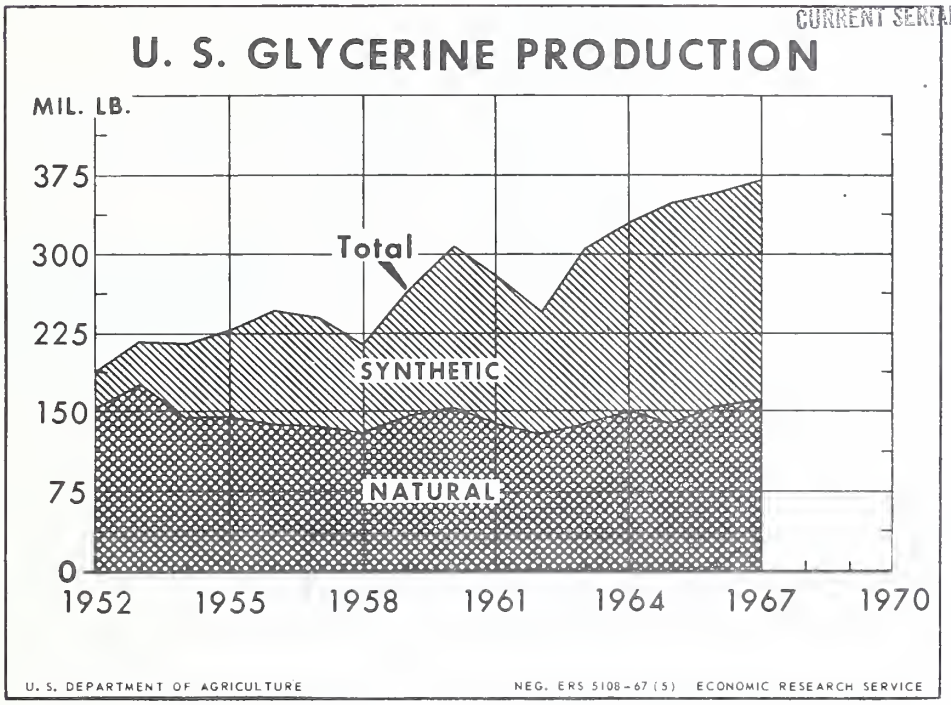
GLYCERINE: DEMAND STRONG FOR LIMITED SUPPLIES

By
George W. Kromer



U.S. glycerine production increased from 188 million pounds in 1952 to an estimated 370 million pounds in 1967. The doubling of output during this period is attributed to the sharp rise in synthetic glycerine production, since output of natural glycerine (a byproduct of fats and oils) remained relatively stable at about 150 million pounds per year. Growth in domestic and export demand for glycerine, with a limited ability of the industry to expand output, resulted in price increases of about one-third since 1963. Future increases in output required to meet expanding needs will continue to come from synthetic sources. Production of natural glycerine, a byproduct of soap manufacturing, is not expected to change much in coming years. (See page 24.)

Reprinted from the Fats and Oils Situation, FOS-238, June 1967, by the Economic and Statistical Analysis Division, Economic Research Service.

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U.S. production of glycerine has approximately doubled since 1952, rising from 188 million pounds that year to a record 355 million pounds in 1966. A further increase to around 370 million pounds is forecast for 1967 (table 14). During this period, natural glycerine (produced from fats and oils) held fairly steady, while synthetic glycerine (produced from chemical industry feed-stocks) increased more than four-fold. Over 50 soapmakers, fat-splitters, and chemical companies produce glycerine in this country.

Glycerine was originally a by-product of soap and candle manufacture; but glycerine output from fat splitting and fatty alcohol manufacture has become increasingly important. Synthetic glycerine (from propylene) was first produced commercially in 1948. Since that time, production has grown until it now accounts for about three-fifths of the total U.S. production. (See cover chart.) Most of the increase in future production of glycerine is expected to be of the synthetic type.

Domestic disappearance of glycerine over the past 15 years has increased at an average annual rate of around 3 percent. Another slight increase is forecast for 1967. Continuing strong demand and limited supplies have resulted in glycerine price increases of about one-third since 1963.

Pure glycerine is a clear, odorless, syrupy liquid.1/ Over 1,500 uses indicate its versatility in all areas of industry. The major market outlets for glycerine are in the manufacture of alkyd resins, cellophane, drugs and cosmetics, tobacco, food and beverages, explosives, and polyurethanes.

