UNITED STATES TARIFF COMMISSION

SUMMARIES OF TRADE AND TARIFF INFORMATION

Prepared in Terms of the Tariff Schedules of the United States (TSUS)

Schedule 4

Chemicals and Related Products
(In 12 volumes)

VOLUME 5

Organic Chemicals I

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SUMMARIES OF TRADE AND TARIFF INFORMATION
BY SCHEDULES

Schedule 1 - Animal and Vegetable Products
(In 14 volumes)
Schedule 2 - Wood and Paper; Printed Matter
(In 5 volumes)
Schedule 3 - Textile Fibers and Textile Products
(In 6 volumes)
Schedule 4 - Chemicals and Related Products
(In 12 volumes)
Schedule 5 - Nonmetallic Minerals and Products
(In 5 volumes)
Schedule 6 - Metals and Metal Products
(In 11 volumes)
Schedule 7 - Specified Products; Miscellaneous
and Nonenumerated Products
(In 8 volumes)
Schedule 8 - Special Classification Provisions
(In 1 volume)

Schedule 4 Volumes

1 - Benzenoid Chemicals and Products
2 - Chemical Elements and Inorganic Chemicals I
3 - Inorganic Chemicals II
4 - Inorganic Chemicals III
5 - Organic Chemicals I
6 - Organic Chemicals II
7 - Drugs, Synthetic Plastics Materials, and Rubber
8 - Flavoring Extracts and Essential Oils
9 - Glue, Gelatin, Aromatic Substances, Toilet Preparations, Surface-Active Agents, Soaps, Dyes, and Tannins
10 - Pigments, Inks, and Paints
11 - Petroleum, Fertilizers, and Explosives
12 - Fatty Substances, Waxes, and Miscellaneous Chemical Products

FOREWORD

In an address delivered in Boston on May 18, 1917, Frank W. Taussig, distinguished first chairman of the Tariff Commission, delineated the responsibility of the newly established Commission to operate as a source of objective, factual information on tariffs and trade. He stated that the Commission was already preparing a catalog of tariff information--

> designed to have on hand, in compact and simple form, all available data on the growth, development and location of industries affected by the tariff, on the extent of domestic production, on the extent of imports, on the conditions of competition between domestic and foreign products.

The first such report was issued in 1920. Subsequently three series of summaries of tariff information on commodities were published--in 1921, 1929, and 1948-50. The current series, entitled Summaries of Trade and Tariff Information, presents the information in terms of the tariff items provided for in the eight tariff schedules of the Tariff Schedules of the United States (TSUS), which on August 31, 1963, replaced the 16 schedules of the Tariff Act of 1930.

Through its professional staff of commodity specialists, economists, lawyers, statisticians, and accountants, the Commission follows the movement of thousands of articles in international commodity trade, and during the years of its existence, has built up a reservoir of knowledge and understanding, not only with respect to imports but also regarding products and their uses, techniques of manufacturing and processing, commercial practices, and markets. Accordingly, the Commission believes that, when completed, the current series of summaries will be the most comprehensive publication of its kind and will present benchmark information that will serve many interests. This project, although encyclopedic, attempts to conform with Chairman Taussig's admonition to be "exhaustive in inquiry, and at the same time brief and discriminating in statement."

This series is being published in 62 volumes of summaries, each volume to be issued as soon as completed. Although the order of publication may not follow the numerical sequence of the items in the TSUS, all items are to be covered. As far as practicable, each volume reflects the most recent developments affecting U.S. foreign trade in the commodities included.

SUMMARIES OF TRADE AND TARIFF INFORMATION

SCHEDULE 4

Volume 5

C O N T E N T S

CONTENTS

Numerical List of TSUS Items in This Volume

Numerical List of TSUS items in This Volume--Continued

INTRODUCTION

Volume 4:5 is the ninth in a series of 12 volumes of summaries on trade and tariff information covering chemicals and related products classified under schedule 4 of the Tariff Schedules of the United States (TSUS). It is also the second of two volumes on nonbenzenoid organic chemicals, grouped according to chemical function.

