even in areas of the United States where they are not banned. During the 1970's, complete bans or limitations on the phosphate content of home laundry detergents in the United States followed general consumer concern for the environment. Of particular concern was the accelerated rates at which bodies of fresh water such as the Great Lakes were undergoing eutrophication, a condition in which algae reproduce too rapidly in the presence of the nutrient phosphates. The resulting corrective legal and regulatory action has been channelled through State and local jurisdictional units. Those areas in which the phosphate laundry detergent builders are banned include the States of Indiana, Michigan, New York, and Vermont; Dale County in Florida; the cities of Chicago and certain Chicago suburbs; the city of Akron, Ohio; and several other communities in the United States.

The enactment of most legislation affecting phosphate content occurred between October 1970 and June 1971. However, Michigan, New York, and Vermont passed such laws as recently as the fall of 1977 and early 1978. These laws and regulations probably necessitated certain revisions of product formulations and of distribution patterns of detergent manufacturers. However, according to the industry, even in nonban areas the phosphate content of laundry detergents was reduced from the level existing in 1970 (9 to 12 percent phosphorus), to an average level of 6 percent at present. As a result the industry reports that overall U.S. consumption of sodium tripolyphosphate declined from 573,000 short tons ( $P_2O_5$  content) in 1969 to 246,000 short tons ( $P_2O_5$  content) in 1976. Consumption of STPP has declined at the rate of 12.9 percent per year since 1970 and is expected to decline further until 1982, at an average rate of 4.5 to 6.0 percent per year.

According to the industry, since the reduction in the use of phosphates, some synthetic detergent manufacturers have substituted sodium carbonate and sodium silicate as builders. These compounds were used as builders before phosphate grew in popularity following World War II. Development is currently proceeding on the possible use of sodium aluminosilicate (including zeolites) and sodium silicate, which control water hardness by ion exchange.

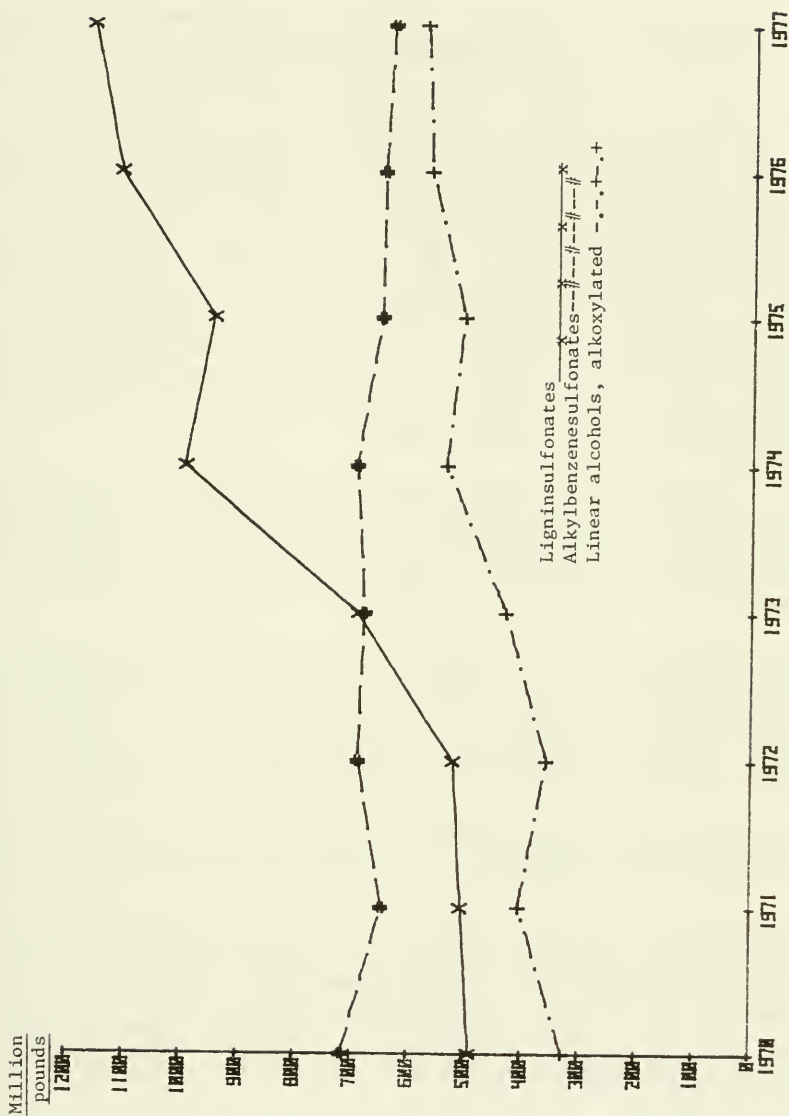
## SYNTHETIC ORGANIC CHEMICALS, 1977

Surface-active agents: U.S. production, imports, exports,  
and apparent consumption, 1970-77.



Source: Production, compiled from official statistics of the U.S. International Trade Commission; Imports and Exports, compiled from official statistics of the U.S. Department of Commerce and partly estimated.

Selected surface-active agents: U.S. production, 1970-77



Source: Production, compiled from official statistics of the U.S. International Trade Commission.

## SURFACE-ACTIVE AGENTS

Anne Klein

The surface-active agents included in this report are organic chemicals that reduce the surface tension of water or other solvents and are used chiefly as detergents, dispersing agents, emulsifiers, foaming agents, or wetting agents in either aqueous or nonaqueous systems. Waxes and products used chiefly as plasticizers are excluded. Surface-active agents are produced from natural fats and oils, from silvichemicals such as lignin, rosin, and tall oil, and from chemical intermediates derived from coal tar and petroleum. A major part of the output of the bulk chemicals shown in this report is consumed in the form of packaged soaps and detergents for household and industrial use. The remainder is used in the processing of textiles and leather, in ore flotation and oil-drilling operations, and in the manufacture of agricultural sprays, cosmetics, elastomers, foods, lubricants, paint, pharmaceuticals, and many other products.

The statistics for production and sales of surface-active agents are grouped by ionic class and by chemical class and subclass. All quantities are reported in terms of 100-percent organic surface-active ingredient and thus exclude all inorganic salts, water, and other diluents. Sales statistics reflect sales of bulk surface-active agents only; sales of formulated products are excluded.

Total U.S. production of surface-active agents in 1977 amounted to 4,718 million pounds, or 1.6 percent less than the 4,796 million pounds reported for 1976. Sales of bulk surface-active agents in 1977 amounted to 2,515 million pounds, valued at \$875 million, compared with sales in 1976 of 2,512 million pounds, valued at \$821 million. In terms of quantity, sales in 1977 were approximately the same as reported in 1976; in terms of value, however, sales in 1977 were 6.5 percent greater than in 1976.

Production of anionic surface-active agents in 1977 amounted to 3,207 million pounds, or 68 percent of the total output reported for 1977. Sales of anionics in 1977 amounted to 1,425 million pounds valued at \$335 million.

Production of cationic surface-active agents in 1977 amounted to 297 million pounds, 17.9 percent greater than the 252 million pounds reported in 1976. Production of nonionic surface-active agents amounted to 1,195 million pounds in 1977, 21.4 percent greater than the 1,170 million pounds reported in 1976. Sales of cationic surface-active agents in 1977 increased by 14.8 percent in terms of quantity and 14.5 percent in terms of value over 1976. Sales of nonionics in 1977, however, declined slightly from 1976, by 1.0 percent, in terms of quantity but increased by 5.1 percent in terms of value over 1976.



The difference between production and sales reflects inventory changes and captive consumption of soaps and surface-active agents by synthetic rubber producers, and by manufacturers of cosmetics, packaged detergents, bar soaps, and other formulated consumer products. In some instances the difference may also reflect quantities of surface-active agents used as chemical intermediates, e.g., nonionic alcohol and alkylphenol ethoxylates which may be converted to anionic surface-active agents by phosphation or sulfation.



TABLE 1.--SURFACE-ACTIVE AGENTS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>

[Listed below are all surface-active agents for which reported data on production or sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists all surface-active agents for which data on production and/or sales were reported and identifies the manufacturers of each]

SURFACE-ACTIVE AGENTS	SALES <sup>3</sup>			
	PRODUCTION <sup>2</sup>	QUANTITY <sup>2</sup>	VALUE	UNIT VALUE <sup>4</sup>
	1,000	1,000	1,000	Per
	pownds	pownds	dollars	pownd
Grand total-----	4,718,174	2,514,583	875,023	\$0.35
Benzenoid <sup>5</sup> -----	989,564	469,432	200,244	.43
Nonbenzenoid <sup>6</sup> -----	3,728,608	2,045,151	674,778	.25
<i>AMPHOTERIC</i>				
Total-----	18,294	17,498	18,880	1.08
<i>ANIONIC</i>				
Total-----	3,207,064	1,425,199	334,771	.23
Carboxylic acids (and salts thereof), total-----	637,808	134,340	51,461	.38
Carboxylic acids having amide, ester, or ether linkages-----	5,290	4,478	4,494	1.00
Coconut oil acids, potassium salt-----	9,016	1,757	1,176	.67
Coconut oil acids, sodium salt-----	129,966	1,726	607	.35
Corn oil acids, potassium salt-----	189	209	146	.70
Mixed vegetable oil acids, potassium salt-----	3,722	3,508	4,893	1.39
Oleic acid, potassium salt-----	451	196	101	.51
Oleic acid, sodium salt-----	301	232	205	.88
Soybean oil acid, potassium salt-----	904	359	160	.44
Tall oil acids, potassium salt-----	6,995	4,247	2,342	.55
Tall oil acids, sodium salt-----	796	522	178	.34
Tallow acids, sodium salt-----	353,862	21,322	5,562	.26
All other carboxylic acids-----	126,316	95,784	31,597	.33
Phosphoric and polyphosphoric acid esters (and salts thereof), total-----	38,622	21,899	15,622	.71
Alcohols and phenols, alkoxylated and phosphated, total-----	25,358	15,405	10,625	.69
Dinonylphenol, ethoxylated and phosphated-----	574	508	373	.73
Mixed linear alcohols, ethoxylated and phosphated-----	3,280	2,993	2,328	.78
Nonylphenol, ethoxylated and phosphated-----	10,392	5,574	3,560	.64
Polyhydric alcohol, ethoxylated and phosphated-----	255	249	152	.61
Tridecyl alcohol, ethoxylated and phosphated-----	673	404	327	.81
All other-----	10,184	5,677	3,885	.69
Alcohols, phosphated or polyphosphated-----	13,264	6,494	4,997	.77
Sulfonic acids (and salts thereof), total-----	1,961,387	1,038,055	164,455	.16
Alkylbenzenesulfonates, total-----	632,605	176,733	62,868	.36
Dodecylbenzenesulfonic acid-----	179,260	88,294	26,415	.30
Dodecylbenzenesulfonic acid, calcium salt-----	6,123	7,868	5,820	.74
Dodecylbenzenesulfonic acid, isopropylamine salt-----	4,954	4,676	2,743	.59
Dodecylbenzenesulfonic acid, potassium salt-----	185	184	97	.53
Dodecylbenzenesulfonic acid, sodium salt-----	318,785	51,815	15,842	.31
Dodecylbenzenesulfonic acid, triethanolamine salt-----	6,823	7,390	2,961	.40
Tridecylbenzenesulfonic acid, sodium salt-----	99,414	...	...	...
All other-----	17,061	16,506	...	.53
Toluenesulfonic acid, potassium and sodium salts-----	19,756	...	...	...

See footnotes at end of table.

TABLE 1.--SURFACE-ACTIVE AGENTS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>--CONTINUED

SURFACE-ACTIVE AGENTS	PRODUCTION <sup>2</sup>	SALES <sup>3</sup>		
		QUANTITY <sup>2</sup>	VALUE	UNIT VALUE <sup>4</sup>
	1,000	1,000	1,000	Per
	pounds	pounds	dollars	pound
<i>ANIONIC--Continued</i>				
Sulfonic acids (and salts thereof)--Continued				
Xylenesulfonic acid, ammonium salt-----	3,194	3,257	888	\$0.27
Xylenesulfonic acid, sodium salt-----	29,055	20,460	5,558	.27
Ligninsulfonates, total-----	1,160,244	762,186	43,197	.06
Ligninsulfonic acid, calcium salt-----	534,609	490,405	15,962	.03
Ligninsulfonic acid, sodium salt-----	109,384	92,062	9,504	.10
All other-----	516,251	179,719	17,731	.10
Naphthalenesulfonates, total-----	11,217	5,741	3,679	.64
Diisopropylnaphthalenesulfonic acid, sodium salt-----	1,776	1,587	1,451	.91
All other-----	9,441	4,154	2,228	.54
Sulfonic acids having amide linkages, total-----	4,603	3,103	3,253	1.05
N-Methyl-N-(tall oil acyl)taurine, sodium salt-----	364	357	367	1.03
All other-----	4,239	2,746	2,886	1.05
Sulfonic acids having ester or ether linkages, total-----	77,032	28,430	33,913	1.19
Sulfosuccinic acid esters, total-----	16,512	13,954	12,949	.93
Sulfosuccinic acid, bis(2-ethylhexyl)ester, sodium salt-----	13,394	11,327	11,209	.99
All other-----	3,118	2,627	1,740	.66
Other sulfonic acids having ester or ether linkages-----	60,520	14,476	20,964	1.45
All other sulfonic acids-----	23,681	38,145	11,099	.29
Sulfuric acid esters (and salts thereof), total-----	533,224	214,437	96,784	.45
Acids, amides, and esters, sulfated, total-----	16,153	12,187	5,452	.45
Butyl oleate, sulfated, sodium salt-----	1,084	1,080	440	.41
Isopropyl oleate, sulfated, sodium salt-----	81	81	51	.63
Propyl oleate, sulfated, sodium salt-----	545	389	174	.45
Oleic acid, sulfated disodium salt-----	5,569	...	...	...
Tall oil sulfated, sodium salt-----	2,107	1,155	320	.28
Other acids, amides, and esters, sulfated-----	6,767	9,482	4,467	.47
Alcohols, sulfated, total-----	222,980	57,875	34,232	.59
Dodecyl sulfate, ammonium salt-----	10,722	...	...	...
Dodecyl sulfate, magnesium salt-----	236	226	251	1.11
Dodecyl sulfate, sodium salt-----	56,375	27,966	15,157	.54
Mixed linear alcohols, sulfated, ammonium salt-----	18,496	1,306	723	.55
Mixed linear alcohols, sulfated, sodium salt-----	...	2,385	1,611	.68
Other alcohols, sulfated-----	137,151	25,992	16,490	.63
Ethers, sulfated, total-----	272,621	124,282	50,561	.41
Dodecyl alcohol, ethoxylated and sulfated, sodium salt-----	11,308	11,129	8,528	.77
Mixed linear alcohols, ethoxylated and sulfated, ammonium salt-----	123,153	...	...	...
Mixed linear alcohols, ethoxylated and sulfated, sodium salt-----	122,059	30,562	11,613	.38
All other-----	16,101	82,591	30,400	.37
Castor oil, sulfated, sodium salt-----	4,235	3,935	2,102	.53
Cod oil, sulfated, sodium salt-----	1,862	1,837	433	.24
Neat's-foot oil, sulfated, sodium salt-----	1,149	763	263	.34
Soybean oil, sulfated, sodium salt-----	697	643	222	.35
Tallow, sulfated, sodium salt-----	4,981	4,761	1,011	.21
Other anionic surface-active agents <sup>7</sup> -----	44,568	24,623	8,977	.36

See footnotes at end of table.

TABLE 1.--SURFACE-ACTIVE AGENTS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>--CONTINUED

SURFACE-ACTIVE AGENTS	PRODUCTION <sup>2</sup>		SALES <sup>3</sup>	
	QUANTITY <sup>2</sup>	VALUE	QUANTITY <sup>2</sup>	UNIT VALUE <sup>4</sup>
	1,000 pounds	1,000 dollars	1,000 pounds	Per pound
<i>CATIONIC</i>				
Total-----	297,353	204,301	140,791	\$0.69
Amine oxides and oxygen-containing amines (except those having amide linkages), total-----	78,332	21,695	15,521	.72
Acyclic, total-----	72,630	18,435	13,407	.73
(Tallow alkyl)amine, ethoxylated-----	3,913	3,509	2,251	.73
All other-----	68,717	14,926	11,156	.74
Cyclic (including imidazoline and oxazoline derivatives), total-----	5,702	3,260	2,114	.65
1-(2-Hydroxyethyl)-2-nor(coconut oil alkyl)-2-imidazoline-----	139	...	...	...
1-(2-Hydroxyethyl)-2-nor(tall oil alkyl)-2-imidazoline-----	932	217	146	.67
All other-----	4,631	3,043	1,968	.64
Amines and amine oxides having amide linkages, total-----	28,437	22,718	16,958	.75
Stearic acid - ethylenediamine condensate, mono-ethoxylated-----	2,903	2,772	2,317	.84
Tall oil acids - diethylenetriamine and polyalkyleneopolyamine condensates-----	14,098	13,390	7,562	.56
All other-----	11,436	6,556	7,079	1.08
Amines, not containing oxygen (and salts thereof), total-----	78,854	59,712	42,234	.71
Diamines, polyamines, and amine salts, total-----	18,578	16,011	10,176	.64
N-(9-Octadecenyl)trimethylenediamine-----	2,963	1,918	1,339	.70
N-(Tallow alkyl)trimethylenediamine-----	5,535	4,789	2,901	.61
All other-----	10,080	9,304	5,936	.64
Primary, secondary, and tertiary monoamines, total-----	60,276	43,701	32,058	.73
(Hydrogenated tallow alkyl)amine-----	3,416	2,784	1,791	.64
9-Octadecenylamine-----	6,619	4,260	2,640	.62
(Tallow alkyl)amine-----	9,786	6,752	5,564	.82
N,N-Dimethyl(mixed alkyl)amine-----	6,115	4,454	3,471	.78
N,N-Dimethyloctadecylamine-----	754	725	639	.88
N-Methyl bis(hydrogenated tallow alkyl)amine-----	3,254	...	...	...
All other-----	30,332	24,726	17,953	.73
Quaternary ammonium salts, not containing oxygen, total-----	88,889	80,270	52,476	.65
Acyclic, total-----	72,990	66,362	35,354	.53
Bis(coconut oil alkyl)dimethylammonium chloride-----	2,934	2,305	1,951	.85
Bis(hydrogenated tallow alkyl)dimethylammonium chloride-----	60,348	55,477	22,794	.41
Trimethyl(tallow alkyl)ammonium chloride-----	1,308	1,498	1,107	.74
All other-----	8,400	7,082	9,502	1.34
Benzenoid, total-----	15,899	13,908	17,122	1.23
Benzyl(coconut oil alkyl)dimethylammonium chloride-----	218	...	...	...
Benzyl(mixed alkyl)ammonium chloride-----	8,241	7,684	10,999	1.43
Benzyltrimethylammonium chloride-----	...	1,024	462	.45
All other-----	7,440	5,200	5,661	1.08
Other cationic surface-active agents-----	22,841	19,906	13,602	.68
<i>NONIONIC</i>				
Total-----	1,195,463	867,585	380,581	.44
Carboxylic acid amides, total-----	80,918	55,522	31,374	.57
Diethanolamine condensates (amine/acid ratio=2/1), total-----	20,327	14,987	9,033	.60

See footnotes at end of table.

TABLE 1.--SURFACE-ACTIVE AGENTS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>--CONTINUED

SURFACE-ACTIVE AGENTS	PRODUCTION <sup>2</sup>	SALES <sup>3</sup>		
		QUANTITY <sup>2</sup>	VALUE	UNIT VALUE <sup>4</sup>
<i>NONIONIC--Continued</i>				
Carboxylic acid amides--Continued	1,000	1,000	1,000	Per
Diethanolamine condensates (amine/acid ratio=2/1)--Continued	pounds	pounds	dollars	pound
Capric acid-----	187	...	...	...
Castor oil acids-----	1,777	992	625	\$0.63
Coconut oil acids-----	10,180	7,880	4,713	.60
Coconut oil and tallow acids-----	1,801	1,694	833	.49
Lauric acid-----	226	198	140	.70
Lauric and myristic acids-----	3,295	1,889	1,240	.66
Oleic acid-----	960	...	...	...
Stearic acid-----	591	366	231	.63
All other-----	1,310	1,968	1,251	.64
Diethanolamine condensate (other amine/acid ratios), total-----	37,475	32,281	17,627	.55
Coconut oil acids (amine/acid ratio=1/1)-----	22,692	22,043	11,669	.53
Lauric acid (amine/acid ratio=1/1)-----	6,569	3,975	2,092	.53
Lauric and myristic acid (amine/acid ratio=1/1)-----	3,156	2,487	1,617	.65
Linoleic acid (amine/acid ratio=1/1)-----	300	300	285	.95
Oleic acid (amine/acid ratio=1/1)-----	641	...	...	...
Stearic acid (amine/acid ratio=1/1)-----	625	631	429	.68
All other-----	3,492	2,845	1,535	.54
All other carboxylic acid amides, total-----	23,116	8,254	4,714	.57
Coconut oil acids (ratio 1/1), ethanolamine condensate-----	...	742	407	.56
All other-----	23,116	7,512	4,307	.57
Carboxylic acid esters, total-----	225,922	190,700	114,656	.60
Anhydrosorbitol monolaurate-----	4,356	2,789	2,221	.80
Anhydrosorbitol mono-oleate-----	4,011	3,680	2,887	.78
Anhydrosorbitol monostearate-----	...	4,657	3,241	.70
Diethylene glycol esters, total-----	1,125	1,098	694	.63
Diethylene glycol distearate-----	383	417	258	.62
Diethylene glycol monolaurate-----	267	275	168	.61
Diethylene glycol monostearate-----	225	156	94	.60
All other-----	250	250	174	.70
Ethoxylated anhydrosorbitol esters, total-----	26,135	26,939	16,875	.63
Ethoxylated anhydrosorbitol monolaurate-----	7,685	...	...	...
Ethoxylated anhydrosorbitol mono-oleate-----	8,034	7,912	5,243	.66
Ethoxylated anhydrosorbitol monostearate-----	6,650	7,996	4,214	.53
All other-----	3,766	11,031	7,418	.67
Ethylene glycol esters, total-----	3,025	3,242	1,682	.52
Ethylene glycol distearate-----	1,448	1,686	644	.38
Ethylene glycol monostearate-----	1,577	1,556	1,038	.67
Glycerol esters, total-----	93,208	79,394	44,521	.56
Glycerol dioleate-----	73	...	...	...
Glycerol mono-oleate-----	3,875	3,273	2,187	.67
Glycerol monostearate-----	21,287	18,581	9,226	.50
Glycerol monoester of hydrogenated cottonseed oil acids-----	2,763	...	...	...
Glycerol monoester of hydrogenated soybean oil acids-----	8,985	9,225	5,926	.64
Glycerol monoester of lard acids-----	...	1,737	971	.56
All other-----	56,225	46,578	26,211	.52
Natural fats and oils, alkoxylated, total-----	15,091	13,907	5,804	.42
Castor oil, ethoxylated-----	8,236	7,487	2,936	.39
Hydrogenated castor oil, ethoxylated-----	...	1,963	1,105	.56

See footnotes at end of table.

TABLE 1.--SURFACE-ACTIVE AGENTS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>--CONTINUED

SURFACE-ACTIVE AGENTS	PRODUCTION <sup>2</sup>	SALES <sup>3</sup>		
		QUANTITY <sup>2</sup>	VALUE	UNIT VALUE <sup>4</sup>
<i>NONIONIC--Continued</i>				
Carboxylic acid esters--Continued	1,000	1,000	1,000	Per pound
Natural fats and oils, alkoxylated--Continued				
Lanolin, ethoxylated-----	1,005	826	642	\$0.78
All other-----	5,850	3,631	1,121	.31
Polyethylene glycol esters, total-----	39,367	31,544	16,425	.52
Polyethylene glycol esters of chemically de-				
fined acids, total-----	20,673	16,357	11,474	.70
Polyethylene glycol dilaurate-----	1,256	1,203	873	.73
Polyethylene glycol dioleate-----	3,390	929	586	.63
Polyethylene glycol distearate-----	2,965	2,888	1,916	.66
Polyethylene glycol monooleate-----	3,459	3,662	2,872	.78
Polyethylene glycol mono-oleate-----	2,707	2,245	1,382	.62
Polyethylene glycol monostearate-----	6,743	5,268	3,696	.70
All other-----	153	162	149	.92
Polyethylene glycol esters of mixed acids,				
total-----	18,694	15,187	4,952	.33
Polyethylene glycol diester of tall oil acids-	3,060	...	...	...
All other-----	15,634	15,187	4,952	.33
Polyglycerol esters-----	1,378	1,282	1,555	1.21
1,2-Propanediol monolaurate-----	49	37	49	1.32
1,2-Propanediol monostearate-----	2,307	2,216	1,481	.67
All other carboxylic acid esters-----	35,870	19,915	17,221	.86
Ethers, total-----	882,905	617,191	229,474	.37
Benzenoid ethers, total-----	225,660	195,004	76,118	.39
Dinonylphenol, ethoxylated-----	...	1,852	1,109	.60
Dodecylphenol, ethoxylated-----	14,785	...	...	...
Nonylphenol, ethoxylated-----	130,384	123,043	41,373	.34
Phenol, ethoxylated-----	2,796	2,222	1,112	.50
All other-----	77,695	67,887	32,524	.48
Nonbenzenoid ethers, total-----	657,246	422,186	153,356	.36
Linear alcohols, alkoxylated, total-----	576,703	361,377	122,113	.34
Decyl alcohol, ethoxylated-----	2,641	...	...	...
Mixed linear alcohols, ethoxylated-----	466,347	336,605	109,400	.33
9-Octadecenyl alcohol, ethoxylated-----	1,075	817	833	.77
Oleyl alcohol, ethoxylated-----	284	254	333	1.31
All other-----	106,356	23,701	11,547	.49
Other ethers and thioethers, total-----	80,543	60,809	31,243	.51
Tridecyl alcohol, ethoxylated-----	7,305	7,273	3,789	.52
All other-----	73,238	53,536	27,454	.51
Other nonionic surface-active agents-----	5,718	4,172	5,077	1.22

<sup>1</sup> The data for production (in thousands of pounds) for 1976 has been revised as shown below:

Grand total-----	4,795,775
Nonionic surface-active agents, total-----	1,170,144
Ethers, total-----	866,210
Nonbenzenoid ethers, total-----	633,414
Linear alcohols, alkoxylated, total-----	567,423
Mixed linear alcohols, ethoxylated-----	441,659

<sup>2</sup> All quantities are given in terms of 100 percent organic surface-active ingredient.

<sup>3</sup> Sales include products sold as bulk surface-active agents only.

<sup>4</sup> Calculated from rounded figures.

<sup>5</sup> The term "benzenoid" used in this report, describes any surface-active agents, except lignin derivatives, whose molecular structure includes 1 or more 6-membered carbocyclic or heterocyclic rings with conjugated double bonds (e.g., the benzene ring or the pyridine ring).

<sup>6</sup> Includes ligninsulfonates.

<sup>7</sup> Includes all other natural fats and oils, sulfated.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA WERE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT. COMPANY IDENTIFICATION CODES WHICH ARE FOLLOWED BY AN "E" ARE SO LABELED BECAUSE THE COMPANY FAILED TO SUPPLY THE U.S. INTERNATIONAL TRADE COMMISSION WITH THEIR DATA IN SUFFICIENT TIME FOR ITS INCLUSION IN THIS REPORT. THE COMPANY IS PRESUMED TO HAVE CONTINUED PRODUCTION OF THE COMPOUND IN QUESTION IN 1977 AND THE VOLUME OF PRODUCTION AND SALES HAS BEEN ESTIMATED BY THE USITC STAFF MEMBERS]

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A M P H O T E R I C	
Acyclic apboteric surface-active agents, all other	: DUP, SCP.
1,1-Bis(carboxyethyl)-2-undecyl-imidazoline, sodium salt	: MOA.
1,1-Bis(carboxymethyl)-2-undecyl-2-imidazolium chloride, disodium salt	: SCP.
1,1-Bis(carboxymethyl)-2-undecyl-2-imidazolium hydroxide, disodium salt	: BBD, MIB.
(1-Carboxyheptadecyl)triethylammonium hydroxide, inner salt	: DUP.
(Carboxymethyl)[3-(coconut oil amide)propyl]diethyl ammonium chloride, sodium salt	: X.
(Carboxymethyl)[3-(coconut oil amide)propyl]diethyl ammonium hydroxide, inner salt	: ICH, WM.
1-Carboxymethyl-2-heptadecyl-(2-hydroxyethyl)-2-imidazolium hydroxide, sodium salt	: MIB.
1-Carboxymethyl-1-codrus derivative sodium salt	: MIB.
1-Carboxymethyl-1-codrus derivative sodium salt	: MIB.
1-Carboxymethyl-1-(2-hydroxyethyl)-2-undecyl-2-imidazolium hydroxide, sodium salt	: GAF, MIB, TCH.
N-(Coconut oil alkyl)- $\beta$ -alanine, partial sodium salt	: GNM.
N-(Coconut oil alkyl)- $\beta$ -alanine, sodium salt	: GNM.
N-Dodecyl- $\beta$ -alanine, partial sodium salt	: GNM.
N-Dodecyl-3-isoindolpropionic acid	: GNM.
N-Dodecyl-3-isoindolpropionic acid, disodium salt	: GNM.
N-(Dodecyl and tetradecyl)- $\beta$ -alanine	: GNM.
N-(Dodecyl and tetradecyl)- $\beta$ -alanine triethanolamine	: GNM.



TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A M P H O T E R I C--Continued	
salt	GNM.
Heptadecylbenzimidazolinesulfonic acid, sodium salt	CGY(E).
1-(2-Hydroxyethyl)-2-heptyl-3-carboxethyl-imidazoline, sodium salt	MOA.
1-(2-Hydroxyethyl)-2-undecyl-3-carboxethylimidazoline, sodium salt	MOA.
Mixed acyclic primary amines, ethoxylated and sulfated, sodium salt	DUP, RH.
Oleic acid-ethylenediamine condensate, propoxylated and sulfated, sodium salt	S.
Polypeptide ammonium salt	X.
Polypeptide ethyl ester	X.
Polypeptide, sodium salt	X.
N-(Tallow alkyl)-3-iminodipropionic acid, disodium salt	GNM.
Cyclic amphoteric surface-active agents, all other	SBC, SCP.
A N I O N I C	
CARBOXYLIC ACIDS (AND SALTS THEREOF):	
AMINE SALTS OF FATI, ROSIN, AND TALL OIL ACIDS:	
Coconut oil acids, diethanolamine salt	SCP.
Coconut oil acids, ethanolamine salt	SBE.
Mixed fatty acids, ethanolamine salt	SBE.
Oleic acid, butylamine salt	DYS.
Oleic acid, diethylamine salt	ASH, WTC.
Oleic acid, triethylamine salt	SNK.
Rosin acids, triethanolamine salt	AES.
Stearic acid, N,N,N',N'-tetrakis(2-hydroxyethyl)ethylenediamine salt	ICI.
Stearic acid, triethanolamine salt	GLV.
Tallow acids, ethanolamine salt	SBP.
Tallow acids, triethanolamine salt	SBE.
Amine salts of fatty, rosin, and tall oil acids, all other	VAL, WM, X.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
CARBOXYLIC ACIDS HAVING AMIDE, ESTER, OR ETHER LINKAGES:	
N-(Coconut oil acyl)polypeptide, potassium salt	X.
N-(Coconut oil acyl)polypeptide, sodium salt	X.
N-(Coconut oil acyl)polypeptide, triethanolamine salt	X.
N-(Coconut oil acyl)sarcosine	HMP
N-(Coconut oil acyl)sarcosine, sodium salt	HMP
N-Lauroylsarcosine	HMF
N-Lauroylsarcosine, sodium salt	CP, HMP, OMX
N-(Mixed alkylsulfonyl)glycine, sodium salt	GAF
N-Oleoylpolypeptide, sodium salt	LMI
N-Oleoylsarcosine	HMP
N-Oleoylsarcosine, sodium salt	GAF
Carboxylic acids with amide, ester or ether linkage, other	AZS, BRD, CHP, HMP, X.
POTASSIUM AND SODIUM SALTS OF FATTY, ROSIN, AND TALL OIL ACIDS:	
Animal grease, sodium salt	NMC
Castor oil acids, potassium salt	NLI, SEA
Castor oil acids, sodium salt	HEM
*Coconut oil acids, potassium salt	RES, CON, DA, DYS, ESS, GRC, HEW, HMT, MCP, NMC, PCH, PEK, SF, SNA, SNW, COF, GRC, HEW, JRG, LEV, NMC, NFR, PG.
Coconut oil acids, sodium salt	GRC, HMT, NMC, DA, PG.
Corn oil acids, potassium salt	RES, DYS, GRC, GRL, LUB, PCH, CCP, SLC.
Corn oil acids, sodium salt	RES, DA, HMT, SNA, USR, WEG, X.
Fish oil acids, sodium salt	LUB, NMC, USB, WEG, WTC.
Lauric acid, potassium salt	GAF
Mixed vegetable fatty acids, potassium salt	RES, DYS, GRC, GRL, LUB, PCH, CCP, SLC.
Oleic acid, potassium salt	RES, DA, HMT, SNA, USR, WEG, X.
Oleic acid, sodium salt	LUB, NMC, USB, WEG, WTC.
Olive oil acids, sodium salt	HMT
Palmitic and stearic acids, potassium salt	HEW
Palmitic and stearic acids, sodium salt	HEW
Palm oil acids, sodium salt	HEW
Rosin acids, potassium salt	PEK, X.
Rosin acids, sodium salt	HBT, SLM, X.
*Soybean oil acids, potassium salt	NMC, PEK, PMK.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A N I O N I C--Continued	
CARBOXYLIC ACIDS (AND SALTS THEREOF)--Continued	
POTASSIUM AND SODIUM SALTS OF FATTY, ROSIN, AND TALLOW ACIDS--Continued	
Stearic acid, potassium salt	CON, DA, WTC.
Stearic acid, sodium salt	DA, JRG, WTC.
*Tall oil acids, potassium salt	X. AES, ASY, CON, DYS, ESS, GRC, HNT, PEK, PNX, SOP, USR,
*Tall oil acids, sodium salt	AES, ASY, CON, DAN, GRC, NMC, SOP, UNE, X.
Tall oil acids and stearic acid, potassium salt	DYS.
Tallow acids, potassium salt	AES, AGP, ASY, DYS, PG, USR.
*Tallow acids, sodium salt	AS1, ES4, CON, CP, GRC, HEW, JRG, LEV, LUB, NMC, NPB, EG, PBX.
Potassium and sodium salts of fatty, rosin, and tall oil acids, all other	HEW, NMC, VAL.
OTHER CARBOXYLIC ACIDS:	SCP, USR.
PHOSPHORIC AND POLYPHOSPHORIC ACID ESTERS (AND SALTS THEREOF):	
ALCOHOLS AND PHENOLS, ALKOXYLATED AND PHOSPHATED:	
*Nonyl alcohol, ethoxylated and phosphated	X.
*Dinonylphenol, ethoxylated and phosphated	AB1, AZS, CTL, DEX, GAP, MOA, SCP, SOP, TCC, W4Y, WTC,
Dodecyl alcohol, ethoxylated and phosphated	GAP.
Hexadecyl alcohol, ethoxylated and phosphated	GAP, MOA, TCH, W4Y, WTC.
Hexylphenol, ethoxylated and phosphated	GAP.
Hexylphenol, ethoxylated and phosphated	ARR, GAP.
Isodecyl alcohol, ethoxylated and phosphated	GRI, W4Y.
*Mixed linear alcohols, ethoxylated and phosphated	AZ1, WTC.
*Nonylphenol, ethoxylated and phosphated	AB1, AZS, CTL, DEX, GAP, MOA, SCP, SOP, TCC, W4Y, WTC,
Nonylphenol, ethoxylated and phosphated, barium	X.
9-Octadecyl alcohol, ethoxylated and phosphated	HRT.
Octylphenol, ethoxylated and phosphated	GAP.
Phenol, ethoxylated and phosphated	RH.
*Polyhydric alcohol, ethoxylated and phosphated	GAP, RH, WTC, X.
*Tridecyl alcohol, ethoxylated and phosphated	DEX, MOA, SCP, TCH, X.
Alcohols and phenols, alkoxyLATED and phosphated or polyphosphated, all other	DAN, GAP, MLL, SNW, WTC, X. BAS, CHP, GAP, W4Y, WTC, X.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A N I O N C--Continued	
PHOSPHORIC AND POLYPHOSPHORIC ACID ESTERS (AND SALTS THEREOF)--Continued	
ALCOHOLS, PHOSPHATED OR POLYPHOSPHATED:	
Butyl phosphate, potassium salt	DUP.
Decyl polyphosphate, sodium salt	USM.
2-Ethylhexyl phosphate	GAF, ICC.
2-Ethylhexyl phosphate, sodium salt	CHP, WTC.
2-Ethylhexyl polyphosphate	X.
2-Ethylhexyl polyphosphate, sodium salt	X.
Hexyl phosphate	ICI, SFS.
Hexyl phosphate, potassium salt	ICI.
Hexyl polyphosphate, potassium salt	DEX.
Mixed alkyl phosphate	CTL, DUP, SFS, X.
Mixed alkyl phosphate, diethanolamine salt	DUP.
Octyl decyl phosphate	X.
Octyl phosphate	SCP, TCH, WTC, X.
Octyl phosphate, alkylamine salt	DUP, SCP.
Octyl phosphate, potassium salt	DEX.
Octyl polyphosphate	DEX.
Phosphated and polyphosphated alcohols, all other	DEX, SNW.
OTHER PHOSPHORIC AND POLYPHOSPHORIC ACID ESTERS:	
Glycerol monoester of mixed fatty acids,	HRD, HLL, YAL, X.
Phosphoric acid	
Phosphoric acid esters, all other	QCP, WTC.
SULFONIC ACIDS (AND SALTS THEREOF):	
ALKYLENESULFONATES:	
*Dodecylbenzenesulfonic acid	ARC, ATR, CO, CRT, CTL, EMK, HLI(E), LAK, LEV, MON, ONX, PFL, PLX, PRX, RCD, STP, TCI, TEN, WTC.
Dodecylbenzenesulfonic acid, (mixed alkyl)amine salt	RCC, X.
Dodecylbenzenesulfonic acid, ammonium salt	AES, HLI(E).
Dodecylbenzenesulfonic acid, branched chain	WTC.
Dodecylbenzenesulfonic acid, butylamine salt	WTC.
*Dodecylbenzenesulfonic acid, calcium salt	ICI, RCD, BH, STP, TWH, WTC, X.
Dodecylbenzenesulfonic acid, diethylamine salt	PIL.
Dodecylbenzenesulfonic acid, ethylenediamine	

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A M I O N I C--Continued	
SULFONIC ACIDS (AND SALTS THEREOF)--Continued	
ALKYLBENZENESULFONATES--Continued	
DODECYLBENZENESULFONATES--Continued	
salt	ICI.
Dodecylbenzenesulfonic acid, isopropanolamine salt	PIL.
Dodecylbenzenesulfonic acid, isopropylamine salt	CIN, CTL, ICI, MRV, RCD, STP, TCH, WTC.
Dodecylbenzenesulfonic acid, potassium salt	RES, RCD, STP.
Dodecylbenzenesulfonic acid, sodium salt	AAC, RES, APA, ABD, ATR, AZS, BLA, CO, CP, CRT, CTL, DUP, FCC, HLI(CE), LEV, NVC, ONA, PER, PG, PFL, PFX, RCD, STP, TEN.
Dodecylbenzenesulfonic acid, sodium salt, urethane salt	WTC.
Dodecylbenzenesulfonic acid, strontium salt	HLI(E).
Dodecylbenzenesulfonic acid, triethanolamine salt	AAC, ARD, ARL, AFR, CIN, CTL, ESS, PIL, RCD, SOP, STP, WTC.
Dodecylbenzene sulfonates, all other	WTC.
OTHER ALKYL BENZENESULFONATES:	
Decylbenzenesulfonic acid, sodium salt	ATR, PLX.
Dodecylbenzenesulfonic acid, potassium salt	STP, RCD, WTC.
Tridecylbenzenesulfonic acid, sodium salt	PLX, RCD, WTC.
Tridecylbenzenesulfonic acid, sodium salt	BLA, CP, NPR, PG, RCD, WTC.
Undecylbenzene sulfonic acid	SCP, WTC.
Undecylbenzene sulfonic acid, sodium salt	SCP, WTC.
Undecylbenzene sulfonic acid, triethanolamine salt	SCP, WTC.
Alkylbenzene sulfonates, all other	USR.
BENZENE-, CUMENE-, TOLUENE-, AND XYLENESULFONATES:	
Cumenesulfonic acid, ammonium salt	NES, STP, WTC.
Cumenesulfonic acid, sodium salt	NES, WTC.
Toluenesulfonic acid, potassium and sodium salts	CO, NES, PFG, WTC.
Xylenesulfonic acid, ammonium salt	CO, NES, STP, WTC.
Xylenesulfonic acid, sodium salt	ATR, CO, NES, PIL, SDC, STP, WTC.
Benzene-, cumene-, toluene-, and xylenesulfonates, all other	WTC.
LIGNANSULFONATES:	
Lignansulfonic acid, ammonium salt	CRZ, SPA.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
SULFONIC ACIDS (AND SALTS THEREOF)--Continued	
LIGNINSULFONATES--Continued	
*Lignansulfonic acid, calcium salt	CRZ, CWP, LKY, MAR, PSP.
*Lignansulfonic acid, chromium salt	MAR, PSP, BAY.
*Lignansulfonic acid, iron salt	CRZ, PSP.
*Lignansulfonic acid, magnesium salt	CWP.
*Lignansulfonic acid, sodium salt	CRZ, MAR, PSP, RAY, SP4.
*Lignansulfonic acid, zinc salt	PSP, WVA.
NAPHTHALENESULFONATES:	
Butylnaphthalenesulfonic acid, sodium salt	DA, ECC.
Dibutylnaphthalenesulfonic acid	GA.
*Dilsopropylnaphthalenesulfonic acid, sodium salt	DA, DUP, UDI.
Dipentylnaphthalenesulfonic acid	X.
Dipentylnaphthalenesulfonic acid, (mixed alkyl) amine salt	X.
Dipentylnaphthalenesulfonic acid, ammonium salt	X.
Methylenedis(2-naphthalenesulfonic acid)	VFC.
Methylenedis(2-naphthalenesulfonic acid), sodium salt	DUP.
Methylnaphthalenesulfonic acid, sodium salt	DA, UDI.
Methylnonylnaphthalenesulfonic acid, sodium salt	UD.
Methylironnaphthalenesulfonic acid, sodium salt	DUP.
Naphthalenesulfonic acid, sodium salt	DUP.
SULFO-SUCCESSORIC ACID DERIVATIVES:	
N-(p- <i>tert</i> -butylphenoxyethyl)-N-octadecylsulfosuccinic acid, tetrasodium salt	ACV, MOA.
N-Octadecylsulfosuccinamic acid, disodium salt	ACV.
N-(Gloxyisopropyl)sulfosuccinamic acid	WTC.
Sulfosuccinamic acid derivatives, all other-	ARD, SBC.
TAURINE DERIVATIVES:	
N-(Coconut oil acyl)-N-methyltaurine, sodium salt	GAF, TWI.
N-Cyclohexyl-N-palmitoyltaurine, sodium salt	GAF.
N-Methyl-N-oleoyltaurine, sodium salt	GAF, HRT.
N-Methyl-N-palmitoyltaurine, sodium salt	GAF.
N-Methyl-N-(tall oil acyl)taurine, sodium salt	CRZ, GAF, USM, X.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A N I O N I C--Continued	
SULFONIC ACIDS (AND SALTS THEREOF)--Continued	
sulfonic acids having ester or ether linkages:	
SULFOSUCCINIC ACID ESTERS:	
Sulfosuccinic acid-bis(diisobutyl)ester, sodium salt	MOA.
Sulfosuccinic acid, bis(2,6-dimethyl-4-heptyl) ester, sodium salt	DAN, GAF, MOA.
*Sulfosuccinic acid, bis(2-ethylhexyl)ester, sodium salt	ACY, CGYLE) CHP, DA, DAN, ECC, FHK, HDG, HBT, MCP, MOA, PC, RH, SCO, SOS, USH, WTC.
Sulfosuccinic acid, dihexyl ester, sodium salt	ACY, MOA.
Sulfosuccinic acid, dodecyl ester, sodium salt	ACI, MOA.
Sulfosuccinic acid, diisooctyl ester, sodium salt	ACY.
Sulfosuccinic acid, diisooctyl ester, sodium salt	X.
Sulfosuccinic acid, dipentyl ester, sodium salt	ACY.
Sulfosuccinic acid, ditiocetyl ester, sodium salt	ACY, MOA.
Sulfosuccinic acid esters, all other LINKAGES:	ABD, HDG, LAK, RH, SCP.
Coconut oil acids, 2-sulfoethyl ester, sodium salt	GAP, LEV, X.
Dodecylphenyloxidedisulfonic acid, disodium salt	DOW.
Dodecyl sulfacetate, sodium salt	STP.
Glycerol monostearate sulfacetate, sodium salt	WTC.
Iso-octylphenol, ethoxylated and sulfonated, sodium salt	RH.
n-Octylphenol, ethoxylated and sulfonated, sodium salt	CRT.
Sulfonic acids with ether linkages, all other	PG, WTC, X.
OTHER SULFONIC ACIDS:	
Butylhydroxybiphenylsulfonic acid (Bwa-50)	RBC.
Mixed alkane sulfonic acid, sodium salt	CCL, DUP, QCP, X.
Petroleum sulfonic acid, water soluble (Acid layer), sodium salt	WTC.
Sulfosuccinic acid-half ester (Coconut monoisoprop	

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A N I O N I C--Continued	
SULFONIC ACIDS (AND SALTS THEREOF)--Continued	
OTHER SULFONIC ACIDS--Continued	
anioniaide, disodium salt - - - - -	NOA.
Sulfonic acids, all other - - - - -	ARD, LAK, SLM, STP, WTC.
SULFURIC ACID ESTERS (AND SALTS THEREOF):	
ACIDS, ALDES, AND ESTERS, SULFATED:	
Coconut oil acids--ethanolamine salt, sulfated, - - - - -	EMK.
CATIONIC ACID ESTERS (EXCEPT NATURAL FATS AND	
ESTERS OF SULFATED OLEIC ACID:	
2-Butoxyethyl oleate, sulfated, sodium salt - - - - -	S.
Butyl heptyl oleate, sulfated, sodium salt - - - - -	AKS, CIN, CRT, ICI, HRV, PC.
Butyl and propyl oleate, sulfated, sodium salt - - - - -	MCP.
Glycerol trioleate, sulfated, sodium salt - - - - -	MRV.
Isobutyl oleate, sulfated, sodium salt - - - - -	DA.
Methpropyl oleate, sulfated, sodium salt - - - - -	CPT, DEX, HRT.
Propyl oleate, sulfated, sodium salt - - - - -	DUP, ICI.
Esters of sulfated oleic acid, all other - - - - -	ACY, AKS, CHP, GAP, MRV.
OTHER SULFATED ESTERS:	
Glycerol monoester of coconut oil acids, sulfated, sodium salt - - - - -	CP.
9-Octadecenyl acetate, sulfated, sodium salt - - - - -	DA, DUP.
OTHER SULFURIC ACID ESTERS:	
Mixed fatty acids, sulfated, potassium salt - - - - -	SCC.
Oleic acid, sulfated, disodium salt - - - - -	ACT, ACY, DA, GAP, TEN.
Sulfuric acid esters, all other - - - - -	SLM.
Tall oil, sulfated, sodium salt - - - - -	ACT, APX, BAO, CHP, CRT, ICI, KAL(E), SEA, WHI, WHW.
ALCOHOLS, SULFATED:	
Decyl and octyl sulfate, sodium salt - - - - -	TCH.
Decyl sulfate, sodium salt - - - - -	HLI(E), ONX, SCP.
DODECYSULFATE SALTS:	
Dodecyl sulfate, ammonium salt - - - - -	AAC, CTL, HLI(E), JRG, ONX, STP, TCH, TNL.
Dodecyl sulfate, diethanolamine salt - - - - -	DUP, JRG, ONX, SCP, STP, TCH.
Dodecyl sulfate, N-diethylcyclohexylamine salt - - - - -	DUP.
Dodecyl sulfate, isopropanolamine salt - - - - -	JRG, ONX, TCH.
Dodecyl sulfate, magnesium salt - - - - -	AAC, HLI(E), STP.



TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A N O N I C--Continued	
SULFURIC ACID ESTERS (AND SALTS THEREOF)--Continued	
ALCOHOLS, SULFATED--Continued	
DODECYLSULFATE SALTS--Continued	
*Decyl sulfate, potassium salt--	PG.
*Decyl sulfate, sodium salt--	AAC, CTL, DUP, HLI(E), OMX, SCP, STP, TCH.
*Decyl sulfate, triethanolamine salt--	AAC, CTL, OMX, SCP, STP, TCH.
2-Ethylhexyl sulfate, sodium salt--	AAC, SCP, TCH.
Hexadecyl sulfate, sodium salt--	AAC.
Hexyl sulfate, potassium salt--	DEX.
*Linear alcohols, sulfated, all other--	AAC, AKS, DUP, PG, X.
*Mixed linear alcohols, sulfated, ammonium salt--	CF, LAK, MTL, PG, RCD, S, SCP, X.
*Mixed linear alcohols, sulfated, sodium salt--	DUP, LAK, PG, RCD, SCP, WTC.
Mixed linear alcohols, sulfated, triethanolamine salt--	LAK, PG, RCD, SCP.
Nonyl sulfate, sodium salt--	LEM.
Octyl sulfate, ammonium salt--	EMK.
Octyl sulfate, sodium salt--	AKX, DUP.
Tridecyl sulfate, sodium salt--	AAC, DA, SCP.
ETHERS SULFATED:	
ALKYLBENZOLES, ETHOXYLATED AND SULFATED:	
Nonylphenol, ethoxylated and sulfated, ammonium salt--	GAN, HLI(E), MOA, STP, WTC.
Nonylphenol, ethoxylated and sulfated, sodium salt--	CRT, GAF.
Octylphenol, ethoxylated and sulfated, sodium salt--	RH.
Sulfated cyclic ethers, all other--	TCH.
Decyl alcohol, propoxylated and sulfated, sodium salt--	APX.
Dodecyl alcohol, ethoxylated and sulfated, ammonium salt--	AAC, AKS, CTL, HLI(E), STP.
*Dodecyl alcohol, ethoxylated and sulfated, sodium salt--	AAC, CTL, HLI(E), OMX, SCP, STP, TCH.
Dodecyl and tetradecyl alcohols, ethoxylated and sulfated, ammonium salt--	LEY.
Hexyl alcohol, propoxylated and sulfated, sodium salt--	APX.
Mixed linear alcohols, ethoxylated and sulfated, ammonium salt--	CO, LAK, MOA, ONX, PG, PTL, RCD, SCP, SHC, STP, WTC.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A M I O N I C--Continued	
SULFURIC ACID ESTERS (AND SLATS THEREOF)--Continued	
ETHERS, SULFATED--Continued	X.
*mixed linear alcohols, ethoxylated and sulfated, sodium salt--	CO, DA, DUP, GAP, HLI(E), LAK, LEV, ONX, PG, PII, RCD, SCP, SHC, STB, TCI, WTC.
Tridecyl alcohol, ethoxylated and sulfated, sodium salt--	AAC.
Sulfated ethers, all other--	PG, WTC.
NATURAL FATS AND OILS, SULFATED:	
*Castor oil, sulfated, sodium salt--	ACT, ACY, AKS, APL, BAO, CRT, DA, DEX, GAF, HRT, ICI, KAL(E), LEA, LUB, MRV, S, SCO, SCP, SEA, SLM, WHH.
Coconut oil, sulfated, sodium salt--	ACT, BAO, DA.
*Cod oil, sulfated, sodium salt--	BAO, SEA, WHI, WHW.
Grease, other than wool, sulfated, sodium salt--	WHI.
Herring oil, sulfated, sodium salt--	SEA, SLM, WHW.
Lard, sulfated, sodium salt--	CRT, WHM, WHW.
Mixed fish oils, sulfated, sodium salt--	ACT, MFD, SLM.
Mixed vegetable oils, sulfated, sodium salt--	LDB.
*Mustard seed oil, sulfated, sodium salt--	DA.
*Neat's foot oil, sulfated, sodium salt--	ACT, ARC, BAO, DA, MRD, PC, SLM.
Peanut oil, sulfated, sodium salt--	ACT, CHF.
Peanut oil, sulfated, sodium salt--	CRT.
Ricebran oil, sulfated, sodium salt--	SEA.
*Soybean oil, sulfated, sodium salt--	ACT, ONX, SEA, WHW.
*Sperma oil, sulfated, sodium salt--	ACT, ONX.
*Tallow, sulfated, sodium salt--	AAI, ACT, AMS, DA, ECC, LUB, MRD, PC, SID, SLM, SOS, WHI.
OTHER ANIONIC SURFACE-ACTIVE AGENTS:	
Fatty acid lactolates, mixed salts--	BFP.
Mixed linear olefin sulfonates--	Y.
Polyethylene-vinyl alcohol copolymer, potassium salt	X.
Tridecyl alcohol, ethoxylated and carbonated, sodium salt--	S.
Anionic surface-active agents, all other--	S, SLM, VAL, WVA.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURERS, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C A T I O N I C	
AMINE OXIDES AND OXYGEN-CONTAINING AMINES (EXCEPT THOSE HAVING AMIDE LINKAGES):	
ACYCLIC:	
N,N-Bis(2-hydroxyethyl)(coconut oil alkyl)amine	: ARC.
N,N-Bis(2-hydroxyethyl)octadecylamine	: ARC, FIN.
N,N-Bis(2-hydroxyethyl)(tallow alkyl)amine	: ARC.
(Coconut oil alkyl)amine, ethoxylated	: ARC, DA, TCH, X.
(Coconut oil alkyl)amine, ethoxylated, acetate	: PG.
(Coconut oil alkyl)amine, ethoxylated, oleate	: DUP.
N,N-Dimethylhexadecylamine oxide	: ARC, ONK.
Ethylendiamine, propoxylated	: DUP.
(Hydrogenated tallow alkyl)amine, ethoxylated	: TCH.
N-(2-Hydroxyethyl)-N,N',N'-tris(2-hydroxypropyl)-ethylendiamine	: X.
(Mixed alkyl)amine, ethoxylated	: GAF, ICI, RH.
(9-Octadecenyl)amine, ethoxylated	: ARC, TCH.
Octadecylamine, ethoxylated	: ARC, TCH.
(Soybean oil alkyl)amine, ethoxylated	: ARC.
(Tallow alkyl)amine, ethoxylated	: ARC, DUP, GAF, TCH.
N-(tallow alkyl)tris(ethylene)amine, ethoxylated	: ARC, TCH.
N,N,N',N'-tetakis(2-hydroxyethyl)ethylendiamine	: X.
N,N,N',N'-tetakis(2-hydroxypropyl)ethylendiamine	: ARC.
Tris(haoli)amine, ethoxylated	: MIL.
Tris(haoli)amine, propoxylated	: MIL.
Amine oxides and oxygen-containing amines (Except those with amide linkages), acyclic, all other	: AFS, BRD, CHP, GAF, ONK, PG, SBC, SDH, TCH, X.
CYCLIC:	
2-(8-Heptadecenyl)-4-hydroxyethyl-4-methyl-2-oxazoline	: BRD.
1-(2-Hydroxyethyl)-2-heptadecyl-3-carboxethylimidazoline	: MOA.
1-(2-Hydroxyethyl)-2-nonyl-2-imidazoline	: BRD, MOA, SBC, SCP.
*1-(2-Hydroxyethyl)-2-nor(coccut oil alkyl)-2-imidazoline	: BRD, GAF, MOA, SCP, TCH.
*1-(2-Hydroxyethyl)-2-nor(tallow oil alkyl)-2-imidazoline	: BRD, HDG, MOA, TCH, X.
1-(2-Hydroxyethyl)-2-undecyl-3-carboxethylimidazo-	

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C A T I O N I C--Continued	
AMINE OXIDES AND OXYGEN-CONTAINING AMINES (EXCEPT THOSE HAVING AMIDE LINKAGES)--Continued	
Cyclig--Continued	
Irene	MOA
Kofina amines	WVA
Kofina amines ethoxylated	HPC, X
Amine oxides and oxygen-containing amines (Except those having amine linkages) cyclic, all other	CG(E), TCH, X
AMINES AND AMINE OXIDES HAVING AMIDE LINKAGES:	
CARBOXYLIC ACID - DIAMINE AND POLYAMINE CONDENSATES:	
Carboxylic acid-diamine and polyamine condensates, all other	ICI, STC, VND, X
Coconut oil acids-N,N-dimethyltrimethylenediamine condensate	SCP
Mixed fatty acids-polyalkylenepolyamine condensate	QCP, TCH, X
Oleic acid-dithylenetriamine condensate	ICI, TCH
Oleic acid-N,N-dimethyltrimethylenediamine condensate	CCW
Oleic acid-ethylenediamine condensate, monoethoxylated	CLD, DEX, SOC
Prelargonic acid-tetraethylenepentamine condensate	ICI
Stearic acid-dithylenetriamine condensate	S, STC
Stearic acid-dithylenetriamine condensate, polyethoxylated	APX
Stearic acid-N,N-diethylethylenediamine condensate	S
*Stearic acid-ethylenediamine condensate, monoethoxylated	CLD, CST, DA, DEX, ICI, MBY, S, SLC
Stearic acid-ethylenediamine condensate, polyethoxylated	ICI
Stearic acid-tetraethylenepentamine condensate	ONK
*Tall oil acids-dithylenetriamine condensate and polyalkylenepolyamine condensate	AZS, NCW, QCP, SCF, X
OTHER AMINES AND AMINE OXIDES HAVING AMIDE LINKAGES:	
3-Lauramido-N,N-dimethylpropylamine oxide	SMH
Stearic acid,dioctanolamine condensate, methyl sulfate	DUP
Amines and amine oxides having amide linkages, all other	HLI(E), SCP

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
AMINES, NOT CONTAINING OXYGEN (AND SALTS THEREOF):	
AMINE SALTS:	
(Cocount oil alkyl)amine acetate	ARC.
(Hydrogenated tallow alkyl)amine acetate	ARC.
(9-Octadecenyl)amine acetate	GNN.
Octadecylamine acetate	ARC.
(Tallow alkyl)amine acetate	ARC.
N-(tallow alkyl)trimethylenediamine oleate	ARC, ASH.
amine salts (Not containing oxygen), all other	SH.
DIAMINES AND POLYAMINES:	
INDAZOLE DERIVATIVES:	
1-(2-aminoethyl)-2-iso(tallow alkyl)-2-imidazo	SCP.
N-(docosyl and eicosyl)trimethylenediamine	ENO.
2-Heptadecyl-2-imidazoline	SCC.
N-(Cocount oil alkyl)trimethylenediamine	ARC, GNN.
N-Dodecylidethylenediamine	ARC.
N-(Bisec alkyl)polyethylenepolyamine	ARC, CCM, SMM.
N-(9-Octadecenyl)trisethylenediamine	ARC, ASH, ENO, GNN.
N-(Soybean oil alkyl)trimethylenediamine	ENO.
*N-(Tallow - alkyl)diisopropylamine	GNN, NCM.
*N-(Tallow alkyl)trimethylenediamine	ARC, ASH, ENO, GNN, NCM.
Diamines and polyamines, all other	ICI, SIC, X.
PRIMARY MONOAMINES:	
(Cocount oil alkyl)amine	ARC, ASH, ENO.
(Docosyl and eicosyl)amine	ENO.
Dodecylamine	ARC, ASH, GNN.
Hexadecylamine	ENO.
*Hydrogenated tallow alkyl)amine	ARC, ASH, ENO, GNN.
(Mixed alkyl)amine	ARC.
*9-Octadecenylamine	ARC, ASH, ENO, GNN.
Octadecylamine	ARC, ASH, ENO, GNN.
Octylamine	ARC.
(Soybean oil alkyl)amine	ARC, ENO.
(Tallow alkyl)amine	GNN.
*Tallow alkyl)amine	ARC, ASH, ENO, GNN, NCM.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C A T I O N I C--Continued	
AMINES, NOT CONTAINING OXYGEN (AND SALTS THEREOF)--Con.:	
SECONDARY AND TERTIARY MONOAMINES:	
Bis(coconut oil alkyl)amine--	ARC.
N,N-dihydrogenated tallow alkylamine--	ARC, ASH.
N,N-dimethyl(coconut oil alkyl)amine--	ARC, BRD.
N,N-dimethyldodecylamine--	BRD.
N,N-dimethylheptadecylamine--	ARC, BRD.
N,N-dimethyl(hydrogenated tallow alkyl)amine--	ARC, ECD.
*N,N-dimethyl(mixed alkyl)amine--	ARC, ECD, ENO.
N,N-dimethyl(octadecyl)amine--	ARC, BRD, EMO, ONX, TNA.
N,N-dimethyloctadecylamine--	ARC, BRD, EMO, ONX.
N,N-dimethyl(9-phenyl alkyl)amine--	BRD.
N,N-dimethyl(tetradecylamine-2)	ARC, EMO.
*N-methylbis(hydrogenated tallow alkyl)amine--	ARC, BRD.
Trisdecylamine--	ARC, ASH, EMO, GNM.
Triaurylamine--	GNM.
Trietylamine--	GNM.
Secondary and tertiary monoamines, all other--	ARC.
OXYGEN-CONTAINING QUATERNARY AMMONIUM SALTS:	
Benzyl(coconut oil alkyl)bis(2-hydroxyethyl)ammonium chloride--	SCP, X.
Benzyl(coconut oil alkyl, ethoxylated)dimethyl ammonium chloride--	ARC, DUP, GAP, SCP.
1-Benzyl-1-(2-hydroxyethyl)-2-nor(tall oil alkyl)-2- isidazoline--	MOA, X.
Benzyl(tallow alkyl)bis(2-hydroxyethyl)ammonium chloride--	DUP.
Bis(2-hydroxyethyl, ethoxylated)methyl(9-octadecyl)-ammonium chloride--	ARC.
Bis(2-hydroxyethyl, ethoxylated)methyloctadecyl ammonium chloride--	ARC.
(Coconut oil alkyl)bis(2-hydroxyethyl, ethoxylated)-methylammonium chloride--	ARC.
(Ethoxybenzyl)dimethyl(octylphenoxy)ammonium chloride--	ARC, RH.
(Ethoxybenzyl)dimethyl(octyltolyl)ammonium	

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
AMINES, NOT CONTAINING OXYGEN (AND SALTS THEREOF)--Con.: OXYGEN-CONTAINING QUATERNARY AMMONIUM SALTS:	
1-Ethyl-2-(8-heptadecenyl)-1-(2-hydroxyethyl)-2-imidazole azolinium ethyl sulfate	RH.
N-Ethyl-N-hexadecylmorpholinium ethyl sulfate	ICI.
N-Ethyl-N-(soybean oil alkyl)sorbolinium ethyl sulfate	RED, ICI.
(2-Hydroxyethyl)dimethyl(3-stearamidopropyl)ammonium dihydrogen phosphate	ICI.
(2-Hydroxyethyl)dimethyl(3-stearamidopropyl)ammonium nitrate	ACY.
(3-Lauramidopropyl)trimethylascnium methyl sulfate	ACY.
(2-(2-Lauroyloxyethyl)carbasoyl-1-methylpyridinium)chloride	WTC.
1-Methyl-2-(2-stearoyloxyethyl)carbasoylpyridinium chloride	WTC.
Oxygen-containing quaternary ammonium salts (Except those having amide linkages), all other	AAC, ARC, HLI(E), ICI, TCH.
Quaternary ammonium salts having amide linkages, all	ASH, MBV, TCH, VND.
QUATERNARY AMMONIUM SALTS, NOT CONTAINING OXYGEN: ACYLIC:	
* Bis(coconut oil alkyl)dimethylammonium chloride	ARC, ASK, ENO, GNM.
* Bis(hydrogenated tallow alkyl)dimethylammonium chloride	ARC, ASH, ENO, GNM.
(Coconut oil alkyl)trimethylammonium chloride	ARC.
Diethylbis(soybean oil alkyl)ammonium chloride	ARC.
Diethyl dioctadecylammonium chloride	ASH.
Diethyltrimethylammonium chloride	ARC, GNM.
Ethyl dimethyl(mixed alkyl)ammonium ethyl sulfate	DEX, JOR, TCC.
Ethyl dimethyl(9-octadecenyl)ammonium bromide	ONK.
Ethyl hexadecyl dimethylammonium bromide	FIN.
Hexadecyltrimethylammonium bromide	ARC, BRD.
Hexadecyltrisethylammonium chloride	FIN.
Hexadecyltrimethylammonium p-toluenesulfonate	FIN.
Methyltrioctylammonium chloride	GNM.
(Mixed linear alkyl)trimethyl ammonium bromide	DUP.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C A T I O N I C--Continued	
QUATERNARY AMMONIUM SALTS, NOT CONTAINING OXYGEN--Con.	
ACYCLIC--Continued	
N,N,N',N',N'-Pentamethyl-N-(tallow alkyl)trimethyl ene-bis(ammonium chloride)	ARC.
Triethyl(mixed alkyl)ammonium chloride	X.
Triethyl(octadecyl)ammonium chloride	ARC.
Triethyl(soybean oil alkyl)ammonium chloride	ARC.
Triethyl(tallow alkyl)ammonium chloride	ARC, ASH, GNM.
Triethyltetradecylammonium bromide	FIN.
BENZENOID:	
* Benzyl(coconut oil alkyl)dimethylammonium chloride	ARC, CIN, CRT, LUB, TCC.
* Benzyl(mixed alkyl)ammonium chloride	BBQ, FIN, ONX, RH, SDH.
* Benzyl(mixed alkyl)ammonium chloride	AAO, FIN, HLI(E), ONX, RH, SGP, SN#, TMI.
Benzyl(mixed alkyl)ammonium chloride	ENO.
Benzyl(mixed alkyl)ammonium chloride	FIN, X.
Benzyl(mixed alkyl)ammonium chloride	FIN, ONX.
Benzyl(mixed alkyl)ammonium chloride	FIN.
Benzyl(mixed alkyl)ammonium chloride	FIN.
* Benzyl(mixed alkyl)ammonium chloride	CHI, CIN, CRT, SN#, TCC.
(3,4-Dichlorobenzyl)dodecyltrimethylammonium chloride	ONX.
(Dodecylbenzyl)triethylammonium chloride	PC.
2-Dodecylisquinolinium bromide	ONX.
(Dodecylmethylbenzyl)trimethylammonium chloride	RH.
1-Dodecylpyridinium chloride	CCl, DAN.
1-Phenethyl-2-picolinium bromide	FIN.
Quaternary ammonium salts not containing oxygen, cyclic, all other	CCl, DEK, ICI, TCC.
Mixed substituted oximes	GNH.
Tallow amine, ethoxylated and propoxylated, methyl sulfate	DUP.
Tallow amine, ethoxylated, quaternary ammonium salt	APF.
Cationic surface-active agents, all other	APX, FIN, WTC.
N O N I O N I C	
CARBOXYLIC ACID AMIDES:	
(AMINE/ACID RATIO = 2/1):	COY(E), SGP, TCH.
* Capric acid (Ratio = 2/1)	



TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS		MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
NONIONIC		
CARBOXYLIC ACID AMIDES--Continued		
(AMINE/ACID RATIO = 2/1)--Continued		
*Castor oil acids (Ratio = 2/1)		CLI, MOA, NTL, PC
*Coconut oil acids (Ratio = 2/1)		AKS, ARD, ABL, AZS, BBD, BSW, CCL, CIN, CLI, CTL, DA, ECG, HRT, LUB, CP, MOA, MRV, PEK, PG, PMX, PVO, RCD, SBC, SGP, STP, TCH, VAL, WTC, X.
*Coconut oil and tallow acids (Ratio = 2/1)		CLI, CRT, CTL, ESS, MOA, Fg, SGP, UNN.
*Lauric acid (Ratio = 2/1)		CLI, CTL, HRT, MOA, RCH, SBC, STP.
*Lauric and myristic acids (Ratio = 2/1)		BRD, HRT, MOA, PC, RCD, SBC, SGP.
*Linoleic acid (Ratio = 2/1)		HRT, KWP, VND.
*Oleic acid (Ratio = 2/1)		CCW, CLI, EMR, SGP, STP.
*Pelargonic acid (Ratio = 2/1)		TCH.
*Soybean oil acids (Ratio=2/1)		MOA.
*Stearic acid (Ratio = 2/1)		CLI, CTL, ONX, SCO, SOS, VAL.
*Tall oil acids (Ratio = 2/1)		MOA, WTC.
*Tallow acids (Ratio = 2/1)		SBC.
Diethanolamine condensates (Amine/acid = 2/1), all other		SOS.
OTHER AMINE/ACID RATIOS:		
*Capric acid (Ratio <sup>1</sup> /1)		MOA.
*Coconut oil acids (Ratio = 1/1)		ARD, AZS, CLI, CON, CTL, DA, GAF, HLI(E), JRG, MOA, MRV, ONX, PIL, SBC, SGP, STP, TCC, WTC.
*Isostearic acid (Ratio=1/1)		MOA.
*Lauric acid (Ratio = 1/1)		CLI, DA, EFH, HLI(E), LEV, MOA, ONX, SBC, SGP.
*Lauric and myristic acid (Ratio = 1/1)		ARD, CLI, SBC, SGP, TCH.
*Linoleic acid (Ratio = 1/1)		MOA, SBC, VND.
*Myristic acid (Ratio=1/1)		MOA.
*Oleic acid (Ratio = 1/1)		EFH, EMK, HLI(E), SBC.
*Soybean oil acids (Ratio=1/1)		MOA.
*Tall oil acids (Ratio = 1/1)		CGX(E), CHP, ECC, MRV, VND, VPC.
*Tallow acids		EFH.
Diethanolamine condensates, amine/acid ratio=1/1, all other		MCA, RPC, TCH.
ALL OTHER CARBOXYLIC ACID AMIDES:		
Alkanolamine condensates, all other		HLI(E), SBC.
Carboxylic acid-alkanolamine condensate, alkyl		EFH, SBC, TCH.
lated, all other		PG.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
M O N I T O R I C--Continued	
CARBOXYLIC ACID AMIDES--Continued	
ALL OTHER CARBOXYLIC ACID AMIDES--Continued	
Carboxylic acid-diamine and polyamine condensate, all other--	HUM.
*Coconut oil acids (Specify amine/acid ratio)	STP.
Coconut oil acids (Ratio = 1/1)	BLI(E), HUM, MOA, SCP, STP, VMD, WTC.
Coconut oil acids (Ratio = 2/1)	STP, TCH.
Coconut oil acids, other code--	SCP.
Coconut oil acids, N,N-dimethyltriethylene-diamine (amine/acid ratio=1/2)	JBG.
Coconut oil acids-ethanolamine condensate, ethoxy labeled--	DA, STP.
Diethanolamine condensate, all other--	EFH, ORO.
Isopropanolamine condensates, all other--	EFH, SBC, WTC, X.
Lauric acid (Ratio = 2/1)	TMI.
Lauric acid (Specify amine/acid ratio)	CLI, MOA.
Lauric acid (Ratio = 1/1)	RCR.
Lauric and myristic acids (Specify amine/acid ratio)	LEV.
Lauric and myristic acids (Ratio = 1/1)	ARD, MOA, PG, SCP.
Oleic acid-ethanolamine condensate, ethoxylated	GAP.
Palmitic acid-diethanolamine condensate, alkoxy labeled--	ROB.
Stearic acid (Ratio = 1/1)	MOA, SBC, VMD, WTC.
Stearic acid (Ratio = 1/2)	HAL, WTC.
Stearic acid (Ratio = 2/1)	CLI, ECC.
Stearic acid-ethylene-diamine condensate amine/acid ratio=1/2	ARC, DA.
Carboxylic acid amides, all other--	VPC.
CARBOXYLIC ACID ESTERS:	
ANHYDROSORBITOL ESTERS:	
Anhydrosorbitol diolate	ICI.
*Anhydrosorbitol monoester of tall oil acids--	HGG, ICI.
	GLY, HDG, ICI, TCH.
*Anhydrosorbitol monoester--	GLY, HDG, ICI, TCH.
Anhydrosorbitol monoester--	GLY, HDG, ICI, TCH.
*Anhydrosorbitol monoester--	GLY, HDG, ICI, PVO, TCH.
Anhydrosorbitol sesquiolate	GLY, HDG, TCH.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
NONIONIC--Continued	
CARBOXYLIC ACID ESTERS--Continued	
ANHYDROSORBITOL ESTERS--Continued	
Anhydrosorbitol triester of tall oil acids	GLY, ICI, TCH.
Anhydrosorbitol trioleate	GLY, ICI, TCH.
Anhydrosorbitol tristearate	CHP, ICI, TCH.
Anhydrosorbitol esters, all other	ARC, GLY, VAL.
DIETHYLENE GLYCOL ESTERS:	
*Diethylene glycol distearate	ARC, GLY, VAL.
*Diethylene glycol monoester of coconut oil acids	DA.
*Diethylene glycol monooleate	ECC, GLY, HAL, HD3, WM.
*Diethylene glycol monooleate	ARC, HAL.
*Diethylene glycol monooleate	DA.
*Diethylene glycol monooleate	ABC, CHP, CLI, HAL, HDG.
*Diethylene glycol monooleate	ECC.
*Diethylene glycol sesquiolaurate	ARC, GLY.
*Diethylene glycol sesquistearate	WIC.
ETHOXYLATED ANHYDROSORBITOL ESTERS:	
*Ethoxylated anhydrosorbitol monooleate	ACC, GLY, HDG, ICI, PVO, TCH.
*Ethoxylated anhydrosorbitol monooleate	ACC, EME, GLI, HD3, ICI, PVO, TCH.
*Ethoxylated anhydrosorbitol monooleate	ICI, TCH.
*Ethoxylated anhydrosorbitol monooleate	ACC, GLI, HDG, ICI, PVO, TCH.
*Ethoxylated anhydrosorbitol monooleate	TCH.
*Ethoxylated anhydrosorbitol triester of tall oil acids	ICI, TCH.
Ethoxylated anhydrosorbitol trioleate	GLY, ICI, TCH.
Ethoxylated anhydrosorbitol tristearate	GLY, HDG, ICI, PVO, TCH.
ETHOXYLATED SORBITOL ESTERS:	
Ethoxylated sorbitol beeswax ester	ICI.
Ethoxylated sorbitol esters, all other	ICI.
Ethoxylated sorbitol hexaester of tall oil acids	TCH.
Ethoxylated sorbitol hexaoleate	ICI, TCH.
Ethoxylated sorbitol lanolin ester	ICI.
Ethoxylated sorbitol mono-oleate	ICI.
Ethoxylated sorbitol pentaoleate	ICI.
Ethoxylated sorbitol tetraester of lauric and oleic acid	ICI.
Ethoxylated sorbitol tetraoleate	ICI.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
CARBOXYLIC ACID ESTERS--Continued	
ETHYLENE GLYCOL ESTERS:	
*Ethylene glycol distearate	: ARC, EMR, HAL, HUM, TCH, WM.
*Ethylene glycol monostearate	: ARC, CLI, GLY, HAL, HDG, KNP, TCH, VND, WM.
GLYCEROL ESTERS:	
COMPLEX GLYCEROL ESTERS:	
Glycerol monoester of mixed fatty acids, acetylated	: EKT.
Glycerol monoester of mixed fatty acids, succinylated	: EKT.
Glycerol mono-oleate, acetylated	: TCH.
Complex glycerol esters, all other	: GLY, SCP.
GLYCEROL ESTERS OF CHEMICALLY DEFINED ACIDS:	
*Glycerol dilaurate	: VND.
*Glycerol dioleate	: ARC, HAL, X.
Glycerol distearate	: ARC, PVO.
Glycerol monocaprylate	: GY, HAL.
*Glycerol monolaurate	: ARC, CCW, EMR, GLY, GRO, HAL, HDG, PVO, TCH, WM, WTC.
*Glycerol mono-oleate	: GLY, HDG.
Glycerol monoricinoleate	: ARC, BLS, CHL, CIN, DA, EMR, GLY, GRO, HAL, HDG, PVO, SOS, TCH, VND, WM, WTC.
*Glycerol monostearate	: ARC.
Glycerol esters of chemically defined acids, all other	: ARC.
GLYCEROL ESTERS OF MIXED ACIDS:	
Glycerol monoester of coconut oil acids	: GLY, PVO, WTC.
Glycerol monoester of cottonseed oil acids	: EKT.
*Glycerol monoester of hydrogenated cottonseed oil acids	: EKT, LEV, WM.
*Glycerol monoester of hydrogenated soybean oil acids	: ASH, BPP, EKT, PVO, TCH, WTC.
*Glycerol monoester of lard acids	: EKT, GLY, PVO.
Glycerol monoester of mixed vegetable oil acid	: LEV.
Glycerol monoester of palm oil acids	: EKT.
Glycerol monoester of safflower oil acids	: EKT.
Glycerol monoester of tall oil acids	: EKT, FER, WTC.
Glycerol monoesters of mixed animal and vegetable oil acids	: BPP.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
N O N I O N I C--Continued	
GLYCEROL ESTERS--Continued	
GLYCEROL ESTERS OF MIXED ACIDS--Continued	
Glycerol sesquiter of hydrogenated tallow acids--	JRG.
NATURAL FATS AND OILS, ETHOXYLATED:	
*Castor oil, ethoxylated--	ICI, PG, SLH, TCH, WTC.
*Corn oil, ethoxylated--	DA, GAF, ICI, MIL, MTL, PVO, TCH, TMH, X.
*Hydrogenated castor oil, ethoxylated--	TCH.
*Lanolin, ethoxylated--	DA, ICI, TCH.
*Tall oil acids, ethoxylated--	ARC, CRD, CRM, ICI, MIL, TCH.
POLYETHYLENE GLYCOL ESTERS: Acetylated, all other--	DA, JCC, MIL, TCH.
POLYETHYLENE GLYCOL ESTERS CP CHEMICALLY DEFINED ACIDS:	
*Polyethylene glycol dilaurate--	ARC, DA, GLY, HAL, HDG, TCH, WM.
*Polyethylene glycol dioleate--	ARC, BRD, CG(E), CLD, EFH, GLY, HAL, HDG, SLC, TCH, WM.
*Polyethylene glycol distearate--	ARC, CHP, GLY, HAL, HDG, TCH.
*Polyethylene glycol monooleate--	ARC, BRD, CCA, DA, SCC, GLY, HAL, HDG, ICI, STC, TCH, VNO, WM.
*Polyethylene glycol mono-oleate--	ARC, BRD, CCA, CIN, CLD, CRT, DA, DEX, EPH, GAF, GLY, HAL, HDG, MBT, MVV, ONX, SCP, TCH, WM.
Polyethylene glycol monopalmitate--	ICI, KNP.
Polyethylene glycol monolinoleate--	HAL, WTC.
*Polyethylene glycol monostearate--	AKS, ARC, ABL, C3(E), CHP, CIN, CRT, DA, EPH, EME, GAF, GLY, HAL, HDG, HRT, ICI, PVO, SLC, SOS, TCH, VNO.
Polyethylene glycol esters of chemically defined acids, all other--	ICI, SBC.
POLYETHYLENE GLYCOL ESTERS CP MIXED ACIDS:	
Polyethylene glycol diester of tall oil acids	ARC, EPH, MIL, X.
Polyethylene glycol monoester of capric and caprylic acids--	ECC.
Polyethylene glycol monoester of soybean oil acids--	GLY.
Polyethylene glycol monoester of tall oil acids	TCH.
Polyethylene glycol monoester of tall oil acids,	

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
N O N I O N I C--Continued	
GLYCEROL ESTERS OF MIXED ACIDS--Continued	
POLYETHYLENE GLYCOL ESTERS--Continued	
POLYETHYLENE GLYCOL ESTERS OF MIXED ACIDS--Continued*	
Polyethyleneglycol sesquiester of coconut oil	X.
Polyethylene glycol sesquiester of tall oil acids	ARC, HRT.
Polyethylene glycol sesquiester of tallow acids	ICI, SLM, X.
Polyethylene glycol esters of mixed acids, all other	ARC, SOS, TCH.
POLYGLYCEROL ESTERS:	
Polyglycerol distearate	GLY, PVO.
Polyglycerol monoester of tall oil acids	PER, HDG.
Polyglycerol mono-oleate	PVO, WTC.
Polyglycerol monostearate	PVO, TCH, VMD.
Polyglycerol esters, all other	PVO, TCB.
PROPANEDIOL ESTERS:	
1,2-Propanediol dioleate	X.
1,2-Propanediol monolaurate	ARC, PVO, SBC.
1,2-Propanediol mono-oleate	EFH.
1,2-Propanediol monostearate	ARC, EXI, GLY, BAL, TCH, WF.
1,2-Propanediol sesquiester of hydrogenated tallow acids	JRG.
Propanediol esters, all other	PVO, TCH.
OTHER CARBOXYLIC ACID ESTERS:	
Cetyl palmitate	ROB.
Di-isobutylene maleate	RH.
Ethoxylated 1,2-propanediol monostearate	ICI.
Methylglucoside laurate	HDG.
Pentaerythritol stearate	VAL.
Polyalkylene glycol adipate	X.
Carboxylic acid esters, all other	ARC, CCW, CRN, DUP, EHR, HDG, PVO, STC, TCH, VMD, WTC, X.
ETHERS:	
BENZOID ETHERS:	
Diisobutylphenol, ethoxylated	GAF.
Dinonylphenol, ethoxylated	GAF, JCC, RH, TCH.
Dodecylphenol, ethoxylated	DA, GAF, HOB, ICH, THH.

TABLE 2. --SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
N O N I O N I C--Continued	
ETHERS--Continued	
BENZENOID ETHERS--Continued	
iso-octylphenol, ethoxylated	: AAC, DA, RH.
(mixed alkyl)phenol, ethoxylated	: HL, NL, X.
(mixed alkyl)phenol, ethoxylated, butyl ether-	: RH.
(mixed alkyl)phenol-formaldehyde	: ARC, NL, X.
(mixed alkyl)phenoxypoly(ethyleneoxy)ethyl chloride	: GAF.
*Nonylphenol, ethoxylated	: GAF, HDG, ICI, JCC, ML, MCN, OMC, RH, STP, TCH, THH, UCC, *TC, X.
Nonylphenol, ethoxylated and propoxylated	: RH.
Nonylphenol, formaldehyde alkoxylated	: X.
Nonylphenol, ethoxylated	: TCH, THH, X.
tert-Octylphenol-formaldehyde	: ARC, DA, SDH.
*Phenol, ethoxylated	: DA, GAF, ICI, TCH.
Phenols, ethoxylated, all other-	: DA, EFH, RH, X.
MONBENZENOID ETHERS:	
LINEAR ALCOHOLS, ALKOXYLATED:	
*Decyl alcohol, ethoxylated	: GAF, ICI, TCH, WTC.
Dodecyl alcohol, ethoxylated	: GAF.
podecyl alcohol, ethoxylated	: AAC, GAF, HDG, ICI, ML.
Hexadecyl alcohol, ethoxylated	: ICI, TCH.
*9-Octadecyl alcohol, ethoxylated	: AAC, GAF, ICI, TCH.
Octadecyl alcohol, ethoxylated	: DA, DUP, ICI.
*Oleyl alcohol, ethoxylated	: CRD, CRM, GAF, HDG.
Wool wax alcohols, ethoxylated	: CRD.
Chemically defined linear alcohol, alkoxylated, all other-	: GAF, ICI, X.
Coconut oil alcohol, ethoxylated	: GLY, JCC, TCH.
Decyl and octyl alcohols, ethoxylated	: GAF.
*Mixed linear alcohols, ethoxylated	: BAS, CO, DA, DUP, GAF, HDG, JCC, RH, SHC, STP, TCH, UCC, WTC.
Mixed linear alcohols, ethoxylated and propoxylated-	
Tallow alcohol, ethoxylated	: ATB, BAS, DUP, JCC, STP, TCH, UCC, WTC.
Mixed linear alcohols, alkoxylated	: AAC, ATR, JCC.
Mixed linear alcohols, alkoxylated, all other-	: GAF, GLY, TCH.
OTHER ETHERS AND THIOETHERS:	
Corn starch, propoxylated-	: VAL.

TABLE 2.--SURFACE-ACTIVE AGENTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

SURFACE-ACTIVE AGENTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
ETHERS--Continued	
OTHER ETHERS AND THIOETHERS--Continued	
Bert-Dodecyl succinate, ethoxylated	: AAC
Glucose ethoxylated	: TCH
Glycerite, alkoxylated	: X
Mixed alcohols, ethoxylated	: CRN, PVO, RH, X, X
Poly(sized ethylene, propylene)glycol	: BAS, UCC, X
Polyalkylene glycols, alkoxylated	: X
Polypropylene glycol, ethoxylated	: BAS, WTC
*Tridecyl alcohol, ethoxylated	: AAC, DA, DUP, GAF, ICI, JCC, MIL, MON, ONC, PVO, TCH, TMH, X
Tridecyl alcohol, propoxylated and ethoxylated	: JCC, MIL, TCH
Trimethylheptanol, ethoxylated	: TCH
Trimethylol alcohol, ethoxylated	: HDG, DCC
Trimethylolpropane, alkoxylated	: BAS, HDG
Ethers and thioethers, all other	: AAC, ICI, TCH, TWA
OTHER NONIONIC SURFACE-ACTIVE AGENTS:	
Octyl phosphate, ethoxylated	: DUP
Tri(castor oil alkyl)phosphate	: GLY
Triethylpropane, ethoxylated	: DUP
Nonionic surface-active agents, all other	: MIL, MON, RH, X, X



TABLE 3.--SURFACE-ACTIVE AGENTS: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of surface-active agents to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
AAC	Alcolac Chemical Corp.	ECC	Eastern Color & Chemical Co.
ACT	Arthur C. Trask Co.	EFH	F.F. Houghton & Co.
ACY	American Cyanamid Co.	EKT	Eastman Kodak Co., Tennessee Eastman Co. Div.
AES	Penetone Corp.	EMK	Emkay Chemical Co.
AGP	Armour-Dial, Inc.	EMR	Emery Industries, Inc.
AIP	Air Products & Chemicals, Inc.	ENO	Enenco, Inc.
AKS	Arkansas Co., Inc.	ESS	Essential Chemicals Corp.
APX	Apex Chemical Co., Inc.	FER	Ferro Corp., Keil Chemical Div.
ARC	Armak Co.	FIN	Hexcel Corp., Hexcel Specialties Chemicals
ARD	Ardmore Chemical Co.	GAF	GAF Corp.
ARL	Arol Chemical Products Co.	GLY	Glyco Chemicals, Inc.
ASH	Ashland Oil, Inc., Ashland Chemical Co.	GNM	General Mills Chemicals, Inc.
ASY	American Synthetic Rubber Corp.	GRC	Chemed Corp., Dubois Chemicals Div.
ATR	Atlantic Richfield Co., ARCO Chemical Co.	GRL	Chemed Corp., Vestal Laboratories, Inc.
AZS	AZS Corp.: AZ Products Co. Div. AZS Chemical Co.	GRO	A.H. Gross & Co., Millmaster Onyx Group, Kewanee Industries, Inc.
BAO	Bayoil Co., Inc.	HAL	C.P. Hall Co.
BAS	BASF Wyandotte Corp.	HDC	Hodag Chemical Corp.
BFP	Breddo Food Products Co., Inc.	HEW	Hewitt Soap Co., Inc.
BLA	Astor Products, Inc., Blue Arrow Div.	HLI	Haag Laboratories, Inc.
BLS	Life Savers, Inc.	HBP	W.R. Grace & Co., Organic Chemicals Div.
BRD	Lonza, Inc.	HNT	Huntington Laboratories, Inc.
BSW	Original Bradford Soap Works, Inc.	HPC	Hercules, Inc.
CCA	Interstab Chemical, Inc.	HRT	Hart Products Corp.
CCL	Catawba-Charlab, Inc.	HUM	Kraft, Inc., Humko Products Div.
CCW	Cincinnati Milacron Chemicals, Inc.	ICI	ICI United States, Inc., Chemical Specialties Co.
CGY	Ciba-Geigy Corp.	JCC	Jefferson Chemical Co., Inc.
CHL	Chemol, Inc.	JOR	Jordan Chemical Co.
CHP	C.H. Patrick & Co., Inc.	JRG	Andrew Jergens Co.
CIN	Cindet Chemicals, Inc.	KAL	Pathan Chemical Co.
CLD	Colloids, Inc.	KNP	Knapp Products, Inc.
CLI	Clintwood Chemical Co.	LAK	Bofors Lakeway, Inc.
CO	Continental Oil Co.	LEA	Leatex Chemical Co.
CON	Concord Chemical Co., Inc.	LEV	Lever Brothers Co.
CP	Colgate-Palmolive Co.	LKY	Lake States Div. of St. Regis Paper Co.
CRD	Croda, Inc.	LMI	North American Chemical Co.
CRN	CPC International, Inc., Amerchol	LUR	Laurel Products Corp.
CRT	Crest Chemical Corp.	HAR	American Can Co.
CRZ	Crown Zellerbach Corp., Chemical Products Div.	MCP	Moretex Chemical Products, Inc.
CST	Charles S. Tanner Co.	MIL	Milliken & Co., Milliken Chemical Div.
CTL	Continental Chemical Co.	MIR	Miranol Chemical Co., Inc.
CWP	Consolidated Papers, Inc.	MOA	Monsanto Industries, Inc.
DA	Diamond Shamrock Corp.	MON	Monsanto Co.
DAN	Dan River, Inc., Chemical Products Dept.		
DEX	Dexter Chemical Corp.		
DOW	Dow Chemical Co.		
DUP	E.I. duPont de Nemours & Co., Inc.		
DYS	Davies-Young Co.		

TABLE 3.--SURFACE-ACTIVE AGENTS: DIRECTORY OF MANUFACTURERS, 1977--CONTINUED

Code	Name of company	Code	Name of company
MRD	Marden-Wild Corp.	SEA	Seaboard Chemicals, Inc.
MRT	Morton Chemical Co. Div. of Morton Norwich Products, Inc.	SFS	Stauffer Chemical Co., Specialty Div.
MRV	Marlowe-Van Loan Corp.	SHC	Shell Oil Co., Shell Chemical Co. Div.
NCW	Nostrup Chemical Works, Inc.	SID	George F. Siddall Co., Inc.
NES	Nease Chemical Co., Inc.	SLC	Soluol Chemical Co., Inc.
NMC	National Milling & Chemical Co., Inc.	SLM	Salem Oil & Grease Co.
NPR	Safeway Stores, Inc.	SM	Mobil Oil Corp., Mobil Chemical Co., Chemical Coatings Div.
NTL	NL Industries, Inc.	SNW	Sun Chemical Corp., Chemicals Div.
OMC	Olin Corp.	SOC	Standard Oil Co. of California, Chevron Chemical Co.
ONX	Kewanee Industry, Millmaster Onyx Group, Onyx Chemical Co. Div.	SOP	Southern Chemical Products Co., Inc.
ORO	Chevron Chemical Co.	SOS	SSC Industries, Inc.
PC	Proctor Chemical Co., Inc.	SPA	Scott Paper Co.
PCH	Peerless Chemical Co.	STC	American Hoechst Corp., Sou-Tex Works
PEK	Peck's Products Co.	STP	Stepan Chemical Co.
PFZ	Pfizer, Inc.	TCC	Tanatex Chemical Corp.
PG	Procter & Gamble Co., Procter & Gamble Mfg. Co.	TCH	Emery Industries, Inc., Trylon Div.
PIL	Pilot Chemical Co.	TCI	Texize Chemical Co.
FLX	Plex Chemical Corp.	TEN	Cities Service Co., Copperhill Operations
PNX	Murphy-Phoenix Co.	TMH	Thompson-Hayward Chemical Co.
PEX	Purex Corp.	TNA	Ethyl Corp.
PSP	Georgia-Pacific Corp.	TNI	The Gillette Co., Chemical Div.
PVO	PVO International, Inc.	UCC	Union Carbide Corp.
QCP	Quaker Chemical Corp.	UDI	Petrochemicals Co., Inc.
RAY	ITT Rayonier, Inc.	UNN	United Chemical Corp. of Norwood
RBC	Fike Chemicals, Inc.	UNP	United Chemical Products Corp.
RCD	Richardson Co.	USM	USM Corp., Bostik Div.
RH	Rohm & Haas Co.	USR	Uniroyal, Inc., Uniroyal Chemical Div.
ROB	Robeco Chemicals, Inc.	VAL	Valchem Div. of United Merchants & Manufacturers, Inc.
RPC	Kewanee Industry, Millmaster Onyx Group, Refined-Onyx Co. Div.	VMD	Van Dyk & Co., Inc.
S	Sandoz, Inc., Sandoz Colors & Chemical Div.	VPC	Mobay Chemical Corp., Verona Div.
SBC	Scher Bros. Inc.	WAIJ	W.A. Wood Co.
SBP	Sugar Beet Products Co.	WAY	Philip A. Hunt Chemical Corp., Organic Chemical Div.
SCO	Scholler Bros., Inc.	WBC	White & Bagley Co.
SCP	Henkel, Inc.	WHI	White & Hodges, Inc.
SDC	Martin-Marietta Corp., Sodyeco Div.	WHW	Whitemore-Wright Co., Inc.
SDH	Sterling Drug, Inc.	WJ	Inolex Corp.
SDW	Hilton-Davis Chemical. Div.	WTC	Witco Chemical Corp.
	Winthrop Laboratories Div.	WVA	Westvaco Corp., Chemicals Div., Polychemicals Dept.