RAW MATERIALS FOR GLYCERINE PRODUCTION

Historically, natural glycerine has been produced as a byproduct from fats and oils used in soap manufacture.2/ Coconut, palm kernel, cottonseed, soybean, and olive oils usually yield more glycerine than animal fats such as tallow and lard. Although soap production has declined sharply from 2.3 billion pounds in 1952 to 1.2 billion in 1966, due to increased use of synthetic detergents, there has not been a proportionate drop in natural glycerine output.

As may be seen in table 15, natural glycerine production during 1952-66 averaged about 10 percent of total soap production. However, the percentage trended upward from just under 7 percent in 1952 to over 13 percent in 1966. The rising glycerine/soap ratio is attributed to increased use of higher grade fats and improved techniques in soap-making, and the recovery of natural glycerine from fatty alcohols.

A technological change in soap making has simplified and reduced the cost of reclaiming byproduct glycerine. The old "soap-kettle" technique has been replaced by production from fatty acids obtained from hydrolysis of fats and oils. Around the same time, the supply of natural glycerine was supplemented from the manufacture of fatty alcohols which also yields byproduct glycerine. Fatty alcohols are

1/ This paper is concerned with commercially-produced glycerine, which normally contains 95% or more, of glycerol and a small percentage of water. Glycerine also occurs naturally in foods, both combined (as in fats) and in the free state (in fermentation products, such as beer and wine).

2/ Glycerine can also be produced by fermentation of sugar. The product is of poor quality and requires much refining. This process is not used in the United States.

Table 14.--Glycerine 1/: Supply and disposition, 1952-67

Year	Supply				Disposition	
	Production	Imports	Stocks, January 1	Total	Exports	Domestic disappearance
	Mil. lb.	Mil. lb.	Mil. lb.	Mil. lb.	Mil. lb.	Mil. lb.
1952	188	15	56	259	9	212
1953	215	35	38	288	4	224
1954	207	14	60	281	17	222
1955	228	27	42	297	10	236
1956	244	18	52	314	10	237
1957	240	27	67	334	10	243
1958	214	18	81	313	17	255
1959	268	10	41	319	21	260
1960	302	15	38	355	20	278
1961	279	15	56	350	16	266
1962	249	9	69	327	13	257
1963	303	2	58	363	31	291
1964	328	9	41	378	28	289
1965	347	4	61	412	52	312
1966	355	4	48	407	43	325
1967 2/	370	8	39	417	32	335
1968 2/			50			

1/ 100 percent glycerol basis.
2/ ERS forecast.
Source: Bureau of the Census.

Table 15.--Soap and natural glycerine production, 1952-66

Year	Production 1/		Glycerine as percent of soap	Year	Production 1/		Glycerine as percent of soap
	Soap	Natural glycerine			Soap	Natural glycerine	
	Mil. lb.	Mil. lb.	Pct.		Mil. lb.	Mil. lb.	Pct.
1952	2,275	152	6.7	1960	1,277	151	11.8
1953	1,986	172	8.7	1961	1,213	138	11.4
1954	1,751	147	8.4	1962	1,240	131	10.6
1955	1,645	148	9.0	1963	1,221	141	11.5
1956	1,599	143	8.9	1964	1,162	150	12.9
1957	1,496	135	9.0	1965	1,162	145	12.5
1958	1,409	132	9.4	1966	1,158	155	13.4
1959	1,284	149	11.6	1952-66 avg.	1,459	146	10.0

1/ Based on estimates of the Soap and Detergent Association.

used in the production of synthetic detergents and have gained wide use, because of the beneficial biodegradable properties of the detergents made from them.

Synthetic glycerine is produced from chemical industry feedstocks (from the basic one, chlorine, and extending through allyl chloride and epichlorohydrin). The supply of feedstocks from precursors appears to be more of a limiting factor in synthetic glycerine production then inadequate capacity for the end-product. The chemical industry is currently expanding plant capacity for the manufacture of intermediates.

Production of natural glycerine during 1952-66 ranged between 131 million and 155 million pounds annually (except for 172 million in 1953). In recent years it has been running around 150 million pounds (table 16). In sharp contrast, synthetic glycerine output has trended upward from 36 million pounds to about 200 million in 1965 and 1966. In 1952, synthetics accounted for nearly 20 percent of the total glycerine production of 188 million pounds but in 1966 they comprised almost 60 percent of the 355 million pounds total output.

