

The plasticizers story: 1963

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MODERATE increases were once again registered in total plant production of plasticizers during 1963. The gain over 1962 was 6.3 percent. Since 1959, production of all plasticizers has increased 54% over-all. Every indication leads to the assumption that these increases will carry through in 1964. Total production (based on U. S. Tariff Commission figures) for the years 1959 through 1963 were as follows:

<u>Year</u>	<u>Production</u> <u>1000 lb.</u>
1959	538,834
1960	602,135
1961	629,715
1962	780,940
1963	829,927

Total sales for 1962 were 665.9 million lb., valued at \$168 million. In 1963, sales were 744.7 million lb., valued at \$167 million, as reported by the U. S. Tariff Commission. Thus, the volume of plasticizers sold increased about 12%, but dollar sales deteriorated and registered a 1% decline. Apparently, one has to run very fast in the wonderland of plasticizers just to stay in place. With minor exceptions, this reduction can be attributed to a decrease in the selling prices of both cyclic and acyclic plasticizers. The pricing attrition in the plasticizer markets is of utmost concern, because it is becoming more difficult to carry out research programs with little, if any, return on current products.

Over the past five years, plasticizer production

has very closely paralleled vinyl resin production. From 1959 to 1963, plasticizer production increased 54% compared with a 56% increase for vinyl resin. However, it is important to point out that in 1963 plasticizer production increased only 6.3%, while vinyl resin moved ahead 16.2 percent (see graphs on p. 122). One explanation is the growing importance of rigid vinyl materials which require little or no plasticizers. Although in future years rigid vinyls will probably increase at a faster rate than plasticized vinyls, plasticizer consumption will still be primarily dependent upon vinyl resin growth.

In the discussion which follows, plasticizers will be covered by chemical composition, since the Tariff Commission figures do not break them down by end use. It is impossible to tell just how much went into applications like jet lubricants or gasoline additives.

Cyclic plasticizers

Total cyclic plasticizer production increased 8.9%, from 571 million lb. in 1962 to 622 million lb. in 1963. Sales value decreased 6.8%, however, from \$104 million in 1962 to \$103 million in 1963. Cyclic plasticizers represent 75% of the total U. S. plasticizer output.

Phthalates: Phthalic anhydride esters remain the largest group of plasticizers in total pounds produced and sold. They account for 63% of the total plasticizers produced and 46% of their dollar sales.

Di-2-ethyl hexyl phthalate production increased very slightly, showing only a 2% gain. Poundage

*Monsanto Co., St. Louis, Mo.