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.

## Pesticides - Developments in 1977

Edmund Cappuccilli

Unfavorable weather conditions in several sections of the country and changes in the markets for agricultural products in 1977 resulted in a decrease in the use of certain organic pesticides, such as acyclic fungicides and herbicides. Continued high level of imports and the increased number of pesticides undergoing reregistration by the Environmental Protection Agency (EPA) also affected the use of some pesticides. Other factors in the domestic market for pesticides in 1977 included the continued use of plant growth regulators for specific crops, and the increased use of synthetic pyrethroids as insecticides on cotton crops.

The production of synthetic organic pesticides in 1977 recovered somewhat from the low output in 1976 but did not reach the high level attained in 1975. While total organic pesticide production increased by approximately 2 percent to 1.39 billion pounds over 1976, fungicides continued to remain at the 1976 level of 142 million pounds. The total value of sales of pesticides increased by 16 percent over the 1976 level to \$2.8 billion and the average unit value of sales increased approximately 10 percent to \$2.22 per pound.

In addition to the unfavorable conditions mentioned above, the output of pesticides in 1977 was affected by the softening of prices for certain farm products. Some of these factors, along with the reported increase in inventories, are also expected to affect the production of pesticides in 1978. It is, therefore, anticipated that pesticide production in 1978 will remain at the 1977 level or increase slightly, from 1 to 5 percent. The value of sales for pesticides in 1978 is also expected to remain close to the 1977 level. However, some downward pressure on prices due to increased inventories at the end of 1977 may depress the value from 1 to 3 percent.

Plant growth regulators

For the past several years, major pesticide producers in the United States have been conducting more research on plant growth regulators. They believe that plant growth regulators are the probable answer to the need for increased food production in the future.

Plant growth regulators--chemicals which increase or modify plant growth--have been used in agriculture for almost 4 decades. The total production of all plant growth regulators in 1976 was estimated to be 7 million pounds. Maleic hydrazide, produced in the largest volume and one of the better known plant growth regulators, is used primarily to increase the yield of tobacco. In 1976, 3.8 million pounds of maleic hydrazide was produced in the United States.

Pesticide producers are continuing to develop plant growth regulators for a wide variety of purposes, such as the loosening of ripened fruits for faster harvesting, controlling the size of fruits, and so forth, despite the increasing costs of development and the uncertainty of commercial utilization. Recently, research on plant growth regulators for sugar cane has

increased. Several major pesticide producers have products either in commercial use or under experimental use permits issued by the EPA. The immediate future of this type of growth regulator does not appear to be optimistic, however, owing to the steep decline of sugar prices from their high in late 1974. Future development of these higher priced plant growth regulators will probably be directed toward certain crops which should financially benefit the farmers by the application of these specialty products.

### Synthetic pyrethroids

Synthetic pyrethroids are a class of pesticides whose properties have made them quite attractive for commercial use in this era of environmental concern. Two of the qualities which make synthetic pyrethroids especially desirable are their high toxicity to insects combined with low toxicity to mammals. These compounds were also found to remain highly effective for longer periods of time than organophosphate insecticides used in similar situations. Interest in these compounds increased in 1977 when the EPA issued an emergency exemption use permit for three synthetic pyrethroids to be used on cotton because of the withdrawal of certain organophosphate insecticides used primarily for bollworm control.

Production of synthetic pyrethroids has been increasing steadily over the past few years and should increase substantially in the near future as new products and uses are introduced despite the higher costs. The favorable environmental qualities of synthetic pyrethroids will probably be the determining factor in future use, as Government controls on other insecticides continue to increase.

### Government regulatory actions continue to increase

The EPA continued to be the dominant Government agency affecting the pesticide industry in 1977. Under the Federal Environmental Pesticides Control Act, the EPA continued its registration/reregistration of all pesticide products. Because of the uncertainty and delays encountered in this reregistration process, the sale of certain pesticide products in 1977 was erratic.

The procedure employed by the EPA to identify pesticides which may be hazardous to man and to the environment is called "Rebuttable Presumption Against Reregistration (RPAR)." Pesticides placed on the RPAR list are reviewed to decide whether they can be reregistered. While these products are awaiting review on the RPAR list, producers usually have shown a tendency to limit production of these products until disposition is determined (the production of several pesticides placed on the RPAR list decreased in 1977).

The notice by EPA to cancel the registration of some widely used pesticides such as chlordane, DBCP and heptachlor, combined with the voluntary withdrawals of several pesticides from the reregistration process, is probably a main reason for the slowdown in the overall rate of production from the previous years. This trend, however, should eventually be offset by increased production of alternative pesticides.

The EPA's involvement with the pesticide industry is not expected to diminish in the near future. The pesticide producers must be willing to reassess their future plans to conform with reasonable Government regulations if they are to remain competitive in the domestic market.

#### Foreign trade

In 1977, imports of benzenoid pesticides (TSUS 405.15) totaled 47.7 million pounds valued at \$101.3 million. This represented a decrease of 19.9 percent in quantity and a decrease of 21.4 percent in value from the 62.1 million pounds, valued at \$128.8 million imported in 1976. Sales from domestic inventory existing throughout most of 1977 and a decrease in consumer demand were two factors primarily responsible for the decrease in imports of pesticides in 1977. Imports of pesticides in the future are expected to continue their general upward trend despite the decrease experienced in 1977. The annual increments, however, are not expected to be as large as in previous years.

An analysis of a large sample of benzenoid pesticide imports in 1975-77, which shows the major pesticides in the "competitive" and "noncompetitive" classes, <sup>1/</sup> is given in table A. Over the past 2 years, the pesticide imported in the greatest quantity has been bentazon, a "noncompetitive" herbicide produced in West Germany. Imports of bentazon in 1977 increased by 97.0 percent over the 1976 level to 19.9 million pounds. Increases of this magnitude are not expected to continue in the future because of increased competition from domestic products with properties similar to this imported postemergence herbicide and the variability of future crop plantings.

Over the past 3 years, one of the largest volume "competitive" pesticides imported into the United States has been 2,4-dichlorophenoxyacetic acid (2,4-D). Imports of 2,4-D decreased by 58 percent in 1977 from a high of 6.0 million pounds reported in 1976. However, the 2.5 million pounds of 2,4-D imported in 1977 is still far above the 80,000 pound per year average imported during the 4 years prior to the 1974 Trade Act. The Trade Act of 1974 has enabled several countries to ship 2,4-D to the United States under the Generalized System of Preferences (GSP) which grants duty-free treatment to

---

<sup>1/</sup> "Competitive" benzenoid imports are those products which are similar to domestic products because they accomplish results substantially equal to those accomplished by the domestic products, when used in substantially the same manner.

"Competitive" imports are subject to a special basis of valuation for customs purposes known as the "American selling price." If the benzenoid imports are "noncompetitive," the products are valued for customs purposes on the basis of the "United States value." The essential difference between these two values is that "American selling price" is based on the wholesale price in the United States of the "competitive" domestic product, whereas "United States value" is based on the wholesale price in the United States of the imported product less most of the expenses incurred in bringing the product to the United States and selling it.

certain imported products from designated beneficiary countries. Imports of "competitive" pesticides from GSP beneficiary countries are expected to increase in the future primarily because of the 15 to 20 percent competitive edge realized by duty-free entry.

Although there were large imports from certain GSP countries, total imports of pesticides in 1977 continued to be dominated by the United Kingdom and West Germany, as shown in table B. Combined imports (principally "noncompetitive" pesticides) from the United Kingdom and West Germany in 1977 amounted to 28.9 million pounds, or 58.0 percent of the total pesticide imports. This was an increase of 12.0 percent over the combined total of the two countries in 1976. Because of their strong positions in the marketing and research areas of the pesticide industry, the United Kingdom and West Germany are expected to remain as the principal foreign sources of pesticides for the next several years. Government regulations and greater competitiveness by U.S. producers should keep imports from increasing more than 10.0 percent per year for the next few years. Imports of certain pesticides, however, may exceed the predicted yearly increase because of consumer preference or because of a favorable cost advantage. There are indications that the beneficiary countries of GSP will be producing more of the "competitive" pesticides in the future to meet the anticipated demand from the U.S. market. In addition, several European countries and Japan are working to develop and to test new environmentally safe pesticides for future distribution, especially in the United States. All these developments indicate a modest rate of increase of pesticides imports for the next several years.

TABLE A.--U. S. imports of major pesticides, 1/ 1975-77

(million pounds)				
Status	1975	1976	1977	
Competitive:				
2,4-D-----	3.0	6.0		2.5
2,4-DB-----	...	...		0.9
Chlordimeform-----	...	0.7		...
Dichloroprop-----	1.3	...		...
Diuron-----	1.4	...		...
MCPA-----	...	2.1		1.0
Noncompetitive:				
Bentazon-----	1.7	10.1		19.9
Chlorothalonil-----	3.8	3.9		3.6
Paraquat dichloride-----	9.5	4.2		5.0

<sup>1</sup> Based on the items examined by the Commission for TSUS item 405.15.

Source: Imports of Benzenoid Chemicals and Products, 1975, 1976, and 1977.

Note.--All of the compounds in the above table are herbicides, except chlorothalonil (a fungicide) and chlordimeform (an insecticide).

Table B.--Pesticides 1/: U.S. imports by principal source, 1975-77

Source	1975	1976	1977
Quantity (1,000 pounds)			
West Germany-----	7,362	15,732	14,941
United Kingdom-----	17,587	12,988	14,025
Japan-----	3,922	5,613	4,870
Switzerland-----	6,388	10,885	3,761
Canada-----	4,842	2,289	4,609
All other-----	10,315	14,607	7,528
Total-----	50,416	62,114	49,734
Value (1,000 dollars)			
West Germany-----	20,035	48,643	41,033
United Kingdom-----	29,493	19,904	20,136
Japan-----	6,323	10,599	13,067
Switzerland-----	14,618	26,060	7,251
Canada-----	5,043	3,383	5,810
All other-----	21,615	20,244	14,000
Total-----	97,127	128,833	101,297
Unit value (per pound)			
West Germany-----	\$2.72	\$3.09	\$2.75
United Kingdom-----	1.68	1.53	1.44
Japan-----	1.61	1.89	2.68
Switzerland-----	2.29	2.39	1.93
Canada-----	1.04	1.48	1.26
All other-----	2.10	1.39	1.86
Average-----	1.93	2.07	2.06

1/ TSUS item 405.15.

Source: Compiled from official statistics of the U.S. Department of Commerce.



## PESTICIDES AND RELATED PRODUCTS

Edmund Cappuccilli

Pesticides and related products include fungicides, herbicides, insecticides, rodenticides, and related products such as plant growth regulators, seed disinfectants, soil conditioners, soil fumigants, and synergists. The data are given in terms of 100 percent active materials; they thus exclude such materials as diluents, emulsifiers, and wetting agents.

U.S. production of pesticides and related products in 1977 amounted to 1,388 million pounds--1.7 percent greater than the 1,364 million pounds reported for 1976 (table 1).<sup>1</sup> Sales in 1977 were 1,263 million pounds, an increase of 5.9 percent, as compared with 1,193 million pounds reported in 1976; the value of sales was \$2,808 million in 1977, compared with \$2,410 million in 1976--an increase of 16.5 percent.

The output of cyclic pesticides and related products amounted to 994 million pounds in 1977--5.7 percent greater than the 940 million pounds produced in 1976. Sales in 1977 were 904 million pounds, valued at \$2,066 million, compared with 839 million pounds, valued at \$1,844 million in 1976. Production of acyclic pesticides and related products in 1977 amounted to 394 million pounds, compared with 424 million pounds reported for 1976, a decrease of 7.2 percent. Sales in 1977 were 359 million pounds, an increase of about 1.4 percent, as compared with 354 million pounds reported in 1976; the value of sales was \$742 million in 1977, compared with \$566 million in 1976--an increase of 31.0 percent.

---

<sup>1</sup> See also table 2 which lists these products and identifies the manufacturers by codes. These codes are given in table 3.



## XIII -- PESTICIDES AND RELATED PRODUCTS

TABLE 1.--PESTICIDES AND RELATED PRODUCTS: U.S. PRODUCTION AND SALES, 1977

[Listed below are all pesticides and related products for which any reported data on production or sales may be published. (Leaders (...)) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists all pesticides and related products for which data on production and/or sales were reported and identifies the manufacturers of each]

PESTICIDES AND RELATED PRODUCTS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>1</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	1,387,519	1,263,007	2,808,273	\$2.22
Benzenoid-----	829,537	691,186	1,664,008	2.41
Nonbenzenoid-----	557,982	571,821	1,144,265	2.00
CYCLIC				
Total-----	993,896	903,794	2,066,441	2.29
Fungicides, total-----	110,624	101,284	150,688	1.49
Naphthenic acid, copper salt-----	1,276	1,148	954	.83
Pentachlorophenol (PCP)-----	44,862	43,349	16,276	1.38
Phenylmercuric acetate (PMA)-----	178	164	1,261	7.70
All other cyclic fungicides <sup>2</sup> -----	64,308	56,623	132,197	2.33
Herbicides and plant growth regulators, total-----	550,145	476,477	1,331,425	2.79
2,4-Dichlorophenoxyacetic acid, dimethylamine salt-----	21,281	16,349	17,380	1.06
2,4-Dichlorophenoxyacetic acid, iso-octyl ester-----	6,392	6,129	6,244	1.02
Plant growth regulators <sup>3</sup> -----	5,438	4,528	17,433	3.85
All other cyclic herbicides <sup>4</sup> -----	517,034	449,471	1,290,368	2.87
Insecticides and rodenticides, total-----	333,127	326,033	584,328	1.79
Organophosphorus insecticides, total-----	113,498	116,815	269,602	2.31
Methyl parathion-----	39,695	49,257	49,992	1.01
All other organophosphorus insecticides <sup>5</sup> -----	73,803	67,558	219,610	3.25
Toxaphene(chlorinated camphene)-----	39,780	...	...	...
All other cyclic insecticides and rodenticides <sup>6</sup> -----	179,849	209,218	314,726	1.50
ACYCLIC				
Total-----	393,623	359,213	741,832	2.07
Fungicides, total-----	32,653	32,249	38,097	1.18
Dithiocarbamic acid salts <sup>7</sup> -----	29,650	30,169	31,832	1.06
All other acyclic fungicides <sup>8</sup> -----	3,003	2,080	6,265	3.01
Herbicides and plant growth regulators <sup>9</sup> -----	124,063	107,863	287,773	2.67
Insecticides, rodenticides, soil conditioners and fumigants, total-----	236,907	219,101	415,962	1.90
Methyl bromide (Bromomethane)-----	34,684	35,280	17,753	.50
Organophosphorus insecticides <sup>10</sup> -----	90,547	71,210	221,674	3.11
Trichlorotromethane (Chloropicrin)-----	5,803	6,266	3,784	.60
All other acyclic insecticides, rodenticides, soil conditioners and fumigants <sup>11</sup> -----	105,873	106,345	172,751	1.62

<sup>1</sup> Calculated from rounded figures.

<sup>2</sup> Includes benomyl, captafol, captan, chlorothalonil, dinocap, DMTT, folpet, pentachloronitrobenzene, sodium pentachlorophenate, 2,4,5-trichlorophenol salts, all other phenylmercury compounds, and others.

<sup>3</sup> Includes maleic hydrazide.

<sup>4</sup> Includes alachlor, atrazine, barban, benefin, benalulide, 2,4-D acid (esters and salts), 2,4-DB, dicamba, dinitrophenol compounds, diuron, isopropyl phenylcarbamates (IPC and CIPC), MCPA, molinate, NPA, picloram, propanil, silvex and its esters, 2,4,5-T acid (esters and salts), triazines, trifluralin, uracils, and others.

<sup>5</sup> Includes carbofenthiol, diazinon, dioxathion, fensulfotthion, peppathion, ronnel, and other phosphorothioates and phosphorodithioates.

<sup>6</sup> Includes carbaryl, carbofuran, chlorinated insecticides (BHC + lindane, chlordan, chlorobenzilate, DDT, dicofol, endosulfan, endrin, heptachlor, methoxychlor, and others), insect attractants, DEET and other insect repellents, small amounts of rodenticides, piperonyl butoxide and other synergists, and others.

*Footnotes--Continued*

<sup>7</sup> Includes ferbam, maneb, nabam, PETD, and zineb, plus the remaining dithiocarbamates which are used chiefly as fungicides.

<sup>8</sup> Includes dodine, and others.

<sup>9</sup> Includes CDAA, dalapon, methanearsonic acid salts, sodium TCA, thiocarbamates, and organophosphorus herbicides, and others.

<sup>10</sup> Includes acephate, DDVP, disulfoton, ethion, malathion, monocrotophos, naled, phorate, and other organophosphorus insecticides.

<sup>11</sup> Includes DBCP, soil conditioners and fumigants, aldicarb, small quantities of rodenticides, and others.

Note.--Does not include data for the insect fumigant, p-dichlorobenzene nor the fungicide, o-phenylphenol. These data are included in the section on "Cyclic Intermediates." It also does not include data for the fungicides, dimethyldithiocarbamic acid, sodium salt and dimethyldithiocarbamic acid, zinc salt (i.e., ziram). These data are included in the section on "Rubber-Processing Chemicals." The data for ethylene dibromide, a fumigant, are included in the "Miscellaneous End-Use Chemicals and Chemical Products" section.

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTRISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT]

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C L I C	
*FUNGICIDES:	
2, 6-Bis(dimethylaminoethyl)cyclohexanone	MRK.
2-Ergo-4-hydroxyacetophenone	BKN.
2, 4-Dichloro-6-(6-chloroanilino)-s-triazine	CHG.
1, 4-Dichloro-2,5-dimethoxybenzene (Chloroneb)	DUP.
1, 2-Dihydro-6-ethoxy-2,2,4-triazethylquinoline (Ethoxyquin)	MON.
5-Ethoxy-3-(trichloromethyl)-2, 4-thiadiazole	OHC, VNC.
Hexahydro-3,5-triazyl-s-triazine	CHG.
Hexyl-9-(butylcarbamoyl)-2-benzimidazolecarbamate (Branonyl)	VBC.
2-(1-methyl-n-heptyl)-4,6-dinitrophenyl crotonate (Dinocap)	DUP.
3-(2-methylpiperidino)propyl 3,4-dichlorobenzoate (Piperalin)	RH.
*Naphthenic acid, copper salt	LIL.
Pentachloronitrobenzene (PCNB)	CCA, MCI, THO, WTC, X.
Pentachlorophenol (PCP)	OHC.
Pentachlorophenol, potassium salt	DMV, PRO, MON, RCI.
Pentachlorophenol, sodium salt	X.
*Phenylmercuric acetate (PMA)	DOV.
Phenylmercuric ammonium acetate	CLY, MSK, THO.
Phenylmercuric oleate	THO.
Phenylmercuric propionate	TRC.
8-Quinolnol(8-hydroxyquinoline),copper salt	MRK.
	ASH, X.

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*FUNGICIDES--Continued	
cis-N-[1,1,2,2-Tetrachloroethyl]thio]-1-cyclohexene	
1,2-dicarbamide (Captafol)	ORO.
2,4,5,6-tetrachloroisophthalonitrile	DA.
Tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione (DMT)	MRK, VCC.
2-(Thiocyanomethylthio)benzothiazole	BKM.
N-Trichloromethylthio-4-cyclohexene-1,2-dicarboximide (Capran)	SFA, SFC, X.
N-Trichloromethylthiothallamide (Folpet)	SFA, SFC.
2,4,5-trichlorophenol	DOM.
2,4,5-trichlorophenol, potassium salt	X.
2,4,5-trichlorophenol, sodium salt	DOM, GAF.
1,3,5-tri(2-isopropenyl)-s-triazine	EFH.
Cyclic fungicides, all other	LLL, X.
*HERBICIDES AND PLANT GROWTH REGULATORS:	
3-Amino-2,5-dichlorobenzoic acid, ammonium salt	(2);
5-Dichloro-3-aminobenzoic acid, ammonium salt	AMC, GAF.
4-Amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazine-5-(4H)-one	CHG, RH.
4-Amino-3,5,6-trichloropicolinic acid (Picloram)	DOM.
4,6-Bis(isopropylamino)-2-methoxy-s-triazine (Prometon)	CGY.
2,4-Bis(isopropylamino)-6-(methylthio)-s-triazine (Prometryn)	CGY.
5-Bromo-3-sec-butyl-6-methyluracil (Bromacil)	DUP.
2-(tert-Butylamino)-4-chloro-6-(ethylamino)-s-triazine	CGY.
2-(sec-Butylamino)-4-ethylamino-6-methoxy-s-triazine	CGY, BH.
2-(tert-Butylamino)-4-ethylamino-6-methoxy-s-triazine	CGY.
2-(tert-Butylamino)-4-ethylamino-6-(methylthio)-s-triazine	CGY.
N-sec-Butyl-4-tert-butyl-2,6-dinitroaniline	AMC, X.
3-tert-Butyl-5-chloro-6-methyluracil	DUP.
N-Ethyl-4-ethyl-1,4,4-trifluoro-2,4,6-dinitro-p-toluidine (Benefin)	LLL.
2-Ethynyl-4-chloro-m-chlorocarbanilate (Barban)	GOC.

C Y C I C--Continued

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C L I C--Continued	
*HERBICIDES AND PLANT GROWTH REGULATORS--Continued	
2-Chloro-4,6-bis(ethylamino)-s-triazine (Simazine)	CGY.
2-Chloro-4,6-bis(isopropylamino)-s-triazine (Propazine)	CGY.
2-Chloro-2,6-diethyl-N-(n-butylmethyl)acetanilide (Butachlor)	MON.
2-Chloro-2,6-diethyl-N-(methoxymethyl)acetanilide (Klachlor)	MON.
2-Chloro-4-(ethylamino)-5-(isopropylamino)-s-triazine (Atrazine)	CGY, PRI, SHC, VTC.
2-(4-Chlorophenyl)ethylamino)-s-triazin-2-ylamino]-2-methylpropionitrile (Cyaziflupr)	CGY.
N-(2-Chloroethyl)- $\alpha$ , $\alpha$ -difluoro-N-propyl-N-toluidine (Fluchloralin), 6-dinitro-N-propyl-N-toluidine (Fluchloralin), 6-dinitro-N-propyl-N-toluidine (Fluchloralin)	BAS.
2-Chloro-N-isopropylacetanilide (Propachlor)	DDN, MON.
4-Chloro-5-(methylamino)-2-( $\alpha$ , $\alpha$ -trifluoromethyl)-3-(2H)-pyridazinone (Nerflurazon)	S.
3-Cyclohexyl-6-(dimethylamino)-4-methyl-1,3,5-triazin-2,4-(1H,3H)-dione	DPP.
N-(Cyclopropylmethyl)- $\alpha$ , $\alpha$ , $\alpha$ -trifluoro-2,6-dinitro-N-propyl-p-toluidine (Profluralin)	CGY.
3,5-dibromo-4-hydroxybenzotrile, octanoic acid esters (Bromoxynil octanoate)	CLY, DDN, RDA.
3,6-dichloro-2-anisic acid (Dicamba)	VEL.
4-(2,4-Dichlorophenoxy)butyric acid (2,4-DB Acid)	RDA.
4-(2,4-Dichlorophenoxy)butyric acid, isobutyl ester	RDA.
4-(2,4-Dichlorophenoxy)butyric acid, iso-octyl ester	BDA.
3-(3,4-Dichlorophenyl)-1,1-dimethylurea (Diuron)	DUP.
3-(3,4-Dichlorophenyl)-1-methoxy-1-methylurea (Linuron)	DUP.
2-(3,4-Dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione (Methazole)	VEL, X.
2,4-Dichlorophenyl p-nitrophenyl ether	RR.
3,4-Dichlorocrotonanilide (Propanil)	EGR, RH.
S-(O-( $\alpha$ -mercapropyl)phosphorodithioate) ester of N-( $\alpha$ -mercaptoethyl)benzenesulfonamide (Bensulfide)	SFA.
N,N-Dimethyl-2,2-diphenylacetamide (Diphenamid)	CN.
1,2-Dimethyl-3,5-diphenyl-1H-Pyrazolium methyl sulfate	ACY, LAK.

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*HERBICIDES AND PLANT GROWTH REGULATORS--Continued	
N-(1,1-dimethyl-2-propenyl)-3,5-dichlorobenzamide (Pronamide)	RR.
Dimethyl-2,3,5,6-tetrachloroterephthalate (DCPA)	DA.
1,1-dimethyl-3-( $\alpha,\alpha$ -trifluoro-m-tolyl)urea (Zluro meturon)	CGY.
Dinitrobutylphenol (DNBP)	DOM, VTC.
Dinitrobutylphenol, ammonium salt	DOM.
Dinitrobutylphenol, triethanolamine salt	DOM, VTC.
2,6-Dinitro-N,N-dipropyl cumidine	LIL.
3,5-Dinitro-N,N-dipropyl sulfanilamide	SDC.
2-(2-thylamino)-4-(isopropylamino)-6-(methylthio)-S-triazine (Ametrine)	CGY.
5-Ethyl cyclohexylethylthiocarbamate	SFA.
S-Ethyl-hexahydro-1H-azepine-1-carbothioate (Mollinate)	SFA.
N-(1-Ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzamide	ACY, X.
3-(2-Chlorophenyl)-4,6-bis(isopropylamino)-S-triazine	CGY.
2-Isopropyl-1H-2,1,3-benzoxadiazin-4(3H)-one 2,2-dioxide	BA.S.
Isopropyl N-(3-chlorophenyl)carbamate	DFG.
1-(2-Methyl-2-chlorophenyl)urea (CIPC)	DFG.
1-(2-Methyl-2-chlorophenyl)urea (Sidauron)	DFG.
Methyl 5-(2,4-dichlorophenoxy)-2-nitrobenzoate	SN.
1-Naphthylphthalamic acid (NPA)	USR.
7-Oxabicyclo-(2,2,1)heptane-2,3-dicarboxylic acid, disodium salt (Endothall)	PAS.
PHENOXYACETIC ACID DERIVATIVES:	
4-Chloro-2-methylphenoxyacetic acid (MCPA)	RDA, TMH.
4-Chloro-2-ethylphenoxyacetic acid, dimethylamine salt	RDA.
4-Chloro-2-ethylphenoxyacetic acid, iso-octyl ester	RDA.
2,4-DICHLOROPHENOXYACETIC ACID, ESTERS AND SALTS:	
2,4-Dichlorophenoxyacetic acid (2,4-D)	DOM, RDA.
2,4-Dichlorophenoxyacetic acid, butoxyethanol ester	DOM.

C Y C L I C--Continued



TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C I C--Continued	
*HERBICIDES AND PLANT GROWTH REGULATORS--Continued	
PHENOXYACETIC ACID DERIVATIVES--Continued	
2,4-DICHLOROPHENOXYACETIC ACID, ESTERS AND SALTS--Continued	
2,4-dichlorophenoxyacetic acid, 2-butoxyethyl ester--	RIV.
2,4-dichlorophenoxyacetic acid, butoxypolypropylene glycol ester--	DOM.
2,4-dichlorophenoxyacetic acid, n-butyl ester--	PBI, RIV.
2,4-dichlorophenoxyacetic acid, sec-butyl ester	DOM.
*2,4-Dichlorophenoxyacetic acid, dimethylamine salt--	DOM, PBI, RDA, RIV, TMH.
2,4-dichlorophenoxyacetic acid, ethanolamine and isopropanolamine salts--	DOM.
2,4-dichlorophenoxyacetic acid, isobutyl ester	RDA.
*2,4-Dichlorophenoxyacetic acid, iso-octyl ester	DOM, PBI, RDA, RIV, TMH.
2,4-Dichlorophenoxyacetic acid, lithium salt--	GTH.
2,4-Dichlorophenoxyacetic acid, sodium salt--	RIV.
2,4,5-TRICHLOROPHENOXYACETIC ACID, ESTERS AND SALTS	
2,4,5-trichlorophenoxyacetic acid, butoxyethanol ester--	DOM.
2,4,5-trichlorophenoxyacetic acid, butoxypolypropylene glycol ester--	DOM.
2,4,5-trichlorophenoxyacetic acid, iso-octyl ester--	RIV, TMH.
2,4,5-trichlorophenoxyacetic acid, triethylamine salt--	DOM.
*PLANT GROWTH REGULATORS:	
2-Chloro-6-(trichloromethyl)pyridine--	DOM.
2,4-Dichlorobenzyltributylphosphonium chloride	SM.
1,2-Dihydro-3,6-pyridazinone (Maleic hydrazide) (MH)--	
Gibberellic acid--	ACI, CRP, PRT, USA.
3-Indolebutyric acid--	ABB, MBK.
1-Naphthaleneacetamide--	ARA, MRK.
1-Naphthaleneacetic acid (NA)--	AMC.
1-Naphthaleneacetic acid, ethyl ester--	AMC.
1-Naphthaleneacetic acid, sodium salt--	GNM.
Plant growth regulators, cyclic, all other--	ABB, MMH.

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C L I C--Continued	
*HERBICIDES AND PLANT GROWTH REGULATORS--Continued	
Sodium 5-[2-chloro-4-(trifluoromethyl)-phenoxy]-2-pyridinylphosphate	RH.
2-(2,4,5-Trichlorophenoxy)picpic acid (Silvex)	THH.
2-(2,4,5-Trichlorophenoxy)propionic acid, 2-butoxy-	DOH.
2-(2,4,5-Trichlorophenoxy)propionic acid, dimethylamine salt	RIV.
2-(2,4,5-Trichlorophenoxy)propionic acid, iso-octyl ester	RIV.
α, α, α-Trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine (Trifluralin)	LIL.
1,1,1-Trifluoro-N-(2-methyl-4-(phenylsulfonyl)-phenyl)methanesulfonamide	CGY.
Cyclic herbicides, all other	MMS, RH.
INSECT ATTRACTANTS AND REPELLENTS:	
tert-Butyl 4(or 5)-chloro-2-methylcyclohexanecarboxylate (Trisedlure)	UOP.
N,N-Diethyltoluamide (DEET)	PFZ.
Di-n-propylisocinchononate	MGE.
INSECTICIDES:	
Bacillus thuringiensis	ABB, S.
(5-Benzyl-3-furyl)methyl-2,2-dimethyl-3-(2-methylpropyl)cyclopropane carboxylate (Resmethrin)	PEN.
2,3,4,5-tetrahydro-2H-pyridin-2-one (Difluthrin)	PLC.
2-(p-tert-Butylphenoxy)cyclohexyl-2-propynyl sulfite	USB.
CHLORINATED INSECTICIDES:	
4,4'-dichloro-α-trichloromethylbenzhydrol (Dicrofol)	RH.
Ethyl 4,4'-dichlorobenzoate (Chlorobenzilate)	CGY.
Heptachloro-tetrahydro-endo-methanoindene (Heptachlor)	VEL.
1,2,3,4,5,6-Hexachlorocyclohexane (Benzene hexachloride) (BHC)	X.
Hexachlorocyclooctahydro-endo,endo-dimethanophthalene (Endrin)	VEL.
Hexachloro-hexahydro-sechano-benzodioxatolepin 3-oxide (Endosulfan)	X.

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
INSECTICIDES--Continued	
CHLORINATED INSECTICIDES--Continued	
Octachloromethydrin-4,7-methanodene (Chlordan)	VEL
1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane	HN, HPC, VTC.
1,1,1-trichloro-2,2-bis(p-methoxyphenyl)ethane	MTO.
1,1,1-trichloro-2,2-bis(p-methoxyphenyl)ethane	CHF, DUP, EGR.
2,3-dihydro-2,4-dimethyl-7-benzofuranyl methylcarbamate	PMN.
Distannaxane, hexakis(2-methyl-2-phenylpropyl)	SHC.
m-(1-Ethylpropyl)phenyl methylcarbamate	ORO.
m-(Methylbutyl)phenyl methylcarbamate	ORO.
1-Naphthyl N-methylcarbamate (Carbaryl)	UGC.
*ORGANOPHOSPHORUS INSECTICIDES:	
O-(4-Bromo-2,5-dichlorophenyl) 0-methylphenyl phosphothioate (Leptophos)	VEL.
4-tert-Butyl-2-chlorophenyl methyl methylphosphoramide (Crufonate)	DOM.
S-[[p-(p-chlorophenyl)thio]methyl] 0,0-dimethyl phosphorothioate (Carbophenothion)	SFA.
2-Chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate (Tetrachlorvinphos)	SHC.
O-(2,4-Dichlorophenyl) 0-ethyl S-propyl phosphorothioate	CHG.
2-(Diethoxyphosphorylamino)-4-methyl-1,3-dithiolane	ACY.
O,0-Diethyl S-(2-chloro-1-phthalimidoethyl) phosphorothioate	HPC.
O,0-Diethyl 0-(2-isopropyl-4-methyl-6-pyridinyl) phosphorothioate (Diazinon)	CCF.
O,0-Diethyl 0-[4-(methylsulfinyl)phenyl]phosphorothioate	CHG.
O,0-Diethyl 0-(p-nitrophenyl)phosphorothioate (Parathion)	RON.
O,0-Diethyl 0-pyrazinyl phosphorothioate	ACF.
O,0-Diethyl 0-3,5,6-trichloro-2-pyridyl phosphorothioate	DOM.
O,0-Diethyl O-[4-(methylthio)-m-tolyl]phosphorothioate (Fenthion)	CHG.

C Y C L I C--Continued

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C L I C--Continued	
INSECTICIDES--Continued	
*ORGANOPHOSPHORUS INSECTICIDES--Continued	
0,0-Dimethyl 0-(p-nitrophenyl)phosphorothioate (Methyl parathion) --	AMP, MOV, VTC.
0,0-Dimethyl S-(4-oxo-2,3-benzotriazin-3(4H)- thioethyl)phosphorodithioate (Azinphos-methyl) --	CHG.
0,0-Dimethyl S-(phthalidomethyl)phosphorodithioate --	SFA.
0,0-Dimethyl 0-(2,4,5-trichlorophenyl)phosphorothioate (Dontol) --	DOW.
2,3-dioxorane-dithiol S-bis-(0,0-diethyl phosphorodithioate (Diovalthion) --	HPC.
0-Ethyl 0-(4-(methylthio)phenyl) S-propyl phosphorodithioate --	CHG.
0-Ethyl 0-(p-nitrophenyl)phenylphosphonothioate (EPN) --	SPA, VEL.
0-Ethyl S-phenylethylphosphonodithioate --	SPA.
0-Ethyl 0-(2,4,5-trichlorophenyl)ethyl phosphonothioate --	CHG.
0,0,0,0'-Tetramethyl-0,0'-thiodi-p-phenylene phthalate --	ACY.
Cyclic insecticides, all other --	EGR, S, X.
NEMATOCIDES:	
0,0-Diethyl 0-(2,4-dichlorophenyl)phosphorothioate (Dichlofenthion) --	SM.
RODENTICIDES:	
3-( $\alpha$ -Acetonylbenzyl)-4-hydroxycoumarin (Warfarin) --	MOT.
2-Diphenylacetyl-1,3-indandione and sodium salt --	NES.
2-Bivaloyl-1,3-indandione (Pindone) --	MOT, PIC.
N-(3-Pyridylmethyl)-N'-(p-nitrophenyl)urea --	CWN.
Rodenticides, cyclic, all other --	MOT.
CYCLIC PESTICIDES, ALL OTHER:	
Benzyl bromoacetate --	MRK.
4-Bromoacetoxyethyl-N-dioxolene --	EPH.
$\alpha$ -(2-(n-Butoxyethoxy)-ethoxy)-4,5-methylenedioxy-2-propyltoluene (Piperonyl butoxide) --	ALP, FMB.
N-(2-Ethylhexyl)biacetyl(2,2,1)-5-heptene-2,3-di-carboximide --	MKG.

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*FUNGICIDES:	
Bis-1,4-bromoacetoxy-2-butene	VIN.
Chloromethoxypropylmercuric acetate	TRO.
Dipotassium cyanodithioisodocarbamate	BKN.
*DITHIOCARBAMIC ACID FUNGICIDES:	
Dimethyldithiocarbamic acid, ferric salt (Ferbas)	FUN.
Dimethyldithiocarbamic acid, potassium salt	BKN.
Dimethyldithiocarbamic acid, sodium salt	VCC.
Ethylene bis(dithiocarbamic acid), diammonium salt	RBC.
Ethylene bis(dithiocarbamic acid), disodium salt (Nabas)	ALC, USB, VCC.
Ethylene bis(dithiocarbamic acid), manganese salt (Faneb)	DUP, FH.
Ethylene bis(dithiocarbamic acid), manganese salt with zinc ions	BH.
Ethylene bis(dithiocarbamic acid), zinc salt (Zincb)	FUN, FH.
n-Dodecylthiocarbamic acid, fungicides, cyclic, all other	BKN, VNC, X.
Dodecylthiocarbamic acetate (Dorline)	ACI, BRK.
Methylthiocarbamate	BRK, VCC.
Acyclic fungicides, all other	BKN.
*HERBICIDES AND PLANT GROWTH REGULATORS:	
M-N-Bis(2-hydroxyethyl)glycine	MON.
2-Chloroethyl dimethylglycinate (CDEC)	MON.
2-Chloro-N,N-diallyldimethylglycinate (CDMA)	MON.
2,2-Dichloropropionic acid, sodium salt (Dala-pon)	DOM.
M-(5-(1,1-Diethyl-2-yl)-1,3,4-thiadiazol-2-yl)-N,N'-diethylurea (Tebuthiuron)	LII.
Ethyl carbamoylphosphonate, ammonium salt	DUP.
S-Ethyl dipropylthiocarbamate (Butylate)	SFA.
Ethyl xanthogen disulfide (EPTC)	RBC.
Methanearsonic acid, disodium salt (DSMA)	CLY, DA, YIN.
Methanearsonic acid, dodecyl- and octyl- ammonium salt	CLY.

A C Y C L I C

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
*HERBICIDES AND PLANT GROWTH REGULATORS--Continued	
N-(Phosphonomethyl)glycine, isopropylamine salt-- FLAM PRODR REGULATOR	MON.
S-(chloroethyl)phosphonic acid	GAF.
Succinic acid, dimethylhydrazide	USR.
S-propyl butylacetylphosphoramidate (Pebulate)	SFA.
S-propyl diisopropylthiocarbamate (Vernolate)	SFA.
S-triethyl phosphorothioate (Merphos)	PLC.
Triethyl phosphorothioate (Merphos)	SM.
Trichloroacetic acid sodium salt (TCA)	DOM.
S-(1,2,3-trichloroallyl) diisopropylthiocarbamate (Nylate)	MON.
Acyclic herbicides, all other--	BKM, S, X.
INSECTICIDES:	
2-(2-Ethoxyethoxy)methyl thiocyanate	RH.
Butyl 3,4-dihydro-2,2-dimethyl-4-oxo-2H-pyran-6-carb- oxylate	KP.
3,3-Dimethyl-1-(methylthio)-2-butanone O-(methyl amino)carbamoyl oxime	EGR.
Methyl N,N'-dimethyl-N'-(methylcarbamoyloxy)-1-thi- ooxamide	DUP.
S-Methyl-N'-(methylcarbamoyloxy)thioacetimidate (Methonyl)	DUP, EGR, SHC.
2-Methyl-2-(methylthio)propionaldehyde O-(methylcarb- amoyl)oxime (Aldicarb)	SHC, UCC.
*ORGANOPHOSPHORUS INSECTICIDES:	
S-[1,2-Bis(ethoxycarbonyl)ethyl]O,O-dimethyl phos- phorothioate (Malathion)	ACY.
2-Carboethoxy-1-propen-2-yl dimethyl phosphate	SHC.
1,2-Dibromo-2,2-dichloroethyl dimethyl phosphate (Maled)	SHC.
O,O-Dimethyl S-[2-(ethylthio)ethyl] phosphorodi- thioate (Disulfoton)	CHG.
O,O-Dimethyl O-[2-(ethylthio)ethyl] phosphoro- thioate (Demeton O)	CHG.

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
INSECTICIDES--Continued	
*ORGANOPHOSPHORUS INSECTICIDES--Continued	
O,O-diethyl S-[(ethythio)methyl] phosphorodi- thioate (Phorate)	ACY, CHG, X.
3-(Dimethoxyphosphinyloxy)-N,N-dimethyl-cis-croton- amide	SHC
O,S-dimethylacetylphosphoraidiothioate (Acephate)	ORO
O,O-dimethyl-O-2,2-dichlorovinyl phosphate (DDVP)	SHC
Dimethyl phosphate of 3-hydroxy-N-methyl-cis-croto- naalide	SHC
O,S-dimethyl phosphoraidiothioate	CHG
O,O-dimethyl phosphorochloridethioate	CHG
S-[2-(Ethylsulfinyl)ethyl]O,O-dimethyl phosphoroth- ioate (Oxymatometethyl)	CHG
O,O,O'-Tetraethyl S,S'-methylene bisphosphorodi- thioate (Ethion)	PMN
Tetraethyl pyrophosphate (TEPP)	X.
O,O,O'-Tetra-n-propyldithiopyrophosphate	SFA
Organophosphorus insecticides, acyclic, all other	X, X.
Acyclic insecticides, all other	X.
RODENTICIDES:	
2-Hydroxyethyl n-octyl sulfide	PIC
Rodenticide acetate	BBC
Rodenticide phosphate	BBC
SOLU CONDITIONERS:yclic, all other	PIC, BBC.
Polyacrylonitrile, hydrolyzed, sodium salt	
SOLI FUMIGANTS:	
1,2-dibromo-1-chloropropane (DBCP)	ACY.
1,3-dichloropropane	DOM, SHC.
1,3-dichloropropane, 1,2-dichloropropane-	DOM.
O-Ethyl S,S-dipropyl phosphorodithioate	SHC.
*Methyl bromide (Bromethane)	SM.
Methyl isothiocyanate	DOM, GFL, VEL.
*Trichloronitrosomethane (Calorpicrin)	MRT.
	DOM, IMC, NLO.

A C Y C L I C--Continued

TABLE 2.--PESTICIDES AND RELATED PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE  
REPORTED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

PESTICIDES AND RELATED PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
ACYCLIC PESTICIDES, ALL OTHER:	
2-[(Hydroxymethyl)amino]-2-methylpropanoi-	: TRQ.
2-[(Hydroxymethyl)ethanol]	: TBC.
3-(2,2-dipropyl butylcarbamate)	: TRQ.
Acyclic pesticides and related products,all other	: BRK, FCM, X.



TABLE 3.--PESTICIDES AND RELATED PRODUCTS: DIRECTORY OF MANUFACTURERS, 1977

## ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of pesticides and related products to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
ABB	Abbott Laboratories	MMY	Minnesota Mining & Manufacturing Co.
ACY	American Cyanamid Co.	MON	Monsanto Co.
ALC	Alco Chemical Corp.	MOT	Motomoco, Inc.
ALP	Alpha Laboratories, Inc.	MRK	Merck & Co., Inc.
AMC	Anchem Products, Inc. Sub. of Union Carbide Corp.	MRT	Morton Chemical Co. Div. of Morton Norwich Products, Inc.
AMP	Kerr-McGee Chemical Corp.	MTO	Montrose Chemical Corp. of California
ARA	Arapahoe Chemical, Inc. Sub/Syntex U.S.A., Inc.	NES	Nease Chemical Co., Inc.
ASH	Ashland Oil, Inc., Ashland Chemical Co.	NLO	Niklor Chemical Co.
BAS	BASF Wyandotte Corp.	QMC	Olin Corp., Agricultural Products Dept.
BKM	Buckman Labs., Inc.	ORO	Chevron Chemical Co.
CCA	Interstab Chemical, Inc.	PAS	Pennwalt Corp.
CCY	Ciba-Geigy Corp., Agricultural Div.	PCW	Pfister Chemical, Inc.
CHF	Chemical Formulators, Inc.	PD	Parke, Davis & Co. Sub of Warner-Lambert Co.
CHG	Mobay Chemical Corp., Chemagro Agricultural Div.	PEN	GPC International, Inc., Penick Div.
CLY	W. A. Cleary Corp.	PFZ	Pfizer, Inc.
CWN	Upjohn Co., Fine Chemical Div.	PIC	Pierce Organics, Inc.
DA	Diamond Shamrock Corp.	PLC	Phillips Petroleum Co.
DOW	Dow Chemical Co.	PPC	PPC Industries, Inc.
DUP	E. I. duPont de Nemours & Co., Inc.	RBC	Fike Chemicals, Inc.
EFH	E. F. Houghton & Co.	RCI	Reichhold Chemicals, Inc.
EGR	Eagle River Chemical Corp.	RDA	Rhodia, Inc.
FMN	FMC Corp., Agricultural Chemical Div.	RH	Rohm & Haas Co.
FMT	Fairmount Chemical Co.	RIV	Riverdale Chemical Co.
FRI	Farmland Industries, Inc.	S	Sandoz Inc., Crop Protection Dept.
FRO	Vulcan Materials Co., Chemical Div.	SDC	Martin-Marietta Corp., Sodyeco Div.
GAF	GAF Corp.	SFA	Stauffer Chemical Co.: Agricultural Div.
GNW	Greenwood Chemical Co.	SFC	Calbio Chemicals, Inc. Div.
GOC	Gulf Oil Corp., Gulf Oil Chemical Co. - U.S.	SHC	Shell Oil Co., Shell Chemical Co. Div.
GTH	Guth Chemical Co.	SM	Mobil Oil Corp., Mobil Chemical Co., Phosphorus Div.
GTL	Great Lakes Chemical Corp.	THM	Thompson-Hayward Chemical Co.
HK	Hooker Chemicals & Plastics Corp.	TRO	Troy Chemical Corp.
HN	Tenneco Chemicals, Inc.	UCC	Union Carbide Corp.
HPC	Hercules, Inc.	UOP	UOP, Inc., Chemical Div.
IMC	IMC Chemical Group, Inc.	USM	USM Corp., Bostik Div.
KF	Kay-Fries Chemicals, Inc.	USR	Uniroyal, Inc., Uniroyal Chemical Div.
LAK	Bofors Lakeway, Inc.	VCC	Vinings Chemical Co.
LIL	Eli Lilly & Co.	VEL	Velsicol Chemical Corp.
MCF	Miller Chemical & Fertilizer Corp.	VIN	Vineland Chemical Co., Inc.
MCI	Mooney Chemical Corp.	VNC	Vanderbilt Chemical Corp.
MCK	McLaughlin, Gormley & King Co.	VTC	Vicksburg Chemical Co. Sub. of Vertac Consolidated
		WTC	Witco Chemical Corp.
		ZOC	Zoecon Corp.