Volumes 5 and 6 in this series cover those chemicals which are not covered elsewhere in schedule 4 by more specific provisions of use, composition, or derivation. Volume 5 includes summaries on nitrogenous compounds, acids, and acid anhydrides, salts of organic acids, aldehydes and ketones listed under subpart D of schedule 4. Volume 6 covers chemical functions such as monohydric and polyhydric alcohols, halohydrins, esters, epoxides, ethers, acetals, lactones, halogenated hydrocarbons, hydrocarbons, sulfur compounds, and mixtures. The complete list of products covered by Volume 5 is shown in appendix A to this volume. Those not included here, indicated by shading out, are mostly covered in Volume 6. Because many compounds covered in Volumes 5 and 6 are embraced within two or more chemical functions, the chemical groups are arranged so that a compound described in two or more groups is classifiable in the first group in which it is described. The order of precedence of these functional groups is generally that used in naming and indexing chemical compounds by Chemical Abstracts, a publication of the American Chemical Society.

The requirements for the chemical products covered in the summaries contained in this volume are supplied almost entirely by domestic production. Much of this production is derived originally from petroleum or natural gas. Domestic consumption of these products is essentially equal to domestic production, since exports and imports are relatively unimportant.

It is estimated that the 1968 total production of the chemicals covered in the summaries in this volume was about 26 billion pounds, valued at about $9 billion. In 1968, production of the nitrogenous compounds covered in this volume was about 4.8 billion pounds; that of aldehydes and ketones was 9.4 billion pounds; and that of acids and anhydrides was 5.6 billion pounds. Some individual chemicals which were produced in large quantities in 1968 were acetic acid (1.7 billion pounds), acetic anhydride (1.7 billion pounds), acrylonitrile (1.0 billion pounds), acetaldehyde (1.6 billion pounds), and formaldehyde (4.1 billion pounds).

Total value of exports of the chemicals covered in this volume is estimated to be about $172 million in 1969. Chemicals exported included acetone ($1.1 million), ethyl methyl ketone ($2.8 million), ethylenediamine ($4.2 million), ethanolamines ($5.2 million), and amines and hydroxy amines ($21.2 million).

In 1969, the value of U.S. imports for consumption of the products covered in the summaries included in this volume amounted to $72 million. The most important products imported in 1969 included triazine compounds ($5.9 million), dicyandiamide and guanidine salts ($9.5 million), amino acids and salts ($5.9 million), and chloroacetic acid ($2.6 million). Principal supplying countries for the imports of these products were the European Economic Community, Japan, Canada, France, and the United Kingdom.

Commodity	TSUS item
Acrylonitrile	425.00

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Acrylonitrile is an important chemical in both domestic and international trade. In 1969, U.S. production amounted to 1,151 million pounds. Exports in that year were estimated by trade sources to be 200 million to 250 million pounds, equivalent to about 20 percent of domestic production. Imports in 1969 amounted to 55,000 pounds, valued at $4,000.

Description and uses

Acrylonitrile, CH_2=CHCN, is a flammable, colorless, toxic liquid. In the United States the usual commercial method for producing acrylonitrile is the catalytic oxidation of a mixture of propylene and ammonia. Smaller amounts are produced commercially by the catalytic reaction of acetylene and hydrogen cyanide. The propylene-ammonia method became a commercial process in 1960 and shortly thereafter began replacing the older acetylene-hydrogen cyanide method. The propylene-ammonia process accounts for more than two-thirds of the annual output of acrylonitrile. Until recently, acrylonitrile was also produced on a commercial basis by the catalytic reaction of propylene and nitric oxide.

Acrylonitrile is consumed principally in the manufacture of acrylic and modacrylic fibers which are used to make blankets, carpets, draperies, upholstery, and woven and knitted clothing. Other important uses for this chemical include the manufacture of acrylonitrile-butadiene-styrene (ABS) resins, styrene-acrylonitrile (SAN) resins, and nitrile rubbers. The ABS and SAN resins are used in the manufacture of automobile parts and home appliances, and the nitrile rubbers are used principally in the production of gaskets, seals, and industrial hose.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.00	Acrylonitrile---	2.5¢ per lb. + 12.5% ad val.	1.25¢ per lb. + 6% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual states of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1969, on acrylonitrile (2 cents per pound plus 10 percent ad valorem) was 37.5 percent; that of the rate in effect on January 1, 1970 (1.7 cents per pound plus 8.5 percent ad valorem) was 31.8 percent.