UNITED STATES DEPARTMENT OF COMMERCE

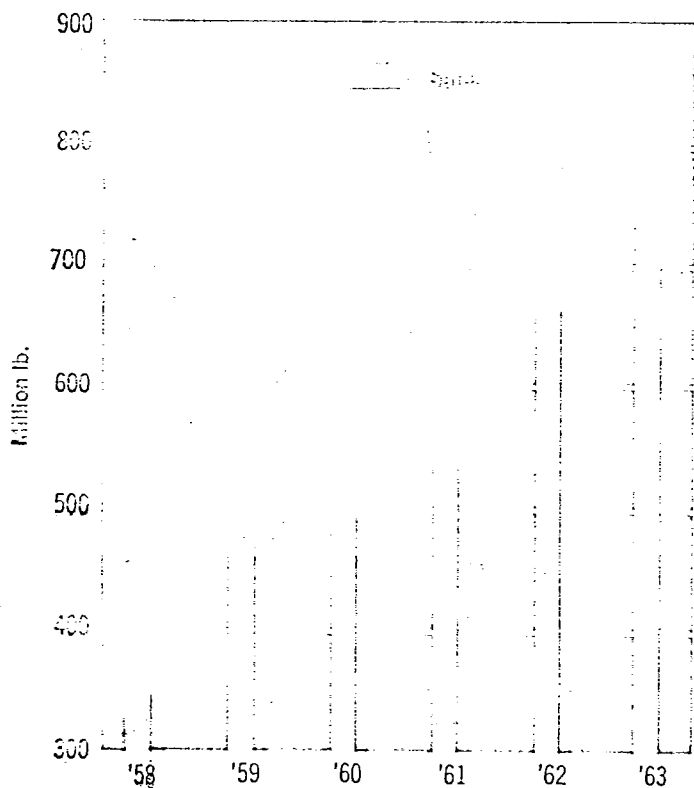
	Production 1000 lb.					Unit value ^b 1963 1962	
	1959	1960	1961	1962	1963	¢/lb.	¢/lb.
GRAND TOTAL	553,834	602,135	629,715	700,943	529,927	22	25
Phosphoric acid esters, total	50,327	54,825	46,992	53,585	52,025	—	—
Cresyl phosphate ^c	31,375	32,485	24,637	27,451	30,713	29	31
Triphenyl phosphate	8,427	9,466	9,399	10,435	10,034	35	36
Cresyl diphenyl phosphate ^c	10,525	12,874	12,956	15,700	11,278	27	25
Phthalic anhydride esters, total	305,415	344,741	376,511	469,996	521,943	16	19
Di(2-ethylhexyl) phthalate	—	4,752	4,783	3,011	—	—	18
Di(2-butoxyethyl) phthalate	—	13,190	15,997	17,833	17,903	15	18
Dibutyl phthalate	15,130	18,946	15,178	15,486	18,183	21	25
Diisobutyl phthalate	—	4,364	3,431	—	—	—	—
Dicyclohexyl phthalate	6,683	5,777	5,557	6,369	6,543	38	40
Diethyl phthalate	16,128	16,767	17,332	16,142	14,602	19	21
Dihexyl phthalate	—	—	—	1,533	595	20	21
Dioctyl phthalate	28,777	35,538	48,345	62,680	66,914	15	16
Di(2-methoxyethyl) phthalate	2,991	3,855	—	3,927	6,946	—	—
Dimethyl phthalate	3,318	3,386	4,121	4,562	3,843	21	23
Ditridecyl phthalate	—	582	2,747	4,398	7,643	21	23
Diethyl phthalates, total	152,702	170,220	181,505	234,883	275,829	15	18
Di(2-ethylhexyl) phthalate	106,575	123,396	138,330	171,037	175,398	15	18
Diisobutyl and mixed octyl phthalates	46,127	46,824	43,176	63,851	100,431	15	20
Octyl decyl phthalates, total	20,466	16,343	16,937	17,475	17,823	18	21
n-Octyl n-decyl phthalate	10,291	10,067	12,752	15,415	17,114	18	21
Iso-octyl iso-decyl phthalate	4,727	6,276	4,235	2,060	709	16	19
All other	5,448	—	—	—	—	—	—
All other phthalic anhydride esters	60,220	51,021	60,527	81,692	84,562	19	23
Trimellitic acid esters	—	—	—	—	882	44	—
All other cyclic plasticizers ^d	46,372	45,178	50,078	47,381	46,837	30	33
Adipic acid esters, total	14,035	22,136	25,742	23,575	23,255	29	30
Diisodecyl adipate	2,989	3,167	5,514	4,851	7,920	30	32
Di(2-ethylhexyl) adipate	1,850	3,040	8,478	5,413	6,032	26	29
Octyl-decyl adipate	1,770	4,983	5,042	8,078	8,226	29	29
Diisobutyl adipate	—	—	520	—	461	38	—
Complex adipic acid polyesters	3,068	4,794	—	—	—	—	—
Dioctyl adipate	3,561	4,233	4,565	4,205	3,967	27	30
Di(2-(2-butoxyethoxy) ethyl) adipate	—	—	—	—	493	48	—
All other	797	1,919	1,623	1,028	1,156	24	46
Sebacic acid esters, total	8,078	7,295	7,335	13,090	16,254	30	34
Complex linear polyesters and polymeric plasticizers	—	—	16,474	33,731	35,740	42	42
Epoxydized esters, total	—	—	15,887	53,993	58,752	29	32
Epoxydized soya oils	—	—	—	37,725	39,965	29	32
Octyl epoxy tallates	—	—	—	14,611	15,915	28	31
All other	—	—	—	1,662	2,872	43	36
Dibutyl maleate	—	5,519	5,372	7,395	—	—	25
Glyceryl monoricinoleate	430	298	367	175	237	39	38
Oleic acid esters, total	7,309	6,219	8,939	6,073	8,003	—	27
Butyl oleate	2,101	1,822	1,827	2,022	2,999	20	26
Glyceryl trioleate	—	—	—	1,618	3,480	20	20
Methyl oleate	948	664	1,287	—	1,073	18	—
n-Propyl oleate	—	—	—	513	451	20	21
All other	4,260	3,733	5,825	1,920	—	—	36
Palmitic acid esters	2,904	—	—	—	—	—	—
Phosphoric acid esters	8,231	9,481	10,623	16,889	12,068	40	40
Sebacic acid esters, total	9,959	13,781	11,500	12,944	11,856	—	56
Dibutyl sebacate	3,993	3,596	3,499	3,847	4,276	63	64
Di(2-ethylhexyl) sebacate	—	9,178	7,434	8,864	7,580	57	53
All other	5,976	1,007	567	233	—	—	82
Stearic acid esters, total	14,792	12,508	7,366	6,371	6,614	24	25
n-Butyl stearate	4,118	3,501	3,150	3,003	2,731	24	25
All other	10,674	8,787	4,216	3,368	3,883	24	24
Triethylene glycol di(caprylate-caprate)	2,688	2,009	2,223	2,601	2,022	32	33
All other acyclic plasticizers ^e	67,284	78,365	44,306	33,138	28,439	36	37