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the appendix.



Organic Flocculants

K. James O'Connor, Jr.

In recent years, the public has become increasingly concerned over the state of the environment, including, among other factors, the quality of water. Not only in response to these concerns, but also as a result of increased Government regulation in this area, the U.S. chemical industry has found it necessary to institute new measures to more thoroughly cleanse the effluent of its manufacturing plants. One facet of this cleansing is the removal of suspended or colloidal particles from wastewater. This is accomplished by a process known as coagulation or flocculation.

This paper will examine the mechanism by which flocculation of colloidal particles occurs. It will also examine the developing market for polyacrylamide, polyamines, and polyepichlorohydrins, all of which are commonly referred to as organic flocculants.

Organic versus inorganic flocculants

In general, the vast majority of particles suspended in wastewater are too small to be seen with the unaided eye. Flocculation causes these smaller particles to coagulate into larger ones called flocs, which can not only be seen, but which will also settle out, or float, depending on their nature, and which can subsequently be rapidly filtered out of the water.

The process of flocculation for the removal of suspended particles from water is not new. In the past, the coagulant aids of choice have generally been inorganic compounds, most often alum or various ferric (iron) salts. While these compounds are effective as flocculants, large quantities are required in relation to the suspended matter. This has never been a significant drawback with regard to cost, as the materials are relatively inexpensive. (In 1977, a typical price for alum was 6.5 cents per pound.) However, the large amount of coagulants used produced a correspondingly large amount of sludge. Consequently, the total cost of using inorganic flocculants, although initially inexpensive, is becoming increasingly costly because of the problem of sludge disposal. Ocean dumping of sludge, once common, is generally prohibited by environmental regulations. Similar regulations have greatly increased the cost of sludge disposal in landfills, as precautions must be taken to avoid any seepage of material into groundwater supplies.

Organic flocculants, on the other hand, produce far less sludge because the mechanism by which they operate reduces the amount of colloidal particles more efficiently than inorganic flocculants. (This mechanism is described below.) Thus the cost of using organic flocculants is greatly reduced because significantly smaller amounts are required (from 1/3 to 1/25 as much as inorganic flocculants, depending on the constituents of the wastewater) and much less sludge is generated.

### Flocculation mechanism

Colloidal particles suspended in water generally carry a small electrical charge which causes the particles to mutually repel one another. For effective flocculation to occur, this charge must be neutralized. Whether the suspended particles are anionic (possessing a negative charge) or cationic (positively charged) depends on the particular contaminant. In general, naturally occurring colloidal particles, such as those found in municipal waste, possess a net negative charge and must be treated with a cationic flocculant. Industrial wastes tend to contain positively charged matter and must be treated with an anionic flocculant. Wastewater which contains a variety of suspended solids is generally most effectively treated with a nonionic polymer which possesses a mixture of charges.

Polyacrylamide comprises the largest segment of the organic flocculant industry. Depending on the degree of hydrolyzation of the amide ( $-\text{CONH}_2$ ) group to carboxyl ( $-\text{COOH}$ ) groups during polymerization, polyacrylamide may be made cationic, nonionic, or anionic. Polyamines and polyepichlorohydrins are generally cationic.

Once the appropriate organic flocculant is in solution, the suspended particles migrate to the polymer molecules which are then adsorbed onto the surfaces of the suspended particle. This process, called bridging, results in a large three-dimensional network which can be rapidly filtered from the solution.

### Market growth and outlook

The following table summarizes production and sales for the last 3 years of polyacrylamide and other polymers used as organic flocculants. While not all polyacrylamide is used for the production of flocculants, this is its major use. As shown in the table, both production and sales declined moderately in the 1975 recession, followed by a strong rebound in 1976, and continued growth in 1977. Production of polymers used as flocculants increased from 49.0 million pounds in 1975, to 71.4 million pounds in 1977, while the value of sales increased from \$39.7 million to \$59.3 million in the same period. The corresponding figures for acyclic organic chemicals<sup>1</sup> are included in the table for comparison. It can be seen that the rate of decline for acyclic chemicals was much more pronounced than that for organic flocculants in 1974-75 and that acyclic chemicals' recovery rate was less pronounced in 1975-77.

As Government regulations governing wastewater become more stringent in the near future, the organic flocculant industry can expect continued steady growth for the following reasons. First, the problem of sludge disposal will become more acute, which will favor the organic flocculants because they decrease the amount of sludge created in effluent cleanup. Second, as new plants are built, their sludge-handling equipment will be designed to process sludge

---

<sup>1</sup> Miscellaneous cyclic and acyclic chemicals, sec. XV, p.

created when organic polymers are used for flocculation instead of inorganic compounds. (Older plants already have sludge-handling equipment which will process flocculant products of inorganic compounds, and conversion of the equipment would not be cost-effective.) Lastly, the organic flocculants have been shown to be pharmacologically inert and therefore virtually devoid of toxicity. The majority of the compounds used for flocculation have received either EPA or FDA approval for their respective uses.

## U.S. production and sales of organic flocculants and all acyclic organic chemicals, by types, 1974-77

Item	(Quantities in thousands of pounds; value in thousands of dollars)				Production quantity				
	1974	1975	1975 from 1974	Percentage change, 1975 from 1974	1974	1975	1976 from 1975	Percentage change, 1976 from 1975	1977 from 1976
Organic flocculants:									
Polyacrylamide-----	29,217	26,276	-10.0		41,507	58.0		45,319	9.2
Other-----	(1)	22,764	-		27,242	19.7		26,069	-4.3
Total-----	(1)	49,040	-		68,749	40.2		71,388	3.8
All acyclic organic chemicals----	97,037,182	83,083,936	-14.4		93,251,568	12.2		104,242,933	11.8
					Sales quantity				
Organic flocculants:									
Polyacrylamide-----	30,844	25,581	-17.1		36,829	44.0		37,244	1.1
Other-----	(1)	15,777	-		21,620	37.0		23,241	7.5
Total-----	(1)	41,358	-		58,449	41.3		60,485	3.5
All acyclic organic chemicals----	46,072,171	37,620,969	-18.3		39,685,672	5.2		45,702,563	15.2
					Sales value				
Organic flocculants:									
Polyacrylamide-----	25,849	25,665	-0.7		41,479	38.1		40,916	1.4
Other-----	(1)	13,984	-		14,697	6.8		18,368	20.0
Total-----	(1)	39,659	-		56,176	29.4		59,284	5.2
All acyclic organic chemicals----	7,141,574	7,256,145	1.6		7,629,105	4.9		8,168,496	7.1

1 Not available.

Source: U.S. International Trade Commission.

Miscellaneous End-Use Chemicals and Chemical Products

K. James O'Connor, Jr. and Janet Dietzman

This section incorporates those end-use groups which are not readily classifiable within the prior sections of this report. Both cyclic and acyclic chemicals fall within this section. With the exception of gasoline additives, both production and sales of all end-use groups contained within this section increased over 1976 levels.

In 1977 the production of miscellaneous end-use chemicals exceeded 19.3 billion pounds, an increase of 16.5 percent over the more than 16.6 billion pounds of production reported for 1976 (see revisions to 1976 data at end of table 1). Sales in 1977 exceeded 10.8 billion pounds, valued at \$2.5 billion. The sales quantity represents an increase of 7.5 percent over that of 1976 with the value of sales increasing by 6.1 percent. As in 1976, polymers for fibers and urea again collectively accounted for 84 percent of the 1977 production of these miscellaneous end-use chemicals. Urea accounted for 73 percent of the 1977 sales quantity of these chemicals.

Production of gasoline additives for 1977 totaled 1.15 billion pounds, a decrease of 10 percent from the previous year. The decline in sales was even more pronounced. Total sales quantity for 1977 was 862 million pounds, down 26.2 percent from the 1976 sales quantity of 1.09 billion pounds. This market is expected to continue its decline as a result of environmental legislation which restricts the use of lead alkyls in gasoline.





TABLE 1.--MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>

[Listed below are all miscellaneous end-use chemicals and chemical products for which any reported data on production or sales may be published. (Leaders (...) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists alphabetically all miscellaneous end-use chemicals and chemical products on which data on production and/or sales were reported and identifies the manufacturers of each]

MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS	SALES				
	PRODUCTION	QUANTITY			UNIT VALUE <sup>2</sup>
		1,000 pound	1,000 pound	1,000 dollars	
Grand total-----	19,347,932	10,855,243	2,547,481	\$0.23	
Chelating agents, nitriloacids and salts, total-----	168,317	140,009	70,128	.50	
(Diethylenetri(ri)lo)pentaaetic acid, penta- sodium salt-----	6,174	4,014	2,582	.64	
(Ethylenedinitri)lo)tetraaetic acid, calcium disodium salt-----	295	...	...	...	
(Ethylenedinitri)lo)tetraaetic acid, tetrasodium salt-----	54,464	36,404	23,555	.65	
(N-Hydroxyethyl)ethylenedinitri)lo)triacetic acid, trisodium salt-----	2,488	3,235	3,022	.93	
All other-----	106,897	96,356	40,969	.43	
Chemical indicators-----	8	6	472	74.33	
Chemical reagents-----	83	72	1,996	35.03	
Enzymes, total-----	( <sup>3</sup> )	( <sup>3</sup> )	52,181	...	
Hydrolytic enzymes, total-----	( <sup>3</sup> )	( <sup>3</sup> )	32,170	...	
Amylases-----	( <sup>3</sup> )	( <sup>3</sup> )	5,853	...	
Proteases, total-----	( <sup>3</sup> )	( <sup>3</sup> )	19,041	...	
Papain-----	( <sup>3</sup> )	( <sup>3</sup> )	2,772	...	
Rennin-----	( <sup>3</sup> )	( <sup>3</sup> )	6,167	...	
All other proteases-----	( <sup>3</sup> )	( <sup>3</sup> )	10,102	...	
All other hydrolytic enzymes-----	( <sup>3</sup> )	( <sup>3</sup> )	7,276	...	
Non-hydrolytic enzymes-----	( <sup>3</sup> )	( <sup>3</sup> )	20,011	...	
Gasoline additives, total <sup>4</sup> -----	1,152,253	861,745	785,709	.92	
N,N'-Disalicylidene-1,2-propanediamine-----	480	...	...	...	
Ethylenedibromide-----	244,238	...	...	...	
Tetraethyl lead-----	326,935	294,383	287,407	.98	
Tetra(methyl-ethyl) lead, (TEL-TML, reacted)-----	432,819	392,625	391,015	1.02	
Tetramethyl lead-----	119,642	...	...	...	
All other gasoline additives-----	28,619	188,062	116,616	.95	
Lubricating oil and grease additives, total-----	1,477,597	1,253,329	491,932	.39	
Oil soluble petroleum sulfonate, calcium salt-----	287,495	273,850	90,098	.33	
Oil soluble petroleum sulfonate, sodium salt-----	117,808	104,916	27,540	.26	
Phenol salts, total-----	126,013	121,059	49,734	.41	
Nonylphenol, barium salt-----	8,363	7,739	5,635	.73	
All other-----	117,650	113,320	44,099	.37	
Sulfur compounds-----	163,044	158,522	64,396	.41	
Zinc dialkylthiophosphate-----	32,587	18,828	10,599	.56	
All other lubricating oil and grease additives-----	750,650	576,154	249,565	.43	
Paint driers, naphthenic acid salts, total <sup>5,6</sup> -----	15,434	10,781	10,654	.99	
Calcium naphthenate-----	1,119	944	644	.68	
Cobalt naphthenate-----	3,735	3,372	5,258	1.56	
Lead naphthenate-----	4,901	3,379	2,262	.67	
Manganese naphthenate-----	1,539	1,015	665	.65	
Zinc naphthenate-----	1,300	1,169	802	.69	
All other-----	2,837	902	1,023	1.13	
Photographic chemicals-----	16,152	3,114	11,039	3.54	

See footnotes at end of table.

TABLE 1.--MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>--CONTINUED

MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>2</sup>
	1,000 pound	1,000 pound	1,000 dollars	Per pound
Polymers for fibers, total-----	6,022,251	355,232	171,215	\$0.48
Nylon 6 and 6/6-----	1,873,993	...	...	...
Polyacrylonitrile and acrylonitrile copolymers-----	795,028	...	...	...
Polyethylene terephthalate-----	2,332,020	176,194	57,334	.33
All other polymers for fibers-----	1,021,210	179,037	113,882	.64
Polymers, water soluble, total-----	252,349	226,531	257,602	1.13
Cellulose ethers and esters-----	149,127	146,187	175,373	1.20
Polymers used as flocculants, total-----	72,181	61,278	60,156	.98
Polyacrylamide-----	46,112	38,037	41,788	1.10
All other-----	26,069	23,241	18,368	.79
Sodium polyacrylate-----	7,911	7,520	5,622	.75
All other water soluble polymers-----	14,419	11,546	16,451	1.42
Tanning materials, synthetic, total-----	61,589	56,206	25,521	.45
2-Naphthalenesulfonic acid, formaldehyde condensate and salt-----	35,510	34,269	14,732	.43
All other-----	26,079	21,937	10,789	.49
Textile chemicals, other than surface-active agents-----	6,999	3,345	3,286	.98
Urea, total-----	10,143,695	7,919,822	568,736	.07
In feed compounds-----	475,228	397,657	25,534	.06
In liquid fertilizer-----	2,946,998	2,557,540	185,659	.07
In solid fertilizer-----	5,368,190	4,397,246	274,446	.06
In plastics-----	1,195,791	416,808	25,213	.06
All other-----	157,488	150,571	57,884	.38
All other miscellaneous end-use chemicals and chem- ical products <sup>7</sup> -----	31,205	25,051	97,010	3.87

<sup>1</sup> Certain data have been revised for 1976. These revisions are shown below:

MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	16,684,908	10,100,710	2,401,932	.25
Gasoline additives, total-----	1,271,143	1,088,445	446,250	.69
All other gasoline additives-----	702,395	526,962	423,866	.81
Urea, total-----	8,995,288	7,307,906	423,507	.06
Urea, in liquid fertilizer-----	2,412,138	2,310,931	108,112	.05
Urea, in solid fertilizer-----	4,866,132	4,149,055	256,593	.06

<sup>2</sup> Calculated from rounded figures.

<sup>3</sup> Not available.

<sup>4</sup> Statistics exclude production and sales of tricresyl phosphate. Statistics on tricresyl phosphate are given with the section on "Plasticizers."

<sup>5</sup> Quantities are given on the basis of solid naphthenate.

<sup>6</sup> Statistics exclude production and sales of copper naphthenate. Statistics for copper naphthenate are given in the section on "Pesticides and Related Products."

<sup>7</sup> Includes all other items listed in table 2 which are not individually publishable or publishable as groups.

TABLE 2.--MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA WERE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT. COMPANY IDENTIFICATION CODES WHICH ARE FOLLOWED BY AN "(E)" ARE SO LABELED BECAUSE THE COMPANY FAILED TO SUPPLY THE U.S. INTERNATIONAL TRADE COMMISSION WITH THEIR DATA IN SUFFICIENT TIME FOR ITS INCLUSION IN THIS REPORT. THE COMPANY IS PRESUMED TO HAVE CONTINUED PRODUCTION OF THE COMPOUND IN QUESTION IN 1977 AND THE VOLUME OF PRODUCTION AND SALES HAS BEEN ESTIMATED BY THE DSLIC STAFF MEMBERS]

MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
Biological stains--	MMC.
*CHELATING AGENTS, NITRILACIDS AND SALTS:	
(Diethylenetriamino)trilo)pentaaetic acid	HMP.
(Diethylenetriamino)trilo)pentaaetic acid, monosodium hydrogen ferric salt	CGY.
*(Diethylenetriamino)trilo)pentaaetic acid, pentasodium salt	CGY, DAN, DOW, HMP, RPO.
(Diethylenetriamino)trilo)pentaaetic acid, sodium salt	CGY.
N,N-Dihydroxyethylglycine, sodium salt	DAM, HMP.
Ethanol diglycine, disodium salt	HMP.
(Ethylenedinitrilo)tetraaetic acid (Ethylenediamine tetraaetic acid) (ETA)	CGY, DOW, HMP.
*(Ethylenedinitrilo)tetraaetic acid, calcium disodium salt	CGY, DOW, HMP.
(Ethylenedinitrilo)tetraaetic acid, diammonium salt	DOW, HMP.
(Ethylenedinitrilo)tetraaetic acid, disodium copper salt, dihydrate	HMP.
(Ethylenedinitrilo)tetraaetic acid, disodium magnesium salt	HMP.
(Ethylenedinitrilo)tetraaetic acid, disodium salt	CGY, DOW, HMP.
(Ethylenedinitrilo)tetraaetic acid, disodium zinc salt, dihydrate	HMP.
(Ethylenedinitrilo)tetraaetic acid, manganese salt	DOW, HMP.
(Ethylenedinitrilo)tetraaetic acid, noncammonium ferric salt	HMP.
(Ethylenedinitrilo)tetraaetic acid, monosodium iron salt	HMP.

TABLE 2.--MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977.--CONTINUED

MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*CHELATING AGENTS, NITRILACIDS AND SALTS--Continued	
(Ethylenedinitrilo)tetraacetic acid, tetraammonium salt	DOW, HMP.
(Ethylenedinitrilo)tetraacetic acid, tetrapotassium salt	CGY, HMP.
(Ethylenedinitrilo)tetraacetic acid, tetrasodium salt	CGY, CRT, DAN, DOM, HMP, JOR, RPC.
(N-Hydroxyethylthylenedinitrilo) triacetic acid	CGY, HMP.
(N-Hydroxyethylthylenedinitrilo) triacetic acid, copper salt	HMP.
(N-Hydroxyethylthylenedinitrilo) triacetic acid, iron salt	HMP.
(N-Hydroxyethylthylenedinitrilo) triacetic acid, magnesium salt	HMP.
(N-Hydroxyethylthylenedinitrilo) triacetic acid, trimethyl salt	CRT, DAN, DOW, HMP, RPC.
Nitriotriacetic acid	HMP, RON.
Nitriotriacetic acid, trisodium salt	HMP, RON.
*Chelating agents, nitrilocius and salts, all other	CGI(2), DOW, EK, HMP.
*Chemical indicators	GC, EK, PA, CS, HMC.
*Chemical reagents	EX, GS, HMC, RBA, X.
*ENZYMES:	
*HYDROLYTIC ENZYMES:	
*AMYLASES:	
*Amylases, all other	BAK, MLS, PPZ, RH, X.
*PROTEASES:	
Bromelain	DOL.
Ficin	PPZ.
*Papain	BAK, MLS, PEN, PPZ.
Pepsin	CHH, SPR.
*Hennin	CHH, MLS, PPZ.
*Proteases, all other	BAK, MLS, PIC, PMP, SPR.
Hydrolytic enzymes including pectic enzymes and lipase, all other	BAK, JFR, MLS, PMP, RH, SPR, WBC.
*NON-HYDROLYTIC ENZYMES:	
Glucose oxidase	DLI.
Nonhydrolytic enzymes	ASH, CGY, DLI, ICI, MLS, OMS, PLR.

TABLE 2.--MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977.--CONTINUED

MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
FLOTATION REAGENTS:	
FOSPHORODITHIOATES (DITHIOPHOSPHATES):	
Dicresylphosphorodithioic acid	ACY.
Dicresylphosphorodithioic acid, ammonium salt	ACY.
Dicresylphosphorodithioic acid, sodium salt	KCU.
OTHER FLOTATION REAGENTS:	
2,2'-Dimethylthiocarbaniide (Di-o-tolythiourea)	RBC.
Rosin amines	HPC.
Thiocarbaniide (Diphenylthiourea)	ACY, RBC.
Flotation reagents, all other	KCU.
*GASOLINE ADDITIVES:	
Butylphenols, mixed	TNA.
N-sec-butyl-N-phenylphenylenediamine	X.
4,4'-Di-sec-butylaminodiphenylmethane	X.
2,6-Di-tert-butylphenol	TNA.
N,N-Di-sec-butyl-p-phenylenediamine	DUP, USR, X.
N,N-Diisopropyl-p-phenylenediamine	DUP, USE.
N,N-Dialcylidene-1,2-propanediamine	DUP, FEB, TI, X.
Ethoxylated hydantoin glycol dicocotate	GLY.
Ethylene dibromide	DOW, PPG, TNA.
Hexylcyclopentadienylmanganese tricarbonyl	TNA.
4,4'-Methylene bis(2,6-di-tert-butyl phenol)	TNA.
Tetraethyl lead	DUF, PEG, TNA, X.
Tetraethyl ethyllead, (Tel-tel,reacted)	DUF, PPG, TNA, X.
1,3,5-Triethyl lead	DUF, TNA, X.
1,3,5-Triethyl lead-tert-butyl-4-hydroxybenzyl	
Toluene	TNA.
Gasoline additives, all other	ASH, DUP, TNA, X.
*LUBRICATING OIL AND GREASE ADDITIVES:	
CHLOROSULFURIZED AND SULFURIZED COMPOUNDS:	
Methylene-bridged polyalkyl phenols	TNA.
4,4'-Thiobis(6-tert-butyl-o-cresol)	TNA.
Chlorosulfurized and sulfurized compounds, used as lubricating oil and grease additives, all other	GLY.

TABLE 2.--MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*LUBRICATING OIL AND GREASE ADDITIVES--Continued	
OIL-SOLUBLE PETROLEUM SULFONATES:	
Oil-soluble petroleum sulfonate, ammonium salt	Mt.
Oil-soluble petroleum sulfonate, barium salt	ORO, WTC, X(E).
Oil-soluble petroleum sulfonate, calcium salt	ORO, PAR, PLC, TNA, TX, WTC, X(E).
Oil-soluble petroleum sulfonate, magnesium salt	WTC
Oil-soluble petroleum sulfonate, sodium salt	ENJ, MOR, PAR, SHC, WTC, X(E).
Oil-soluble petroleum sulfonate, all other	SHC
*PHENOL SALTS:	
Alkylphenol, calcium salt	ORO
Alkylphenol, barium salt	CCA, ENJ, X.
Phenol salts, all other	TNA, TX, WTC, X(E).
PHOSPHORODITHIOATES (DITHIOPHOSPHATES):	
Di-2-ethylhexylphosphorodithioic acid	ELC, SPA.
Di-n-propylphosphorodithioic acid	ELC, SPA.
Zinc dialkylthiophosphate	ELC, ORO, TNA, TX.
Zinc hydrocarbon dithiophosphate	X(E).
Zinc isopropyl hexyl phosphorodithioate	ELC.
Phosphorodithioates used as lubricating oil and grease additives, all other	ELC, ORO, TX.
*SULFUR COMPOUNDS:	
Aliphatic hydrocarbon sulfides	ELC, X(E).
Aliphatic imides, sulfur compounds	ORO.
Chlorosulfurized sperm oil	CCW.
Diisobutylene polysulfide	ELC, TX.
Di-tertiary nonylpoly sulfide	PAS.
Sulfurized lard oil	CCW, FER, QCP, WBS.
Sulfurized sperm oil	ELC.
Sulfurized sperm oil substitutes	CCW, FER.
Triisobutylene polysulfide	TX.
Sulfur compounds, all other	CCW, ELC, ORO.
Lubricating oils and grease additives, all other	ALX, ELC, ENJ, GRH, MIL, ORO, PLC, SHC, SH, TNA, TX, X(P).
*PAINT DRIERS, NAPHTHENIC ACID SALTS:	
Aluminum naphthenate	SHP.
Barium naphthenate	CCA.
Cadmium naphthenate	CCA.

TABLE 2. -- MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*PAINT DRIERS, NAPHTHENIC ACID SALTS--Continued	
*Calcium naphthenate	CCA, HM, MCI, SHP, TRO, WTC, X.
Chromium naphthenate	MCI, WTC.
*Cobalt naphthenate	CCA, HM, MCI, SHP, TRO, WTC, X.
Iron naphthenate	CCA, HM, WTC.
*Lead naphthenate	CCA, MCI, SHP, SW, TRO, TX, WTC, X.
Lithium naphthenate	CCA, MCI.
*Manganese naphthenate	CCA, HM, MCI, SHP, SW, TRO, WTC, X.
Rare earths naphthenate	CCA.
Strontium naphthenate	CCA.
*Zinc naphthenate	CCA, HM MCI, SW, TRO, WTC, X.
Faint dryers, naphthenic acid salts, all other	ER, MCI, SM, SW.
*PHOTOGRAPHIC CHEMICALS:	
N-2-(4-Amino-N-ethyl-N-toluidino)ethyl methane-sulfona	X.
3-Amino-1,2,4-triazole (5-Amino-1,3,4-triazole)	PMT.
Benzotriazole	PMT, SW.
p-Benzylaminophenol hydrochloride	EK.
p-Chloro-2-chloro-N,N-diethylamine-zinc chloride	ESA.
Chloro-2-chloro-N,N-diethylamine-zinc chloride	EK.
4-Diethyl-5-diethoxythiocresol salts	PMT.
2,5-Diethoxy-4-norpholinobenzediazonium chloride	ALL, ESA.
p-Diethylaminobenzediazonium chloride (p-Diazo-N,N-diethylaniline)-zinc chloride	ESA, PMT.
N,N-Diethyltoluene-2,5-diaaine, monohydrochloride	EKT.
p-Dimethylaminotobenzediazonium chloride (p-Diazo-N,N-diethylaniline)-zinc chloride	ESA, PMT.
p-Diphenylaminediazonium sulfate	PMT.
p-(p-Ethylbenzimid)benzenediazonium chloride (p-Di-azo-N-benzyl-N-ethylaniline)-zinc chloride	PMT.
p-[Ethyl(2-hydroxyethyl)amino]benzenediazonium chloride (p-Diazo-N-ethyl-N-hydroxyethylamine)-zinc chloride	ESA, PMT.
N-Ethyl-N-hydroxyethyl-p-phenylenediamine sulfate	WAY.
Hydroquinone (Hydroquinol)	EKT.

TABLE 2.--MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*PHOTOGRAPHIC CHEMICALS--Continued	
p-[(2-hydroxyethyl)methylamino]benzamidazolum de (p-Diazo-N-hydroxyethyl-N-methylaniline)-zinc chloride	ESA, FMT. X.
4-Methoxy-1-naphthol	X.
p-Methylamino phenol sulfate (Metol)	EK.
5-Methylbenzotriazole	EK.
6-Nitrobenzimidazole	EK, FMT.
Phenyl-5-mercaptotetrazole	FMT.
1-Phenyl-3-pyrazolidine	CGI.
Photographic chemicals, all other	DUP, EK, ESA, FMT, HST, MIL, WAY, X.
*POLYMERS FOR FIBERS:	
Cellulose acetate	CEL, DUP, EKT.
Nylon 6 and 6/6	ALF, CEL, DUP, FRF, MON.
*Polyacrylonitrile and acrylonitrile copolymers	ACI, DUP, MON.
*Polyethylene terephthalate	CEL, DUP, EK, EXT, GTR.
Polymers for fibers, all other	EKL, DUP, EKT, FRF, MON, SKP.
*POLYMERS, WATER-SOLUBLE:	
*CELLULOSE ETHERS AND ESTERS:	
Hydroxyethylcellulose	HFC, UCC.
Sodium cellulose	DM.
Sodium carboxymethylcellulose (100%)	DM, BUK, HFC, KON.
Cellulose ethers and esters, all other	DM, HFC.
Dextran	PHR.
*POLYMERS USED AS FLOCCULANTS:	
*Polyacrylamide	ACY, CEL, DM, HFC, MRK, X.
*All other polymers used as flocculants	ACY, DM, X, Y.
POLYACRYLIC ACID SALTS:	
Ammonium polyacrylate	BFG.
*Sodium polyacrylate	ALC, BFG, CEL, DA, RH, X.
Polyacrylic acid salts, all other	BFG, X.
Polyethyleneimine	DM.
Polymethacrylic acid, sodium salt	GRD, X.
1-Vinyl-2-pyrrolidinone, polymers	DAN, GAF.
RARE SUGARS:	
Rare sugars	PFN.
Silicone greases	DCC, SPD, SMS.



TABLE 2.--MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
<b>*TANNING MATERIALS, SYNTHETIC:</b>	
Hydroxybenzenesulfonic acid, formaldehyde condensate (Cresol-formaldehyde sulfonate), sodium salt	DA
1-Naphthalenesulfonic acid, formaldehyde condensate	DA
*2-Naphthalenesulfonic acid, formaldehyde condensate	AKS, DA, GRD, RH
and salt	
1-Phenol-sulfonic acid-formaldehyde condensate	RH
2-Phenol-sulfonic acid-sulfonated	CGY(E), DA, MIF, UCG
Textile chemicals, synthetic, all other	
<b>*TEXTILE CHEMICALS, OTHER THAN SURFACE-ACTIVE AGENTS:</b>	
Diethyloldihydroxyethylene urea	CHP, DAN
2,2',4,4'-Tetrahydroxybenzophenone	GAP
Tri(phenyloxymethyl)triethoxymethylamine	DUP
Textile chemicals, other than surface active agents, all other	DAN, DUP, GAP, HDJ
<b>UREA, BY END-USE MARKETS:</b>	
Urea, primary solution (Report on 100% urea-content basis)	ACN, ACS, ACY(E), AGY, AIP, APD, ARM, BIC, BOR, CFA, CFI, CHN, CNC, COL, FMS, FRI, GCC, GPI, HKY, HPC, JDC, MSC, OMC, PLC, SAG, SMP, SNI, SOH, TER, TRI, TVA, VLN, WLC, WYC
Urea in feed ccpounds (100% Basis)	ACN, AGY, APD, BIC, FMS, JDC, MSC, SMI, SOH, TER, TRI, VLN, WYC
*Urea in liquid fertilizer (100% Basis)	ACN, AGY, AIP, APD, ARM, BIC, CFA, CFI, CHN, CNC, FRI, GPI, HKY, HPC, JDC, MSC, PLC, SAG, SHP, SNI, SOH, TER, TRI, TVA, VLN, WLC, WYC
*Urea in plastics (100% Basis)	ACS, ACY(E), BOR, FMS, OMC, SOH, TRI
*Urea in solid fertilizer (100% Basis)	ACN, ACS, AGY, APD, BIC, CFA, CFI, COL, FMS, GCC, HPC, JDC, MSC, OMC, SOH, TER, TRI, TVA, VLN, WLC, WYC
Urea liquor	TER
Urea in compounds and mixtures (100% Basis), all other	ACS, SOH, WYC

TABLE 3.--MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS: DIRECTORY OF MANUFACTURERS, 1977

ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of miscellaneous end-use chemicals and chemical products to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
	Allied Chemical Corp.:	FRF	Firestone Tire & Rubber Co., Firestone Synthetic Fibers Co.
ACN	Agricultural Div.	FRI	Farmland Industries, Inc.
ACS	Specialty Chemicals Div.		
ACY	American Cyanamid Co.	GAF	GAF Corp.
AGY	Agway, Inc., Olean Nitrogen Complex	GCC	W. R. Grace & Co.
AIP	Air Products & Chemicals, Inc.	GFS	G. Frederick Smith Chemical Co.
AKS	Arkansas Co., Inc.	GLY	Glyco Chemicals, Inc.
ALC	Alco Chemical Corp.	GPI	Goodpasture, Inc.
ALF	Allied Chemical Corp., Fibers Div.	GRD	W. R. Grace & Co.:
ALL	Alliance Chemical, Inc.	GRH	Polymers & Chemicals Div.
ALX	Alox Corp.	GRY	Hatco Chemical Div.
APD	Atlas Powder Co. Sub. of Tyler Corp.		Goodyear Tire & Rubber Co.
ARM	USS Agri-Chemicals Div. of U.S. Steel Corp.	HDG.	Hodag Chemical Corp.
ASH	Ashland Oil, Inc., Ashland Chemical Co. Div.	HKY	Hawkeye Chemical Co.
		HMP	W. R. Grace & Co., Organic Chemicals Div.
BAX	Baxter/Travenol Laboratories, Inc.	HN	Tenneco Chemicals, Inc.
BOC	Buffalo Color Corp.	HPC	Hercules, Inc.
BFG	B. F. Goodrich Co., B. F. Goodrich Chemical Co. Div.	HST	American Hoechst Corp., Industrial Chemicals Div.
BIC	Baker Industries, Inc.		
BOR	Borden Co., Borden Chemical Div.	ICI	ICI United States, Inc.
BUK	Buckeye Cellulose Corp.		
		JDC	Nipak, Inc.
CCA	Interstab Chemical, Inc.	JFR	George A. Jeffrey's & Co., Inc.
CCW	Cincinnati Milacron Chemicals, Inc.	JOR	Jordan Chemical Co.
CEL	Celanese Corp.:		
	Celanese Fibers Co.	KCU	Kennecott Copper Corp., Utah Copper Div.
	Celanese Polymers Specialties Co.		
CFA	Cooperative Farm Chemicals Association	MCI	Mooney Chemicals, Inc.
CFI	CF Industries, Inc.	MIL	Milliken & Co., Milliken Chemical Div.
CGY	Ciba-Geigy Corp.	MLS	Miles Laboratories, Inc., Marschall Div.
CHH	CHR. Hansen's Laboratory, Inc.	MMC	MC&B Manufacturing Chemists, Inc.
CHN	N-Ren Corp., Cherokee Nitrogen Div.	MON	Monsanto Co.
CHP	C. H. Patrick & Co., Inc.	MOR	Marathon Merco, Co.
CNC	Columbia Nitrogen Corp.	MRK	Merck & Co., Inc.
COL	Collier Carbon & Chemicals Corp.	MSC	Mississippi Chemical Corp.
CRN	CPC International, Inc., Amerchol		
CRT	Crest Chemical Corp.	NTL	NL Industries, Inc.
		OMC	Olin Corp.
DA	Diamond Shamrock Corp.	OMS	E. R. Squibb & Sons, Inc.
DAN	Dan River, Inc., Chemical Products Dept.	ORO	Chevron Chemical Co.
DCC	Dow Corning Corp.		
DLI	Dawe's Laboratories, Inc.	PAR	Pennzoil Co., Penneco Div.
DOL	Castle & Cooke, Inc., Castle & Cooke Foods, Hawaii Region	PAS	Pennwalt Corp.
DOW	Dow Chemical Co.	PCW	Pfister Chemical Inc.
DUP	E. I. duPont de Nemours & Co., Inc.	PEN	CFC International, Inc., Penick Corp.
		PFN	Pfanstiehl Laboratories, Inc.
EK	Eastman Kodak Co.:	PFZ	Pfizer, Inc.
EKT	Tennessee Eastman Co. Div.	PHR	Pharmachem Corp.
ELC	Elco Corp. Sub. of Detrex Chemical Industries, Inc.	PIC	Pierce Chemical, Inc.
ENJ	Exxon Chemical Co. U.S.A.	PLB	P-L Biochemicals, Inc.
ESA	East Shore Chemical Co., Inc.	PLC	Phillips Petroleum Co.
		PMF	Premier Malt Products, Inc.
FER	Ferro Corp., Keil Chemical Div.	PPG	PPG Industries, Inc.
FIN	Hexcel Corp., Hexcel Specialty Chemicals	QCP	Quaker Chemical Corp.
FMP	FMC Corp., Industrial Chemical Group		
FMS	First Mississippi Corp.	RBC	Fike Chemicals, Inc.
FMT	Fairmount Chemical Co., Inc.	RH	Rohm & Haas Co.
FND	Fiber Industries, Inc.	RPC	A Kewanee Industry, Millmaster Onyx Group, Refined-Onyx Co. Div.

TABLE 3.--MISCELLANEOUS END-USE CHEMICALS AND CHEMICAL PRODUCTS: DIRECTORY OF MANUFACTURERS, 1977--CONTINUED

Code	Name of company	Code	Name of company
RSA	R.S.A. Corp.	TER	Terra Chemicals International, Inc.
SAG	Swift Agricultural Chemicals	TNA	Ethyl Corp.
SFA	Stauffer Chemical Co., Agricultural Div.	TRI	Triad Chemicals
SHC	Shell Oil Co., Shell Chemical Co. Div.	TRO	Troy Chemical Corp.
SHP	Shepherd Chemical Co.	TVA	Tennessee Valley Authority
SKP	Shakespeare Co., Monofilament Div.	TX	Texaco, Inc.
SM	Mobil Oil Corp., Chemical Co., Chemical Coatings Div.	UCC	Union Carbide Corp.
SMP	J.R. Simplot Co., Minerals & Chemical Div.	USR	Uniroyal, Inc., Uniroyal Chemical Div.
SNI	Kaiser Aluminum & Chemical Corp., Kaiser Agricultural Chemicals Div.	VLN	Valley Nitrogen Producers, Inc.
SOH	Vistron Corp.	WAY	Phillip A. Hunt Chemical Corp., Organic Chemical Div.
SPD	General Electric Co., Silicone Products Dept.	WBC	Worthington Biochemical Corp.
SPR	Scientific Protein Laboratories, Inc.	WBG	White & Bagley Co.
SW	Sherwin-Williams Co.	WLC	Agrico Chemical Co.
SWS	Stauffer Chemical Co., SWS Silicones Div.	WTC	Witco Chemical Corp.
		WYC	Wycon Chemical Co.

Note.--Complete names and addresses of the above reporting companies are listed in Table I of the Appendix.



## Miscellaneous Cyclic and Acyclic Chemicals

K. James O'Connor, Jr. and Janet Dietzman

The term miscellaneous chemicals as it is used here comprises those synthetic organic products that are not included in the use groups covered by the other sections of this report. They include products that are employed in a great variety of uses. The number of chemicals used extensively for only one purpose is not large. Among the products covered are those used for refrigerants, aerosols, solvents, and a wide range of chemical intermediates.

U.S. production of miscellaneous cyclic and acyclic chemicals in 1977 amounted to 87 billion pounds, an increase of 7.5 percent over 1976. U.S. sales for 1977 totaled 39 billion pounds valued at \$7.9 billion. Compared with 1976, sales quantity increased by 17 percent and sales value increased by 11.7 percent. Production of miscellaneous cyclic chemicals comprised only 2.4 percent of this section's total production.

The group among miscellaneous acyclic chemicals with the greatest volume of production and sales is the halogenated hydrocarbons. U.S. production for this group in 1977 was 23.9 billion pounds, an increase of 15 percent over the previous year. Production increased in all segments of this group except fluorinated hydrocarbons. The production of fluorinated hydrocarbons decreased from 1 million pounds in 1976 to 921,000 pounds in 1977. This segment of the industry is expected to continue its decline because of Federal regulations limiting the use of certain fluorinated hydrocarbons.



TABLE 1.--MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>

[Listed below are all miscellaneous cyclic and acyclic chemicals for which any reported data on production or sales may be published. (Leaders (...) are used where the reported data are accepted in confidence and may not be published or where no data were reported.) Table 2 lists all miscellaneous cyclic and acyclic chemicals for which data on production and/or sales were reported and identifies the manufacturers of each]

MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>2</sup>
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Grand total-----	86,968,069	38,753,311	7,919,082	\$0.20
CYCLIC				
Total-----	2,076,136	1,044,011	663,163	.63
Benzoyl acid, sodium salt-----	13,600	12,348	6,632	.54
Benzoyl peroxide-----	7,048	7,101	16,410	2.31
Benzyl alcohol-----	8,096	5,526	3,982	.72
tert-Butyl peroxybenzoate-----	3,329	3,417	6,303	1.84
Caprolactam-----	867,339	...	...	...
2,6-Di-tert-butyl-p-cresol (BHT):				
Food grade-----	10,777	9,543	8,079	.85
Tech. grade-----	11,942	11,706	9,802	.84
Dioxane (1,4-Diethylene oxide)-----	12,251	5,671	3,902	.69
Hexamethylenetetramine, tech. grade-----	88,171	41,926	12,850	.31
p-Hydroxybenzoic acid, propyl ester-----	230	...	...	...
2-Hydroxy-4-methoxybenzophenone-----	793	704	1,681	2.39
Maleic anhydride-----	293,965	224,116	69,000	.31
α-Pinene-----	93,018	7,376	745	.10
β-Pinene-----	38,658	6,773	1,910	.28
Tall oil salts-----	2,887	2,725	1,810	.66
All other miscellaneous cyclic chemicals-----	624,032	705,079	520,057	.73
ACYCLIC				
Total-----	84,891,933	37,709,300	7,255,919	.19
<i>Nitrogenous Compounds</i>				
Total <sup>3</sup> -----	7,236,831	2,050,792	764,851	.37
Amides-----	297,050	125,605	69,857	.56
Amines, total-----	1,410,088	416,757	225,756	.55
Butylamines, total-----	...	38,963	20,334	.52
n-Butylamine, mono-----	3,977	...	...	...
Di-n-butylamine-----	4,424	3,636	2,169	.60
All other butylamines-----	...	35,327	18,165	.51
Ethylamines:				
Diethylamine-----	14,179	6,964	3,943	.57
Triethylamine-----	13,700	10,983	8,016	.73
Isopropylamine, mono-----	42,632	39,561	14,016	.35
Methylamines:				
Dimethylamine-----	71,815	62,094	19,807	.32
Methylamine, mono-----	53,227	31,353	9,958	.32
Trimethylamine-----	31,705	27,613	8,316	.30
All other-----	1,174,429	199,226	141,366	.75
2-Dimethylaminoethanol (N,N-Dimethylethanolamine)-----	7,008	5,411	4,120	.76
Ethanolamines, total-----	308,409	268,910	93,954	.35
2-Aminoethanol (Monoethanolamine)-----	102,732	89,356	30,037	.34
2,2'-Aminodiethanol (Diethanolamine)-----	100,932	83,773	29,451	.35
2,2',2''-Nitrilotriethanol (Triethanolamine)-----	104,745	95,781	34,466	.36

See footnotes at end of table.

TABLE 1.--MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS: U.S. PRODUCTION  
 AND SALES, 1977<sup>1</sup>--CONTINUED

MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>2</sup>
ACYCLIC--Continued				
<i>Nitrogenous Compounds--Continued</i>				
Hexamethylene diamine adipate (Nylon salt)	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Nitriles, total	876,500	...	...	...
Acetonitrile	...	717,325	156,347	.22
Acrylonitrile	57,840	...	...	...
2-Methylacetonitrile (Acetone cyanohydrin)	1,646,021	526,389	127,869	.24
Nitriles, all other	843,692	...	...	...
	...	190,936	28,478	.15
All other nitrogenous compounds	1,790,223	516,784	214,817	.42
<i>Acids, Acyl Halides, and Anhydrides</i>				
Total	6,590,128	1,480,422	438,051	.30
Acetic acid, 100%	2,570,238	599,990	79,729	.14
Acetic anhydride, 100%	...	138,563	30,618	.22
Acrylic acid	283,358	40,137	12,894	.32
Adipic acid	1,535,500	181,097	61,554	.34
Dodecylsuccinic anhydride	1,342	1,264	868	.69
Fumaric acid	33,971	28,567	11,689	.41
Lauroyl chloride	2,045	...	...	...
Oxalic acid	12,285	12,278	4,899	.40
Polyacrylic acid	1,948	1,821	1,671	.92
Propionic acid	84,020	48,619	8,518	.18
All other acids, acyl halides, and anhydrides	2,065,421	428,086	225,611	.53
<i>Salts of Organic Acids</i>				
Total	401,897	322,087	166,266	.52
Acetic acid salts, total	23,054	20,082	11,258	.56
Barium acetate	99	58	103	1.77
Sodium acetate	18,496	...	...	...
Zinc acetate	415	417	521	1.25
All other	4,044	19,607	10,634	.54
2-Ethylhexanoic acid ( $\alpha$ -Ethylcaproic acid) salts, total	16,281	15,683	19,470	1.24
Calcium 2-ethylhexanoate	1,991	2,003	1,377	.69
Cobalt 2-ethylhexanoate	4,409	3,975	6,582	1.66
Lead 2-ethylhexanoate	1,896	1,899	1,126	.59
Manganese 2-ethylhexanoate	1,401	1,442	1,056	.73
Zinc 2-ethylhexanoate	1,565	1,545	1,285	.83
Zirconium 2-ethylhexanoate	2,660	2,619	3,650	1.39
All other	2,359	2,200	4,394	2.00
Maleic acid salts	1,327	534	1,719	3.22
Stearic acid salts, total <sup>4</sup>	91,579	90,722	57,130	.61
Aluminum distearate	3,005	2,967	2,242	.76
Aluminum tristearate	297	298	229	.77
Barium stearate	795	797	578	.73
Cadmium stearate	48	48	98	2.04
Calcium stearate	50,535	50,980	28,297	.56
Lead stearate	1,444	1,211	904	.75
Magnesium stearate	4,991	4,583	3,141	.56
Zinc stearate	26,680	25,865	18,313	.71
All other	3,782	3,973	3,328	.84
All other salts of organic acids	269,656	195,066	76,689	.39

See footnotes at end of table.