U.S. consumption

U.S. consumption of acrylonitrile increased from about 475 million pounds in 1964 to about 925 million pounds in 1969. Industry sources estimate that 80 percent of the current annual output of acrylonitrile is consumed in the production of acrylic and modacrylic fibers, ABS and SAN resins, and nitrile rubber, with the fibers accounting for about 60 percent of total consumption.

U.S. producers

Acrylonitrile was produced in the United States in 1969 by five companies at six plants--two in Texas and one each in Kentucky, Louisiana, Ohio, and Tennessee. Four of the producers are among the largest and most diversified in the chemical industry. All of these companies consume a considerable part of their output of acrylonitrile in the manufacture of fibers, ABS and SAN resins and nitrile rubbers. The fifth firm is primarily a merchant producer of acrylonitrile but may produce acrylamide, a minor outlet for acrylonitrile.

U.S. production

U.S. production of acrylonitrile increased irregularly from 594 million pounds in 1964 to 671 million pounds in 1967 and to 1,022 million pounds in 1968 (see accompanying table), or by more than 52 percent in the one year from 1967 to 1968. Production in 1969 was 1,157 million pounds.

The use of acrylonitrile by the producers in their own operations increased irregularly from about 50 percent of production in 1964 to about 57 percent of production in 1968. The principal reason for this rise in the captive use of acrylonitrile has been the 20 to 25 percent annual growth in the production of acrylic and modacrylic fibers in recent years.

U. S. exports

Although official statistics on U. S. exports are not available for acrylonitrile, the domestic producers report that exports increased from about 150 million pounds in 1964 to 200-225 million pounds in 1968. Europe has been the principal market for U. S. exports of acrylonitrile in recent years.

U. S. imports

U. S. imports of acrylonitrile have been small as shown in the following tabulation:

Year	Quantity 1,000 pounds	Value 1,000 dollars
1965	1,204	264
1966	7	2
1967	3	8
1968	35	7
1969	55	4

All imports came from Japan in 1965 and 1967 and from West Germany in 1966, 1968 and 1969. Imports in 1965 were equivalent to less than half of 1 percent of U. S. production.

Foreign production and trade

Acrylonitrile is produced in most of the industrialized nations. Trade sources have estimated Japanese annual capacity at almost 500 million pounds in 1970 and the combined annual capacity of the EEC and EFTA countries at over 1.3 billion pounds in 1970, increasing to 1.5 billion pounds by 1971.

Acrylonitrile: U.S. production and sales, 1964-69

Year	Production		Sales	
	Quantity	Value 1/	Quantity	Value
	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
1964	594,177	95,068	311,147	48,808
1965	771,622	123,459	303,339	48,354
1966	716,074	93,090	318,169	40,284
1967	670,764	80,492	270,454	31,875
1968	1,020,957	1,021,096 3/	2/	2/
1969	1,156,585	2/	2/	2/

1/ Calculated from the average unit value of sales.
2/ Not available. 3/ Estimated.

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

Commodity	TSUS item
Amino acids	425.04
Amino acid salts, not elsewhere enumerated	425.06

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

In 1969, U.S. imports of amino acids and salts totaled 13.0 million pounds, valued at $6.6 million. U.S. production was somewhat lower and U.S. exports were probably negligible.

Description and uses

Amino acids are organic compounds which contain both an acidic and an amino (basic or alkaline) group; such compounds are amphoteric. They form two types of salts: one (formed by the reaction of the acidic group with a metal or other base) is more basic than the original compound; the other (formed by the reaction of the amino group with an acid) is more acidic than the original compound. Monosodium glutamate (item 425.30), the most important salt, is discussed in a separate summary in this volume.

Amino acids of benzenoid structure, such as tyrosine or tryptophan, are included under part 1 of schedule 4 of the TSUS if obtained, derived, or manufactured in part from any product provided for in subpart A, B, or C thereof. They are provided for under part 2 if derived from an animal or vegetable product in which the benzenoid structure occurs naturally.

Two or more amino acids can be joined through the amido linkage of the amino group of one acid with the acidic group of another to form peptides and many more complex biochemicals. Protein molecules are made from hundreds or thousands of individual amino acids, and their number, kind, and arrangement determine the differences between the many proteins.