a—Does not include data for clearly defined extenders or secondary plasticizers. 1963 production totals are preliminary. b—Calculated from rounded figures. c—Includes material produced for use as motor-fuel additive. d—Includes data for toluenesulfonamides, tetrahydrofurfuryl oleate, and other cyclic plasticizers. e—Includes data for citric and acetylcitric, palmitic, oleic, ricinoleic, sebacic and tartaric acid esters, and

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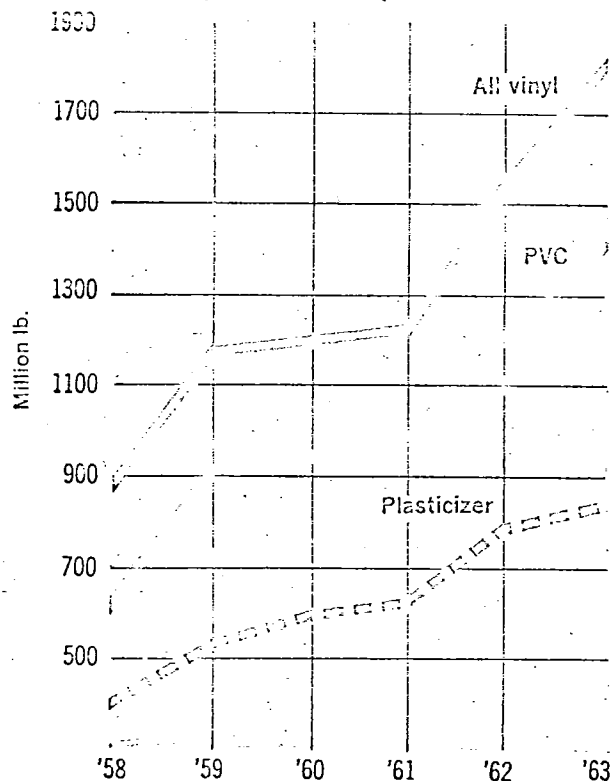
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U.S. production and sales of plasticizers^a



^a—Source: U.S. Tariff Comm. 1963 figures are preliminary.