GLYCERINE USAGE SHOWS STEADY GROWTH RATE

Natural and synthetic glycerine are used interchangeably by industry. Total domestic disappearance of glycerine has increased rather steadily from 212 million pounds in 1952 to a record 325 million pounds in 1966. The rate of increase averaged about 3 percent per year for the entire 1952-66 period. However, all market outlets for glycerine have not shared in this growth. (See figure 1 below). Detailed data on the use of glycerine in end-products are not available from the Bureau of the Census. However, some end-use estimates for 1961-66 have been developed by the Glycerine Producers' Association, a Division of the Soap and Detergent Association (SDA). These are shown in Table 17.

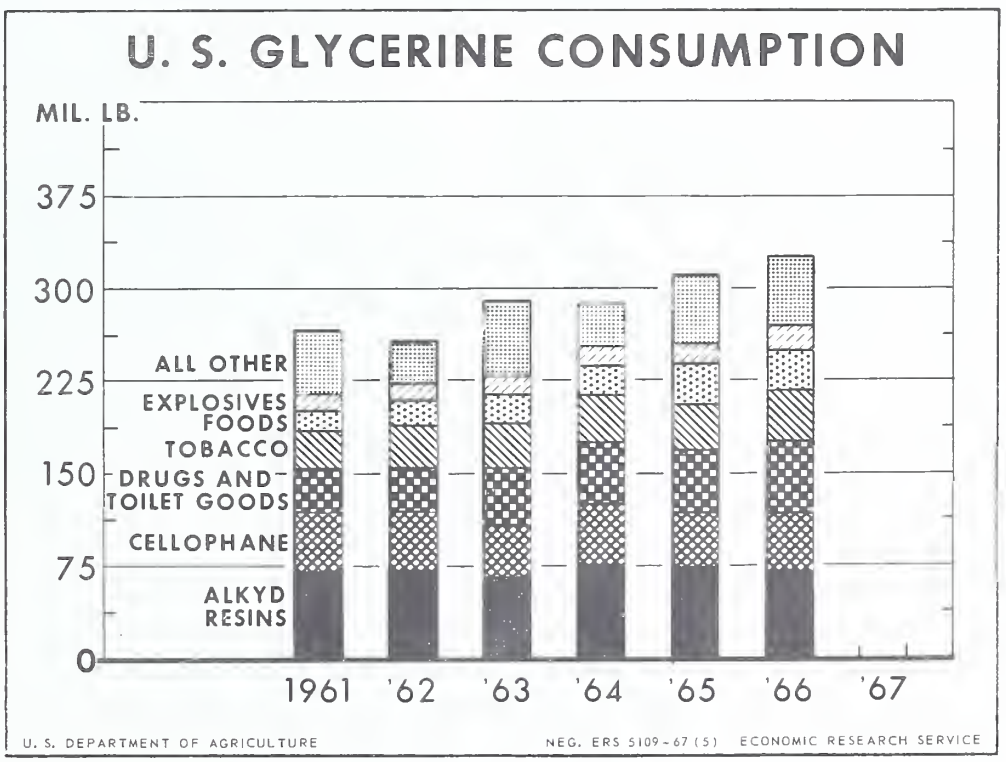

Figure 1

Table 16.--U.S. production of natural and synthetic glycerine, actual and percentage, 1952-66

Year	Production			Percentage distribution		Production as percentage of preceding year		
	Natural 1/	Synthetic 1/	Total	Natural	Synthetic	Natural	Synthetic	Total
	Mil. lb.	Mil. lb.	Mil. lb.	Pct.	Pct.	Pct.	Pct.	Pct.
1952	152	36	188	81	19	89	90	89
1953	172	43	215	80	20	113	119	114
1954	147	60	207	71	29	85	139	96
1955	148	80	228	65	35	101	133	110
1956	143	101	244	59	41	97	126	107
1957	135	105	240	56	44	94	104	98
1958	132	81	214	62	38	98	77	89
1959	149	118	268	56	44	113	146	125
1960	151	150	302	50	50	101	127	113
1961	138	141	279	49	51	91	94	92
1962	131	118	249	53	47	95	84	89
1963	141	161	303	47	53	108	136	122
1964	150	178	328	46	54	106	110	108
1965	145	201	347	42	58	97	113	106
1966 2/	155	200	355	44	56	107	100	102
1967			3/370					
1952-66 avg.	146	118	264	55	45	100	113	104

1/ Estimates of the Soap and Detergent Association.
2/ Preliminary.
3/ ERS Forecast.