When the alpha carbon atom (the carbon adjacent to the acid group) is joined to an amino group and two other groups, it is asymmetric and forms stereoisomers which are mirror images. Amino acids derived from proteins are mostly levorotatory and are designated as the "L-form." Amino acids obtained synthetically are racemic mixtures of the dextrorotatory and levorotatory isomers (DL-form). The L-form amino acids are

generally utilized in biosynthesis and are priced considerably higher than the mixtures.

The breakdown of proteins yields 20 to 25 specific alpha-amino acids. "Essential" amino acids are those that man must obtain directly from food because his body cannot synthesize them; most are normally present in animal protein, but some are often absent in vegetable protein. Sustained deficiency of one or more of these essential amino acids can result in malnutrition in people who subsist on vegetable products only. Most of the naturally occurring amino acids are produced commercially by either the breakdown of large protein molecules from animal or vegetable sources or by the buildup of smaller molecules from industrial sources.

Methionine, commercially the most important amino acid, is a sulfur-containing essential amino acid principally used as an additive to poultry feed to obtain the optimum utilization of the grain protein. It is produced from two petrochemicals--methyl mercaptan and acrolein. The D-, L-, and DL-forms are all effective. Natural products, such as soybean meal and fish meal, which contain methionine are also used as additives, but their supply and price are more variable. Although not an amino acid, the hydroxy analog of methionine (2-hydroxy-4-(methylthio)butyric acid) (item 425.98) also increases the efficiency of grain protein and is widely used as a feed additive.

Glycine (aminoacetic acid), the simplest amino acid, is a dietary nonessential which in commercial importance is next to methionine. It is made from ammonia and chloroacetic acid and is used as an industrial and pharmaceutical buffer, an additive for food and cosmetics, a medicinal, and an intermediate in the synthesis of other chemicals. Other important commercial amino acids are cysteine, lysine, alanine, glutamic acid, tyrosine, tryptophan, isoleucine, and proline. They are used in intravenous feeding, as dietary supplements, and in biochemical research.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.04	Amino acids-------	12.5% ad val.	6% ad val.
425.06	Amino acid salts--	10.5% ad val.	5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round

of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Methionine, an amino acid chiefly used in mixed feeds for poultry, was subject to classification as an animal-feed ingredient under item 184.75 prior to December 7, 1965. Effective on that date, headnote 1(a) to part 15C of schedule 1, TSUS, was amended pursuant to Public Law 89-241, to assure that the products provided for in schedule 4 (except part 2E) and 5 (except part 1K), even though chiefly used for "animal feeds and ingredients therefor" would be classified under schedule 4 or 5. Accordingly, methionine became classifiable under item 425.04 effective December 7, 1965.

U.S. consumption, production, exports, and imports

Annual U.S. consumption of amino acids has been growing steadily. in 1968 it was valued at about $10 million. U.S. imports were slightly larger than production. U.S. exports are not separately reported but are believed to be small.

In 1968 one or more amino acids and salts were produced by about 20 firms, many of which were pharmaceutical producers. U.S. production of methionine and its hydroxy analog in 1968 totaled 10.1 million pounds, valued at $6.6 million, but production of the hydroxy analog (item 425.98) was significantly larger than that of the amino acid. Production of the other amino acids and salts in that year exceeded 1 million pounds.

Imports of amino acids and salts have increased steadily, and in 1969 totaled 13.0 million pounds, valued at $6.6 million (see accompanying table). Methionine, which came principally from Japan, France, and West Germany, was by far the most important amino acid imported in 1969, when imports totaled 11.3 million pounds, valued at $4.9 million. Glycine--from Japan, France and the Netherlands--was next in importance. Cysteine was imported from West Germany, and about 20 other amino acids--including many research products--came from Japan.

The Tariff Commission has completed an investigation under section 201(a) of the Antidumping Act, 1921, as amended to determine whether a domestic industry was being or was likely to be injured, or prevented from being established by reason of the importation of glycine from France. In this investigation the Commission determined that injury had occurred to a domestic industry as a result of such importation. 1/

1/ See U.S. Tariff Commission, Glycine From France, TC Publication 313, 1970 (processed).