Growth of vinyl resin, PVC, and plasticizer production^a



^a—Source: U.S. Tariff Comm. 1963 figures are preliminary.

sold increased 17%, but dollar sales decreased 5 percent. Diisooctyl phthalate and the mixed octyl phthalates came through with a major 57% gain in production and a 21% increase in dollar sales. This increase reflects the greater acceptance of the isooctyl material during the past year.

Diisodecyl phthalate registered a 6.7% increase in production from 63 million lb. to 67 million lb., but it registered a 1% decrease in poundage sold and a 6% decrease in the dollar value of sales. This probably indicates that more DIDP is being used in captive operations by wire compound suppliers. Production of its companion product in electrical wire compounds, ditiodecyl phthalate, increased 74% from 4.4 million to 7.6 million lb., and registered a 46% gain in poundage sold and 37% in dollar sales. Ditiodecyl phthalate continues to gain broader acceptance in high-temperature wire and cable compounds.

The "all other" category increased slightly in production (3.5%) and more so in poundage sales (21%). In terms of dollar value of sales, this group just about held its own, showing an increase of 0.1 percent.

All other phthalates reported by the Tariff Commission showed minor fluctuation with the exception of dihexyl phthalate. DHP production fell 61% and dropped 35% in sales.

Phosphates: Phosphate esters represent the second major group in production and sales when cyclic and acyclic are combined. This group accounted for 8% of the total plasticizer produced and 16% of total sales. It is interesting to note that, for the past two years, the cyclic phosphates have increased in all categories, while the acyclic phosphates have declined.

Phosphoric acid esters showed across-the-board decreases in production, sales, and dollar value. Production of both cyclic and acyclic decreased 9%; cyclic dropped 3% and acyclic 29 percent. Sales decreased 5 percent. Total dollar value of sales decreased 7 percent.

Tricresyl phosphate continues to hold the lead over all the rest of the phosphate esters with production increasing 12% and sales increasing 18 percent. The dollar value of sales went up 11 percent. Cresyl diphenyl phosphate production decreased 28 percent. Both sales and dollar value of sales were down also. This undoubtedly is due to the fact that cresyl diphenyl has partially lost its position as a gasoline additive.

Triphenyl phosphate remained practically constant with a 4% decrease in production and a 1% decrease in sales. There was no change in dollar value.

Major decreases in acyclic phosphate esters

were reported in the new Tariff Commission figures. Trioctyl phosphate and tributoxo ethyl phosphate make up the bulk of this category.

Acyclic plasticizers

Total acyclic plasticizer production decreased 1% from 210 million lb. in 1962 to 208 million lb. in 1963. Sales in pounds increased about 4% while dollar value of sales remained nearly constant. Acyclic plasticizers consist of the low temperature diesters, permanent plasticizers, epoxy plasticizers, and some miscellaneous groupings. These represent 25% of the total plasticizers produced.

Adipates: The largest percentage of low temperature diester production belongs to adipic acid esters with 3% of total U. S. plasticizers produced. Adipates in 1963 jumped over 1962 by 20% in production, 7% in sales, and 2% in sales dollars. The biggest increase was shown for diisodecyl adipate, which increased from 4.8 million lb. to 7.8 million lb., representing a 63% gain in production. Sales in pounds and dollars increased 25 and 22% respectively. Di (2-ethyl hexyl) adipate increased 11% in production but decreased 1% in sales dollars. This reflects the lower selling price of DOA, which has gone down from a unit value of 18¢ in 1962 to 15¢ in 1963. The mixed octyl decyl adipates containing both normal and iso alcohols increased 2% in production and 7 to 8% in sales dollars.

Azelates: Among all the low temperature diesters, azelaic acid esters showed the biggest increase over 1962. Production jumped 24%, from 13 million to 16 million pounds. Sales showed a gain of 34%; dollar value of sales itself enjoyed a 22% increase.