TABLE 1.--MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>--CONTINUED

MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS	PRODUCTION		SALES		UNIT VALUE <sup>2</sup>
	QUANTITY	VALUE	QUANTITY	VALUE	
ACYCLIC--Continued					
<i>Aldehydes</i>	1,000 pounds	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Total	8,904,565	3,147,460	204,397		.06
Butyraldehyde	791,942	42,948	7,821		.18
Formaldehyde (37% by weight)	6,046,497	2,789,782	127,517		.05
Isobutyraldehyde	382,853	4,953	670		.14
All other	1,633,273	309,777	68,389		.22
<i>Ketones</i>					
Total	3,335,042	2,450,700	403,060		.16
Acetone, total	2,218,619	1,556,443	211,240		.14
From cumene	1,323,751	1,117,867	147,837		.13
From isopropyl alcohol	894,868	438,576	63,403		.14
2-Butanone (Methyl ethyl ketone)	511,581	509,463	95,293		.19
4-Hydroxy-4-methyl-2-pentanone (Diacetone alcohol)	...	46,750	12,688		.27
4-Methyl-2-pentanone (Methyl isobutyl ketone)	241,455	165,043	41,882		.25
4-Methyl-3-penten-2-one (Mesityl oxide)	37,639	22,372	5,851		.26
All other	325,748	150,629	36,106		.24
<i>Alcohols, Monohydric, Unsubstituted</i>					
Total	14,374,044	8,639,319	1,030,250		.12
Alcohols, C <sub>11</sub> or lower, unmixed, total	13,371,423	...	...		...
<i>Butyl alcohols:</i>					
n-Butyl alcohol (n-Propylcarbinol)	840,488	420,425	72,940		.17
Isobutyl alcohol (Isopropylcarbinol)	173,319	130,014	17,250		.13
Ethyl alcohol, synthetic <sup>5</sup>	1,338,635	942,972	170,860		.18
2-Ethyl-1-hexanol	492,589	339,429	70,468		.21
n-Hexyl alcohol	41,431	24,719	5,743		.23
Isopropyl alcohol	1,888,413	1,281,993	162,165		.13
Methanol, synthetic	6,452,741	3,630,385	210,111		.06
Propyl alcohol (Propanol)	111,067	86,929	20,643		.24
All other	2,032,740	...	...		...
Alcohols, C <sub>12</sub> and higher, unmixed	380,661	...	...		...
All other unmixed monohydric alcohols	...	1,364,300	167,823		.12
Mixtures of alcohols	580,529	418,153	132,247		.32
<i>Esters of Monohydric Alcohols</i>					
Total	3,916,779	2,108,331	588,550		.28
n-Butyl acetate, unmixed	114,291	109,797	27,090		.25
Butyl acrylate	260,067	125,852	44,078		.35
Dibutyl maleate	4,826	5,273	1,978		.38
Di(2-ethyl-1-hexyl) maleate	779	...	...		...
Dilauryl-3,3'-thiodipropionate	2,100	2,093	2,548		1.22
Ethyl acetate (85%)	217,846	220,225	38,302		.17
Ethyl acrylate	260,187	128,118	36,318		.28
2-Ethyl-1-hexyl acrylate	47,430	48,337	19,102		.40
<i>Fatty Acid Esters, not included with plasticizers or surface-active agents</i>					
Isobutyl acetate	25,570	25,890	13,487		.52
Methyl acetate	...	42,734	10,262		.24
Methyl methacrylate	4,466	...	...		...
Phosphorus acid esters, not elsewhere specified	744,950	194,969	72,055		.37
Propyl acetate	54,830	45,087	36,030		.80
Vinyl acetate	49,411	44,654	11,376		.25
All other	1,585,745	789,442	140,333		.18
	544,281	325,860	135,591		.42

See footnotes at end of table.

TABLE 1.--MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS: U.S. PRODUCTION  
 AND SALES, 1977<sup>1</sup>--CONTINUED

MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS	Production	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>2</sup>
ACYCLIC--Continued				
<i>Polyhydric Alcohols<sup>5</sup></i>				
Total-----	4,993,181	4,016,911	918,946	.23
Ethylene glycol-----	3,675,461	2,958,366	556,557	.19
Glycerol, synthetic only-----	140,631	131,768	62,726	.48
Pentaerythritol-----	114,114	107,341	47,036	.44
Propylene glycol-----	489,064	487,152	121,146	.25
Sorbitol (70% by weight)-----	196,036	163,507	54,343	.33
All other-----	377,875	168,777	77,138	.46
<i>Polyhydric Alcohol Esters</i>				
Total-----	345,531	120,902	58,536	.48
Trimethylolpropane triacrylate-----	1,067	...	...	...
All other-----	344,464	120,902	58,536	.48
<i>Polyhydric Alcohol Ethers</i>				
Total-----	1,764,468	1,304,165	385,770	.30
2-Butoxyethanol-----	170,165	148,805	44,017	.30
2-(2-Butoxyethoxy)ethanol (Diethylene glycol monobutyl ether)-----	34,485	25,413	7,965	.31
2-[2-(2-Butoxyethoxy)ethoxy]ethanol (Triethylene glycol, monobutyl ether)-----	7,457	...	...	...
Diethylene glycol-----	327,158	244,867	41,198	.17
Dipropylene glycol-----	54,266	50,602	12,090	.24
2-Ethoxyethanol-----	232,928	116,725	29,815	.26
2-(2-Ethoxyethoxy)ethanol (Diethylene glycol monoethyl ether)-----	36,352	32,143	8,493	.26
2-[2-(2-Ethoxyethoxy)ethoxy]ethanol (Triethylene glycol monoethyl ether)-----	19,383	...	...	...
2-Methoxyethanol (Ethylene glycol monomethyl ether)-----	113,024	96,579	25,755	.27
2-(2-Methoxyethoxy)ethanol (Diethylene glycol monomethyl ether)-----	17,335	12,648	3,636	.29
2-[2-(2-Methoxyethoxy)ethoxy]ethanol (Triethylene glycol monomethyl ether)-----	24,613	9,208	3,269	.35
Polyethylene glycol-----	109,728	81,041	30,517	.38
Polypropylene glycol-----	30,394	24,388	9,060	.37
Propylene glycol, mixed ethers-----	27,674	...	...	...
Tetraethylene glycol-----	...	16,583	6,096	.37
Triethylene glycol-----	129,622	101,237	29,521	.29
All other-----	429,884	343,926	134,338	.39
<i>Halogenated Hydrocarbons</i>				
Total-----	23,901,524	9,743,606	1,579,750	.16
<i>Brominated hydrocarbons</i>				
Total-----	83,453	...	...	...
<i>Chlorinated hydrocarbons, total</i>				
Carbon tetrachloride-----	22,897,188	8,879,757	1,165,373	.13
Chlorinated paraffins, total-----	809,063	385,491	49,078	.13
35%-64% chloride-----	...	81,502	23,127	.28
Other-----	71,777	70,926	18,755	.26
Chloroethane (Ethyl chloride)-----	...	10,576	4,372	.41
Chloroform-----	612,481	295,717	40,807	.14
Chloromethane (Methyl chloride)-----	301,526	285,114	49,387	.17
1,2-Dichloroethane (Ethylene dichloride)-----	475,975	195,933	26,868	.14
Dichloromethane (Methylene chloride)-----	10,996,772	1,525,984	123,107	.08
1,2-Dichloropropane (Propylene dichloride)-----	477,856	475,118	87,494	.18
Tetrachloroethylene (Perchloroethylene)-----	58,529	...	...	...
Total-----	614,126	526,993	62,994	.12

See footnote at end of table.

TABLE 1.--MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS: U.S. PRODUCTION AND SALES, 1977<sup>1</sup>--CONTINUED

MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE <sup>2</sup>
ACYCLIC--Continued				
Halogenated Hydrocarbons--Continued	1,000	1,000	1,000	Per
	pounds	pounds	dollars	pound
Chlorinated hydrocarbons, total--Continued:				
1,1,1-Trichloroethane (Methyl chloroform)-----	634,844	560,070	114,428	.20
Trichloroethylene-----	297,503	295,386	47,094	.16
Vinyl chloride, monomer (Chloroethylene)-----	5,985,912	4,127,058	507,545	.12
All other chlorinated hydrocarbons-----	1,560,824	125,391	33,444	.27
Fluorinated hydrocarbons, total-----	920,825	...	...	...
Chlorodifluoromethane (F-22)-----	179,368	128,676	88,123	.68
Dichlorodifluoromethane (F-12)-----	358,281	339,559	135,923	.40
Tetrafluoroethylene, monomer-----	24,990	...	...	...
Trichlorofluoromethane (F-11)-----	212,556	197,211	66,907	.34
All other fluorinated hydrocarbons-----	145,630	...	...	...
Iodinated hydrocarbons-----	58	...	...	...
All other halogenated hydrocarbons-----	...	198,403	123,424	.62
All Other Miscellaneous Acyclic Chemicals				
Total-----	9,127,943	2,324,605	717,492	.31
2-Butanone peroxide-----	8,236	8,386	9,911	1.18
tert-Butyl peroxide (Di-tert-butyl peroxide)-----	2,830	2,728	2,669	.98
Carbon disulfide-----	504,528	389,963	31,164	.08
Epoxides, ethers, and acetals, total-----	6,664,811	1,611,567	369,352	.23
Ethylene oxide-----	4,364,070	548,640	129,049	.24
Ethyl ether, absolute-----	8,141	...	...	...
Propylene oxide-----	1,865,838	...	...	...
All other epoxides, ethers, and acetals-----	426,762	1,062,927	240,303	.23
Hydrocarbons-----	...	4,693	2,720	.58
Phosgene (Carbonyl chloride)-----	665,993	...	...	...
Silicone fluids-----	142,408	68,797	114,687	1.67
Sodium methoxide (Sodium methylate)-----	9,982	15,323	4,775	.31
All other-----	1,129,155	223,148	182,214	.81

<sup>1</sup> Certain data have been revised for 1976. These revisions are summarized below:

MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS	PRODUCTION	SALES		
		QUANTITY	VALUE	UNIT VALUE
	1,000	1,000	1,000	Per
	pounds	pounds	dollars	pound
Grand Total-----	80,891,931	33,109,792	7,087,731	.21
Miscellaneous chemicals, cyclic, total-----	2,214,054	1,019,104	635,006	.62
All other miscellaneous chemicals, cyclic-----	1,026,402	751,087	514,005	.68
Miscellaneous chemicals, acyclic, total-----	78,677,877	32,090,688	6,452,725	.20
Nitrogenous compounds, total-----	6,561,675	1,904,620	742,255	.39
Amines, total-----	1,317,039	415,658	227,511	.55
Amioes, all other-----	327,433	283,490	174,833	.62
Nitrogenous compounds, all other-----	760,188	424,383	190,114	.45

<sup>2</sup> Calculated from rounded figures.

<sup>3</sup> Statistics exclude production and sales of fatty amines. Statistics on fatty amines are given with "Surface-Active Agents."

<sup>4</sup> Statistics exclude production and sales of potassium and sodium stearates. Statistics on these stearates are included with "Surface-Active Agents."

<sup>5</sup> Statistics on production of ethyl alcohol from natural sources by fermentation are issued by the Department of the Treasury, Bureau of Alcohol, Tobacco, and Firearms.

<sup>6</sup> Some polyols which are used as intermediates for urethanes have been included with "Plastics and Resin Materials."

TABLE 2.-- MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977

[CHEMICALS FOR WHICH SEPARATE STATISTICS ARE GIVEN IN TABLE 1 ARE MARKED BELOW WITH AN ASTERISK (\*); CHEMICALS NOT SO MARKED DO NOT APPEAR IN TABLE 1 BECAUSE THE REPORTED DATA ARE ACCEPTED IN CONFIDENCE AND MAY NOT BE PUBLISHED. MANUFACTURERS' IDENTIFICATION CODES SHOWN BELOW ARE TAKEN FROM TABLE 3. AN "X" SIGNIFIES THAT THE MANUFACTURER DID NOT CONSENT TO HIS IDENTIFICATION WITH THE DESIGNATED PRODUCT. COMPANY IDENTIFICATION CODES WHICH ARE FOLLOWED BY AN "(E)" ARE SO LABELED BECAUSE THE COMPANY FAILED TO SUPPLY THE U.S. INTERNATIONAL TRADE COMMISSION WITH THEIR DATA IN SUFFICIENT TIME FOR ITS INCLUSION IN THIS REPORT. THE COMPANY IS PRESUMED TO HAVE CONTINUED PRODUCTION OF THE COMPOUND IN QUESTION IN 1977 AND THE VOLUME OF PRODUCTION AND SALES HAS BEEN ESTIMATED BY THE USITC STAFF MEMBERS.]

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
6-Acetoxy-2,4-dimethyl-1,3-dioxane	
Acetylcyclohexene sulfonyl peroxide	: GIV.
4-(3-Aminopropyl) morpholine	: WIL.
BENZIC ACID SALTS:	: JCC.
* Sodium benzoate	: HN, MON, PFZ.
* Benzoic acid salts, all other	: SYP(E).
* Benzothiazole (P-Duiron)	: EKT.
* Benzothiazole, substituted	: ACY, RCI.
* Benzoyl peroxide	: AZT, CAD, NOC, WTC, WIL.
* Benzyl alcohol	: MWR, SFS, UOP, VEL.
Bis(2,4-dichlorobenzoyl) peroxide	: CAD, WTL.
Bis(4,4-dimethylbenzyl)peroxide	: ABC, WTL.
2,4-Bis(4-hydroxy-3,5-di-tert-butylphenoxy)-6-(n-octylthio)-1,3,5-triazine	: CGY(E).
2,4-Bis(n-octylthio)-6-(4'-hydroxy-3',5'-di-tert-butylamino)-1,3,5-triazine	: CGY(E).
Boron fluoride-phenol complex	: ACS.
N-Bromosuccinimide (Succinobromide)	: ARA.
Butyl benzoate	: PFZ, TCC, VEL.
2-(and 3)-tert-Butyl-4-methoxyphenol (BHA)	: EKT, X.
*tert-Butyl peroxybenzoate	: AZT, CAD, NOC, WTC, WIL.
4-tert-Butylpyrocatechol	: BKL, DOM.

C Y C L I C

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
C Y C L I C--Continued	
Camphene	HPC, NCI, SCM.
*Caproactam (2-Oxohexamethylenimine)	ALP, CNP, DBC.
Cellulose acetate phthalate	EK, UCC.
1-(3-Chloroallyl)-3,5,7-triaza-1-azoniaadamantane chloride	DOM.
Camene hydroperoxide	ACS, CLK, RCI.
Cyanuric acid	FHB.
Cyclohexanone peroxide	NCC.
1,4-Cyclohexylenedimethanol	EKT.
Cyclopropane	OB.
Decarobiphenyl ether	DOM, FIN, WCC.
Decahydronaphthalene (Decalin)	DUP.
Dehydroacetic acid or sodium salt	EKT, GAN.
Diazodinitrophenol	HPC.
*2,3-Dibenzoyl peroxy-2,4,5-dimethylhexane	WTC, WTL.
*2,4-Di-tert-butyl-p-ctesol, (BHT), food grade	ASH, KFT, SHC, USR.
*2,5-Di-tert-butyl-p-ctesol, (BHT), technical grade	ASH, KFT, SHC, USR.
1,3-Bis(2-cyanoethyl)acetoin	EKT.
Dichloro-ortho-triazine-2,4,6-tris(1H,5H)trione (Dichloro isocyanuric acids and salts)	GLP.
4,4-Dichloro-3-(trifluoromethyl)carbamide	PMB.
Dicyclohexylammonium nitrite	CGV.
2,5-Dihydrokithophene-1,1-dioxide (Sulfolene)	OMC.
2,2-Dihydroxy-4,4-dimethoxybenzophenone	GAN, ELC, WTC.
3,5-Dihydroxy-3,5-dimethyl-1,2-peroxy-cyclopentane	WTL.
2,2-Dihydroxy-4-methoxybenzophenone	ACV.
Difodromethyl-p-tolylalphone	ABA.
Diacetone	HPC.
Diketene	EKT.
p-Dimethoxybenzene (Dimethyl ether of hydroquinone)	ASL, EKT.
4,4-Dinitrocarbanilide-4,6-dimethyl-2-pyrimidinol-phosphate	MRK.
Di-n-octadecyl-3,5-di-tert-butyl-4-hydroxyphenyl phosphate	CGY(E).
*Dioxane (1,4-Diethylene oxide)	CMW, DOM, FER, UCC.
1,3-Dioxolane	FER.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
4-(Dodecyloxy)-2-hydroxybenzophenone	DUP, EXT.
1,2-Epoxy-3-phenoxypropane (glycidyl phenyl ether)	X.
Ethyl cellulose pthalate	EK.
Ethyleneimine, monomer	DOM.
2-Ethylhexyl benzoate	TCC.
Ethylidene norbornene	CCC, X.
FD&A DERIVATIVES:	
2-Furaldehyde (Furfural)	OKO.
Tetrahydrofurfuryl alcohol	WKC.
Gallic acid, tech.	VAL.
Hexamethylphosphoramide, tech.	BBB.
Hydroquinone	BBB, HKD, HMP, HN, PLS, WCL.
Hexamethylphosphoramide, tech.	HEX, PIC.
Hydroquinone	HN.
p-Cresylic acid, butyl ester	HN, LEM.
p-Cresylic acid, ethyl ester	HN.
p-Hydroxybenzoic acid, methyl ester	ABS, HN, LEM.
p-Hydroxybenzoic acid, propyl ester	ABS, HN, LEM.
2-Hydroxy-4-methoxybenzophenone	ACY, GAP, GLY.
2-Hydroxy-4-methoxy-5-sulfolobenzophenone trihydrate	ACY.
2-(2-Hydroxy-5-tert-octylphenyl)benzotriazole	ACY.
Isopropyl o-cresols	UCC.
LACTONES:	
Butyrolactone	GAF.
Glucono- $\delta$ -lactone	PFZ.
Maleic anhydride	ACC, ASH, DKA, HN, KPT, MON, PTT, RCI, USS.
p-Heptane	HPC.
8- <i>n</i> -Nenthyl hydroperoxide	HPC.
p-Methoxybenzylidene malonic acid, diethyl and dimethyl esters	ACY.
p-Methoxybenzylidene malonic acid, dimethyl ester	ACY.
4-Methoxyphenol	ASH, EXT.
2,2'-Methylenebis[4-chlorophenol] (Dichlorophene)	GIV.
2,2'-Methylenebis[3,4,6-trichlorophenol] (Hexachloro phenol)	GIV.
4-Methylmorpholine	JCC, UCC.

C Y C L I O--Continued

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
1-Methyl-2-pyrrolidone, monomer	GAF.
Morpholine	DOM, JCC.
Morpholine salt of p-toluene sulfonic acid	AMB, ASH.
Octadecyl-3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate	CGY(E).
Phenothiazine	WAG.
2-Phenoxyethanol (Ethylene glycol monophenyl ether)	DOM, TCH.
2-(2-Phenoxyethoxy)ethanol (Diethylene glycol phenyl ether)	DOM.
Phthalic acid, lead salt (dibasic)	NZL.
Picraic acid, sodium salt	SDC.
*p-Pinene	ARZ, CBY, MCI, SCM.
Pinene	ABZ, CBY, HPC, MCI, SCM.
Pinene, wood	HPC.
Piperazine, ethoxylated	HPC.
Poly-4-(2-acryloxyethoxy)-2-hydroxybenzophenone	GAB.
Propyl gallate	ACY.
Besorcinol monobenzoate	EXT.
ROSIAC ACID SALTS:	EXT.
Calcium resinate	CBV.
Calcium zinc resinate	CBV.
Salicylic acid, lead salt	WTI.
Styrene oxide	UCC.
Succinic anhydride	ACS, OBO.
Tall oil, chemically modified	FOC, X.
TALL OIL SALTS (LIMOLEIC-ROSIAC ACID SALTS):	
Calcium manganese tallate	MCI.
Calcium tallate	CCA, HN, MCI, X.
Cobalt tallate	CCA, HN, MCI, SHP.
Lead manganese tallate	MCI.
Lead tallate	HN, MCI.
Manganese tallate	HN, MCI, SHP.
Tri(oxyaluminum tallate)	KCH.
Zinc tallate	MCI.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
*TALL OIL SALTS (LINOLEIC-ROSIIN ACID SALTS)--Continued	
Tall oil salts, all other (Linoleic-rosin acid salts) - - - - -	MCI, ZGL.
Terpine hydrocarbons, monocyclic (Solvenol)- - - - -	MCI,
tetrabromobiphenol A - - - - -	GTI,
2,3,5,6-tetrachloro-4-(methylsulfonyl) pyridine - - - - -	DOM,
1,2,3,4-tetrahydronaphthalene (tertralin) - - - - -	DUF,
tetrayldithiophene - - - - -	PAS,
tetraylthiophene-1,1-dioxide (Sulfolane) - - - - -	PLC,
[2,2',3'-thiobis(4-octylphenolate)]-n-butylamine nickel - - - - -	
thioblene - - - - -	ACY,
thiobutene - - - - -	PAS,
thiobutyl cyanurate - - - - -	ACI,
3,4,4'-trichlorocarbanilide - - - - -	MON,
1,3,5-Trichloro-s-triazine-2,4,6-(1H,3H,5H)trione (Trichloroisocyanuric acid) - - - - -	MON,
1,2,3-Triketohydrindene hydrate - - - - -	PIC,
3,5,5-Trimethyl-2-cyclohexene-1-one (Isophorone) - - - - -	ENJ,
2,4,6-Trinitroresorcinol and lead derivative - - - - -	REM,
Triphenyl phosphite - - - - -	MON,
1-Vinyl-2-pyrrolidinone--other copolymers - - - - -	GAF,
1-Vinyl-2-pyrrolidinone ethylacrylate, copolymer - - - - -	GAF,
1-Vinyl-2-pyrrolidinone-methylacrylic acid, dimethyl amine ethyl ester, copolymer - - - - -	GAF,
1-Vinyl-2-pyrrolidinone, monomer - - - - -	GAF, TKI,
1-Vinyl-2-pyrrolidinone--vinyl acetate copolymer - - - - -	GAF, UCC,
Cyclic chemicals, all other - - - - -	AAC, AIP, ALB, AMB, ARA, ARS, AZT, CAP, CGY(E), CMT, CTN, DOM, EK, EKT, EVN, FIN, GAF, GIV, GLY, GOC, HMY, HPC, JCC, KCU, MON, PAS, PD, PFN, PIC, SCM, SAL, SH, STC, SH, SYP(E), TNA, TNI, UCC, URJ, VEL, VIK, VTC, WAY, WCC, WTC, WTL, X, X.
A C Y C L I C	
*MITOGENOUS COMPOUNDS:	
Acetamidooethanol (N-Acetyl-ethanolamine) - - - - -	SBC,
B-Alanine - - - - -	HFT,
Di-Allyl-3-(2-hydroxyethyl)-2-thiourea - - - - -	PMT,



TABLE 2.---MISCELLANEOUS CHEMICALS FOR WHICH U. S. PRODUCTION AND JOB SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
NITROGENOUS COMPOUNDS--Continued	
*AMIDES:	
Acetamide	ACS, X.
Acrylamide monomer	ACY, X.
1,1'-Azobisformamide	FMT, NPI, USR.
N-Bromosuccinimide	ARA.
Chloro-N-(2-hydroxyethyl)acetamide	KF.
Coconut oil amide	ARC, HUM.
N,N-Diethyldecylamide	EK, X.
N,N-Diethylacetamide	DUP.
3-Dimethylformamide	AIP, DUP.
Erucamide	FIN, HUM.
Erucamide - lauramide	FIN.
N,N'-Ethylenebis-oleamide (Cis:ic acid-ethylene di- amine condensate (Amine/acid ratio = 1/2))	ARC.
N,N'-Ethylenebis(stearamide)	CCM.
Fish oil fatty acid amide	HUM.
Formamide	DUP.
12-Hydroxystearamide	CCM.
Methacrylamide	DUP.
N-Methylacetamide	ARS.
N,N'-Methylenebis(acrylamide)	ACY, FIN, GLY, HUM.
Oleamide (Octadecene amide)	FIN.
Oleoylpalmitamide	ARC, FIN, GLY, HUM.
Stearamide (Octadecane amide)	ARC, FIN, GLY, HUM.
Stearylsuccinimide	FIN.
Tallow amide, hydrogenated	ARC.
*AMIDES, all other	ARS, EKT, FIN, HAL, KP, TKL, VGC.
Allylamines	SHC.
Bis-hexamethylenetetraamine	DUP.
*BUTYLAMINES:	
n-Butylamine, mono	AIP, PAS, VGC.
sec-Butylamine, mono	PAS, VGC.
tert-Butylamine, mono	HOM.
*DI-N-BUTYLAMINE	AIP, PAS, VGC.
Di-n-butylamine	AIP, VGC.
Tri-n-butylamine	PAS, VGC.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
NITROGENOUS COMPOUNDS--Continued	
AMINES--Continued	
BUTYLAMINES--Continued	
n-Butylethylamine	PAS.
Diethylenetriamine	DOM, UCC.
N,N'-Diethyl-1,4-pentanediamine (Novoldiamine)	MOR.
Diisopropylamine	PAS, UCC.
Dimethylaminopropylamine	JCC.
1,3-Dimethylbutylamine	VGC.
ETHYLAMINES:	
*Diethylamine	AIP, PAS, UCC, VGC.
Ethylamine, mono-	AIP, PAS, UCC, VGC.
*Triethylamine	AIP, PAS, UCC, VGC.
Hexylenediamine	DOM, JCC, UCC.
(2-Ethylhexyl)amine, mono-	VGC.
1,6-Hexanediamine (Hexamethylenediamine)	CEL, DUP, ELE, NON.
n-Hexylamine	PAS.
3,3'-Iminodispropylamine	JCC.
*Isopropylamine, mono	AIP, PAS, UCC, VGC.
HEXILAMINES:	
*Dimethylamine	AIP, DUP, GAF, IMC.
*Diethylamine sulfate	GLD, RH.
*Triethylamine, mono-	GLD, RH, GAF, IMC.
*Triethylamine	AIP, DUP, GAF, IMC.
n-Octylamine	VGC.
Pentamethylenediamine	UCC.
PENTYLAMINES (ARYLAMINES):	
Diethylamine	PAS.
Pentylamine, mono-	PAS.
1,2-Propanediamine (Propylenediamine)	VGC.
1,3-Propanediamine (1,3-Diaminopropane)	JCC.
Triethylamine	PAS.
PROPYLAMINES:	
Dipropylamine	AIP, VGC.
Propylamine, mono-	PAS, VGC.
Tripropylamine	PAS, VGC.
Tetraethylenepentamine	DCW, DCC.
N,N,N',N'-tetraethyl-1,3-butanediamine	UCC.
Tetramethylethylenediamine	RH.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
NITROGENOUS COMPOUNDS--Continued	
AMINES--Continued	
Triethylenetetramine	DOH, UCC.
Amines, all other--	AAC, ABB, BAS, EK, JCC, ONX, PAS, RH, UCC, USR, VCC, VGC, WAI, X.
MISCELLANEOUS CHEMICALS	
2-Amino-1-butanol	DOH, HDG, UCC.
2-Aminoethanol (Monoethanol amine) sulfite	IMC.
Aminoethoxyethanol	EVN.
2-(2-Aminoethylamino)ethanol (Aminoethylethanol amine)	JCC.
2-Aminoethyl mercaptoacetate (Monoethanolamine thio glycolate)	DOH, HDG, UCC.
2-Amino-2-ethyl-1,3-propanediol	EVN.
2-Amino-2-(hydroxymethyl)-1,3-propanediol [Tris (hydroxymethyl)aminomethane]	IMC.
2-Amino-2-methyl-1,3-propanediol	IMC.
2-Amino-2-methyl-1,3-propanediol condensate	IMC.
2-Amino-2-methyl-1-propanol	IMC.
2-Amino-2-methyl-1-propanol hydrochloride	VAL.
1,3-Bis(hydroxymethyl)urea (Dimethylolurea)	GLY.
Ureol (Carbonyl urea)	DOH.
Butyl-3-ethyl-2-thiouraa	PAS.
Socyanate	UPJ, X.
Chloroform	ACV.
2-Chloro-N,N-diethylethylamine hydrochloride	HEX, VEL.
2-Chloro-N,N-diethylmethylethylamine (Diethylamino ethyl carbodiimide hydrochloride)	HEX, VEL.
2-Chloro-N,N-diethylpropylamine hydrochloride	VEL.
3-Chloro-N,N-diethylpropylamine hydrochloride	VEL.
Choline base	RH.
Cyanoacetic acid	KF.
2-Dibutylaminoethanol	PAS.
1,3-Dibutyl-3-thiourea	PAS, REC.
1,4-Dicyanobutene	DUP.
2-Diethylaminoethanol (N,N-Diethylethanolamine)	PAS, UCC.
2-Diethylaminoethyl acrylate	CPS.
2-Diethylaminoethyl methacrylate	CPS, DUP, UCC.
Diethylhydroxylamine	PAS.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
MITROGENOUS--Continued	
1,3-Diethyl-2-thiourea	PAS, RBC.
2-Diisopropylaminoethanol (N,N-Diisopropylethanolamine)	PAS, UCC.
2-Diisopropylaminoethyl methacrylate	X.
Di-(methoxyethyl)hydroxylamine	X.
2-Dimethylaminoethanol hydrochloride	EVN.
*2-Dimethylaminoethanol (N,N-Dimethylethanolamine)	JCC, PAS, UCC.
Dimethylaminoethyl methacrylate	AAQ, CPS.
Dimethylaminoethylmethacrylate, methyl chloride, quaternary salt	ARC.
Dimethylamino-2-propanol	PAS.
1,1-Dimethylhydrazine	USR.
Dimethyl isocyanate	GNM.
2,5-Dithiobiurea	FMI.
Dithiooxamide	RBC.
*ETHANOLAMINES:	
*2,2'-Aminodiethanol (Diethanolamine)	DOH, JCC, OMC, UCC.
*2-Aminoethanol (Monoethanolamine)	DOM, SLL, JCC, OMC, UCC.
*2,2',2''-Nitrioltriethanol (Triethanolamine)	DOM, JCC, OMC, UCC.
2-Ethylaminoethanol (Ethylaminoethanolamine)	PA5, UCC.
Ethyl cyanoacetate	ARC.
Ethyl cyanoglycine	SDM.
5-(N-Ethyl-N-isopropylamino)-2-pentanone	WV, UCC.
Creosolacetaldehyde hydrochloride	WV.
Crystalline ethanocetic acid chloride	SPS.
Crystalline ethanocetic acid, non-medical	CHT.
*Hexamethylenediamine adipate (Nylon salt)	CEL, DUP, MON.
2-(Hydroxymethyl)-2-nitro-1,3-propanediol (Tris(hydroxymethyl)nitromethane)	IMC.
ISOPROPANOLAMINES:	
1-Amino-2-propanol (Monoisopropanolamine)	DOM.
1,1'-Iainodi-2-propanol (Diisopropanolamine)	DCN.
1,1',1''-Nitrioltri-2-propanol (Triisopropanolamine)	DOM.
2-Isopropylaminoethanol	PAS.
Isopropyl ethylthiocarbamate	DCN.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
NITROGENOUS COMPOUNDS--Continued	
3-Ketimine, tetrafunctional	SNM, BEL.
3-Methoxypropylamine	SCC.
2-Methylaminoethanol (N-Methylethanolamine)	PAS, UCC.
Methyl carbamate	BK, UCC.
Methyl cyanoacetate	KP.
Methyl $\alpha$ -cyanoacrylate	EKT.
2,2'-(Methylbisino)diethanol (Methyldiethanolamine)	PAS, UCC.
Methyl isocyanate	UCC.
2-Methyl-2-nitro-1-propanol	IMC.
N-Methyltaurine	GAP.
Nitrated lard oil	SM.
*NITRILES:	
*Acetonitrile	DUP, EKK, MON, SOH.
*Acrylonitrile, monomer	ACY, DUP, MON, SOH.
Adiponitrile	DUP, ELP, MON.
n-Butyronitrile	EKK, WVT.
Coconitrile	ASH.
Crotonitrile	BBC.
3-Dimethylaminopropionitrile	ACY.
3-Ethoxypropionitrile	DIX.
Glycolonitrile	KP.
Hydracrylonitrile (Ethylene cyanohydrin)	TKI.
Isobutyronitrile	AIP, EKK.
Lactonitrile	MON.
Malonitrile	ASH.
Methacrylonitrile	DOW.
*2-Methylacetonitrile (Acetone cyanohydrin)	DUP, MON, RH.
Oleonitrile (Octadecene nitrile)	ARC.
Stearonitrile (Octadecane nitrile)	ASH.
Tall oil nitrile	ASH.
Tallow nitrile	ASH.
Tallow nitrile, hydrogenated	ASH.
3,3-Diiodopropionitrile	EVN.
Vinylacetonitrile	BBC.

A C Y C L I C--Continued

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
NITROGENOUS COMPOUNDS--Continued	
NITRILES--Continued	
Nitriles, all other--	ARA, ASH, HMP, KP.
Nitroethane--	IMC.
Nitromethane--	IMC.
1-Nitropropane--	IMC.
2-Nitropropane--	IMC.
Octadecyl isocyanate--	UFG.
Pentaerythritol tetranitrate--	DUP, RPC.
n-Propyl carbamate--	BKI.
Propylisocyanate--	RPC.
Sarcosine (N-Methylaminoacetic acid)--	CGY, HMP.
Semicarbazide hydrochloride--	PMI.
N,N',N''-trakis(2-hydroxypropyl)ethylenediamine	BSA.
Tetramethylammonium bromide--	RSA.
Tetramethylammonium chloride--	RSA.
Tetramethylguanidine--	ACT.
Thiosemicarbazide--	ACT, FMT.
Nitrogenous compounds, acyclic, all other--	AAA, ACS, ARA, BME(E), CHP, CFS, DAN, DOM, DHP, EK, EKT, EVN, GOC, HCP, HMP, IMC, JCC, MON, PAS, PCW, PD, PEZ, PIC, RSC, REN, RH, RSA, S, SBC, SCP, SK, STC, TKL, TWA, USE, VAL, VEL, WAY, WYC, X, Y, X.
*ACIDS, ACID ANHYDRIDES, AND ACYL HALIDES:	
*ACETIC ACID, 100%:	
Acetic acid, synthetic (100%)-	BOR, CEL, EKT, FMP, MON, UCC.
*ACETIC ANHYDRIDE, 100%:	
Acetic anhydride from acetaldehyde (100%)-	EKT.
Acetic anhydride from acetic acid, other than recovered, by the vapor-phase process (100%)-	CEL, ICC.
*Adipic acid--	CEL, DBC, UCC.
*Azelaic acid--	ALK, CEL, DUF, ELP, X.
Bromobutyric acid--	EMR.
α-Bromosuccinic and stearic acids--	DIB.
tert-Butylperoxy maleic acid--	DUF.
	WIC, WTL.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
ACIDS, ACID ANHYDRIDES, AND ACYL HALIDES--Continued	
Butyric acid	: CEL, EKT.
Butyric anhydride	: EKT.
Butyryl chloride	: MCC.
Castor oil fatty acids, dehydrated	: MTL
Chloroacetic acid, mono-	: BHK, DOM, PFZ.
Chloroacetyl chloride	: DOM.
Citric acid	: MLS, PFZ.
Crotonic acid (2-Butenoic acid)	: EKT.
Decanoyl chloride	: WTL
2,2-Dichloropropionic acid	: DOM.
Dimer acid (C-36 Aliphatic dibasic acid)	: EHR.
Di-n-propylacetic acid	: ARA.
Di-n-propylacetyl chloride	: ARA.
Dithiodipropionic acid	: EYN.
Dodecanedioic acid	: DUP.
*Dodecylsuccinic anhydride	: ACS, BCC, DIK, HMY.
Dodecylsuccinic anhydride	: HN.
2-Ethylbutyric acid (Diethylacetic acid)	: UCC.
2-Ethylhexanoic acid ( $\alpha$ -Ethylcaproic acid)	: EMT, UCC.
2-Ethylhexanoyl chloride	: AZI, CAD, WTL.
Formic acid, 90%	: HZA, UCC.
*Fumaric acid	: HZA, BON, PFZ, USS.
Gluconic acid, technical	: PFZ.
Glutaric anhydride	: UCC.
Glycolic acid (Hydroxyacetic acid)	: DUP.
n-Hexadecylsuccinic anhydride	: HMY.
Isethionic acid (2-Hydroxyethanesulfonic acid)	: GAF, WTC.
Isoascorbic acid (Erythorbic acid)	: PFZ.
Isobutyric acid	: EKT.
Isobutyric anhydride	: EKT.
Isocadodecylsuccinic anhydride	: HMY.
Isocadodecylsuccinic acid	: PFZ.
LACTIC ACID:	
Lactic acid, edible, 100%	: CLN, MON.
Lactic acid, technical, 100%	: MON.
*Lauroyl chloride	: GAF, ONX, UOP, MCC, WTL.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE J)
ACIDS, ACID ANHYDRIDES, AND ACYL HALIDES--Continued	
Malic acid	ACS, PFN, PFZ.
Maleic acid	ACS
Malic phosphoric acid (Thioglycolic acid)	EFN
Maleic phosphoric acid (Thioglycolic acid)	EYN
Methacrylonitrilic acid (Thioallic acid)	EFN
Methacrylic acid	DUP, BH.
Methanesulfonic acid	PAS.
Methanesulfonyl chloride	PAS.
Neodecanoic acid	ENJ
Neopentanoic acid	ENJ
Nonanoic acid (Pelargonic acid)	PMR, GIV.
Nonenylsuccinic anhydride	HMY.
Octenylsuccinic anhydride	HMY.
Oleic acid	ASH.
Oleoyl chloride	GAP, HRT.
Oxalic acid	ACS, HK, PFZ.
Palmitoyl chloride	GAP, PD.
Peroxyacetic acid	PFE, UCC.
Pivaloyl chloride	AZI, MCC.
*Polyacrylic acid	BFG, DA, RH, SMW, TKL, X.
*Propionic acid	CEL, EKT, INC, UCC.
Propionic anhydride	EKT.
Sebacic acid	BAS, ETH.
Sebacoyl chloride	MTI.
Sorbic acid	MON.
Stearoyl chloride	JOP.
Succinic acid	ACS.
3-Propylidene adipic acid	EYN, HSA.
Thiolactic propionic acid	EYN.
Thiolactic acid	EYN.
Trichloroacetic acid	DOW.
Valeric acid	UCC.
Acids, acid anhydrides, and acyl halides, all other	ABB, ARA, BCC, BFG, CHG, DOW, EK, ENJ, EYN, HMP, HMY, MON, PIC, SE, TX, WAY, WCC, WTL.
*SALTS OF ORGANIC ACIDS:	
*ACETIC ACID SALTS:	
Aluminum acetate	ACY, UCC.



TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE J)
SALTS OF ORGANIC ACIDS--Continued	
ACETIC ACID SALTS--Continued	
*Ammonium acetate	ACS, BKC, MAL.
*Butyl acetate	ACS, BKC, CEN, MAL.
*Butyl acetate (dibutyltin diacetate)	MEI.
Calcium acetate	ACS, MAL.
Cobalt acetate	SHS, SHP, UCC.
Copper acetate	ACS, BKC.
Lead acetate	ACS, BKC, MAL.
Lead subacetate	BKC.
Lead tetraacetate	ARA.
Magnesium acetate	BKC, SHP.
Manganese acetate	SHS, SHP.
Mercuric acetate	MAL.
Nickel acetate	BKC, HSH, SHP.
*Potassium acetate	ACS, BKC, MAL, UCC.
Sodium acetate	ACS, BKC, CHP, DAN, EXT, HCP, HSH, MAL, UCC.
Sodium diacetate	UCC.
*Strontium acetate	MAL.
*Zinc acetate	BKC, BKC, SHP, UCC.
Zirconium acetate	HSH, IZC.
Acetic acid salts, all other	BKC, X.
Adipic acid, ammonium salt	FD, X.
Allylsulfonic acid, sodium salt	IOC, UOP.
Chloroacetic acid, sodium salt	DOW.
CITRIC ACID SALTS:	
Ammonium citrate	MAL, PFZ.
Calcium citrate	PFZ.
Ferric ammonium citrate	PFZ.
Potassium citrate	PFZ.
Sodium citrate	PFZ.
*2-ETHYLHEXANOIC ACID (ALPHA-ETHYLCAPROIC ACID) SALTS:	
Aluminum 2-ethylhexanoate	NOC, WTC.
Barium 2-ethylhexanoate	CCA.
Cadmium 2-ethylhexanoate	CCA.
*Calcium 2-ethylhexanoate	CCA, HN, MCI, TRO, WTC, X.
*Cobalt 2-ethylhexanoate	CCA, HN, MCI, TRO, WTC, X.
Copper 2-ethylhexanoate	CCA.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
SALTS OF ORGANIC ACIDS--Continued	
2-ETHYLHEXANOIC ACID( $\alpha$ -ETHYLGLAIC ACID) SALTS--Con.	
*Iron 2-ethylhexanoate	CCA, HN
*Lead 2-ethylhexanoate	CCA, HN, NTL, THO, WTC, X
Lithium 2-ethylhexanoate	WTC
*Manganese 2-ethylhexanoate	CCA, HN, MCI, THO, X
Nickel 2-ethylhexanoate	MCI, WTC
Potassium 2-ethylhexanoate	CCA, MCI
Rare earths 2-ethylhexanoate	WTC, X
*Stannous 2-ethylhexanoate	CCA, MCI
*Zinc 2-ethylhexanoate	CCA, HN, MCI, SYP(E), WTC, X
*Zirconium 2-ethylhexanoate	CCA, HN, MCI, THO, WTC, X
2-Ethylhexanoic acid salts, all other--	MCI
FORMIC ACID SALTS:	
Chromic formate	GAP
Lead formate	NTL
Nickel formate	SHP
Potassium formate	HCF
Sodium formate, refined	BKC
Sodium formate, technical	CEL
Formic acid salts, all other	SHP
Pumaric acid, lead salt	NIL
GLUCOHEPTANOIC ACID SALTS:	
Calcium glucoheptanoate	PFM
Sodium glucoheptanoate	HMP, PFM
GLUCONIC ACID SALTS:	
Ammonium gluconate	PFZ
Malic acids, sodium salts	X
Isosaccharic acid, sodium salt (sodium erythorbate)	PFZ
LACTIC ACID SALTS:	
Calcium lactate	HUM
Sodium lactate	SAL, BFN
Lactic acid salts, all other	HRK, PFM, TCC
LAURIC ACID SALTS:	
Lauric acid, barium-cadmate salt	X
Lauric acid salts, all other	CC, X
Lauroauric acid, dibutyltin salt	CCA