Amino acids and salts: U.S. imports for consumption, by principal sources, 1964-69

Source	1964 1/	1965 1/	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Japan	121	156	702	3,162	3,677	6,339
France	123	194	4,005	2,166	3,467	4,319
West Germany	172	142	934	532	1,179	1,688
Italy	6	9	9	7	73	162
Netherlands	112	180	324	368	357	470
All other	84	8	43	9	14	63
Total	618	689	6,017	6,244	8,767	13,041
	Value (1,000 dollars)					
Japan	346	428	758	2,374	2,539	3,454
France	116	155	3,184	1,467	1,625	1,771
West Germany	247	271	919	593	888	910
Italy	11	28	35	25	57	94
Netherlands	78	119	199	200	176	232
All other	351	29	30	19	63	134
Total	1,149	1,030	5,125	4,678	5,348	6,595

1/ Data do not include imports of methionine, which were classified as a feed additive under item 184.75 prior to 1966.

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

Commodity	TSUS item
3-Amino-1,2,4-triazole----------	425.08

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Annual U.S. consumption of 3-amino-1,2,4-triazole is valued at about $1 million. Most of the supply is imported by an American chemical firm from its Canadian plant.

Comment

3-Amino-1,2,4-triazole, a heterocyclic compound made from nitroguanidine, which, in turn, is derived from calcium carbide, is used principally as a plant-growth regulator (U.S. patent 2,670,280, effective February 23, 1954). In small amounts, it stimulates germination and plant growth. In larger amounts, it destroys chlorophyll, causing the plant to die. Some of the chemical is used in photography.

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.08	3-Amino-1,2,4-triazole.	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. First of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Annual U.S. consumption of 3-amino-1,2,4-triazole is valued at about $1 million. Imports, which account for most of the supply, increased steadily from 616,000 pounds, valued at $539,000, in 1964 to 903,000 pounds, valued at $828,000, in 1967, then declined slightly

to 890,000 pounds, valued at $832,000, in 1969 (see accompanying table). Imports originated principally in Canada at an American-owned plant that produces calcium carbide and many of its derivatives.

The chemical is produced in the United States for use in photography, by a single firm, situated in New Jersey. No statistics on production of 3-amino-1,2,4-triazole are available.

3-Amino-1,2,4-triazole: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Canada	616	616	749	753	679	740
West Germany	-	-	30	30	75	75
France	-	40	-	116	35	75
United Kingdom	-	-	-	4	-	1/
Total	616	656	779	903		890
	Value (1,000 dollars)					
Canada	539	566	690	691	650	704
West Germany	-	-	265	25	64	64
France	-	34	-	98	30	63
United Kingdom	-	-	-	14	-	1
Total	539	600	715	828	744	832

1/ Less than 500 pounds.

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

Commodity	TSUS item
Cyanuric chloride, melamine, and other compounds containing a triazine ring	425.10

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

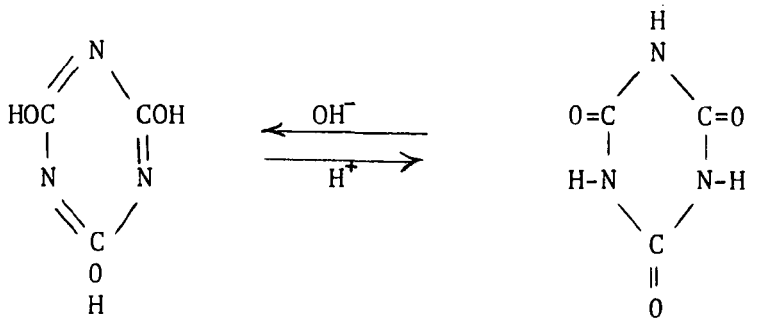
U.S. trade position

U.S. consumption of triazine compounds was estimated at a quarter of a billion pounds in 1969 and is increasing rapidly. U.S. imports in 1969 supplied over 15 percent of domestic consumption. Exports are believed to be negligible.

Description and uses

The triazine ring is a heterocyclic molecular structure composed of three nitrogen and three carbon atoms. Three isomers (1,2,3-, 1,2,4-, and 1,3,5-) are theoretically possible, but only the 1,3,5-form (also known as symmetrical or s-form) is commercially important.