Sebacates: Sebacic acid esters showed a drop in production in 1963. They went from 13 million lb. in 1962 to 12 million lb. in 1963.

Permanents: Permanent plasticizers include high-molecular-weight polyester products as well as lower-molecular-weight products which are lower in cost and permanence than the polymeric.

The reporting by the Tariff Commission on these plasticizers was changed in 1962, resulting in a much more realistic production figure than for 1961. The growth from 1962 to 1963 has been about the same as that over the past several years. Production increased 6%, sales volume grew 13%, and sales value 8 percent.

The current growth rate will most likely continue as new products are developed with price/performance characteristics which make them better suited to replace the less permanent monomeric plasticizers. Significant (To page 196)

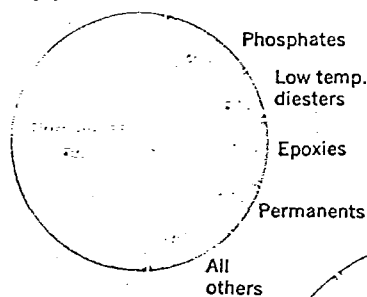
Plasticized polyvinyl chloride end-use applications (% of the total PVC market)

Application	1960	1961	1962	1963
Wire insulation	16	16	15	15
Molding and extrusion	16	17	19	19
Miscellaneous	15	13	15	15
Flooring	19	21	21	21
Paper and textile coatings	7	7	8	10
Film and sheeting	27	26	22	20

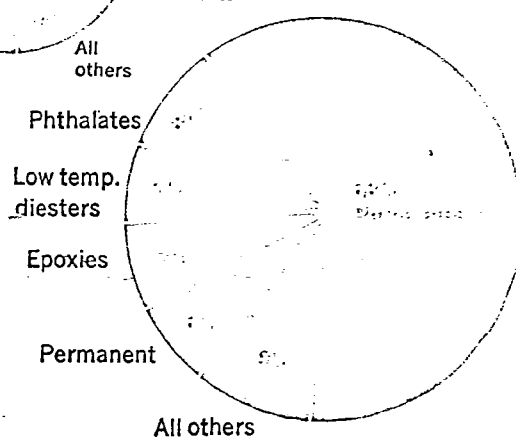
Plasticizer production, 1958-1963

	1958	1963
Phthalates	227,000,000	522,000,000
Phosphates	49,000,000	64,000,000
Permanents	30,000,000	52,000,000
Low temperature diesters	23,000,000	56,000,000
Adipates		
Azelates		
Sebacates		
Epoxyes	30,000,000	59,000,000
All others	59,000,000	77,000,000
Total	418,000,000	830,000,000

By percentage 1958



By percentage 1963



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Plasticizers

(From page 123)

developments have already been made in permanent plasticizers. Newer, lower-cost products are beginning to be used in greater quantities. These products generally are easier to process and have faster fusing characteristics. Their degree of permanence is usually related to price. The less the permanence of the plasticizer, the lower the cost.

The cost/performance properties of these plasticizers, however, have encouraged their growing use in many applications, particularly where permanence cannot be obtained with monomeric plasticizers and where permanence requirements are not sufficiently severe to require use of the more costly polymers.

Epoxies: Epoxies maintained a 7% share of total plasticizer production, increasing from 54 million to 58.8 million lb. in 1963. This represents a 9% increase in production. Sales volume increased 10%, but sales value only 1%, again indicating the problem of price deterioration.

Epoxidized soya oils maintained their position as the major epoxy produced. They represented 70% of all epoxies in 1962 and declined only slightly to 68% in 1963. Their production increased 6% from 37.7 million in 1962 to 40 million lb. in 1963. Their sales volume grew 12% over that same period, while sales value followed the trend and actually showed only a 1% growth.