Table 17.--Estimated consumption of glycerine, by end-product groups, 1961-66 1/

Product	1961	1962	1963	1964	1965	1966
	Mil. lb.	Mil. lb.	Mil. lb.	Mil. lb.	Mil. lb.	Mil. lb.
Alkyds	70	70	65	75	73	70
Tobacco	30	35	38	40	42	43
Cellophane	50	50	44	50	45	45
Explosives	15	15	15	15	18	23
Drugs and Toilet Goods (Including Toothpaste)	35	35	45	46	48	60
Foods and Monoglycerides	14	15	22	23	26	30
Urethane Foams			9	10	13	14
Triacetin (Plasticizer)			3	3	4	4
Miscellaneous	52	37	50	27	43	36
Total	266	257	291	289	312	325

1/ Estimates of the Glycerine Producers' Association.

The largest single market outlet for glycerine takes advantage of its chemical properties in making alkyd resins for paints and protective coatings. Glycerine's physical properties are its moistening, lubricating, and softening characteristics and thus is used in conditioning tobacco, pharmaceuticals, perfumes and scores of other products. In food processing, edible monoglycerides are used as emulsifiers and stabilizers for many products.

Alkyd resins accounted for about 24 percent of domestic glycerine consumption during 1961-66, but its proportion of the total glycerine usage has declined slightly. In 1966, alkyds used an estimated 70 million pounds of glycerine or about the same as in 1961. Alkyds are used mainly in paint finishes for automobiles, trucks, tractors, ships, stoves, refrigerators, washing machines and other industrial equipment requiring coatings which combine toughness and durability with gloss and color retention.

Glycerine used as a plasticizer in cellophanes accounted for 19 percent of domestic glycerine consumption in 1961 but dropped to 14 percent in 1966. An estimated 45 million pounds of glycerine was used in the manufacture of cellophane in 1966 compared with 50 million in 1961. Cellophane packaging has met increased competition from thinner packaging films (polyethylene and polypropylene packaging films). The trade anticipates further declines in regular cellophane packaging films and further increases in the other competitive categories. Glycerine is added to many types of paper--crepe, tissue, parchment, glasine, waxed--to reduce shrinkage during processing and to produce a softer, permanently plasticized product.

The tobacco industry consumed an estimated 43 million pounds of glycerine in 1966--13 percent of all glycerine used in the United States, compared with 30 million pounds and 11 percent in 1961. Cigarettes are prepared with a humectant (usually glycerine) to keep them from drying out. A glycerine content of about 3 percent keeps tobacco moist and soft to prevent breaking and crumbling during processing, and to insure freshness in packaged tobacco products. In 1966, U.S. smokers consumed a record 541 billion cigarettes, nearly $2\frac{1}{2}$ percent more than in 1965. Cigarette consumption in 1967 may register a modest increase over 1966. Glycerine is also used with cigar, pipe, and "plug" tobaccos.

Glycerine used in drugs, cosmetics, and dentifrices has shown a steady growth pattern and now accounts for about 18 percent of total glycerine used domestically. In 1966, an estimated 60 million pounds was consumed by this industry group, compared with 35 million in 1961. New drug and medical uses of glycerine are continually being researched and developed. In the cosmetics industry, glycerine is widely used in skin lotions, hand creams, vanishing and cleansing creams, deodorant pastes, eye washes, and shaving soaps and creams. Glycerine is the basic medium for toothpaste.

Food and beverage uses of glycerine accounted for about 7 percent of domestic glycerine consumption during 1961-66. The annual proportion has increased slightly, as use rose from 14 million pounds in 1961 to an estimated 30 million in 1966. Glycerine functions in foods and beverages as an emulsifier, humectant, solvent, sweetner and preservative. Edible monoglycerides are added to margarines, shortenings, salad dressings, frozen desserts, candy and food coatings. The trend to prepared foods and changing technology in food processing are factors which will help boost glycerine consumption in this category.

Glycerine use in explosives during 1961-64 averaged about 15 million pounds annually, or about 5 percent of the total domestic glycerine consumption. Estimated usage increased to 23 million pounds in 1966, because of stepped up activity in several federal arsenals and munition plants.

U.S. GLYCERINE EXPORTS TREND UPWARD, IMPORTS DOWNWARD

Annual exports of glycerine have varied considerably but have generally increased from 4 million pounds in 1953 to a record 52 million in 1965 (table 14). The latter figure represents about 15 percent of the 1965 glycerine production in the United States. Exports fell to 43 million pounds in 1966 and a further decline is likely in 1967, mainly because of the relatively tight domestic supply situation and higher prices this year.