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
SALTS OF ORGANIC ACIDS--Continued	
LINOLEIC ACID--Continued	
Calcium linoleate	CCA, SHP.
Manganese linoleate	SHP.
*MALEIC ACID SALTS:	
Maleic acid, dibutyltin salt	CCA, X, X.
Maleic acid, tribasic lead salt	NFL.
Maleic acid salts, all other	CCA, X.
NEPCADROACETIC ACID (THIOGLYCOLIC ACID) SALTS:	
Arsonium mercaptoacetate	EWN.
Calcium mercaptoacetate	EWN.
Sotassium mercaptoacetate	EWN.
Sodium mercaptoacetate	EWN.
Mercaptoacetic acid (Thioglycolic acid) salts, all other	CCA.
Mercaptosuccinic acid, dibutyltin salt	CCA.
NEDECANOIC ACID SALTS:	
Calcium neodecanoate	CCA, MCI.
Cobalt neodecanoate	HPC.
Cobalt manganese neodecanoate	MCI, SHP.
Lead-cobalt neodecanoate	MCI.
Lead neodecanoate	MCI.
Lithium neodecanoate	MCI, SHP.
Manganese neodecanoate	CCA, MCI, SHP.
Zinc neodecanoate	CCA, MCI.
Zirconium neodecanoate	CCA, MCI, SHP.
Neodecanoic acid salts, all other	
OCTANOIC-ACID (CAPRYLIC ACID) SALTS:	
Aluminum octanoate	DA.
Stannous octanoate	CCW, X.
Octanoic acid (Caprylic acid) salts, all other	X.
OLEIC ACID SALTS:	
Lead oleate	NCC.
Stannous oleate	X.
Oleic acid salts, all other	HAL, SHP.
OXALIC ACID SALTS:	
Ammonium oxalate	ACS.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977.--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
SALTS OF ORGANIC ACID--Continued	
OXALIC ACID SALTS--Continued	
Potassium oxalate	BKC.
Sodium oxalate	BKC.
PALMITIC ACID SALTS:	
Aluminum palmitate	DA.
PHOSPHOROTHIOIC ACID SALTS (DITHIOPHOSPHATES):	
Sodium di-sec-butyl/diethyl phosphorodithioate	ACY.
Sodium di-sec-butyl phosphorodithioate	ACY.
Sodium diethyl phosphorodithioate	ACY.
Sodium dihexyl phosphorodithioate	ACY.
Sodium diisopropyl phosphorodithioate	ACY.
Phosphorodithioc acid salts (Dithiophosphates), All other	ACY.
PROPIONIC ACID SALTS:	
Calcium propionate	HFT, PFZ.
Sodium propionate	HFT, PFZ.
Propionic acid salts, all other	UCC.
RICINOLEIC ACID SALTS:	
Calcium ricinoleate	NFL.
Sodium ethyl oxalacetate	FME(E).
Sodium glycolate	HCP, SAL.
Sodium sorbitol borate	ICI.
SOBEIC ACID SALTS: Potassium sorbate	MON.
*STEARIC ACID SALTS:	
ALUMINUM STEARATES:	
*Aluminum distearate	DA, NOC, PEN, SYP, WTC.
*Aluminum monostearate	DA, NOC, SYP, WTC.
*Aluminum tristearate	DA, NOC, SYP, WTC.
AMMONIUM STEARATES:	
*Ammonium stearate	DA, NOC, PEN, SYP, WTC.
*Calcium stearate	NOC, SYP, WTC.
*Cadmium stearate	DA, FER, HN, MAL, NOC, PEN, SYP, WTC, X.
*Cobalt stearate	SHP, WTC, X.
*Ferric stearate	SHP, WTC, X.
*Lithium stearate	NFL, WTC, X.
*Magnesium stearate	DA, NOC, PEN, SYP, WTC.
*Manganese stearate	DA, NOC, PEN, SYP, WTC.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
SALTS OF ORGANIC ACIDS--Continued	
STEARIC ACID SALTS--Continued	
Nickel stearate--	WTC.
Silver stearate--	PEM.
*Zinc stearate--	DN, HN, MAL, NUC, PEN, PLS, SYP, WTC, X.
Stearic acid salts, all other--	WTC.
Succinic acid, sodium salt--	MAB.
TARTARIC ACID SALTS:	
Antimony potassium tartrate--	PFZ.
Potassium sodium tartrate--	PFZ.
XANTHIC ACID SALTS:	
Potassium aeylxanthate--	DOM.
Potassium ethylxanthate--	DOM.
Potassium pentylxanthate--	ACV.
Sodium n-butylxanthate--	KCC, USB.
Sodium sec-butylxanthate--	DOM.
Sodium ethylxanthate--	DOM.
Sodium isobutylxanthate--	DOM.
Sodium isopropylxanthate--	DOM.
Salts of organic acids, all other--	CCA, EK, HCP, HSH, MCI, MON, STP, TCH, UCC, WTC.
*ALDEHYDES:	
Acetaldehyde--	CEL, EXX, PUB, SHC, UCC.
Acrolein (Acrylaldehyde)--	SHC, UCC.
Butyraldehyde--	CEL, EXX, UCC.
Chloral (Trichloroacetaldehyde)--	MTO.
Crotonaldehyde--	ENT.
2-Ethylbutylaldehyde--	UCC.
2-Ethylhexanal (n-Ethylcaproaldehyde)--	EXX.
*Formaldehyde (37% HCHO by weight)--	ACS, AMP, BOR, CBD, CEL, DUP, GAF, GOC, GP, HKD, HN, HPC, IMC, MON, RCI, WGL.
Glutaraldehyde--	UCC.
Glyoxal--	UCC.
*Isobutyraldehyde--	ACR, UCC.
Isopentaldehyde, mixed isomers--	CEL, DEC, EXX, UCC.
2-Methylvaleraldehyde (2-Methylpentaldehyde)--	UCC.
Propionaldehyde--	EXX, UCC.
Valeraldehyde (Pentanal)--	EXX, UCC.
Aldehydes, acyclic, all other--	ER, RDA, UCC, X.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
*KETONES:	
*Acetone from cumene-	ACS, CLK, DOM, GP, GYR, MON, SHC, SOC, UCC, USS.
*Acetone from isopropyl alcohol-	EKI, ENJ, SHC, UCC.
Acetone, all other	OCC.
Acetone, crude	SKO.
*2-Butanone (Methyl ethyl ketone)-	ATR, CEL, ENJ, SHC, UCC.
1-Chloro-1-pentan-3-one ( $\beta$ -chlorovinyl ethyl ketone)	ABB.
Chloro-2-propanone (Chloroacetone)-	EK.
1,3-Dihydroxy-2-propanone (Dihydroxyacetone)-	BAK, PFZ.
Diisopropyl ketone (2,4-dimethyl-3-pentanone)	EKI.
2-Heptanone (Methyl amyl ketone)-	UCC.
3-Heptanone (Ethyl butyl ketone)-	ABS.
2,5-Hexanedione (Acetylacetone)-	CEL, SHC, UCC.
*4-Hydroxy-4-methyl-2-pentanone (Diacetone alcohol)	CEL, UCC.
Isovalerone (Diisobutyl ketone)	EKI, UCC.
Lactide (3,6-Dimethyl-2,5-p-dioxanedione)	CLR.
4-Methoxy-4-methyl-2-pentanone	SHC.
*Methyl-2-hexanone (Methyl isamyl ketone)-	EKI.
*Methyl-2-pentanone (Methyl isobutyl ketone)	EKI, ENJ, SHC, UCC.
*4-Methyl-3-pentan-2-one (Mesityl oxide)	ENJ, SHC, UCC.
Methylsulfoxidone	MDA.
3-Octanone (Ethyl amyl ketone)-	MIH.
2,4-Pentanedione (Acetylacetone)-	UCC.
2-Pentanone	EKI.
2-Pentanone (Diethyl ketone)-	BEA, ORT, UCC.
Pseudonone	UCC.
2,6-Dimethyl-4-nonanone (Isobutyl heptyl ketone)	UCC.
*KETONES, ALCOHOLS, ALKYL HALIDES	
*ALCOHOLS, MONOHYDRIC, UNSUBSTITUTED:	
*ALCOHOLS, C11 OR LOWER, UNMIXED (95% OR MORE PURE):	
Myl alcohol-	
2-Methyl-1-butanol	ARC, CHG, DUP, EK, EKI, HRK, ORT, PFZ, SHC, UCC.
2-Pentanol	FMP, SHC.
Myl alcohols:	
2-Methyl-1-butanol	UCC.
2-Pentanol	UCC.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
ALCOHOLS, MONOHYDRIC UNSUBSTITUTED--Continued	
ALCOHOLS, C-11 OR LOWER, UNMIXED (95% OR MORE PURE)--Continued	
BUTYL ALCOHOLS:	
n-Butyl alcohol (n-Propylcarbinol)--	CEL, CO, DBC, EXX, GAR(E), OXO, SHC, TNA, UCC.
sec-Butyl alcohol (Methylcarbinol)--	ENJ, SHC.
tert-Butyl alcohol (Trimethylcarbinol)--	OCG, SHC.
*Isobutyl alcohol (Isopropylcarbinol)--	CEL, DBC, EXX, OXO, SHC, UCC.
*Ethyl alcohol, synthetic only--	EXX, PUB, SHC, UCC, USI.
2-Ethyl-1-hexanol--	DBC, EXX, OXO, SHC, UCC.
2-Ethyl-4-methyl-1-pentanol--	EXX.
n-Heptyl alcohol--	EXX.
*Hexyl alcohol--	CO, ENJ, TNA, UCC.
Iso-octyl alcohol--	ENJ, USS.
*Isopropyl alcohol--	ATR, ENJ, SHC, UCC.
Methanol, synthetic only--	ALP, BOB, CEL, DUP, GP, HCF, HN, MON, BH, UCC.
2-Methyl-1-pentanol--	UCC.
2-Octanol--	CC.
2-Octanol (sec-capryl alcohol)--	WTH.
Propyl alcohol (Propanol)--	CEL, EXX, UCC.
2-Propyl-1-ol (propargyl alcohol)--	GAP.
ALCOHOLS, UNMIXED C11 OR LOWER, ALL OTHER--	
1-Decanol, C12 OR HIGHER, UNMIXED (95% OR MORE PURE):	ENJ, PUB, SHC, UCC, VEL.
Dodecyl alcohol (Lauryl alcohol)--	CO, TNA.
1-Hexadecanol (cetyl alcohol)--	CO, TNA.
Isodecyl alcohol--	CO, PG.
1-Octadecanol (stearyl alcohol)--	ENJ, USS.
cis-9-Octadecen-1-ol (oleyl alcohol)--	CO, PG.
1-Tetradecanol (Myristyl alcohol)--	ASH, PG.
1-Tridecanol--	CO, UCC.
2,6,8-Trimethyl-4-nonanol--	ENJ.
ALCOHOLS, UNMIXED C12 OR HIGHER, ALL OTHER--	UCC.
*MIXTURES OF ALCOHOLS:	SCP.
Alcohol mixtures, all other--	CO, CPS, EXX, ENJ, NCI, PG, SHC, TNA, UCC, WTH.
*ESTERS OF MONOHYDRIC ALCOHOLS:	
Acrylic monomers, mixed--	BH.
Allyl methacrylate--	GLY, JCC, SAR.
AMYL ACETATES:	
Amyl acetate (n-pentyl acetate)--	UCC.
Amyl acetates, all other--	PUB.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
ESTERS OF MONOHYDRIC ALCOHOLS--Continued	
Diethyl malonate	CEL, EKT, UCC.
n-Butyl acetate	CEL, EKT, EKK, UCC.
* Isobutyl acetate	CEL, DBC, BH, SM, UCC.
* Butyl acrylate	CTN.
N-Butyl chloroformate	CTN.
sec-Butyl chloroformate	TMC.
Butyl lactate	TCH.
Butyl maleate	EVN.
Butyl mercaptopropionate	BH, TK.
Butyl methacrylate	AZI, WTL.
tert-Butyl peroxyacetate	AZI, WTC.
tert-Butyl peroxy-2-ethylhexanoate	AZI, WTL.
tert-Butyl peroxyisobutyrate	WTL.
tert-Butyl peroxyisopropylcarbonate	WTC, WTL.
tert-Butyl peroxyundecanoate	AZI, WTC.
tert-Butyl peroxyvalerate	SBC, VND.
Diethyl maleate	FMP(E).
Diethyl fumarate	ACL.
* Diethyl maleate	BH, BCI, USS.
Diethyl carbonato (ethyl carbonate)	CTN.
Diethyl (ethoxyethylene)malonate	KF.
* Di-(2-ethyl-1-hexyl) maleate	CHP, DAN, HBT, RUB.
Diethyl maleate	ACY.
Diethyl malonate (Malonic ester)	ABB, KF.
Diethyl methyalmalonate	SFS.
Diethyl oxalate (Ethyl oxalate)	FPP, PFZ.
Diisobutyl maleate	RUB.
Diisobutyl maleate	RUB.
Diisopropyl maleate	RUB.
Diisopropyl peroxydicarbonate (Isopropyl percarbonate)	PPG.
* Diisobutyl-3,3'-thiodipropionate	ACY, CCW, EVN.
Dimethyl carbonate	CTN.
Dimethyl maleate	AAC.
Dimethyl malonate	KF.



TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
ESTERS OF MONOHYDRIC ALCOHOLS--Continued	
Dioctyl maleate	RCI, USS.
Di-n-propyl peroxycarbonate	WTL.
Distearyl-3,3'-thiodipropionate	ACV, EVN.
Dihexyl stearyl propionate	EVN.
Ditridecyl maleate	EPN.
Di(tridecyl)3,3'-thiodipropionate	ACV, EVN.
2-Ethoxyethyl acetate	EKK.
*Ethyl acetate (85%)	CEL, EKT, EKK, MON, PUB, UCC.
*Ethyl acetoacetate	EKT.
*Ethyl acrylate	CEL, DBC, RH, UCC.
*Ethyl chloroacetate	DOM.
*Ethyl chloroformate	CTN.
Ethylene carbonate	JCC.
2-Ethyl-1-hexyl acetate	EKT.
*2-Ethyl-1-hexyl acrylate	CEL, DBC, UCC.
2-Ethyl-1-hexyl methacrylate	DUP.
*Ethyl silicate	SFS.
*FATTY ACID ESTERS, NOT INCLUDED WITH PLASTICIZERS OR SURFACE ACTIVE AGENTS:	
Butyl palmitate	TKL.
Dimethyl brassylate	ERR.
Isopropyl linoleate	ND.
Methyl esters of coconut oil	HUN, PG.
Methyl esters of tallow	HL, FER, HUM, PG.
Methyl 12-hydroxysebacate	NL, WTH.
Methyl sebacate	CHU.
Methyl stearate	VND.
*Fatty acid esters not included with plasticizers or surface-active agents, all other:	
Isobutyl acrylate	ABC, CCH, CHP, CRN, FER, UCC, WTC.
Isobutyl chloroformate	CTN.
Isobutyl isobutyrate	EKK.
Isodecyl thioglycolate	EVN.
Iso-octyl mercaptoacetate	CCW, EVN.
Iso-octyl-3-mercaptopropionate	EVN.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
ESTERS OF MONOHYDRIC ALCOHOLS--Continued	
Isopropyl acetate--	: EKT, UCC.
Isopropyl chloroformate--	: CTN, PFG, WTL.
Isostearyl neopentanoate--	: VND.
Lauryl lactate--	: VND.
Lauryl methacrylate--	: RH, TX.
Menthallylidene diacetate--	: RDA.
2-Methoxyethyl diacetate--	: AAC.
*Methyl acetate--	: GRD, MDN, UCC.
Methyl acetoacetate--	: EKT.
Methyl acrylate, monomer--	: CEL, RH.
Methyl borate--	: SFS.
Methyl chloroacetate--	: DON.
Methyl chloroformate--	: CTN.
Methyl formate--	: CEL, DUP.
*Methyl methacrylate, monomer--	: CYN, DUF, RH.
Methyl sulfate (Dimethyl sulfate)--	: DUF.
Nyristyl lactate--	: VND.
*Octadecyl-3-mercaptopropionate--	: EYN.
*PHOSPHORUS ACID ESTERS:	
Bis(2-ethylhexyl) hydrogen phosphate--	: UCC.
Bis(2-ethylhexyl) hydrogen phosphite--	: SZ.
Butyl acryl phosphate--	: HY, SM.
Diethyl hydrogen phosphite--	: SFA.
Diethyl hydrogen phosphite--	: DUP.
Diethyl phosphochloridobutanoate--	: SFA.
Diethyl methylphosphonate--	: SM.
Diethyl phosphoridithionate--	: SFA.
2-Ethylhexyl hydrogen phosphate--	: SM.
Iso-octyl hydrogen phosphite--	: SM.
Methyl dihydrogen phosphate--	: HK.
Trialkyl phosphite--	: MCB.
Tributyl phosphite--	: PFP, SFS.
Triethyl phosphite--	: SFA, SFS, SM.
Triiso-octyl phosphite--	: MCB, SM.
Triisopropyl phosphite--	: SM.
Trimethyl phosphite--	: SFA, SFS, SM.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURERS, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
ESTERS OF MONOHYDRIC ALCOHOLS--Continued	
PHOSPHORUS ACID ESTERS--Continued	
Tris(2,3-dibromopropyl)phosphate	VEL
Tris(2-ethylhexyl)phosphate	SM
Phosphorus acid esters, all other	DUP, HK, HN, ML, SFA, SM, USO.
*Propyl acetate	CEL, EKT, UCC.
Propylene carbonate	JCC.
Stearyl methacrylate	HH, TX.
Tetraethyl orthosilicate (Tetraethyl silicate)	UCC.
Tetraethyl silicate, condensed	UCC.
TITANIC ACID ESTERS:	
Tetraoctyl orthosilicate	NON.
Tetrabutyl titanate	DUP.
Tetraisopropyl titanate	DUP.
Tetrakis(2-ethylhexyl)titanate	DUP.
Titanic acid esters, all other	DUP.
Triethyl orthoacetate	KE.
Triethyl orthoformate	KE.
Triethyl orthopropionate	KE.
Triisodecyl orthoformate	KE.
Trimethyl orthoformate	KE.
*Vinyl acetate, monomer	BOR, CEL, DUP, NSC, DCC, USI.
Monohydric alcohol esters, all other	AAC, CTN, DAN, DUP, EK, EKT, EMS, EVN, FER, SFA, TKL, UCC, VND, WTL.
*POLYHYDRIC ALCOHOLS:	
2,2-Bis(bromomethyl)-1,3-propanediol	DOM.
1,2-(and 1,3)-butanediol	CEL, DUP.
1,4-Butanediol	BAS, GAP.
2-Butene-1,4-diol	GAP.
2-Butyne-1,4-diol	GAP.
2-Chloro-1,2-propanediol (Glycerol <i>o</i> -chlorohydrin)	EKT, EVN.
*2-Dimethyl-1,3-propanediol (Neopentyl glycol)	EXX.
*Ethylene glycol	BAS, CAD, CEL, DIX, DOM, EKI, JCC, NWP, OHC, PEG, SFC, UCC.
2-Ethyl-1,3-hexanediol	UCC.
2-Ethyl-2-(hydroxymethyl)-1,3-propanediol (Tri methylolpropane)	CEL.
*Glycerol, synthetic only	DOM, PMP, SFC.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS* IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
POLYHYDRIC ALCOHOLS--Continued	
1,6-Hexanediol	: CEL
Mannitol	: ICI
3-Mercapto-1,2-propanediol (Thioglycerol)	: EVN
2-Methyl-2,4-pentanediol (Hexylene glycol)	: SHC
*Pentaerythritol	: CEL, HPC, IMC, PST
1,5-Pentanediol	: UCC
*Propylene glycol (1,2-Propanediol)	: DOM, JCC, OCC, OMC, UCC
*Sorbitol (70% by Weight)	: BRD, ICI, MKK, PFZ
2,2,4-Trimethyl-1,3-pentanediol	: EKK
Polyhydric alcohols, all other	: ARA, GAP, GLY, JCC, UCC
ESTERS AND ETHERS OF POLYHYDRIC ALCOHOLS:	
* POLYHYDRIC ALCOHOL ESTERS:	
1,3-Butanediol dimethacrylate	: SAR
2-Butoxyethyl acetate	: EKI
Diethylene glycol chloroformate	: PFG
2-(2-Ethoxyethoxy)ethyl acetate	: EKI
Ethylene glycol diacetate	: EKI, UCC
Ethylene glycol dimercaptoacetate	: EVN
Ethylene glycol dimethacrylate	: SAR
Ethylene glycol hydroxyacetate	: CCA
Glyceryl diacetate (Diacetin)	: ABC, HAL
Glyceryl monoacetate (Monocetin)	: EYN, HAL
Glyceryl triacetate (Triacetin)	: ABC, EKI, UCC
Glyceryl trioleate	: PYO
Glycol adipate	: AB
1,6-Hexanediol diacrylate	: CEL, SAR
Hexylene glycol diacetate	: UCC
Hydroxyethyl acrylate	: UCC
Hydroxypropyl acrylate	: DOM
Hydroxypropyl methacrylate	: CW, RH
Lanolin acetate	: CSN
Lanolin alcohol acetate	: CSN
Pentaerythritol caprylate	: MOP
Pentaerythritol tetraacrylate	: CEL, SAR, UCC
Pentaerythritol tetraakis (3-Mercapto)propionate	: EYN
Polyethylene glycol dimethacrylate	: SAR

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
ESTERS AND ETHERS OF POLYHYDRIC ALCOHOLS--Continued	
POLYHYDRIC ALCOHOL ESTERS--Continued	
Sucrose octa-acetate	HFT, FD.
2-Sulfoethyl methacrylate	DOM.
Tetraethylene glycol diacrylate	CEL, TKL.
Triethylene glycol dimethacrylate	AAC, CEL, SAB.
Triethylene glycol diacrylate	CEL, SAR, TKL.
Triethylene glycol dimethacrylate	SAR.
*Triethylolpropane triacrylate	CEL, SAR, TKL.
Triethylolpropane tri(3-mercaptopropionate)	EVM.
2,2,3-Trimethyl-1,3-pentanediol monosubstrate	EXX.
Polyhydric alcohol esters, all other	ARC, CCM, CEL, CTN, EKT, EVM, GOC, RH, SAR, SH, TKL, UCC, USB, WCC, WH.
*POLYHYDRIC ALCOHOL ETHERS:	
Di(2-butoxyethyl)ether	(Diethylene glycol di-n-butyl ether)
Bis(2-ethoxyethyl)ether	(Diethylene glycol diethyl ether)
Bis(2-butoxyethyl)ether	(Diethylene glycol diethyl ether)
Bis(hydroxyethyl)ether	butynediol
Bis(2-(2-ethoxyethoxy)ethyl) ether	(Tetraethylene glycol dimethyl ether)
Bis(2-methoxyethyl)ether	(Diethylene glycol dimethyl ether)
*2-Butoxyethanol	ASL.
*2-(2-Butoxyethoxy)ethanol	(Diethylene glycol mono-butyl ether)
*2-[2-(2-Butoxyethoxy)ethoxy]ethanol	(Triethylene glycol monobutyl ether)
1-Butoxyethoxy-2-propanol	UCC.
*Diethylene glycol	BAS, CEL, DIX, DOM, EKK, JCC, NWP, OMC(E), PPG, SHC, UCC.
Dimethoxyethane (Ethylene glycol dimethyl ether)	ASL.
*Dipropylene glycol	DOM, JCC, OCC, OMC, UCC.
*2-Ethoxyethanol	DOM, EKK, JCC, OMC, SHC, UCC.
*2-(2-Ethoxyethoxy)ethanol	(Diethylene glycol monoethyl ether)
*2-[2-(2-Ethoxyethoxy)ethoxy]ethanol	(Triethylene glycol monoethyl ether)
	DOM, EKK, JCC, OMC, SHC, UCC.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS		MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued		
ESTERS AND ETHERS OF POLYHYDRIC ALCOHOLS--Continued		
POLYHYDRIC ALCOHOL ETHERS--Continued		
2-[2-(Hexyloxy)ethoxy]ethanol		UCC.
Isobutoxyethanol		UCC.
2-(2-Isobutoxyethoxy)ethanol (Diethylene glycol monoisobutyl ether)		UCC.
1-Isobutoxy-2-propanol (propylene glycol isobutyl ether)		DOM.
*2-methoxyethanol (Ethylene glycol monomethyl ether)		DOM, JCC, OMC, PFG, SHC, UCC.
*2-[2-methoxyethoxy]ethanol (Diethylene glycol mono ether)		DOM, JCC, OMC, PFG, SHC, UCC.
*2-(2-methoxyethoxy)ethoxy]ethanol (Triethylene glycol monomethyl ether)		DOM, JCC, OMC, PFG, SHC, UCC.
2-[2-Methoxyethoxy]ethyl-2-methoxyethyl ether (Triethylene glycol dimethyl ether)		DOM, OMC, UCC.
Methoxypolyethylene glycol		ASL
1-Methoxy-2-propanol		DUP, UCC.
3-(3-Methoxypropoxy)propanol		DOM.
3-[3-(3-Methoxypropoxy)propoxy]propanol		DOM.
Paraformaldehyde		CEL, HN.
*Polyethylated-1,4-butanediol		HDG.
*Polyethylene glycol		HDG.
POLYPROPoxy ETHERS:		
Polypropoxybutyl ether		BAS, CAU, DA, DOM, DUP, JCC, OMC, UCC, X.
Polypropoxy ethers, all other		BAS, DA.
Polyglycols, ethylene glycol and glycol ether, mixed		TNI, UCC.
Polyoxypropylene polyoxyethylene glycol, mixed		DOM.
*Polypropylene glycol		BAS, DOM, HDG, JCC, OMC, UCC.
Polytetramethylene glycol ether		DUP, OKO.
*Propylene glycol, mixed ethers		BAS, DOM, JCC, UCC.
Sorbitol, ethoxylated		GLY, ICI, TCH.
Sorbitol, propoxylated		ICI.
*Tetraethylene glycol		DOM, EXK, OMC, UCC.
1, 1, 3, 3-tetraethoxypropane		KF.
*Triethylene glycol		CEL, DOM, EXK, JCC, OMC, PFG, SHC, UCC.
Tripropylene glycol		DOM, HDG, UCC.
Polyhydric alcohol ethers, all other		CEL, EXK, JCC, TCH, TX, UCC, X.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
*HALOGENATED HYDROCARBONS:	
*BROMINATED (INCLUDING BROMOCHLORINATED) HYDROCARBONS:	
1-Bromobutane (n-Butyl bromide)	ABB.
2-Bromobutane (sec-Butyl bromide)	MCC.
Bromochloroethane	DOM.
1-Bromo-3-chloropropane (Trimethylenedichloromide)	VEL.
1-Bromododecane	MCC.
Bromoethane (Ethyl bromide)	DCM.
1-Bromohexane (n-Hexyl bromide)	MCC.
1-Bromo-octadecane	HMV.
1-Bromopentane (n-Amyl bromide)	HMV.
1-Bromopropane (n-Propyl bromide)	MCC.
Bromotrichloroethane	VEL.
Dibromoethane (Methylene bromide)	DOM.
1,1,2,2-tetrabromoethane (Acetylene tetrabromide)	DOM.
Vinyl bromide (Bromoethylene)	TNA.
Brominated (Including bromochlorinated) hydrocarbons, all other	EK, GTL, HMV, PD, VEL, MCC.
*CHLORINATED (NOT OTHERWISE HALOGENATED) HYDROCARBONS:	
*Carbon tetrachloride	ACS, DA, DOM, DUP, FFB, FRO, SFI, TNA.
*CHLORINATED PARAFFINS (C10-C30):	
Chlorinated paraffins, 35-64% chlorine	CCH, DA, DVC, FER, HPC, ICI, NEV, PLX.
Chlorinated paraffins, less than 35% chlorine	HK.
Chlorinated paraffins, 65% or more chlorine	DA, DVC, NEV.
1-Chlorobutane (n-Butyl chloride)	PUB, UCC.
Chloroethane (Ethyl chloride)	DOM, DUF, HPC, PFG, SFP, SHC, TNA.
Chloroform	ACS, DA, DOM, FRO, SFI.
*Chloroethane (Methyl chloride)	ACS, CO, DCC, DOM, DUP, FRO, SFI, TNA, UCC.
2-Chloro-2-methylpropane (tert-Butyl chloride)	EK.
3-Chloropropene (Methallyl chloride)	FMP.
3-Chloropropene (Allyl chloride)	DOM, SHC.
Dichlorobutadiene	DUF.
1,1-Dichlorobutene	DUF, PTT.
*1,2-Dichloroethane (Ethylene dichloride)	ACS, BAS, BFG, CO, DA, DOM, FRO, PFG, SFP, SHC, TNA, UCC.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
HALOGENATED HYDROCARBONS--Continued	
CHLORINATED (NOT OTHERWISE HALOGENATED) HYDROCARBONS--Continued	
* Dichloroethane (Methylene chloride)-	ACS, DA, DOM, DUP, FRO, SFI.
* 1,2-Dichloropropane (Propylene dichloride)-	BAS, DOM, JCC.
2,3-Dichloropropene-	DCW.
Octyl chloride-	HDV.
1,1,2,2-Tetrachloroethane (Acetylene tetrachloride)-	HK.
* Tetrachloroethylene (Perchloroethylene)	DA, DOM, DUP, FRO, HK, PPG, SFI, TNA.
1,1,1-Trichloroethane (Methyl chloroform)	DOM, PRO, PPG.
* 1,1,2-Trichloroethane (Vinyl trichloride)	DM, DCH, HK, PPG, TNA.
* Trichloroethylene-	DM, DCH, HK, PPG, TNA.
1,2,3-Trichloropropene-	DOM, SHC.
1,2,3-Trichloropropene-	DOM, SHC.
* Vinyl chloride, monomer (Chloroethylene)-	ACS, BFG, BOB(E), CO, DOM, FBO, MNO, PPG, SFP, SHC, TNA, USR.
Vinylidene chloride, monomer (1,1-Dichloroethylene)-	DOM, PPG.
Chlorinated (Not otherwise halogenated) hydrocarbons, all other-	DUP, RDA, RH.
* FLUORINATED (INCLUDING OTHER HALOGENATED) HYDROCARBONS:	
2-Bromo-2-chloro-1,1,1-trifluoroethane-	ICI.
Bromotrifluoroethane-	DUP.
1-Chloro-1,1-difluoroethane-	PAS.
* Chlorodifluoroethane (P-22)	ACS, DUP, KAI, PAS, RCN, UCC.
Chloropentafluoroethane-	DUP.
Chlorotrifluoroethylene (Trifluorovinyl chloride)	ACS, MMH.
Chlorotrifluoroethane-	X.
Dibromodifluoroethane-	DUP.
1,2-Dibromo-1,1,2,2-tetrafluoroethane-	DUP.
* Dichlorodifluoroethane (P-12)	ACS, DUP, KAI, PAS, RCN, UCC.
Dichlorotetrafluoroethane-	ACS, DUP, PAS.
1,1-Difluoroethane-	ACS, DUP.
Difluorotetrafluoroethane-	X.
Hexafluoropropylene, monomer-	DUP.
1-Iodoheptafluorohexane-	DUP.



TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
HALOGENATED HYDROCARBONS--Continued	
FLUORINATED (INCLUDING OTHER HALOGENATED)	
HYDROCARBONS--Continued	
*Tetrafluoroethylene, monomer	ACS, DUP, ICI.
Tetrafluoroethane	DUP.
*Trichlorofluoromethane (F-11)	ACS, DUP, KAI, PAS, RCN, UCC.
Trichlorofluoromethane	ACS, DUP, KAI, PAS, RCN, UCC.
Wet fluoride	ACS, DUP.
Wet fluoride monomer	X.
Wet fluoride monomer	PAS, X.
Fluorinated (including other fluorohalogenated)	DUP, ICI.
Hydrocarbons, all other--	
*IODINATED (NOT OTHERWISE HALOGENATED) HYDROCARBONS:	
Diiodomethane (Methylene iodide)	MTB.
Iodoethane (Ethyl iodide), non-medical	PFT, BSA.
Iodoform (Triiodomethane)	MTB.
Iodomethane (Methyl iodide)	PFT, BSA.
OTHER MISCELLANEOUS ACYCLIC CHEMICALS:	
Acetyl peroxide	WTL.
Aluminum isopropoxide (Aluminum isopropylate)	WTL, KCH.
*2-Butanone peroxide	WTL, KCH, RCI, WTC, WTL.
tert-Butyl hydroperoxide	CAD, NOC.
*tert-Butyl peroxide (Di-tert-butyl peroxide)	CAD, OCC, WTC, WTL.
*Carbon disulfide	CAD, NOC, SHC, WTC, WTL.
2-Chloroethanol (Ethylene chlorohydrin)	ACS, FMB, PAS, PG, SFI.
Decanoyl peroxide	UCC.
2, 3-Dibromopropanol	WTC, WTL.
2, 5-Diethyl-2, 5-bis(2-ethyl-1-hexanoyl peroxy)hexane	GTL.
2, 5-Dimethyl-2, 5-di(tert-butylperoxy)hexane	WTC, WTL.
2, 5-Dimethyl-2, 5-di(tert-butylperoxy)hexane-3-	WTL.
*EPOXIDES, ETHERS, AND ACETALS:	
1-(Allyloxy)-2, 3-epoxypropane (Allyl glycidyl ether)	
Bis(2-chloroethoxy)methane (Dichloroethylformal)	ARC.
Bis(2-chloroethyl)ether (Dichloroethyl ether)	TXL.
Bis(2-chloro-1-methylethyl)ether (Dichloroisopropyl ether)	DOW.
Butylene oxide	DOW.
Butyl vinyl ether	DOW.
	GAF, PUB.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
OTHER MISCELLANEOUS ACYCLIC CHEMICALS--Continued	
EPOXIDES, ETHERS, AND ACETALS--Continued	
2-Chloroethyl vinyl ether--	: AAC.
Chloromethyl methyl ether--	: RHX.
2,2-Dichloro-1,1-difluoroethyl methyl ether--	: DOM.
Dimercaptodiethyl ether--	: EYN.
*Epichlorohydrin--	: DOM, SHC.
*Ethylene oxide--	: BASF, CAD, CEL, DOM, EXX, JCC, NWP, OMC, PPG, SHC, SMO, UCC, USI.
Ethyl ether, U. S. P.--	: MLI, USI.
Ethyl ether, absolute--	: EXX, MLI, USI.
Ethyl ether, tech.--	: BJI, PUB, UCC, USI.
Ethyl methyl ether--	: GAF.
Glycidyl 2-hydroxy-1-propanol--	: DIX.
Isopropyl vinyl ether--	: GAF.
Isopropyl ether--	: BJI, SHC.
Methylal (Dimethoxymethane)--	: CEL, SHC.
Methyl vinyl ether--	: GAF, UCC.
*Propylene oxide--	: BAS, DOM, JCC, OCC, OMC, OXI.
Epoxydes, ethers, acetals, all other--	: DA, PIN, PG, UCC, VIK.
PATS AND OILS, CHEMICALLY MODIFIED:	
Hydrogenated tallow glyceroldehydes--	: CHL.
Stearic acid glycerides and oxidized stearic acid glycerides--	: SDW.
Fats and oils, chemically modified, all other--	: DOM.
n-Hexadecyl bis(sodium bisulfite)--	: EK, FMT.
*HYDROCARBONS:	: PAS.
n-Decane--	: HBY, PLC.
n-Dodecane--	: HBY.
Hexadecane--	: HBY.
Myrcene--	: SCM, X.
n-Octadecane--	: HBY.
n-Octane--	: HBY.
Hydrocarbons, all other--	: CBY, HBY, SFS, UCC.
Lauryl peroxide--	: WTC, WTL.
2-Mercaptoethanol--	: PLC.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
OTHER MISCELLANEOUS ACYCLIC CHEMICALS--Continued	
Methyl sulfide (dimethyl sulfide)-----	CRZ, PAS.
Methyl sulfoxide (dimethyl sulfoxide)-----	CRZ.
ORGANO-ALUMINUM COMPOUNDS:	
Diethylaluminum chloride-----	TNA, TSA.
Diethylaluminum iodide-----	TNA, TSA.
Diisobutylaluminum chloride-----	TNA, TSA.
Diisobutylaluminum hydride-----	TNA, TSA.
Ethylaluminum dichloride-----	TNA, TSA.
Ethylaluminum sesquichloride-----	TNA, TSA.
Isopropylaluminum sesquichloride-----	TNA.
Methylaluminum sesquichloride-----	TNA.
Sodium aluminum chlorohydroxylactate-----	REH.
Sodium aluminum hydroxylactate-----	REH.
Triethylaluminum-----	TNA, TSA.
Triisobutylaluminum-----	TNA, TSA.
Organo-aluminum compounds, all other-----	TNA, TSA.
ORGANO-BORON COMPOUNDS:	
Boron fluoride-ethyl ether complex-----	ACS.
Trimethyl borate-----	MHI.
Organo-boron compounds, all other-----	ACS, ADC, TSA.
ORGANO-LITHIUM COMPOUNDS:	
n-Butyllithium-----	FTE.
sec-Butyllithium-----	FTE.
Organo-lithium compounds, all other-----	UCC.
ORGANO-MAGNESIUM COMPOUNDS:	
Methylmagnesium bromide-----	ARA.
Methylmagnesium chloride-----	ARA, X.
Organo-magnesium compounds, all other-----	TNA, TSA.
ORGANO-SILICON COMPOUNDS:	
a-Chloropropyltrichlorosilane-----	DCC.
Chloropropyltrimethoxysilane-----	DCC.
Chlorotrimethylsilane-----	DCC.
Dichlorodimethylsilane-----	DCC.
Dichloromethylsilane-----	DCC.
Dichloromethylvinylsilane-----	DCC, UCC.
Diethoxyphosphoryltriethyltriethoxysilane-----	UCC.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U.S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED, IDENTIFIED BY MANUFACTURERS, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
OTHER MISCELLANEOUS ACYCLIC CHEMICALS--Continued	
ORGANO-SILICON COMPOUNDS--Continued	
α-glycidioxypropyltrimethoxysilane	UCC.
Hexapropyltrimethoxysilane	UCC.
Methylhexyltrimethoxysilane	UCC.
Polymethylmethoxytri- and polymethyltrisiloxane	UCC, UCC.
*Silicone fluids	UCC, SPD, SWS, UCC.
Trichloromethylsilane	UCC.
Trichloropropylsilane	UCC.
Trichlorovinylsilane	UCC.
Vinyltriethoxysilane	UCC.
Organo-silicone compounds, all other	ARA, DCC, RSA, UCC.
ORGANO-TIN COMPOUNDS:	
Bis(tributyltin)oxide	X.
Dibutyltin bis(isooctylmercaptoacetate)	CCH, X, X.
Dibutyltin bis(mercaptoacetate)	X.
Dibutyltin dichloride	CCH, X.
Dibutyltin methoxide (Dibutylmethoxytin)	CCA.
Dibutyltin oxide	X.
Tributyltin chloride	X.
Tributyltin fluoride	X.
Organo-tin compounds, all other	CCA, CCW, X.
ORGANO-ZINC COMPOUNDS:	
Diethylzinc	TSA.
Perchloromethanethiol (Perchloromethyl mercaptan)	SFA, SFC.
*Phosgene (carbonyl chloride)	ACS, CTM, DUP, OMC, PPG(E), BUC, UCC, URP.
Pine oil, synthetic	GRY, NCI, SCM.
Sodium ethoxide	FMP.
Sodium formaldehyde bisulfite	EK, MAY.
Sodium formaldehyde sulfoxylate	DA.
*Sodium methoxide (Sodium methylate)	DA, HSH, RBC.
Succinyl peroxide	WTI.
Zinc formaldehyde sulfoxylate	UCC.
Miscellaneous acyclic chemicals, all other	AAA, ABB, ABA, CAD, DAN, EK, GAF, GLY, GNM, HK, HAY, KCH, PLC, PYO, RBC, SAB, SES, SHC, SH, INA, UCC, USR, YTC, MAY, WTL, X, X, X.

TABLE 2.--MISCELLANEOUS CHEMICALS FOR WHICH U. S. PRODUCTION AND/OR SALES WERE EITHER REPORTED OR ESTIMATED,  
IDENTIFIED BY MANUFACTURER, 1977--CONTINUED

MISCELLANEOUS CHEMICALS	MANUFACTURERS' IDENTIFICATION CODES (ACCORDING TO LIST IN TABLE 3)
A C Y C L I C--Continued	
MIXTURES NOT SPECIFICALLY ITEMIZED:	
Mixtures of miscellaneous acyclic chemicals not specifically itemized	ALX, ARA, CEL, DUP, EKK, HPC, ICI, MON, MRK, MRT, NCI, PAS, PG, PLC, PRP, PYO, RH, S, SCE, SM, TMA, VEL, WLN.

TABLE 3.--MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS: DIRECTORY  
OF MANUFACTURERS, 1977

ALPHABETICAL DIRECTORY BY CODE

[Names of manufacturers that reported production or sales of miscellaneous cyclic and acyclic chemicals to the U.S. International Trade Commission for 1977 are listed below in the order of their identification codes as used in table 2]

Code	Name of company	Code	Name of company
AAC	Alcolac Chemical Corp.	CNP	Nipiro Inc.
ABB	Abbott Laboratories	CO	Continental Oil Co.
ACS	Allied Chemical Corp., Specialty Chemicals Div.	CPS	CPS Chemical Co.
ACY	American Cyanamid Co.	CPV	Cook Paint & Varnish Co., Inc.
ADC	Anderson Development Co.	CRN	CPC International, Inc., Amerchol
AIP	Air Products & Chemicals, Inc.	CRZ	Crom Zellerbach Corp., Chemical Products Div.
ALB	Ames Laboratories, Inc.	CTN	Chemtron Corp., Chemical Products Div.
ALD	Aldrich Chemical Co., Inc.	CWN	Upjohn Co., Fine Chemical Div.
ALF	Allied Chemical Corp., Fibers Div.		
ALX	Alox Corp.	DA	Diamond Shamrock Corp.
AMB	American Bio-Synthetics Corp.	DAN	Dan River, Inc., Chemical Products Dept.
ARA	Arapahoe Chemicals, Inc. Sub/Syntex Corp. (U.S.A.)	DBC	Dow Badische Co.
ARC	Armark Co.	DCC	Dow Corning Corp.
ARS	Arsynco, Inc.	DIX	Dixie Chemical Co.
ARZ	Arizona Chemical Co.	DKA	Denka Chemical Corp.
ASH	Ashland Oil, Inc., Ashland Chemical Co.	DOM	Dominion Products, Inc.
ASL	Ansul Chemical Co.	DOW	Dow Chemical Co.
AZT	Dart Industries, Inc., Aztec Chemicals Div.	DUP	E. I. duPont de Nemours & Co., Inc.
		DVC	Dover Chemical Corp. Sub. of ICC Industries, Inc.
BAS	BASF Wyandotte Corp.	EFH	E. F. Houghton & Co.
BAX	Baxter/Travenol Laboratories, Inc.	EK	Eastman Kodak Co.:
BCC	Buffalo Color Corp.	EKT	Tennessee Eastman Co. Div.
BFG	B. F. Goodrich Co., B. F. Goodrich Chemical Co. Div.	EKX	Texas Eastman Co. Div.
BKC	J. T. Baker Chemical Co.	ELP	El Paso Products Co.
BKL	Kewanee Industries, Inc., Millmaster Chemical Co. Div.	EMR	Emery Industries, Inc.
BME	Bendix Corp., FMD Div.	ENJ	Exxon Chemical Co. U.S.A.
BOR	Borden Co., Borden Chemical Div.	EVN	Evans Chemicals, Inc.
BRD	Lonza, Inc.		
BUK	Buckeye Cellulose Corp.	FER	Ferro Corp.:
			Grant Chemical Div.
CAD	Noury Chemical Corp.		Keil Chemical Div.
CAU	Calcasieu Chemical Corp.	FIN	Hexcel Corp., Hexcel Specialty Chemicals FMC Corp.:
CBF	Chembond Corp.	FMB	Industrial Chemical Group
CBY	Crosby Chemicals, Inc.	FMB	Specialty Chemicals Group
CCA	Interstab Chemical, Inc.	FMP	Industrial Chemical Group
CCR	Pearsall Chemical Corp.	FMT	Fairmount Chemical Co., Inc.
CCL	Catawba-Charlab, Inc.	FOC	Handschy Chemical Co., Farac Oil & Chemical Div.
CCW	Cincinnati Milacron Chemicals, Inc.	FRO	Vulcan Materials Co., Chemicals Div.
CEL	Celanese Corp.:	FTE	Foote Mineral Co.
	Celanese Chemical Co.		
	Celanese Fibers Co.	GAF	GAF Corp.
CGY	Ciba-Geigy Corp.	GAN	Gane's Chemical Works, Inc.
CHG	Mobay Chemical Corp., Chemagro Agricultural Div.	GIV	Givaudan Corp.
CHL	Chemol, Inc.	GLY	Glyco Chemicals, Inc.
CHP	C. H. Patrick & Co., Inc.	GNM	General Mills Chemicals, Inc.
CHT	Chatten Drug & Chemical Co., Chatten Chemicals Div.	GOC	Gulf Oil Corp., Gulf Oil Chemicals Co.-U.S.
CLK	Clark Chemical Corp.	GP	Georgia-Pacific Corp.:
CLN	Standard Brands, Inc., Clinton Corn Processing Co. Div.		Plaquemine Div.
			Resins Operations

TABLE 3.--MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS: DIRECTORY  
OF MANUFACTURERS, 1977--CONTINUED

Code	Name of company	Code	Name of company
GRD	W. R. Grace & Co., Polymers & Chemicals Div.	OCC	Oxirane Chemical Co.
GTL	Great Lakes Chemical Corp.	OH	Airco, Inc., Ohio Medical Products Div.
GVR	Goodyear Tire & Rubber Co.	OMC	Olin Corp.
HAL	C.P. Hall Co.	ONX	A Kewanee Industry, Millmaster Onyx Group, Onyx Chemical Co.
HCF	Hercofina	ORO	Chevron Chemical Co.
HCP	Honig Chemical & Processing Corp.	ORT	Roehr Chemicals, Inc.
HDG	Hodag Chemical Corp.	OXC	Oxochem Enterprise
HDW	Hardwicke Chemical Co.	OXI	Oxirane Chemical Co. (Channelview)
HEX	Hexagon Laboratories, Inc.	PAS	Pennwalt Corp.
HFT	Syntex Agrusiness, Inc.	PD	Parke, Davis & Co. Sub of Warner-Lambert Co.
HK	Hooker Chemicals & Plastic Corp.:	PEN	CPC International, Inc., Penick Corp.
HKD	Durez Div.	PFN	Pfanstiehl Laboratories, Inc.
HMP	W. R. Grace & Co., Organic Chemicals Div.	PFX	Plastifax, Inc.
HMY	Humphrey Chemical Co.	PFZ	Pfizer, Inc. & Pfizer Pharmaceuticals, Inc.
HN	Tenneco Chemicals, Inc.	PG	Procter & Gamble Co.
HPC	Hercules, Inc.	PIC	Pierce Chemical, Inc.
HRT	Hart Products Corp.	PLC	Phillips Petroleum Co.
HSB	Harshaw Chemical Co.	PLS	Plastics Engineering Co.
HUM	Kraft, Inc., Humko Products Chemical Div.	PMP	Premier Malt Products, Inc.
ICI	ICI United States, Inc.:	PPG	PPG Industries, Inc.
	Chemical Specialties Group	PST	Perstorp, Inc., Toledo Div.
	Plastics Div.	PTT	Petro-Tex Chemical
IMC	IMC Chemical Group, Inc., Nitroparaffin Div.	PUB	Publisher Industries, Inc.
IOC	Ionac Chemical Co. Div. of Sybron Corp.	PVO	PVO International, Inc.
JCC	Jefferson Chemical Co., Inc.	QKO	Quaker Oats Co.
KAI	Kaiser Aluminum & Chemical Corp.	RBC	Fike Chemicals, Inc.
KCC	Kennecott Copper Corp., Chino Mines Div.	RCI	Reichhold Chemicals, Inc.
KCH	Joseph Ayers, Inc.	RCN	Racon, Inc.
KF	Kay-Fries Chemicals, Inc.	RDA	Rhodia, Inc.
KPT	Koppers Co., Inc.	REH	Reheis Chemical Co. Div. of Armour Pharmaceutical Co.
LEM	Napp Chemicals, Inc.	REM	Remington Arms Co., Inc.
MAL	Mallinckrodt Chemical Works	RH	Rohm & Haas Co.
MCB	Borg-Warner Corp., Borg-Warner Chemicals	RSA	R.S.A. Corp.
MCI	Mooney Chemicals, Inc.	RUB	Hooker Chemical Corp., Ruco Div.
MHI	Ventron Corp.	RUC	Rubicon Chemicals, Inc.
MLL	Milliken & Co., Milliken Chemical Div.	S	Sandoz, Inc.
MLS	Miles Laboratories, Inc., Marschall Div.	SAL	Salsbury Laboratories
MMM	Minnesota Mining & Manufacturing Co.	SAR	Sartomer Industries, Inc.
MNO	Monochem, Inc.	SEC	Scher Bros.
MNR	Monroe Chemical	SCM	SCM Corp.
MOB	Mobay Chemical Co.	SCP	Henkel, Inc.
MON	Monsanto Co.	SDC	Martin-Marietta Corp., Sodeyco Div.
MRK	Merck & Co., Inc.	SDW	Sterling Drug, Inc., Winthrop Laboratories Div.
MRT	Morton Chemical Co. Div. of Morton Norwich Products, Inc.		Stauffer Chemical Co.:
MTO	Montrose Chemical Corp. of California	SFA	Agricultural Div.
NCI	Union Camp Corp.	SFC	Calhio Chemicals, Inc. Div.
NEV	Neville Chemical Co.	SFI	Industrial Div.
NOC	Norac Co., Inc. and Mathe Div.	SFP	Plastics Div.
NP1	Stephan Chemical Co., Polychem Dept.	SFS	Specialty Chemical Div.
NSC	National Starch & Chemical Corp.	SHC	Shell Oil Co., Shell Chemical Co. Div.
NTB	National Biochemical Co.	SHP	Shepherd Chemical Co.
NTL	NL Industries, Inc.	SK	SmithKline Chemicals
NWP	Northern Petrochemicals Co.	SKO	Getty Refining & Marketing Co.