Epoxy tallates declined 4% in sales volume and 14% in sales value. Production was up about 9%, however. Formulators may be moving more towards the use of low temperature diesters along with epoxidized soya oil for heat stability instead of employing the epoxy tallates for this purpose.

Growth potential

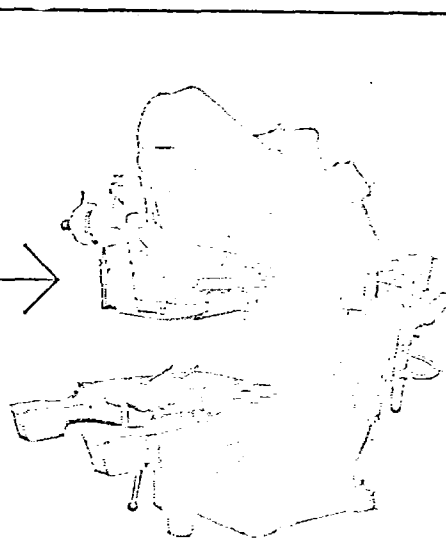
The major growth areas will certainly come from vinyl applications even though, as previously stated, more and more rigid PVC is expected to be used. Of the major end uses for polyvinyl chloride molding and extrusion, floor covering and coatings hold out prospects for the greatest produc-

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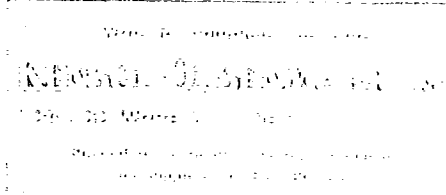
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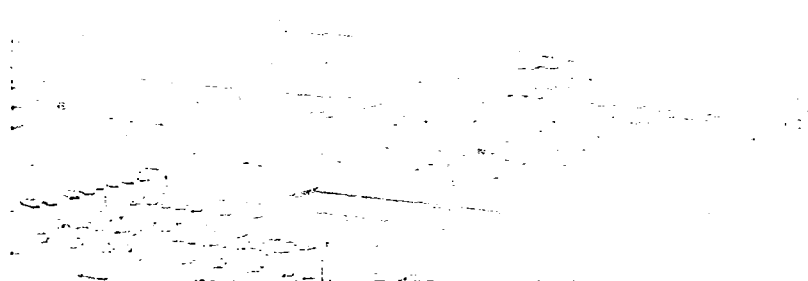
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tion and sales growth over the next several years.

The table on p. 123 indicates that certain applications have not grown as rapidly as others. Film and sheeting continues to maintain the top spot as the largest user of PVC, even though its percentage of the total has changed. This is true also of the wire and cable industry, where use continues to grow but at a smaller percentage than the flooring, paper, and textile applications.

Polyvinyl chloride is expected to grow approximately 7.5 to 8% per year over the next few years. Of this volume, plasticized vinyl applications should increase at least 6% per year. The difference will be in rigid vinyl applications which will have a slow growth over the next few years, but should then really start to boom.

The growth of flexible vinyl depends on satisfying the consumer's need for highly styled products. The resilient flooring industry has already recognized this desire as evidenced by the many patterns and designs that are available.

Expanded vinyl applications continue to show good growth rates. Here, too, styling has played an important role. The automobile industry and furniture manufacturers will probably increase their use of expanded vinyl for upholstery. The material is also finding good acceptance as a floor covering material. It has been estimated that the total domestic market for expanded vinyl applications is already in excess of 50 million yards per year.

Technological advancements will be the cause of even greater uses of vinyl. New applications being developed could possibly be based on such chemicals as reactive plasticizers. We can also expect to see more and better extraction-resistant products that will be more permanent to active solvents. Another area that will definitely show accelerated growth is protective coatings, via fluidized-bed organosol spray coating techniques.

The development and expansion of all new plasticized vinyl applications insures a continued growth rate for plasticizers, and thereby provides all industries with a challenge to aggressively pursue every new idea and concept.—End

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