During 1966, our largest markets for glycerine were Canada, Japan, the Republic of South Africa and Western Europe (table 18). Explosives for South Africa's mines are a major outlet for U.S. glycerine, as shipments to that country rose from 69,000 pounds in 1962 to 9,953,000 in 1965.

U.S. imports of glycerine have declined fairly steadily from 35 million pounds in 1953 to only 4 million pounds in 1965 and 1966. Imports accounted for about 12 percent of the U.S. supply in 1953 but in 1966 it was only 1 percent. Imports are expected to increase in 1967 mainly because of higher U.S. prices. The United States imports of glycerine have been mostly from Argentina, the Phillipine Republic, and Indonesia in recent years.

GRADES OF GLYCERINE

The 2 grades of crude natural glycerine for refining are saponification (88%) and soap lye (80%). Saponification crude is obtained from fat-splitting and soap lye crude is the product of the spent lye of the soap kettle.

There are several grades of refined glycerine, such as U.S.P., often referred to as C.P. (chemically pure), high-gravity, dynamite, and yellow distilled. The specifications for each grade vary depending upon the consumer and intended use. U.S.P. - grade is a water-white product, meeting the requirements of the U.S. Pharmacopoeia. It is classified as GRAS (generally recognized as safe for human use) by the Food and Drug Administration and the USDA and is suitable for use in foods, beverages, pharmaceuticals, and cosmetics, or when the highest quality is demanded or the end product is designed for human consumption. High-gravity is a pale-yellow glycerine for industrial use while the dynamite grade for explosives manufacture is more yellow. Yellow distilled is used for industrial purposes.

PRICE TRENDS

Historically, the price of glycerine has fluctuated widely. This was especially true in the earlier years of the industry when glycerine was derived almost exclusively from soap fats and oils, which have always demonstrated the price fluctuations characteristic of farm commodities. In recent years, glycerine prices have tended to be more stable as a larger proportion of the total production became available from synthetic sources.

Crude glycerine (80% soap lye, tanks, New York) prices have varied from a postwar peak of 42 cents per pound in 1951 to a low of 10.5 cents in 1963. Prices have since increased and in June 1967 averaged 16.3 cents per pound (table 19). For all of 1967, crude glycerine prices probably will average about a tenth above the 14.4 cents in 1966.

The average price of natural glycerine (refined, U.S.P., 99%, New York) rose from 19 cents per pound in 1963 to 24 cents in 1966. Prices continued to advance in 1967 and in June were 24 7/8 cents per pound, 1 cent above June 1966. Refined synthetic glycerine (U.S.P., 99.5%) has shown a similar price trend averaging about 1 percent higher than natural glycerine prices. (See figure 2.)

Table 18.--U.S. glycerine exports, by country of destination, 1962-66

Country of destination	1962	1963	1964	1965	1966 1/	1967
	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.
North America						
Canada	5,459	7,189	9,176	10,086	10,640	
Mexico	1,574	2,360	---	2,983	4,918	
Total	7,033	9,549	9,176	13,069	15,558	
Western Europe						
Germany, West	1,210	988	---	4,450	987	
Netherlands	2,639	5,018	8,089	10,970	5,113	
United Kingdom	-	3,441	---	3,175	895	
Total	3,849	9,447	8,089	18,595	6,995	
Asia and Oceania						
Australia	---	1,245	---	---	---	
Japan	388	5,941	3,605	7,965	9,347	
Vietnam, South	304	---	581	444	639	
Total	692	7,186	4,186	8,409	9,986	
Africa						
Republic of South Africa	69	3,281	5,948	9,953	8,926	
Other Countries	1,750	1,278	745	1,995	1,920	
Grand total	13,393	30,741	28,144	52,021	43,385	

1/ Preliminary.

Table 19.--Wholesale prices of natural and synthetic glycerine at New York, 1952-67

Year	Glycerine price per pound, tanks, delivered, New York				
	Crude, 80 percent soap lye	Natural			Synthetic, refined 99.5 percent
		USP, chemically pure		High-gravity	
		Refined 99 percent 1/	96 percent		
	Cents	Cents	Cents	Cents	Cents
1952	23.3	38.0	36.7	36.1	---
1953	27.4	42.0	40.8	40.8	---
1954	20.1	30.5	29.5	30.7	30.7
1955	20.6	30.0	29.0	30.0	30.0
1956	16.7	29.3	28.3	29.2	29.3
1957	15.2	27.9	27.0	27.8	28.0
1958	16.0	27.6	26.8	27.6	27.8
1959	18.4	28.0	27.2	27.9	28.2
1960	18.5	29.1	28.2	29.0	29.1
1961	13.2	25.5	24.8	25.6	25.8
1962	10.7	21.6	21.0	21.6	21.9
1963	10.5	18.9	18.3	18.7	19.0
1964	13.8	22.4	21.7	22.2	22.5
1965	12.7	22.6	22.0	22.5	22.8
1966 2/	14.4	23.8	23.2	23.6	24.0
1967 3/	15.9	24.6	24.0	24.4	24.7

1/ 98 percent 1952-July 1956.
2/ Preliminary.
3/ January-May 1967 average.