TABLE 3.--MISCELLANEOUS CYCLIC AND ACYCLIC CHEMICALS: DIRECTORY OF MANUFACTURERS, 1977--CONTINUED

Code	Name of company	Code	Name of company
SM	Mobil Oil Corp., Chemical Co.: Chemical Coatings Div. Phosphorus Div.	USB	U.S. Borax Research Corp.
SNO	SunOlin Chemical Co.	USI	U.S. Industrial Chemicals Co., National Distillers & Chemicals Corp.
SNW	Sun Chemical Corp., Chemical Div.	USO	U.S. Oil Company
SOC	Standard Oil Co. of California, Chevron Chemical Co.	USR	Uniroyal, Inc., Uniroyal Chemical Div.
SOH	Vistron Corp.	USS	USS Chemicals Div. of U.S. Steel Corp.
SPD	General Electric Co., Silicone Products Dept.	VAL	Valchem Div. of United Merchants & Manufacturing, Inc.
STC	American Hoechst Corp., Sou-Tex Works	VEL	Velsicol Chemical Corp.
STP	Stepan Chemical Co.	VGC	Virginia Chemicals, Inc.
SW	Sherwin-Williams Co.	VIK	Viking Chemical Co.
SWS	Stauffer Chemical Co., SWS Silicones Div.	VND	Van Dyk & Co., Inc.
SYP	Dart Industries, Inc., Synthetic Products Co. Div.	VTC	Vicksburg Chemical Co. Sub. of Vertac Consolidated
TCC	Tanatex Chemical Co.	WAG	West Agro Chemical, Inc.
TCH	Emery Industries Inc., Trylon Div.	WAY	Phillip A. Hunt Chemical Corp., Organic Chemical Div.
TKL	Thiokol Chemical Corp.	WCC	White Chemical Corp.
TNA	Ethyl Corp.	WCL	Wright Chemical Corp.
TNI	The Gillette Co., Chemical Div.	WLN	Wilmington Chemical Corp.
TRO	Troy Chemical Corp.	WM	Inolex Corp.
TSA	Texas Alkyls, Inc.	WTC	Witco Chemical Corp.
TX	Texaco, Inc.	WTH	Union Camp Corp., Chemical Div.
TZC	Magnesium Elektron, Inc.	WTL	Pennwalt Corp., Lucidol Div.
UCC	Union Carbide Corp.	WYC	Wycon Chemical Co.
UOP	UOP, Inc., Chemical Div.	WYT	Wyeth Laboratories, Inc., Wyeth Laboratories Div. of American Home Products Corp.
UPJ	Upjohn Co.	ZGL	Carolina Processing Corp.
UPM	UOP, Inc.		

Note.--Complete names and addresses of the above reporting companies are listed in table 1 of the Appendix.



## APPENDIX

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977

(Names of synthetic organic chemical manufacturers that reported production and/or sales to the U.S. International Trade Commission for 1977 are listed below alphabetically, together with their identification codes as used in table 2 of the 15 individual sections of this report)

Identification code	Name of company	Office address
AEP	A & E Plastik Pak Co., Inc-----	14505 Proctor Ave., Industry, CA 91749.
AZS	AZS Corp.: AZ Products Co. Div----- AZS Chemical Co.-----	2525 So. Combee Rd., Eaton Park, FL 33840. 762 Marietta Blvd., N.W., Atlanta, GA 30313.
ABB	Abbott Laboratories-----	14th St. and Sheridan Rd., N. Chicago, IL 60064.
ABS	Abex Corp., Friction Products Group-----	P. O. Box 3207, Winchester, VA 22601.
WLC	Agrico Chemical Co-----	P. O. Box 3166, Tulsa, OK 74101.
ACY	Agway, Inc., Olean Nitrogen Div-----	1446 Buffalo St., Olean, NY 14760.
OH	Airco, Inc., Ohio Medical Products Div-----	3030 Airco Dr., Madison, WI 53701.
AIP	Air Products & Chemicals, Inc.-----	P. O. Box 538, Allentown, PA 18105.
ALC	Alco Chemical Corp-----	Trenton Ave. and William St., Philadelphia, PA 19134.
AAC	Alcolac, Inc-----	3440 Fairfield Rd., Baltimore, MD 21212.
ALD	Aldrich Chemical Co., Inc-----	940 W. St. Paul Ave., Milwaukee, WI 53233.
ALL	Alliance Chemical Corp----- Allied Chemical Corp.:	33 Avenue P, Newark, NJ 07105.
ACN	Agricultural Div-----	P. O. Box 2120, Houston, TX 77001.
ALF	Fibers Div-----	1411 Broadway - 38th Fl., New York, NY 10018.
ASC	Semet-Solvay Div-----	Columbia Rd., Morristown, NJ 07960.
ACS	Specialty Chemicals Div-----	P. O. Box 1219 R., Morristown, NJ 07960.
ACU	Union Texas Petroleum Div-----	P. O. Box 2120, Houston, TX 77001.
ALX	Alox Corp-----	3943 Buffalo Ave., Niagara Falls, NY 14303.
APH	Alpha Chemical Corp-----	P. O. Drawer A, Collierville, TN 38017.
ALP	Alpha Laboratories, Inc-----	1685 S. Fairfax St., Denver, CO 80222.
AMC	Amchem Products, Inc. Sub. of Union Carbide Corp.	Brookside Ave. and Spring Garden St., Ambler, PA 19002.
HES	Amerada Hess Corp. (Hess Oil Virgin Islands Corp.)	1 Hess Plaza, Woodridge, NJ 07095.
AMB	American Bio-Synthetics Corp-----	710 W. National Ave., Milwaukee, WI 53204.
MAR	American Can Co.-----	American Lane, Greenwich, CT 06830.
AC	American Color & Chemical Corp-----	P. O. Box 51, Reading, PA 19603.
ACY	American Cyanamid Co----- American Hoechst Corp.:	Wayne, NJ 07470.
HST	Hoechst Fibers Industries Div-----	Route 202-206 North, Somerville, NJ 08876.
HST	Industrial Chemicals Div-----	129 Quidnick St., Coventry, RI 02816.
STC	Sou-Tex Works-----	P. O. Box 866, Mount Holly, NC 28120.
ASY	American Synthetic Rubber Corp-----	4500 Camp Ground Rd., Louisville, KY 40216.
ALB	Ames Laboratories, Inc-----	200 Rock Lane, Milford, CT 06460.
ACC	Amoco Chemicals Corp-----	200 E. Randolph Dr., Chicago, IL 60680.
AMQ	Amoco Oil Company-----	200 E. Randolph Dr., Chicago, IL 60680.
PAN	Amoco Production Co-----	P. O. Box 591, Tulsa, OK 74102.
AMQ	Amoco Texas Refining Co-----	200 E. Randolph Dr., Chicago, IL 60680.
ADC	Anderson Development Co-----	1415 E. Michigan St., Adrian, MI 49221.
ASL	Ansul Chemical Co-----	1 Stanton St., Marinette, WI 54143.
APX	Apex Chemical Co., Inc-----	200 S. 1st St., Elizabethport, NJ 07206.
APO	Apollo Colors, Inc-----	899 Skokie Blvd., Northbrook, IL 60062.
ARA	Arapahoe Chemicals, Inc. Sub/Syntex U.S.A., Inc.	2075 N. 55th St., Boulder, CO 80302.
KPP	ARCO/Polymers, Inc-----	1500 Market St., Philadelphia, PA 19101.
ARD	Ardmore Chemical Co., Inc-----	840 Valleybrook Ave., Lyndhurst, NJ 07071.
ARN	Arenol Chemical Corp-----	40-33 23d St., Long Island City, NY 11101.
ARZ	Arizona Chemical Co-----	Berdan Ave., Wayne, NJ 07470.
AKS	Arkansas Co., Inc-----	185 Foundry St., Newark, NJ 07105.
ARC	Arnak Co-----	300 S. Wacker Dr., Chicago, IL 60606.
ACP	Armour-Dial, Inc-----	2000 Aucutt Rd., Montgomery, IL 60538.
ARP	Armour Pharmaceutical Co-----	P. O. Box 511, Kankakee, IL 60901.

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identifi- cation code	Name of company	Office address
ARK	Armstrong Cork Co-----	Charlotte & Liberty Sts., Lancaster, PA 17604.
ARL	Arol Chemical Products Co-----	649 Ferry St., Newark, NJ 07105.
ARS	Arsynco, Inc-----	P. O. Box 8, Carlstadt, NJ 07072.
ASH	Ashland Oil, Inc-----	1401 Winchester Ave., Ashland, KY 41101 and P. O. Box 2458, Columbus, OH 43216.
	Ashland Chemical Co-----	P. O. Box 2219, Dublin, OH 43216.
BLA	Astor Products, Inc., Blue Arrow Div-----	5244 Edgewood Ct., Jacksonville, FL 32205.
AST	Astra Pharmaceutical Products, Inc-----	7 Neponset St., Worcester, MA 01606.
ATL	Atlantic Chemical Corp-----	10 Kingsland Rd., Nutley, NJ 07110.
ATR	Atlantic Richfield Co-----	515 S. Flower St., Los Angeles, CA 90064.
APD	Atlas Powder Co. Sub. of Tyler Corp-----	P. O. Box 87, Joplin, MO 64801.
APR	Atlas Processing Co-----	P. O. Box 3099, 3333 Midway St., Shreveport, LA 71103.
KCH	Joseph Ayers, Inc-----	Route #2, Bethlehem, PA 18017.
BAS	BASF Wyandotte Corp-----	100 Cherry Hill Rd., Parsippany, NJ 07054.
BRP	BP Oil, Inc-----	397 Midland Bldg., Cleveland, OH 44115.
BKC	J. T. Baker Chemical Co-----	222 Red School Lane, Phillipsburg, NJ 08865.
BAL	Baltimore Paint & Chemical Co-----	2325 Hollins Ferry Rd., Baltimore, MD 21230.
BAX	Baxter/Travenol Laboratories, Inc-----	6301 N. Lincoln Ave., Morton Grove, IL 60053.
BAO	Bayoil Co., Inc-----	2 Union St., Peabody, MA 01960.
BEE	Beecham, Inc-----	65 Industrial S., Clifton, NJ 07012.
BIC	Beker Industries Corp-----	120 W. Putnam Ave., Greenwich, CT 06830.
BCM	Belding Chemical Industries-----	1430 Broadway, New York, NY 10018.
BME	Bendix Corp., FMD Div-----	P. O. Box 238, Troy, NY 12180.
BEN	Bennett's-----	2131 S. 300 West, Salt Lake City, UT 84115.
BDO	Benzenoid Organics, Inc-----	P. O. Box 157, Route 140, Bellingham, MA 02019.
PDC	Berncolors-Poughkeepsie, Inc-----	75 N. Water St., Poughkeepsie, NY 12602.
BNS	Binney and Smith, Inc-----	P. O. Box 431, 1100 Church Lane, Easton, PA 18042.
BOC	Biocraft Laboratories, Inc-----	12 Industrial Way, Waldwick, NJ 07463.
LAK	Bofors Lakeway, Inc-----	5025 Evanston Ave., Muskegon, MI 49443.
BOR	Borden, Inc.: Borden Chemical Div----- Printing Ink Div., Pigments Div-----	180 E. Broad St., Columbus, OH 43215. 630 Glendale-Hilford Rd., Cincinnati, OH 45215. International Center, Parkersburg, WV 26101.
MCB	Borg-Warner Corp., Borg-Warner Chemicals-----	18th and Kansas Avenue, Kansas City, KS 66105.
BFP	Breddo Food Products Corp., Inc-----	345 Park Ave., New York, NY 10022.
BRS	Bristol-Meyers Co-----	52d St. and Grays Ave., Philadelphia, PA 19143.
BRU	M. A. Bruder & Sons, Inc-----	2899 Jackson Ave., P.O. Box 8407, Memphis, TN 38108.
BUK	Buckeye Cellulose Corp-----	1256 N. McLean Blvd., Memphis, TN 38108.
BKM	Buckman Laboratories, Inc-----	340 Elk St., Buffalo, NY 14210.
BCC	Buffalo Color Corp-----	1953 S. Harvey St., Muskegon, MI 49442.
BUL	Burdick & Jackson Laboratories, Inc-----	3030 Cornwallis Rd., Research Triangle Park, NC 27709.
BUR	Burroughs Wellcome Co-----	
CFI	CF Industries, Inc----- CPC International, Inc.:	Salem Lake Dr., Long Grove, IL 60047
ACR	Acme Resin Corp-----	1401 S. Circle Avenue, Forest Park, IL 60130.
CRN	Amerchol-----	Talmadge Rd., Edison, NJ 08817.
PEN	Penick Corp-----	1050 Wall St. W., Lyndhurst, NJ 07071.
CPS	CPS Chemical Co-----	P. O. Box 162, Old Bridge, NJ 08857.
CBT	Samuel Cabot, Inc-----	One Union St., Boston, MA 02108.
CAU	Calcasieu Chemical Corp-----	P. O. Box 1522, Lake Charles, LA 70602.
CBM	Carborundum Co-----	P. O. Box 477, Niagara Falls, NY 14302.
CGL	Cargill, Inc-----	P. O. Box 9300, Minneapolis, MN 55402.
GOR	Carl Gordon Industries, Inc-----	1001 Southbridge St., Worcester, MA 01610.
ZGL	Carolina Processing Corp-----	P.O. Box 161, Severn, NC 27877.
CHC	Carpenter Chemical Co-----	P. O. Box 27205, Richmond, VA 23261.
JWC	J.W. Carroll & Sons Div. of U.S. Industries, Inc-----	P. O. Box 4908, Carson, CA 90745.
CRS	Carus Chemical Co-----	1500 8th St., LaSalle, IL 61301.

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identifi- cation code	Name of company	Office address
DOL	Castle & Cooke, Inc., Castle & Cooke Foods, Hawaii Pineapple Div.	650 Iwilei Rd., P. O. Box 3380, Honolulu, HI 96801.
CCL	Catawba-Charlab, Inc-----	5046 Old Pineville Rd., Charlotte, NC 28231.
CEL	Celanese Corp.: Celanese Chemical Co----- Celanese Fibers Co----- Celanese Plastics Co----- Celanese Polymer Specialties Co-----	1211 Avenue of the Americas, New York, NY 10036. P. O. Box 1414, Charlotte, NC 28201. 26 Main St., Chatham, NJ 07928. One Riverfront Plaza, Louisville, KY 40202. P. O. Box 860, Valley Forge, PA 19482.
CNT	Certainteed Corp-----	U.S. Highway 22, Hillside, NJ 07205.
CFR	Certified Processing Corp-----	P. O. Box 9176, Corpus Christi, TX 78408.
GRS	Champlin Petroleum Co-----	P. O. Box 5008, Houston, TX 77012.
SOG	Charter International Oil Co-----	1715 W. 38th St., Chattanooga, TN 37409.
CHT	Chattam Drug & Chemical Co-----	P. O. Box 270, Springfield, OR 97477.
CBD	Chembond Corp----- Chemed Corp.:	Dubois Tower, Cincinnati, OH 45202. 4963 Manchester Ave., St. Louis, MO 63110.
GRC	Dubois Chemicals Div-----	
GRL	Vestal Laboratories Div----- Chemetron Corp.:	P. O. 66251-AMP O'Hare, Chicago, IL 60666. 491 Columbia Ave., Holland, MI 49423.
CIN	Chemical Products Div-----	
HSC	Pigments Div., Sub. of Allegheny Ludlum Industries, Inc.	
CI	Chem-Fleur, Inc-----	200 Pulaski St., Newark, NJ 07105.
CHF	Chemical Formulators, Inc-----	P. O. Box 26, Nitro, WV 25143.
CHL	Chemol, Inc-----	P. O. Box 20687, Greensboro, NC 27420.
CFX	Chemplex Co-----	3100 Golf Rd., Rolling Meadows, IL 60008.
OKO	Chevron Chemical Co-----	575 Market St., Rm. 3280, San Francisco, CA 94105.
CHH	CHR. Hansen's Laboratory, Inc-----	9015 W. Maple St., West Allis, WI 53214.
CGY	Ciba-Geigy Corp----- Agricultural Div----- Pharmaceutical Div----- Resins Dept-----	444 Saw Mill River Rd., Ardsley, NY 19502. P. O. Box 11422, Greensboro, NC 27409. 556 Morris Ave., Summit, NJ 07901. 444 Saw Mill River Rd., Ardsley, NY 10502.
CCW	Cincinnati Milacron Chemicals, Inc-----	West St., Reading, OH 45215.
CIN	Cindet Chemicals, Inc-----	2408 Doyle St., P. O. Box 20926, Greensboro, NC 27406.
CBN	Cities Service Co.:	
TEN	Columbian Div-----	P. O. Box 300, Tulsa, OK 74102.
CBN	Copperhill Operations----- Petrochemicals Div-----	Copperhill, TN 37317. P. O. Box 1522, Lake Charles, LA 70602, and 6th & Boston Sts., Tulsa, OK 74102.
CSO	Petroleum Products Group-----	P. O. Box 1562, Lake Charles, LA 70602.
CLK	Clark Oil & Refining Corp-----	131st St. & Kedzie Ave., Blue Island, IL 60406.
CLY	W. A. Cleary Corp-----	P. O. Box 10, Somerset, NJ 08873.
CLI	Clintwood Chemical Co-----	4342 S. Wolcott Ave., Chicago, IL 60609.
CSP	Coastal States Petrochemical Co-----	P. O. Drawer 521, Corpus Christi, TX 78403.
CP	Colgate-Palmolive Co-----	300 Park Ave., New York, NY 10022.
COL	Collier Carbon & Chemical Corp-----	P. O. Box 60455, Los Angeles, CA 90060.
CLD	Colloids, Inc-----	394 Frelinghuysen Ave., Newark, NJ 07114.
CRC	Columbia Nitrogen Corp-----	P. O. Box 1483, Augusta, GA 30903.
CMF	Commercial Products Co., Inc-----	117 Ethel Ave., Hawthorne, NJ 07506.
COR	Commonwealth Oil Refining Co., Inc-----	Petrochemical Complex, Ponce, PR 00731.
CPI	Commonwealth Petrochemicals, Inc-----	Petrochemical Complex, Ponce, PR 00731.
CNI	Conap, Inc-----	1405 Buffalo St., Olean, NY 14760.
CNE & SED	Conchemco, Inc-----	1000 Marshall Dr., Lenexa, KS 66215, and 18th & Garfield Sts., Kansas City, MO 64127.
CON	Concord Chemical Co., Inc-----	17th & Federal Sts., Camden, NJ 08105.
CMF	Consolidated Papers, Inc-----	231 1st Ave N., Wisconsin Rapids, WI 54494.
CTL	Continental Chemical Co-----	270 Clifton Blvd., Clifton, NJ 07015.
CO	Continental Oil Co-----	P. O. Box 1267, 1000 South Pine, Ponce City, OK 74601.
CPV	Cook Paint & Varnish Co-----	P. O. Box 389, Kansas City, MO 64141.
CFA	Cooperative Farm Chemicals Association-----	P. O. Box 308, Lawrence, KS 66044.

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identifi- cation code	Name of company	Office address
COP	Coopers Creek Chemical Corp-----	River Rd., W. Conshohocken, PA 19428.
CPY	Copolymer Rubber & Chemical Corp-----	P. O. Box 2591, Baton Rouge, LA 70821.
SWC	Corco Cyclohexane, Inc-----	Petrochemical Complex, Ponce, PR 00731.
CSD	Cosden Oil & Chemical Co-----	P. O. Box 1311, Big Spring, TX 79720.
CRT	Crest Chemical Corp-----	225 Emmett St., Newark, NJ 07114.
CRD	Croda, Inc-----	51 Madison Ave., Suite 2518, New York, NY 10010.
ALT	Crompton & Knowles Corp., Dyes & Chemicals Div.	500 Pear St., Reading, PA 19603.
CBY	Crosby Chemicals, Inc-----	P. O. Box 460, Picayune, MS 39466.
CCP	Crown Central Petroleum Corp-----	1 N. Charles St., Baltimore, MD 21203.
CRZ	Crown Zellerbach Corp., Chemical Products Div.	Camas, WA 98607.
CTR	Customs Resins Div. of Bemis Co., Inc-----	P. O. Box 933, Henderson, KY 42420.
DAN	Dan River, Inc., Chemical Products Dept----- Dart Industries, Inc.:	P. O. Box 261, Danville, VA 24541.
AZT	Aztec Chemicals Div-----	555 Garden St., Elyria, OH 44035.
SYD	Synthetic Products Co. Div-----	1636 Wayside Rd., Cleveland, OH 44112.
DYS	Davies-Young Co-----	2700 Wagner Place, Maryland Heights, MO 63043.
DLI	Dawe's Laboratories, Inc-----	450 State St., Chicago Heights, IL 60411.
DGO	Day-Glo Color Corp-----	4732 St. Clair Ave., Cleveland, OH 44103.
DEG	Degen Oil & Chemical Co-----	200 Kellogg St., Jersey City, NJ 07305.
DKA	Denka Chemical Corp-----	8701 Park Place Blvd., Houston, TX 77017.
DNS	Dennis Chemical Co-----	2701 Papin St., St. Louis, MO 63103.
DSO	DeSoto, Inc-----	1700 S. Mt. Prospect Ave., Des Plaines, IL 60018.
DEX	Dexter Chemical Corp-----	845 Edgewater Rd., Bronx, NY 10474.
HYC	Hysol Div-----	211 Franklin St., Olean, NY 14760.
MID	Midland Div-----	1-7 E. Water St., Waukegan, IL 60085.
DA	Diamond Shamrock Corp-----	1100 Superior Ave., Cleveland, OH 44114.
PLN	Disogrin Industries Corp-----	Grenier Field, Manchester, NH 03130.
DIX	Dixie Chemical Co-----	3635 W. Dallas Ave., P. O. Box 13410, Houston, TX 77019.
DPP	Dixie Pine Chemicals, Inc-----	P. O. Box 470, Hattiesburg, MS 39401.
DOM	Dominion Products, Inc-----	882 3d Ave., Brooklyn, NY 11232.
DVC	Dover Chemical Corp. Sub. of ICC Industries, Inc.	15th & Davis Sts., Dover, OH 44622.
DBC	Dow Badische Chemical Co-----	602 Copper Rd., Freeport, TX 77541.
DOW	Dow Chemical Co-----	2020 Dow Center, Midland, MI 48640.
DCC	Dow Corning Corp-----	P. O. Box 1767, Midland, MI 48640.
DUP	E. I. duPont de Nemours & Co., Inc-----	DuPont Bldg., Wilmington, DE 19898.
DSC	Dye Specialties, Inc-----	26 Journal Sq., Jersey City, NJ 07306.
EP1	Eagle Pitcher Industries, Ohio Rubber Co. Div.	P. O. 1398, Denton, TX 76201.
EGR	Eagle River Chemical Corp-----	P. O. Box 2648, W. Helena, AR 72390.
ECC	Eastern Color & Chemical Co-----	35 Livingston St., Providence, RI 02904.
EK	Eastman Kodak Co-----	343 State St., Rochester, NY 14650.
EKT	Tennessee Eastman Co. Div-----	P. O. Box 511, Kingsport, TN 37662.
EXX	Texas Eastman Co. Div-----	P. O. Box 511, Kingsport, TN 37662.
ESA	East Shore Chemical Co., Inc-----	1221 E. Barney Ave., Muskegon, MI 49443.
ELN	Elan Chemical Co-----	268 Doremus Ave., Newark, NJ 07105.
ELC	Elco Corp. Sub. of Detrex Industries, Inc.	P. O. Box 09168, Cleveland, OH 44109.
ELP	El Paso Products Co-----	P. O. Box 3986, Odessa, TX 79760.
EMR	Emery Industries, Inc-----	1300 Carew Tower, Cincinnati, OH 45202.
TCH	Trylon Div-----	P. O. Box 628, Mauldin, SC 29662.
EMK	Emkay Chemical Co-----	319 2d St., Elizabeth, NJ 07206.
EN	Endo Laboratories, Inc-----	1000 Stewart Ave., Garden City, NY 11530.
ENO	Enenco, Inc-----	P. O. Box 398, Memphis, TN 38101.
ESS	Essential Chemicals Group-----	28391 Essential Rd., Merton, WI 53056.
TNA	Ethyl Corp-----	330 S. 4th St., Richmond, VA 23231.
EVN	Evans Chematics, Inc-----	90 Tokeneke Rd., Darien, CT 06820.
ENJ	Exxon Chemical Co. U.S.A-----	P. O. Box 3272, Houston, TX 77001.

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identification code	Name of company	Office address
	FMC Corp.:	
FMN	Agricultural Chemical Div-----	100 Niagara St., Middleport, NY 14105.
FMB	Industrial Chemical Group-----	2000 Market St., Philadelphia, PA 19103.
FMP	Industrial Chemical Group-----	2000 Market St., Philadelphia, PA 19103.
FMB	Specialty Chemicals Div-----	Sawyer Ave. & River Rd., Town of Tonawanda, NY 14150.
FRP	FRP Co-----	P. O. Box 349, Baxley, GA 31513.
FAB	Fabricolor Manufacturing Corp-----	24-1/2 Van Houten St., Paterson, NJ 07509.
FMT	Fairmount Chemical Co., Inc-----	117 Blanchard St., Newark, NJ 07105.
FRI	Farmland Industries, Inc-----	P. O. Box 7305, Kansas City, MO 64116.
FEL	Felton International, Inc-----	599 Johnson Ave., Brooklyn, NY 11235.
FER	Ferro Corp.:	
	Grant Chemical Div-----	P. O. Box 263, Baton Rouge, LA 70821.
	Keil Chemical Div-----	3000 Sheffield Ave., Hammond, IN 46320.
	Ottawa Chemical Div-----	700 N. Wheeling St., Toledo, OH 43605.
PRD	Productol Chemical Div-----	13215 E. Penn St., Whittier, CA 90602.
FND	Fiber Industries, Inc-----	P. O. Box 10038, Charlotte, NC 28201.
RBC	Fike Chemicals, Inc-----	P. O. Box 546, Nitro, WV 25143.
	Firestone Tire & Rubber Co.:	
FIR	Firestone Plastics Co. Div-----	P. O. Box 699, Pottstown, PA 19464.
FRF	Firestone Synthetic Fibers Co-----	P. O. Box 450, Hopewell, VA 23869.
FRS	Firestone Synthetic Rubber & Latex Co. Div.	381 W. Wilbeth Rd., Akron, OH 44301.
FST	First Chemical Corp-----	P. O. Box 1427, Pascagoula, MS 39567.
FMS	First Mississippi Corp-----	P. O. Box 1249, Jackson, MS 39205.
FLM	Fleming Laboratories, Inc-----	P. O. Box 10372, Charlotte, NC 28237.
CIK	Flint Ink Corp., Cal/Ink Div-----	1404 4th St., Berkeley, CA 94710.
FLO	Florasynth, Inc-----	410 E. 62nd St., New York, NY 10021.
FTE	Foote Mineral Co-----	Route 100, Exton, PA 19341.
FOM	Formica Corp-----	120 E. 4th St., Cincinnati, OH 45202.
FC	Foster Grant Co., Inc-----	289 N. Main St., Leominster, MA 01453.
FLN	Franklin Chemical Corp-----	2020 Bruck St., Columbus, OH 43207.
FRE	Freeman Chemical Corp-----	222 E. Main St., Port Washington, WI 53074.
FB	Fritzsche Dodge & Olcott, Inc-----	76 9th Ave., New York, NY 10011.
FLH	H. B. Fuller Co., Polymer Div-----	4450 Malsbary Rd., Blue Ash, OH 45242.
GAF	GAF Corp-----	P. O. Box 6037, Chattanooga, TN 37401 and 33 Riverside Ave., Rensselaer, NY 12144.
GLX	Galaxie Chemical Corp-----	26 Piercy St., Paterson, NJ 07524.
GAN	Gane's Chemicals, Inc-----	1144 Avenue of the Americas, New York, NY 10036.
GE	General Electric Co-----	1 Plastics Ave., Pittsfield, MA 01201 and 1350 S. Second St., Coshocton, OH 43812.
CEI	Insulating Materials Products Section-----	1 Campbell Rd., Schenectady, NY 12306.
SPD	Silicone Products Dept-----	Bldg. 11-24, Waterford, NY 12188.
GNF	General Foods Corp., Maxwell House Div-----	1125 Hudson St., Hoboken, NJ 07030.
GLC	General Latex & Chemical Corp-----	666 Main St., Cambridge, MA 02139.
GNM	General Mills Chemicals, Inc-----	4620 W. 77th St., Minneapolis, MN 55435.
GPM	General Plastics Manufacturing Co-----	3481 S. 35th St., Tacoma, WA 98409.
GNT	General Tire & Rubber Co., Chemical/ Plastics Div-----	1 General St., Akron, OH 44329.
GRC	P. D. George Co-----	5200 N. 2d St., St. Louis, MO 63147.
PSP	Georgia-Pacific Corp-----	P. O. Box 1235, Bellingham, WA 98225.
CP	Plaquemine Div-----	P. O. Box 629, Plaquemine, LA 70764.
CP	Resins Operations-----	900 S.W. 5th Ave., Portland, OR 97240.
SKO	Getty Refining & Marketing Co-----	P. O. Box 1650, Tulsa, OK 74102.
TID	Delaware Refinery-----	Delaware City, DE 19706.
TNI	The Gillette Co., Chemical Div-----	3500 W. 16th St., N. Chicago, IL 60064.
GIL	Gilman Paint & Varnish Co-----	216 W. 8th St., Chattanooga, TN 37401.
GIV	Givaudan Corp-----	100 Delawanna Ave., Clifton, NJ 07014.
GLY	Glyco Chemicals, Inc-----	51 Weaver St., Greenwich, CT 06830.
GPI	Goodpasture, Inc-----	P. O. Drawer 921, Brownfield, TX 79316.

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identifi- cation code	Name of company	Office address
BFG	B. F. Goodrich Co., B. F. Goodrich Chemical Co. Div.	6100 Dak Tree Blvd., Cleveland, OH 44131.
GVR	Goodyear Tire & Rubber Co-----	1144 E. Market St., Akron, OH 44316.
GCC	W. R. Grace & Co-----	P. O. Box 277, Memphis, TN 38101.
GRH	Hatco Chemical Div-----	King George Post Rd., Fords, NJ 08861.
MRO	Hatco Polyester Div-----	1711 Elizabeth Ave. West, Linden, NJ 07036.
HMF	Organic Chemicals Div-----	Poission Ave., Nashua, NH 03060.
GRD	Polymers & Chemicals Div-----	55 Hayden Ave., Lexington, MA 02173.
GRA	Great American Chemical Corp-----	650 Water St., Fitchburg, MA 01420.
CTL	Great Lakes Chemical Corp-----	P. O. Box 2200, West Lafayette, IN 47906.
GRW	Great Western Sugar Co-----	P. O. Box 5308, Terminal Annex, Denver, CO 80217.
GNM	Greenwood Chemical Co-----	P. O. Box 26 - State Highway #690, Greenwood, VA. 22943.
GRO	A. Gross & Co., Millmaster Onyx Group, Keweenaw Industries, Inc.	625 Doremus Ave., Newark, NJ 07105.
GRV	Guardsman Chemical, Inc-----	1350 S. 15th St., Louisville, KY 40210.
GOC	Gulf Oil Corp., Gulf Oil Chemicals Co. - U.S.	P. O. Box 3766, Houston, TX 77001.
GTH	Guth Corp-----	322 S. Center St., Hillside, IL 60162.
HNC	H & N Chemicals Co-----	90 Maltese Dr., Totowa, NJ 07512.
HLI	Haag Laboratories, Inc-----	14010 S. Seeley Ave., Blue Island, IL 60406.
HAL	C. P. Hall Co-----	7300 S. Central Ave., Chicago, IL 60638.
FOC	Handschy Chemical Co., Farac Oil and Chemical Div.	13601 S. Ashland Ave., Riverdale, IL 60627.
HAN	Hanna Chemical Coatings Corp-----	P. O. Box 147, Columbus, OH 43216.
HDM	Hardman, Inc-----	600 Cortlandt St., Belleville, NJ 07109.
HDW	Hardwicke Chemical Co-----	Route 2, Box 50A, Elgin, SC 29045.
HRC	Harmon Colors Corp-----	550 Belmont Ave., Haledon, NJ 07507.
HSR	Harshaw Chemical Co-----	1945 E. 97th St., Cleveland, OH 44106.
HRT	Hart Products Corp-----	173 Sussex St., Jersey City, NJ 07302.
HVG	Haveg Industries, Inc. Sub. of Hercules, Inc.	900 Greenback Rd., Wilmington, DE 19808.
HKY	Hawkeye Chemical Co-----	P. O. Box 899, Clinton, IA 52733.
SCP	Henkel, Inc-----	400 Alfred Ave., Teaneck, NJ 07666.
HCF	Hercofina-----	310 N. Front St., Wilmington, NC 28402.
HCR	Hercor Chemical Corp-----	Petrochemical Complex, Ponce, PR 00731.
HPC	Hercules, Inc-----	910 Hercules Tower, Wilmington, DE 19899.
HER	Heresite & Chemical Co-----	822 S. 14th St., Manitowoc, WI 54220.
HET	Heterochemical Corp-----	111 E. Hawthorne Ave., Valley Stream, NY 11580.
HEW	Hewitt Soap Co., Inc-----	333 Linden Ave., Dayton, OH 45403.
HEX	Hexagon Laboratories, Inc-----	4166 Boston Rd., Bronx, NY 10475.
REZ	Hexcel Corp-----	20701 Nordhoff St., Chatsworth, CA 91311.
FIN	Hexcel Specialty Chemicals-----	205 Main St., Lodi, NJ 07644.
HDG	Hodag Chemical Corp-----	7247 N. Central Park Ave., Skokie, IL 60076.
HOF	Hoffmann-LaRoche, Inc-----	324-424 Kingsland St., Nutley, NJ 07110.
HCP	Honig Chemical & Processing Corp-----	414 Wilson Ave., Newark, NJ 07105.
HK	Hooker Chemicals & Plastics Corp-----	MPO Box 8, Niagara Falls, NY 14302.
HKD	Durez Div-----	Walck Ed., N. Tonawanda, NY 14121.
RUB	Ruco Div-----	P. O. Box 456, Revin Rd., Burlington, NJ 08016.
EPH	E. F. Houghton & Co-----	303 W. Lehigh Ave., Philadelphia, PA 19133.
HMY	Humphrey Chemical Co-----	Devine St., North Haven, CT 06473.
WAY	Phillip A. Hunt Chemical Corp., Organic Chemical Div.	P. O. Box 4249, E. Providence, RI 02914.
HNT	Huntington Laboratories, Inc-----	970 E. Tipton St., Huntington, IN 46750.
HUS	Husky Industries, Inc-----	62 Perimeter Center E., Atlanta, GA 30346.
HYN	Hynson, Westcott & Dunning, Inc-----	Charles and Chase Sts., Baltimore, MD 21201.
ICI	ICI United States, Inc.: Chemical Specialties Co----- Plastics Div----- Specialty Chemicals Group-----	Wilmington, DE 19897. Wilmington, DE 19897. Wilmington, DE 19897.

TABLE I.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identifi- cation code	Name of company	Office address
IMC	IMC Chemical Group, Inc----- McWorter Resins----- Nitroparaffin Div-----	P. O. Box 207, Terre Haute, IN 47808; P. O. Box 149, Orrington, ME 04474 and 100 Lister Ave., Newark, NJ 07105. P. O. Box 308, Cottage Pl., Carpentersville, IL 60110
RAY	ITT Rayonier, Inc-----	666 Garland Pl., Des Plaines, IL 60016.
IND	Indol Chemical Co., Inc-----	605 3d Ave., New York, NY 10016.
INF	Indpol, Inc-----	Ft. of Leffert St., Carterit, NJ 07008.
INL	Inland Steel Co., Inland Steel Container Co.	P. O. Box 1213, Tustin, CA 92680. 4300 W. 130th St., Chicago, IL 60658.
ICC & ICF	Inmont Corp-----	1255 Broad St., Clifton, NJ 07015, and 150 Magaraw Rd., Hawthorne, NJ 07506.
WM	Inolex Corp-----	Jackson & Swanson Sts., Philadelphia, PA 19148.
WIL	Inolex Pharmaceutical Div-----	2600 Bond St., Park Forest South, IL 60466.
SPC	Insilco Corp., Sinclair Paint Co. Div-----	3960 E. Washington Blvd., Los Angeles, CA 90023.
IFF	International Flavor and Fragrances, Inc-----	521 W. 57th St., New York, NY 10019.
IPC	Interplastic Corp-----	2015 ME. Broadway St., Minneapolis, MN 55413.
GCA	Interstab Chemical, Inc-----	500 Jersey Ave., New Brunswick, NJ 08903.
IOC	Ionac Chemical Co. Div. of Sybron Corp-----	Birmingham Bldg., Birmingham, NJ 08011.
IRI	Ironsidcs Co-----	270 W. Round St., Columbus, OH 43216.
JCC	Jefferson Chemical Co., Inc-----	P. O. Box 52332, Houston, TX 77052.
JFR	George A. Jeffreys & Co., Inc-----	P. O. Box 709, Salem, VA 24153.
JEN	Jenison-Wright Corp-----	P. O. Box 691, Toledo, OH 43694.
JRG	Andrew Jergens Co-----	2535 Spring Grove Ave., Cincinnati, OH 45214.
UPF	Jim Walter Resources, Inc-----	3300 1st Ave. N., Birmingham, AL 35207.
JNS	S. C. Johnson & Son, Inc-----	1525 Howe St., Racine, WI 53403.
JOB	Jones-Blair Co-----	2728 Empire Central, Dallas, TX 75235.
JOR	Jordan Chemical Co-----	1830 Columbia Ave., Folcroft, PA 19032.
KAI	Kaiser Aluminum & Chemical Corp-----	P. O. Box 337, Gramercy, LA 70052.
SNI	Kaiser Agricultural Chemicals Div-----	P. O. Box 246, Savannah, GA 31402.
KLM	Kalama Chemical, Inc-----	1110 The Bank of California Center, Seattle, WA 98164
KF	Kay-Fries Chemicals, Inc., Member Dynamit Nobel Group.	200 Summit Ave., Montvale, NJ 07645.
KMP	Kelly-Moore Paint Co----- Kennecott Copper Corp.:	987 Commercial St., San Carlos, CA 94070.
KCC	Chino Mines Div-----	Hurley, MN 88043.
KCU	Utah Copper Div-----	P. O. Box 11299, Salt Lake City, UT 84147.
AMP	Kerr-McCee Chemical Corp----- A Kewanee Industry:	1101 McGee Tower, Oklahoma City, OK 73102.
BKL	Millmaster Chemical Co. Div----- Millmaster Onyx Group:	99 Park Ave., New York, NY 10016.
ONX	Onyx Chemical Co. Div-----	190 Warren St., Jersey City, NJ 07302.
RPC	Refined-Onyx Co. Div-----	624 Schuyler Ave., Lyndhurst, NJ 07071.
KYS	Keycor Corp-----	P. O. Box 308, Saugus, CA 91350.
KCW	Keystone Color Works, Inc-----	151 W. Gay Ave., York, PA 17403.
KNP	Knapp Products, Inc-----	187 Garibaldi Ave., P. O. Box 405, Lodi, NJ 07644.
KMC	Kohler-McLister Paint Co-----	P. O. Box 546, Denver, CO 80201.
KON	H. Kohnstamm & Co., Inc-----	161 Avenue of the Americas, New York, NY 10013.
KPT	Koppers Co., Inc-----	Koppers Bldg., Pittsburgh, PA 15219.
HUM	Roads Materials Div----- Kraft, Inc., Humko Sheffield Chemical Operation.	Koppers Bldg., Pittsburgh, PA 15219. P. O. Box 398, Memphis, TN 38101.
LKY	Lake States Div. of St. Regis Paper Co-----	515 W. Davenport St., Rhinelander, WI 54501.
LUR	Laurel Products Corp-----	2600 E. Tioga St., Philadelphia, PA 19134.
LEA	Leatex Chemical Co-----	2722 N. Hancock St., Philadelphia, PA 19133.
LEV	Lever Brothers Co-----	390 Park Ave., New York, NY 10022.
LVR	C. Lever Co., Inc-----	736 Dunks Ferry Rd., Cornwells Hgts. PA 19020.
BLS	Life Savers, Inc-----	Church St., Canajoharie, NY 13317.
LIL	Eli Lilly & Co-----	P. O. Box 618, Indianapolis, IN 46206 and C.P.O. Box 4388, San Juan, PR 00936.
BRD	Lonza, Inc-----	22-10 Route 208, Fair Lawn, NJ 07410.



TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identifi- cation code	Name of company	Office address
MMC	MC&B Manufacturing Chemists, Inc-----	2909 Highland Ave., Norwood, OH 45212.
SOR	MW Manufacturers, Southern Resin Div-----	P. O. Box 68, Thomasville, NC 27360.
TZC	Magnesium Elektron, Inc-----	Star Route A, Box 202-1, Flemington, NJ 08822.
MGR	Magruder Color Co., Inc-----	1029 Newark Ave., Elizabeth, NJ 07201.
MAL	Mallinckrodt, Inc-----	675 Brown Rd., St. Louis, MO 63134.
TRD	Manufacturing Enterprises, Inc., Squibb Manufacturing, Inc., Trade Enterprises, Inc., Ersana, Inc.-----	P. O. Box 609, Humacao, PR 00661.
MOR	Marathon Morco Co-----	P. O. Drawer C, 4401 Park Ave., Dickinson, TX 77539.
MOC	Marathon Oil Co., Texas Refining Div-----	P. O. Box 1191, Texas City, TX 77590.
MRB	Marlette Co-----	37-31 30th St., Long Island City, NY 11101.
MRD	Marden-Wild Corp-----	500 Columbia St., Somerville, MA 02143.
MRV	Marlowe-Van Loan Corp-----	P. O. Box 1851, High Point, NC 27260.
SDC	Martin-Marietta Corp., Sodyeco Div-----	P. O. Box 10098, Charlotte, NC 28237.
MRX	Max Marx Color & Chemical Co-----	192 Goit St., Irvington, NJ 07111.
MCA	Masonite Corp., Alpine Chemical Div-----	P. O. Box 2392, Gulfport, MS 39503.
MAY	Otto B. May Co. Div. of Cone Mills Corp-----	52 Amsterdam St., Newark, NJ 07105.
MCC	McCloskey Varnish Co-----	7600 State Rd., Philadelphia, PA 19136.
MCC	McCloskey Varnish Co. of the Northwest-----	4155 N.W. Yeon Ave., Portland, OR 97210.
MCC	McCloskey Varnish Co. of the West-----	5501 E. Slauson, Los Angeles, CA 90040.
MGK	McLaughlin Gormley King Co-----	8810 10th Ave., N., Minneapolis, MN 55427.
MDJ	Mead Johnson & Co-----	2404 Penna. St., Evansville, IN 47721.
MLC	Melamine Chemicals, Inc-----	P. O. Box 748, Donaldsonville, LA 70346.
MRK	Merck & Co., Inc-----	126 E. Lincoln Ave., P. O. Box 2000, Rahway, NJ 07065.
MER	Merichem Co-----	1914 Haden Rd., Houston, TX 77015.
PPF	Midwest Manufacturing Corp-----	Oak St. at Bluff Rd., Burlington, IA 52601.
MLS	Miles Laboratories, Inc.: Marschall Div----- Sumner Div-----	1127 Myrtle St., Elkhart, IN 46514. 1127 Myrtle St., Elkhart, IN 46514.
MIL	Milliken & Co., Milliken Chemical Div-----	P. O. Box 817, Inman, SC 29349.
MMM	Minnesota Mining & Manufacturing Co-----	3M Center, St. Paul, MN 55101.
MIR	Miranol Chemical Co., Inc-----	277 Cuit St., Irvington, NJ 07111.
MSC	Mississippi Chemical Corp-----	P. O. Box 388, Yazoo City, MS 39194.
MOB	Mobay Chemical Corp-----	Penn Lincoln Parkway, W. Pittsburgh, PA 15205.
CHG	Chemagro Agricultural Div-----	P. O. Box 4913, Hawthorne Rd., Kansas City, MO 64120.
VPC	Verona Div-----	lorio Ct., Union, NJ 07083.
SM	Mobil Oil Corp----- Mobil Chemical Co----- Chemical Coatings Div----- Phosphorus Div-----	P. O. Box 900, Dallas, TX 75221. P. O. Box 3868, Beaumont, TX 77704. 1024 South Ave., Plainfield, NJ 07062. P. O. Box 26683, Richmond, VA 23261.
MOA	Mona Industries, Inc-----	65 E. 23d St., Paterson, NJ 07524.
MNO	Monocho, Inc-----	P. O. Box 488, Geismar, LA 70734.
MNR	Monroe Chemical Co-----	1296 N.W. 3rd, Kalamazoo, WA 98625.
MON	Monsanto Co-----	800 N. Lindbergh Blvd., St. Louis, MO 63166.
MTO	Montrose Chemical Corp. of California-----	3250 Wilshire Blvd. Suite 1800, Los Angeles, CA 90010.
MCI	Mooney Chemicals, Inc-----	2301 Scranton Rd., Cleveland, OH 44113.
MCP	Moretex Chemical Products, Inc----- Morton Norwich Products, Inc.:	P. O. 1799, Spartanbury, SC 29304.
MRT	Morton Chemical Co. Div-----	110 N. Wacker Dr., Chicago, IL 60606.
NOR	Norwich Eaton Pharmaceutical Div-----	17 Eaton Ave., Norwich, NY 13815.
MOT	Motomco, Inc-----	267 Vreeland Ave., P. O. Box 300, Paterson, NJ 07513.
PNX	Murphy-Phoenix Co-----	9505 Cassius Ave., Cleveland, OH 44105.
NTL	NL Industries, Inc-----	1230 Avenue of the Americas, New York, NY 10020.
CHN	N-Ren Corp., Cherokee Nitrogen Div-----	P. O. Box 429, Pryor, OK 74361.
LEM	Napp Chemicals, Inc-----	199 Main St., Lodi, NJ 07644.
NTB	National Biochemical Co-----	3127 W. Lake St., Chicago, IL 60612.
NTC	National Casein Co-----	601 W. 80th St., Chicago, IL 60620.