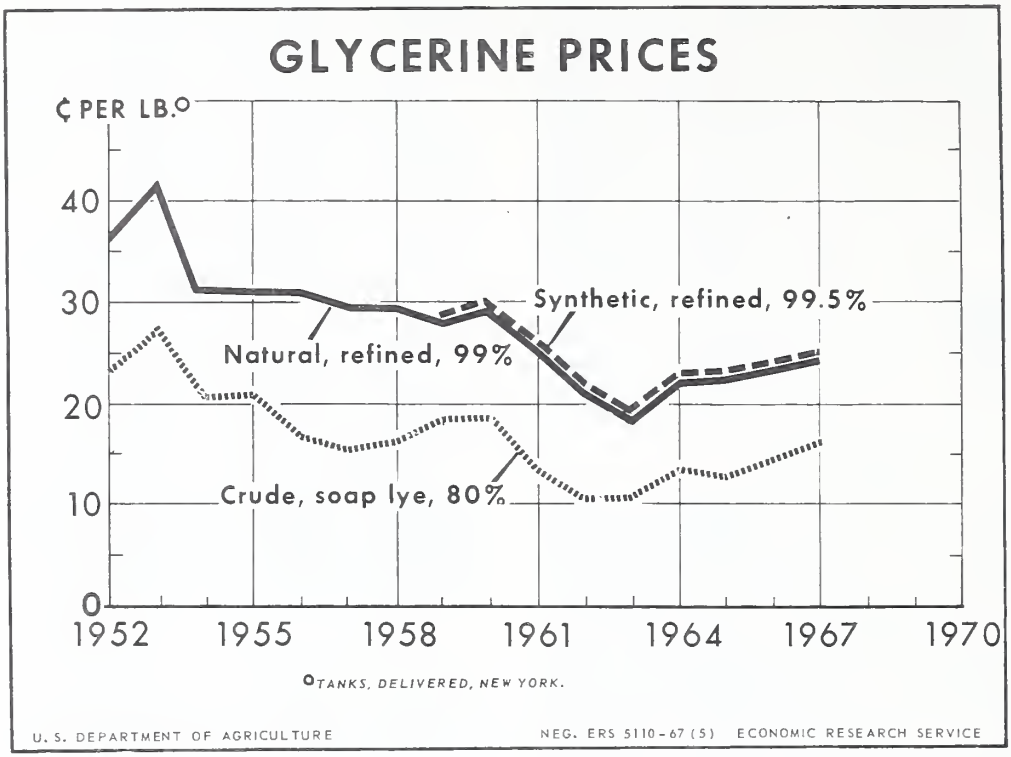

Figure 2

The 1967 price increases stem mainly from short glycerine supplies. Producers of natural glycerine cannot respond to increased demand, since their output is limited by the production of fats for soaps. Synthetics have taken up the slack in the past but chemical feedstocks are currently in short supply.

OUTLOOK

Production and use of glycerine likely will continue upward but natural glycerine from fats and oils probably will not grow because of its byproduct nature tied to soap manufacturing rates. The U.S. per capita consumption of soap has trended downward and this is the prime source of natural glycerine. Also, the use of fats and oils (mainly coconut oil) in fatty alcohols is expected to decline as an increasing share of the expanding fatty alcohol market is supplied from petrochemical sources. Natural glycerine supplies will also be affected when synthetic fatty acids are produced in the United States. Glycerine is not a byproduct of synthetic fatty alcohols or synthetic fatty acids. For these reasons, most of the increased supply required to meet further requirements will have to come from synthetic sources as natural glycerine output will do well to hold its current level.

According to trade estimates, present U.S. capacity for producing synthetic glycerine is about 290 million pounds a year and the refining or purification capacity for natural glycerine is about 240 million pounds per year. Capacity for producing synthetic glycerine is now being increased primarily by expansion of plants for the manufacture of precursors.

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