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identifi- cation code	Name of company	Office address
NMC	National Milling & Chemical Co-----	4601 Flat Rock Rd., Philadelphia, PA 19127.
NSC	National Starch & Chemical Corp-----	10 Funderne Ave., Bridgewater, NJ 08876.
NES	Nease Chemical Co., Inc-----	P. O. Box 221, Route 26N, State College, PA 16801.
NEP	Nepera Chemical Co., Inc-----	Route 17, Harriman, NY 10926.
NEV	Neville Chemical Co-----	Neville Island P. O., Pittsburgh, PA 15225.
NLO	Niklor Chemical Co-----	2060 E. 220th St., Long Beach, CA 90810.
NIL	Nilok Chemicals, Inc-----	2235 Langdon Farm Rd., Cincinnati, OH 45230.
JDC	Nipak, Inc-----	P. O. Box 2820, Dallas, TX 75221.
CNP	Nipro, Inc-----	P. O. Box 1483, Augusta, GA 30903.
NOC	Norac Co., Inc-----	405 S. Motor Ave., Azusa, CA 91703.
	Mathe Div-----	169 Kennedy Dr., Lodi, NJ 07644.
NEO	Norda, Inc-----	140 Route 10, E. Hanover, NJ 07936.
NPV	Norris Paint & Varnish Co., Inc-----	P. O. Box 2023, Salem, OR 97308.
LMI	North American Chemical Co-----	19 S. Canal St., Lawrence, MA 01843.
NWP	Northern Petrochemical Co-----	2350 E. Devon Ave., Des Plaines, IL 60018.
NW	Northwestern Chemical Co-----	120 N. Aurora St., W. Chicago, IL 60185.
NPC	Northwest Petrochemical Corp-----	P. O. Box 99, Anacortes, WA 98221.
NCW	Nostrup Chemical Works, Inc-----	P. O. Box 160, Bedricktown, NJ 08067.
CAD	Noury Chemical Corp-----	2153 Lockport-Olcott Rd., Burt, NY 14028.
NVT	Novamont Corp-----	P. O. Box 189, Kenova, WV 25530.
CMC	Nyanza, Inc-----	Megunco Rd., Ashland, MA 01721.
OB	O'Brien Corp-----	2001 W. Washington Ave., South Bend, IN 46634.
FLW	Fuller-O'Brien Div-----	450 E. Grand Ave., S. San Francisco, CA 94080.
OMC	Olin Corp-----	120 Long Ridge Rd., Stamford, CT 06904.
	Agricultural Products Dept-----	P. O. Box 991, Little Rock, AR 72203.
OPC	Orbis Products Corp-----	140 Route 10, E. Hanover, NJ 07936.
ORG	Organics, Inc-----	7125 N. Clark St., Chicago, IL 60628.
BSW	Original Bradford Soap Works, Inc-----	200 Providence St., W. Warwick, RI 02893.
OCF	Owens-Corning Fiberglas Corp-----	Fiberglas Tower, Toledo, OH 43659.
OCC	Oxirane Chemical Co-----	10801 Choate Rd., Pasadena, TX 77507.
OXI	Oxirane Chemical Co. (Channelview)-----	P. O. Box 580, Channelview, TX 77530.
OXC	Oxochem Enterprise-----	King George Post Rd., Fords, NJ 08863.
PLB	P-L Biochemical, Inc-----	1037 W. McKinley Ave., Milwaukee, WI 53201.
PPC	PPG Industries, Inc-----	1 Gateway Center, Pittsburgh, PA 15222.
PTO	P. R. Chemical Co., Inc-----	P. O. Box 496, Arecibo, PR 00612.
PVO	PVO International, Inc., Chemical Specialties Div-----	416 Division St., Boonton, NJ 07005.
AMR	Pacific Resins & Chemicals, Inc-----	1754 Thorne Rd., Tacoma, WA 93421.
PMT	Fantasote Co. of New York, Inc-----	26 Jefferson St., Passaic, NJ 07056.
PD	Parke, Davis & Co. Sub. of Warner- Lambert Co-----	P. O. Box 118, Detroit, MI 48232.
PSC	Passaic Color & Chemical Co-----	28-36 Paterson St., Paterson, NJ 07501.
KAL	Fathan Chemical Co-----	427 Moyer St., Philadelphia, PA 19125.
CHP	C. H. Patrick & Co., Inc-----	P. O. Box 2526, Greenville, SC 29602.
CCH	Peargall Chemical Corp-----	P. O. Box 437, Houston, TX 77001.
PEK	Peck's Products Co-----	610 E. Clarence St., Louis, MO 63147.
PCH	Peerless Chemical Co-----	12416 Cloverdale St., Detroit, MI 48204.
AES	Penetone Corp-----	74 Hudson Ave., Tenafly, NJ 07670.
PAS	Pennwalt Corp-----	3 Parkway, Philadelphia, PA 19102.
WTL	Lucidol Div-----	1740 Military Rd., Buffalo, NY 14240.
PAR	Pennzoil Co., Penreco Div-----	Union Bank Bldg., Butler, PA 16001.
PER	Perry & Derrick Co., Inc-----	2510 Highland Ave., Norwood, OH 45212.
PST	Perstop, Inc., Toledo Div-----	600 Matzinger Rd., Toledo, OH 43612.
UDI	Petrochemicals Co., Inc-----	P. O. Box 2199, Fort Worth, TX 76101.
PTT	Petro-Tex Chemical Corp-----	8600 Park Place Blvd., Houston, TX 77017.
PCN	Pfanstiehl Laboratories, Inc-----	1219 Glen Rock Ave., Waukegan, IL 60085.
PFW	Pfister Chemical, Inc-----	Route 46 & Linden Ave., Ridgefield, NJ 07657.
PFZ	Pfizer, Inc-----	235 E. 42d St., New York, NY 10017.
	Pfizer Pharmaceuticals, Inc-----	P. O. Box 628, Barceloneta, PR 00617.

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identification code	Name of company	Office address
PHR	Pharmachem Corp-----	P. O. Box 1035, Bethlehem, PA 18018.
FDI	Phelps Dodge Industries, Inc., Phelps Dodge Magnet Wire Co. Div.	132 E. Creighton Ave., Fort Wayne, IN 46863.
PLC	Phillips Petroleum Co-----	15C1 Phillips Bldg., Bartlesville, OK 74003.
PPR	Phillips Puerto Rico Core, Inc-----	GPO Box 4129, San Juan, PR 00936.
PIC	Pierce Chemical Co-----	3747 N. Meridian Rd., Rockford, IL 61103.
PIL	Pilot Chemical Co-----	11756 Burke St., Santa Fe Springs, CA 90670.
PPL	Pioneer Plastics Div. of LOF Plastics, Inc.	Pionite Rd., Auburn, ME 04210.
PIT	Pitt-Consol Chemical Co-----	P. O. Box 1267, 1000 S. Pine, Ponca City, OK 74601.
PLS	Plastics Engineering Co-----	3518 Lakeshore Rd., Sheboygan, WI 53081.
PMC	Plastics Manufacturing Co-----	2700 S. Westmoreland, Dallas, TX 75224.
PFX	Plastifax, Inc-----	P. O. Box 2216, Gulfport, MS 39503.
PLX	Plex Chemical Corp-----	1205 Atlantic St., Union City, CA 94487.
PFW	Polak's Frutal Works, Inc-----	33 Sprague Ave., Middletown, NY 10990.
PYC	Polycast Technology Corp-----	69 Southfield Ave., Stamford, CT 06902.
POL	Polymer Corp-----	2120 Fairmont Ave., Reading, PA 19603.
PLY	Polyrez Co., Inc-----	P. O. Box 320, Woodbury, NJ 08096.
PLR	Polysar Resins, Inc----- Polysar Latex Div	29 Fuller St., Leominster, MA 01453. 3305 Amnicola Hwy., Chattanooga, TN 37406.
PVI	Polyvinyl Chemical Industries-----	730 Main St., Wilmington, MA 01887.
POP	Pope Chemical Corp-----	33 6th Ave., Paterson, NJ 07524.
PRT	Pratt & Lambert, Inc-----	P. O. Box 22, Buffalo, NY 14240.
PMP	Premier Malt Products, Inc-----	917 W. Juneau Ave., Milwaukee, WI 53201.
PG	Procter & Gamble Co., Procter & Gamble Mfg. Co.	P. O. Box 599, Cincinnati, OH 45201.
PC	Proctor Chemical Co., Inc-----	P. O. Box 399, Salisbury, NC 28144.
PRC	Products Research & Chemical Corp-----	2820 Empire Ave., Burbank, CA 91505.
PUB	Publicker Industries, Inc-----	1429 Walnut St., Philadelphia, PA 19102.
PUE	Puerto Rico Olefins Co-----	Firm Delivery, Ponce, PR 00731.
PRX	Purex Corp-----	5101 Clark Ave., Lakewood, CA 90712.
QCP	Quaker Chemical Corp-----	Lime & Elm Sts., Conshohocken, PA 19428.
QKO	Quaker Oats Co-----	Merchandise Mart Plaza, Chicago, IL 60654.
QUN	K. J. Quinn & Co., Inc-----	195 Canal St., Malden, MA 02148.
QH	Quintana-Howell Joint Venture-----	P. O. Box 4656, Corpus Christi, TX 79408.
RSA	R.S.A. Corp-----	690 Sawmill River Rd., Ardsley, NY 10502.
RLS	Rachelle Laboratories, Inc-----	700 Henry Ford Ave., Long Beach, CA 90801.
RACN	Racon, Inc-----	P. O. Box 198, Wichita, KS 67201.
RAB	Raybestos-Manhattan, Inc., RM Friction Materials Co. Div.	75 E. Main St., Stratford, CT 06497.
RED	Red Spot Paint & Varnish Co., Inc-----	110 Main St., Evansville, IN 47703.
REH	Reheis Chemical Co. Div. of Armour Pharmaceutical Co.	236 Snyder Ave., Berkely Hgts., NJ 07922.
RCI	Reichhold Chemicals, Inc-----	525 N. Broadway, White Plains, NY 10603.
RIL	Reichhold Polymers, Inc-----	525 N. Broadway, White Plains, NY 10603.
RIF	Reilly Tar & Chemical Corp-----	3615 Merchants Bank, Indianapolis, IN 46204.
REL	Reliance Universal, Inc., Louisville Resins Operation	P. O. Box 21-423, Louisville, KY 40221.
REM	Remington Arms Co., Inc-----	939 Barnum Ave., Bridgeport, CT 06602.
RSC	Resinoids Chemicals Corp-----	1399 W. Blancke St., Linden, NJ 07036.
RSY	Resyn Corp-----	1401 W. Blancke St., Linden, NJ 07036.
RCC	Rexene Polyolefins Co-----	W. 115 Century Rd., Paramus, NJ 07652.
RCC	Rexene Styrenics Co-----	W. 115 Century Rd., Paramus, NJ 07652.
RDA	Rhodia, Inc-----	120 Jersey Ave., New Brunswick, NJ 08903.
RCD	Richardson Co----- Polymeric Systems Div	2400 E. Devon Ave., Des Plaines, IL 60018. 15 Meigs Ave., Madison, CT 06443.
LKL	Richardson-Merrell, Inc., Merrell-National Laboratories Div.	110 E. Amity Rd., Cincinnati, OH 45215.
RCO	Rico Chemical Corp-----	P. O. Box 387, Guayanilla, PR 00656.
AMS	Ridgway Color & Chemical-----	75 Front St., Ridgway, PA 15853.
RIK	Riker Laboratories, Inc. Sub. of 3M Co-----	19901 Nordhoff St., Northridge, CA 91324.
RSN	Rilsan Corp-----	139 Harristown Rd., Glen Roc, NJ 07452.
RT	Ritter International-----	4001 Goodwin Ave., Los Angeles, CA 90039.

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identifi- cation code	Name of company	Office address
RIV	Riverdale Chemical Co-----	220 E. 17th St., Chicago Heights, IL 60411.
ROB	Robeco Chemicals, Inc-----	99 Park Ave., New York, NY 10016.
RBT	Robintech, Inc-----	1407 Texas St., Fort Worth, TX 76102.
MFG	Rockwell International Corp-----	4501 Benefit Ave., Ashtabula, OH 44004.
ORT	Roehr Chemicals Div. of Aceto Industrial Chemical Corp.	52-20 37th St., Long Island City, NY 11101.
RCG	Rogers Corp-----	Rogers, CT 06263.
RH	Rohm & Haas Co-----	Independence Mall West, Philadelphia, PA 19105.
RUC	Rubicon Chemicals, Inc-----	P. O. Box 517, Geismar, LA 70734.
SCM	SCM Corp-----	299 Park Ave., New York, NY 10017.
SOS	SSC Industries, Inc-----	P. O. Box 90987, East Point, GA 30344.
NPR	Safety Stores, Inc-----	2800 Ygnacio Valley Rd., Walnut, CA 94604.
SLM	Salem Oil & Grease Co-----	60 Grove St., Salem, MA 01970.
SAL	Salsbury Laboratories-----	2000 Rockford Rd., Charles City, IA 50616.
S	Sandoz, Inc-----	P. O. Box 357, Fair Lawn, NJ 07410.
	Colors & Chemicals Div-----	Route #10, E. Hanover, NJ 07936.
	Crop Protection-----	P. O. Box 207, Wasco, CA 93280.
SAR	Sartomer Industries, Inc-----	Gov. Printz Blvd. & Wanamaker Ave., Essington, PA 19029.
SCN	Schenectady Chemicals, Inc-----	P. O. Box 1046, Schenectady, NY 12301.
SBC	Scher Bros., Inc-----	P. O. Box 1236, Allwood Station, Clifton, NJ 07012.
SGH	Schering Corp-----	1011 Morris Ave., Union, NJ 07083.
SCO	Scholler Bros., Inc-----	Collins and Westmoreland Sts., Philadelphia, PA 19134.
SPA	Scott Paper Co-----	Scott Plaza, Philadelphia, PA 19113.
SEA	Seaboard Chemicals, Inc-----	30 Foster St., Salem, MA 01970.
SRL	C. D. Searle & Co-----	P. O. Box 5110, Chicago, IL 60680.
SKP	Shakespeare Co., Monofilament Div-----	P. O. Box 246, Columbia, SC 29202.
SHO	Shell Oil Co-----	P. O. Box 2463, Houston, TX 77001.
SHC	Shell Chemical Co. Div-----	P. O. Box 2463, Houston, TX 77001.
SHP	Shepherd Chemical Co-----	4900 Beech St., Norwood, OH 45212.
SW	Sherwin-Williams Co-----	1370 Ontario St. NW., Cleveland, OH 44101.
SHT	Shintech, Inc-----	3800 Buffalo Speedway-Suite 210, Houston, TX 77098.
SID	George F. Siddall Co., Inc-----	P. O. Box 925, Spartanburg, SC 29304.
SMP	J. R. Simplot Co., Minerals Chemical Div-----	P. O. Box 912, Pocatello, ID 83210.
SIM	Simpson Timber Co., Chemicals Div-----	2301 N. Columbia Blvd., Portland, OR 97217.
GFS	C. Frederick Smith Chemical Co-----	867 McKinley Ave., P. O. Box 23214, Columbus, OH 43223.
SK	SmithKline Chemicals-----	1500 Spring Garden St., Philadelphia, PA 19101.
SLT	Soltex Polymer Corp-----	P. O. Box 1000, Deer Park, TX 77536.
SLC	Soluol Chemical Co., Inc-----	Green Hill and Market Sts., W. Warwick, RI 02893.
SAC	Southeastern Adhesives Co., Inc-----	P. O. Box 791, Lenoir, NC 28645.
SOP	Southern Chemical Products Co., Inc-----	430 Lower Boundary St., Macon, GA 31202.
SWL	Southwest Latex Corp-----	1001 Chemical Rd., Pasadena, TX 77507.
SPL	Spaulding Fibre Co., Inc-----	310 Wheeler St., Tonawanda, NY 14150.
OMS	E. R. Squibb & Sons, Inc-----	40 W. 57th St., New York, NY 10019.
STA	A. E. Staley Mfg. Co-----	2200 E. Eldorado St., Decatur, IL 62525.
UBS	Chemical Specialties Div-----	2200 E. Eldorado St., Decatur, IL 62525.
CLN	Standard Brands, Inc., Clinton Corn Processing Co. Div.	1251 Beaver Channel Parkway, Clinton, IA 52733.
SCC	Standard Chlorine of Delaware, Inc., Sub. of Standard Chlorine Chemical Co., Inc.	1035 Belleville Turnpike, Kearny, NJ 07032.
SIO	Standard Oil Co-----	270 Midland Bldg., Cleveland, OH 44130.
SOC	Standard Oil Co. of California, Chevron Chemical Co.	575 Market St., Rm. 3280, San Francisco, CA 94105.
STT	Standard T Chemical, Inc-----	P. O. Box A-3351, Chicago, IL 60690.
STG	Stange Co-----	342 N. Western Ave., Chicago, IL 60612.
	Stauffer Chemical Co.:	
SFA	Agricultural Div-----	636 California St., San Francisco, CA 94119.
SFC	Calbio Chemicals, Inc-----	636 California St., San Francisco, CA 94119.
SFF	Food Ingredients Div-----	636 California St., San Francisco, CA 94119.
SFI	Industrial Div-----	636 California St., San Francisco, CA 94119.
SFP	Plastics Div-----	636 California St., San Francisco, CA 94119.
SFS	Specialty Div-----	636 California St., San Francisco, CA 94119.
SWS	SWS Silicones Div-----	636 California St., San Francisco, CA 94119.
STP	Stepan Chemical Co-----	RR #1, Elwood, IL 60421 and 100 West Hunter Ave., Maywood, NJ 07067.

TABLE I.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identification code	Name of company	Office address
	Sterling Drug, Inc.:	
SDG	Glenbrook Laboratories Div-----	90 Park Ave., New York, NY 10016.
SDH	Hilton-Davis Chemical Co. Div-----	2235 Langdon Farm Rd., Cincinnati, OH 45237.
TMS	Thomasset Colors Div-----	120 Lister Ave., Newark, NJ 07105.
SDW	Winthrop Laboratories Div-----	90 Park Ave., New York, NY 10016.
SLV	Stevens Chemicals, Inc-----	Military Rd., Rothschild, WI 54474.
STY	Styrochem Corp-----	Petrochemical Complex, Ponce, PR 00731.
SBP	Sugar Beet Products Co-----	P. O. Box 1387, Saginaw, MI 48605.
	Sun Chemical Corp.:	
SNW	Chemical Div-----	P. O. Box 70, Chester, SC 29706.
SNA	Pigments Div-----	441 Tompkins Ave., Staten Island, NY 10305.
SUN	Sun Company, Inc-----	100 Matsonford Rd., Radnor, PA 19087.
SKG	Sunkist Growers, Inc-----	P. O. Box 7888, Van Nuys, CA 91409.
SNO	SunOlin Chemical Co-----	P. O. Box F, Claymont, DE 19703.
SME	Swedcast Corp-----	7350 Empire Dr., Florence, KY 41042.
SAG	Swift Agricultural Chemicals-----	P. O. Box 2175, Beaumont, TX 77704.
BCU	Synalloy Corp., Blackman-Uhler Chemical Div.	P. O. Box 5627, Spartanburg, SC 29301.
FAR	Syncon Resins, Inc-----	77 Jacobus Ave., S. Kearny, NJ 07032.
FCD	Synres Chemical Corp-----	1036 Commerce Ave., Union, NJ 07083.
HFT	Syntex Agribusiness, Inc-----	P. O. Box 1246 S.S.S., Springfield, MO 65805.
	Tanatex Chemical Corp-----	P. O. Box 388, Lynhurst, NJ 07071.
TCC	Charles S. Tanner Co-----	1310 Barcelona Dr., Greenville, SC 29605.
CST	Tauber Oil Co-----	1610 Melrose Blvd., Houston, TX 77052.
TBO	Teknor Apex Co-----	505 Central Ave., Pawtucket, RI 02662.
HN	Tenneco Chemicals, Inc-----	Park Eighty Plaza West-One, Saddle Brook, NJ 07662.
TOC	Tenneco Oil Co-----	P. O. Box 2511, Houston, TX 77001.
TVA	Tennessee Valley Authority-----	Muscle Shoals, AL 35660.
TER	Terra Chemicals International, Inc-----	P. O. Box 1828, Sioux City, IA 51121.
COO	Terrell Corp-----	820 Woburn St., Wilmington, MA 01887.
TX	Texaco, Inc-----	P. O. Box 430, 4800 Fournace Pl., Bellaire, TX 77401.
TSA	Texas Alkyls, Inc-----	P. O. Box 600, Deer Park, TX 77536.
TUS	Texas-U.S. Chemical Co-----	P. O. Box 667, Port Neches, TX 77651.
TCI	Texize Chemicals Co-----	P. O. Box 368, Greenville, SC 29602.
SKT	Textron, Inc., Spencer Kellogg Div-----	120 Delaware Ave., Buffalo, NY 14240.
TKL	Thiokol Corp-----	P. O. Box 1000, Newtown, PA 18940.
TMH	Thompson-Hayward Chemical Co-----	2 E. Madison St., Maukegan, IL 60085, and 5200 Speaker Rd., Kansas City, MO 66110.
TRC	Toms River Chemical Corp-----	P. O. Box 71, Toms River, NJ 08753.
TNO	Tranco Chemical Corp-----	312 Ash St., Reading, MA 01867.
ACT	Arthur C. Trask Co-----	7666 W. 63d St., Summit, IL 60501.
TRI	Triad Chemical-----	P. O. Box 310, Donaldsonville, LA 70346.
TRO	Troy Chemical Co-----	One Avenue L, Newark, NJ 07105.
UPM	UOP, Inc-----	10 UOP Plaza, Des Plaines, IL 60016.
UOP	Chemical Div-----	State Highway 17, E. Rutherford, NJ 07073.
USM	USM Corp., Bostik, Inc-----	Boston St., Middleton, MA 01949, and P. O. Box 5695, Greenville, SC 29606.
ARM	USS Agri-Chemicals Div. of U.S. Steel Corp-----	P. O. Box 1685, Atlanta, GA 30301.
USS	USS Chemicals Div. of U.S. Steel Corp-----	600 Grant St., Rm. 2880, Pittsburgh, PA 15230.
UHL	Paul Uhlich & Co., Inc-----	1 Railroad Ave., Hastings on the Hudson, NY 10706.
UNG	Ungerer & Co-----	161 Avenue of the Americas, New York, NY 10013.
NCI	Union Camp Corp-----	P. O. Box 6170, Jacksonville, FL 32205.
WTH	Chemical Div-----	P. O. Box 220, Dover, OH 44622.
UCC	Union Carbide Corp-----	270 Park Ave., New York, NY 10017.
UOC	Union Oil Co. of California-----	1650 E. Golf Rd., Schaumburg, IL 60196.
USR	Uniroyal, Inc., Uniroyal Chemical Div-----	Emic Bldg., Spencer St., Naugatuck, CT 06770.
SWT	Unitech Chemical, Inc-----	115 W. Jackson Blvd., Chicago, IL 60604.
UNN	United Chemical Corp. of Norwood-----	Endicott St., Norwood, MA 02062.

TABLE 1.--SYNTHETIC ORGANIC CHEMICALS: ALPHABETICAL DIRECTORY OF MANUFACTURERS,  
BY COMPANY, 1977--CONTINUED

Identifi- cation code	Name of company	Office address
UNP	United Chemical Products Corp-----	472 York St., Jersey City, NJ 07302.
UNO	United-Erie, Inc-----	438 Huron St., Erie, PA 16512.
ROM	United Merchants & Manufacturers, Inc., Roma Chemical Div.	749 Quequechan St., Fall River, MA 02721.
USB	U.S. Borax Research Corp-----	3075 Wilshire Blvd., Los Angeles, CA 90005.
USI	U.S. Industrial Chemicals Co.: National Distillers & Chemicals Corp----- National Petro Chemical Corp-----	99 Park Ave., New York, NY 10016. 99 Park Ave., New York, NY 10016.
USO	U.S. Oil Co-----	P. O. Box 4228, E. Providence, RI 02914.
UPJ	Upjohn Co-----	7000 Portage Rd., Kalamazoo, MI 49002.
CWN	Fine Chemical Div-----	410 Sackett Point Rd., North Haven, CT 06473.
VAL	Valchem Div. of United Merchants & Manufacturers, Inc.	1407 Broadway, New York, NY 10018.
VSV	Valentine Sugars, Inc., Valite Div-----	726 Whitney Bldg., New Orleans, LA 70130.
VLN	Valley Nitrogen Producers, Inc-----	1111 Van Ness Ave., Fresno, CA 93717.
MNP	The Valspar Corp-----	1101 S. 3d St., Minneapolis, MN 55415.
VNC	Vanderbilt Chemical Corp-----	31 Taylor Ave., Bethel, CT 06801, and Rt. 5 - Box 54, Murray, KY 42071.
VND	Van Dyk & Co., Inc-----	Main & Williams Sts., Belleville, NJ 07109.
VEL	Valiscol Chemical Corp-----	341 E. Ohio St., Chicago, IL 60611.
MHI	Ventron Corp-----	152 Anderson St., Danvers, MA 01923.
VTC	Vicksburg Chemical Co. Sub. of Vertac Consolidated.	P. O. Box 3, Vicksburg, MS 39180.
VIK	Viking Chemical Co-----	838 Baker Bldg., Minneapolis, MN 55402.
VIN	Vineland Chemical Co., Inc-----	W. Wheat Rd., Vineland, NJ 08360.
VCC	Vinings Chemical Co-----	2555 Cumberland Pkwy., Suite 200, Atlanta, GA 30339.
VGC	Virginia Chemicals, Inc-----	3340 W. Norfolk Rd., Portsmouth, VA 23703.
SOH	Vistron Corp-----	393 Midland Bldg., Cleveland, OH 44115.
SIC	Silmar Div-----	12333 S. Van Ness Ave., Hawthorne, CA 90250.
VTM	Vitamins, Inc-----	200 E. Randolph Dr., Chicago, IL 60601.
FRO	Vulcan Materials Co., Chemicals Div-----	P. O. Box 7689, Birmingham, AL 35223.
WJ	Warner-Jenkinson Manufacturing Co-----	2526 Baldwin St., St. Louis, MO 63106.
WAG	West Agro-Chemical, Inc-----	501 Santa Fe, Kansas City, MO 64105.
WCA	West Coast Adhesives Co., Inc-----	11104 NW. Front Ave., Portland, OR 97231.
EW	Westinghouse Electric Corp., Industrial Materials Div.	Manor, PA 15665.
WVA	Westvaco Corp., Polychemicals Dept-----	P. O. Box 5207, N. Charleston, SC 29406.
WRD	Meyerhaeuser Co-----	118 S. Palmetto Ave., Marshfield, WI 54449.
WBG	White & Bagley Co-----	P. O. Box 706, Worcester, MA 01613.
WHI	White & Hodges, Inc-----	576 Lawrence St., Lowell, MA 01853.
WCC	White Chemical Corp-----	P. O. Box 278, Bayonne, NJ 07002.
WHL	Whitmoyer Laboratories, Inc-----	19 N. Railroad St., Myerstown, PA 17067.
APT	Whittaker Corp., Whittaker Coatings & Chemicals, Mol Rez Resins.	3134 California St., NE., Minneapolis, MN 55418.
WHW	Whittemore-Wright Co., Inc-----	62 Alford St., Boston, MA 02129.
WLN	Wilmington Chemical Corp-----	P. O. Box 66, Wilmington, DE 19899.
WTC	Witco Chemical Corp-----	P. O. Box 305, Paramus, NJ 07652.
WAW	W. A. Wood Co-----	108 Spring St., Everett, MA 02149.
WBC	Worthington Biochemical Corp-----	Halls Mill Rd., Freehold, NJ 07728.
WCL	Wright Chemical Corp-----	Acme Station, Riegelwood, NC 28456.
WYC	Wycon Chemical Co-----	5 Greenway Plaza East, Houston, TX 77046.
WYT	Wyeth Laboratories, Inc., Wyeth Laboratories Div. of American Home Products Corp.	P. O. Box 831, Paoli, PA 19301.
ZOC	Zocon Corp-----	975 California Ave., Palo Alto, CA 94304.

## U.S. IMPORTS OF BENZENOID CHEMICALS AND PRODUCTS

U.S. general imports of benzenoid chemicals and products entered under the Tariff Schedules of the United States (TSUS), schedule 4, part 1, subparts B and C are analyzed by the U.S. International Trade Commission annually and published in detail in a separate report.<sup>1</sup> General imports of benzenoid items entered in parts 1B and 1C totaled 412.5 million pounds with a foreign invoice value of \$570.5 million in 1977 compared with 362.4 million pounds with a foreign invoice value of \$493.8 million in 1976.

Benzenoid products that are "competitive" with similar domestic products, because they accomplish results substantially equal to those accomplished by the similar domestic product when used in substantially the same manner, are subject to a special basis of valuation for customs purposes known as the "American selling price." If "noncompetitive," the benzenoid products are valued for customs purposes on the basis of the "United States value." The essential difference between these two values is that "American selling price" is based on the wholesale price in the United States of the "competitive" domestic product, whereas "United States value" is based on the wholesale price in the United States of the imported product less most of the expenses incurred in bringing the product to the United States and selling it. When neither of these two valuation bases applies, then the "export value," "foreign value," or "constructed value" is used as the valuation basis under section 402 and 402a Tariff Act of 1930, as amended. The competitive status of benzenoid imports in 1977 is shown in table 2.

Industrial organic chemicals that are entered under part 1B consist chiefly of benzenoid intermediates and small quantities of acyclic compounds which are derived in whole or in part from benzenoid compounds. Also included are mixtures and small quantities of finished products not specially provided for in part 1C (e.g., rubber-processing chemicals). In terms of value, 34.6 percent of all the benzenoid imports under part 1B in 1977 came from West Germany; 21.2 percent, from Japan; 9.8 percent, from Italy; and 9.0 percent, from the United Kingdom.

Finished organic chemical products entered under part 1C include dyes, pigments, medicinals, flavor and perfume materials, pesticides, plastics materials, and certain other specified products. In terms of value 34.4 percent of all finished benzenoid imports under part 1C in 1977 came from West Germany; 16.4 percent, from the United Kingdom; and 12.0 percent, from Japan.

---

<sup>1</sup> *Imports of Benzenoid Chemicals and Products, 1977*, TC Publication 900, 1978.

TABLE 2.--BENZENOID CHEMICALS AND PRODUCTS: SUMMARY OF U.S. GENERAL IMPORTS ENTERED UNDER SCHEDULE 4, PARTS 1B AND 1C OF THE TSUS, AND ANALYSIS BY COMPETITIVE STATUS, 1977

Part and competitive status	Number of items	Quantity	Percent of total quantity	Foreign invoice value	Percent of foreign value	Unit foreign value
<u>Schedule 4, Part 1B</u>		1,000 pounds		1,000 dollars		Per pound
Total <sup>1</sup> -----	819	247,775	100.0	196,215	100.0	\$0.79
Competitive:						
Duty based on ASP <sup>2</sup> -----	368	208,232	84.0	123,832	63.1	.59
Noncompetitive:						
Duty based on U.S. value-----	284	22,772	9.2	35,125	17.9	1.54
Duty based on export value-----	157	14,087	5.7	34,257	17.5	2.43
Competitive status not available-----	10	2,685	1.1	3,001	1.5	1.12
<u>Schedule 4, Part 1C</u>						
Total <sup>1</sup> -----	1,851	164,736	100.0	374,293	100.0	2.27
Competitive:						
Duty based on ASP <sup>2</sup> -----	671	72,297	43.9	148,132	39.6	2.05
Noncompetitive:						
Duty based on U.S. value-----	970	28,686	17.4	80,281	21.4	2.80
Duty based on export value-----	197	60,356	36.7	133,286	35.6	2.21
Competitive status not available-----	13	3,397	2.1	12,593	3.4	3.71
<u>Summary (Schedule 4, Parts 1B and 1C)</u>						
Total <sup>1</sup> -----	2,670	412,511	100.0	570,508	100.0	1.38
Competitive:						
Duty based on ASP <sup>2</sup> -----	1,039	280,529	68.0	271,964	47.7	.97
Noncompetitive:						
Duty based on U.S. value-----	1,254	51,458	12.5	115,406	20.2	2.24
Duty based on export value-----	354	74,443	18.0	167,543	29.4	2.25
Competitive status not available-----	23	6,082	1.5	15,594	2.7	2.56

<sup>1</sup> Detail may not add to total due to rounding.

<sup>2</sup> American selling price.

Source: Compiled by the U.S. International Trade Commission from records of the U.S. Bureau of Customs.

Note.--The totals shown in this table differ from those given in the official statistics of the U.S. Department of Commerce chiefly because of differences in coverage and in the methods used in compiling the data. In general, the statistics coverage in 1977 varies from a low of 63 percent for pigments, to about 86 percent coverage of 86 percent flavor and perfumes materials, 85 percent dyes, 81 percent intermediates, and 73 percent medicinals and pharmaceuticals.



TABLE 3.--CYCLIC INTERMEDIATES: GLOSSARY OF SYNONYMOUS NAMES

Common name	Standard (Chemical Abstracts) name
A Acid-----	3,5-Dihydroxy-2,7-naphthalenedisulfonic acid.
1,2,4-Acid-----	4-Amino-3-hydroxy-1-naphthalenesulfonic acid (1-Amino-2-naphthol-4-sulfonic acid).
Acid yellow 9-----	6-Amino-3,4'-azodibenzenesulfonic acid. Sulfanilic acid and salt.
p-Aminobenzenesulfonic acid-----	4-Hydroxy-7-(m-aminobenzamido)-2-naphthalenesulfonic acid.
m-Aminobenzoyl J acid-----	8-Amino-1,6-naphthalenedisulfonic acid.
Aminoepiison acid-----	7-Amino-1,3-naphthalenedisulfonic acid.
Amino G acid-----	6-Amino-1,3-naphthalenedisulfonic acid.
Amino J acid-----	3-Amino-2,7-naphthalenedisulfonic acid.
Amino R salt-----	Aniline.
Aniline oil-----	2,6-Dihydroxyanthraquinone.
Anthraflavic acid-----	1,5-Dihydroxyanthraquinone.
Anthrarufin-----	4-Hydroxy-2-naphthalenesulfonic acid.
Armstrong & Wynne's acid-----	
B Acid-----	5-Amino-4-hydroxy-1,7-naphthalenedisulfonic acid.
2B Acid-----	6-Amino-4-chloro-m-toluenesulfonic acid.
4B Acid-----	6-Amino-m-toluenesulfonic acid.
Benzal chloride-----	o,o-Dichlorotoluene.
Benzanthrone-----	7H-Benz[de]anthracen-7-one.
Benzotrifluoride-----	o,o,o,-Trichlorotoluene.
Bisphenol A-----	4,4'-Isopropylidenediphenol.
B.O.N.-----	3-Hydroxy-2-naphthoic acid.
Broenner's acid-----	6-Amino-2-naphthalenesulfonic acid.
Bromamine acid-----	1-Amino-4-bromo-2-anthraquinonesulfonic acid.
Bromobenzanthrone-----	3-Bromo-7H-benz[de]anthracene-7-one.
C Acid (Cassella acid)-----	3-Amino-1,5-naphthalenedisulfonic acid.
C.A. Acid-----	3-Amino-6-chloro-4-sulfobenzoic acid.
C-Amine (Lake Red C acid)-----	2-Amino-5-chloro-p-toluenesulfonic acid.
Chicago Acid (SS acid)-----	4-Amino-5-hydroxy-1,3-naphthalenedisulfonic acid.
Chlorobenzanthrone-----	Chloro-7H-benz[de]anthracen-7-one.
Chromotropic acid-----	4,5-Dihydroxy-2,7-naphthalenedisulfonic acid.
Chrysazin-----	1,8-Dihydroxyanthraquinone.
1,6-Cleve's acid-----	5-Amino-2-naphthalenesulfonic acid.
1,7-Cleve's acid-----	8-Amino-2-naphthalenesulfonic acid.
Crocein acid-----	7-Hydroxy-1-naphthalenesulfonic acid.
2-Cyanopyridine-----	Picolinonitrile.
3-Cyanopyridine-----	Nicotinonitrile.
Cyanuric chloride-----	2,4,6-Trichloro-s-triazine.
D Acid-----	6-Amino-1-naphthalenesulfonic acid.
DADI-----	Dianisidine diisocyanate.
DBB-----	p-Dibutoxybenzene.
Decacyclene-----	Diacenaphthol[1,2-j;1,2'-k]fluoranthene.
Dehydrothio-p-toluidine-----	2-(p-Aminophenyl)-6-methylbenzothiazole.
Developer Z-----	3-Methyl-1-phenyl-2-pyrazolin-5-one.
o-Dianisidine-----	3,3'-Dimethoxybenzidine.
1,1'-Dianthrimide-----	1,1'-Iminodianthraquinone.
Dibenzanthrone-----	Violanthrone.
4,4'-Dihydroxydiphenylsulfone-----	4,4'-Sulfonyldiphenol.
Dimethyl POPOP-----	1,4-Bis[2-(4-methyl-5-phenyloxazolyl)]benzene.
4,5-Dinitrochrysazin-----	1,8-Dihydroxy-4,5-dinitroanthraquinone.
Di oxy S acid-----	4,5-Dihydroxy-1-naphthalenesulfonic acid.
Diphenyl Epsilon Acid-----	6,8-Dianilino-1-naphthalenesulfonic acid.
Durene-----	1,2,4,5-Tetramethylbenzene.
Epsilon Acid (Andresen's acid)-----	8-Hydroxy-1,6-naphthalenedisulfonic acid.
F Acid-----	7-Hydroxy-2-naphthalenesulfonic acid.
Fast Red G base-----	2-Nitro-p-toluidine [NH <sub>2</sub> =1].
Fast Scarlet R base-----	5-Nitro-o-anisidine [NH <sub>2</sub> =1].
Fischer's aldehyde-----	1,3,3-Trimethyl-4',6'-indolinesacetaldehyde.
Fischer's base-----	1,3,3-Trimethyl-2-methyleneindoline.
Freund's acid-----	4-Amino-2,7-naphthalenedisulfonic acid.

TABLE 3.--CYCLIC INTERMEDIATES: GLOSSARY OF SYNONYMOUS NAMES--CONTINUED

Common name	Standard (Chemical Abstracts) name
G salt-----	7-Hydroxy-1,3-naphthalenedisulfonic acid.
Gamma acid-----	6-Amino-4-hydroxy-2-naphthalenesulfonic acid, sodium salt.
Gold salt-----	9,10-Dihydro-9,10-dioxo-1-anthracenesulfonic acid and salt.
H Acid-----	4-Amino-5-hydroxy-2,7-naphthalenedisulfonic acid. (8-Amino-1-naphthol-3,6-disulfonic acid).
Hellimellitene-----	1,2,3-Trimethylbenzene.
Indoxyl-----	3(2H)-Indolone.
J Acid-----	7-Amino-4-hydroxy-2-naphthalenesulfonic acid, sodium salt.
J Acid Urea-----	7,7'-Ureylenebis[4-hydroxy-2-naphthalenesulfonic acid].
K Acid-----	4-Amino-5-hydroxy-1,7-naphthalenedisulfonic acid.
Koch's Acid-----	8-Amino-1,3,6-naphthalenetrisulfonic acid.
L Acid-----	5-Hydroxy-1-naphthalenesulfonic acid.
Lake Red C amine-----	2-Amino-5-chloro-p-toluenesulfonic acid.
Laurent's acid-----	5-Amino-1-naphthalenesulfonic acid.
M Acid-----	8-Amino-4-hydroxy-2-naphthalenesulfonic acid.
MEP-----	5-Ethyl-2-picoline (2-Methyl-5-ethylpyridine).
Mesitylene-----	1,3,5-Trimethylbenzene.
Methane base-----	4,4'-Methylenebis[N,N-dimethylanimine].
Michler's hydrol-----	4,4'-Bis[dimethylamino]benzhydrol.
Michler's ketone-----	4,4'-Bis[dimethylamino]benzophenone.
Naphthionic acid-----	4-Amino-1-naphthalenesulfonic acid.
alpha-Naphthionic acid-----	1-Amino-2-naphthalenesulfonic acid.
beta-Naphthol-----	2-Naphthol, tech.
Naphthol AS-----	3-Hydroxy-2-naphthanilide.
alpha-Naphthylamine-----	1-Naphthylamine.
Neville & Winther's acid-----	4-Hydroxy-1-naphthalenesulfonic acid.
m-Nitrobenzoyl J acid-----	4-Hydroxy-7-(m-nitrobenzamido)-2-naphthalenesulfonic acid.
Oxy Koch's acid-----	1-Naphthol-3,6,8-trisulfonic acid.
Pentaanthrimide-----	1,4,5,8-Tetrakis(1-anthraquinonylamino)anthraquinone.
Peri Acid-----	8-Amino-1-naphthalenesulfonic acid.
Phenylbiphenyl-----	Terphenyl.
N-Phenyldiethanolamine-----	2,2'-(1-Phenyl)imino]diethanol.
Phenyl Gamma acid-----	6-Anilino-4-hydroxy-2-naphthalenesulfonic acid.
Phenyl J acid-----	7-Anilino-4-hydroxy-2-naphthalenesulfonic acid.
Phenyl peri acid-----	8-Anilino-1-naphthalenesulfonic acid.
POPOP-----	1,4-Bis[2-(5-phenyloxazoly)]benzene.
Pseudocumene-----	1,2,4-Trimethylbenzene.
Pyrazoleanthrone-----	Anthra[1,9-cd]pyrazol-6(2H)-one.
Pyrazoleanthrone yellow-----	[3,3'-Bianthra[1,9-cd]pyrazole]-6,6'-(2H,2'H)dione.
Pyrazolone T-----	5-Oxo-1-(p-sulfohenyl)-2-pyrazoline-3-carboxylic acid.
Quinizarin-----	1,4-Dihydroxyanthraquinone.
2-Quinizarinsulfonic acid-----	9,10-Dihydro-1,4-dihydroxy-9,10-dioxo-2-anthracenesulfonic acid.
Quinoline yellow base-----	Quinophthalone.
R salt-----	3-Hydroxy-2,7-naphthalenedisulfonic acid, disodium salt.
RG Acid (Violet acid)-----	4-Hydroxy-2,7-naphthalenedisulfonic acid.
Rhoduline acid (J Acid Imide)-----	7,7'-Iminobis[4-hydroxy-2-naphthalenesulfonic acid].
RR acid-----	3-Amino-5-hydroxy-2,7-naphthalenedisulfonic acid.
S Acid-----	4-Amino-5-hydroxy-1-naphthalenesulfonic acid.
Schaffer's acid-----	6-Hydroxy-2-naphthalenesulfonic acid.
Silver salt-----	9,10-Dihydro-9,10-dioxo-2-anthracenesulfonic acid and salt.

TABLE 3.--CYCLIC INTERMEDIATES: GLOSSARY OF SYNONYMOUS NAMES--CONTINUED

Common name	Standard (Chemical Abstracts) name
Solvent Yellow 1-----	p-Phenylazoaniline and hydrochloride.
Solvent Yellow 3-----	4-(o-Tolylazo)-o-toluidine.
SS Acid (Chicago acid)-----	4-Amino-5-hydroxy-1,3-naphthalenedisulfonic acid.
o-Sulfobenzaldehyde-----	o-Formylbenzenesulfonic acid.
Thioindoxyl-----	3(2H)-Thiansphthenone.
Thiosalicylic acid-----	o-Mercaptobenzoic acid.
Tobias Acid-----	2-Amino-1-naphthalenesulfonic acid.
TODI-----	Bitolylene diisocyanate.
o-Tolidine-----	3,3'-Dimethylbenzidine.
α-Toluic acid-----	Phenylacetic acid.
α-Tolunitrile-----	Phenylacetoneitrile.
4-m-Tolylenediamine-----	Toluene-2,4-diamine.
Trimellitic anhydride-----	1,2,4-Benzenetricarboxylic acid, 1,2-anhydride.
Trimethyl base-----	1,3,3-Trimethyl-2-methyleneindoline.
Trinitrophenol-----	Picric acid.
Urea J Acid (J Acid Urea)-----	7,7'-Ureylenebis[4-hydroxy-2-naphthalenesulfonic acid].
Vinyltoluene-----	ar-Methylstyrene.
Violet acid (RG Acid)-----	4-Hydroxy-2,7-naphthalenedisulfonic acid.







Library Cataloging Data

U.S. International Trade Commission.  
Synthetic organic chemicals, United  
States production and sales, 1977.  
Washington [U.S. Govt. Print. Off.  
1978]

355, A 417 p. illus. 27 cm.  
(USITC Publication 920)

Appendix includes: Directory of  
manufacturers, p. 400-412; U.S. imports  
of benzenoid chemicals and products,  
p. 413-414; Cyclic intermediates:  
glossary of synonymous names, p. 415-417.

1. Coal-tar products.
  2. Petroleum industry and trade--U.S.
  3. Intermediates.
  4. Dyes and dyeing.
  5. Drugs.
  6. Flavoring essences.
  7. Plastics industry and trade--U.S.
  8. Rubber industry and trade.
  9. Elastomers.
  10. Cleaning compounds.
  11. Pesticides.
  12. Chemicals--Manufacture and industry--U.S.--Directories.
- I. Title.