Compounds with six-member triazine ring structure differ greatly from those with a six-member benzene ring and the two types cannot be used interchangeably. The benzene ring is opened only with great difficulty, but the triazine ring is opened easily and has many reactions similar to those of acyclic compounds. Some triazine compounds exhibit keto-enol tautomerism. For example, cyanuric acid has two molecular forms in a water solution.



Cyanuric acid (s-triazine-2,4,6-triol)

Isocyanuric acid (s-triazine-2,4,6-(1H,3H,5H)-trione)

Benzenoid compounds occur naturally in coal tar and many animal and vegetable products. Triazine compounds seldom occur naturally but are derived synthetically by ring closure of acyclic compounds. Compounds which contain both a benzene and a triazine ring are provided for in part 1 of the TSUS; practically all other triazine compounds are included in item 425.10.

About 25 triazine compounds are commercially important. Cyanuric chloride (2,4,6-trichloro-s-triazine) is prepared by the trimerization of cyanogen chloride and is used as an intermediate in the synthesis of dyes, fluorescent brightening agents, and herbicides.

Melamine (2,4,5-triamino-s-triazine) may be condensed with formaldehyde to produce strong, translucent, and heat resistant thermosetting resins which are used for making dinnerware and decorative laminates and for the treatment of textiles and paper. Melamine has long been obtained from dicyandiamide (item 425.39) which, in turn, is derived from calcium carbide, an electrochemical produced from coal and limestone. By a newer and increasingly important method, melamine is produced from urea (item 480.30) which, in turn, is derived from ammonia and carbon dioxide.

Chlorine derivatives of isocyanuric acid are produced from urea and chlorine. They decompose when wet to yield free chlorine and are used as dry bleaches for scouring cleansers, in swimming pool sanitizers, and for household and commercial textile bleaches since they are less harsh than hypochlorite bleaches.

Triazine compounds with chlorine, alkylamino, alkoxy, and alkylmercapto substitutents are used as herbicides, the selection of substitutents conferring a high degree of plant specificity. Atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine), the most important compound, is used as a pre-emergent herbicide for corn and sugar cane.

Dinitrosopentamethylenetetramine (DNPT, or 3,7-dinitroso-1,3,5,7-tetraazobicyclo [3.3.1]nonane) is produced by nitrosation with sodium nitrite of ammonia-formaldehyde solution of hexamethylenetetramine. Since it decomposes when heated, liberating nitrogen gas, it is used as a blowing agent in the production of foam rubber.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.10	Cyanuric chloride, melamine, and other compounds containing a triazine ring-----	10.5% ad val.	5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUSA), through 1967.

U.S. consumption, production, imports, and exports

U.S. consumption of triazine compounds has increased rapidly and reached an estimated quarter of a billion pounds in 1969. U.S. imports supplied over 15 percent of domestic consumption in that year. No export statistics are available. Melamine is consumed in larger volume than any other triazine compound. Apparent U.S. consumption of melamine has increased as shown in the following tabulation:

Year	Production	Imports	Apparent consumption	Ratio of imports to consumption
	1,000 pounds	1,000 pounds	1,000 pounds	Percent
1965	73,201	1/ 8,688	1/ 81,889	1/ 10.6
1966	82,177	18,375	100,552	18.3
1967	78,082	25,048	103,130	24.3
1968	61,949	38,416	100,365	38.3

1/ Includes imports of all triazine compounds.

In 1968, melamine was produced from imported dicyandiamide by three companies at plants in Connecticut, New Jersey, and West Virginia, and from urea by another company at a plant in Ohio. However, in 1968 the plant

in New Jersey ceased production and began importing its requirements. Imports of melamine in that year were supplied by more than eight countries, with Japan and West Germany as the principal suppliers (table 1).

In 1968 cyanuric chloride was produced by three companies at two plants in New York and one in New Jersey. Two producers consume most of their production in the synthesis of dyes, fluorescent brightening agents, and agricultural chemicals; sales of the domestic product in 1967 totaled 5.1 million pounds, valued at $1.6 million. West Germany and Japan supplied a significant part of U.S. imports.

Triazine herbicides are imported, as well as being domestically produced in Alabama and New York by the U.S. affiliate of a large Swiss chemical company. Dinitrosopentamethylenetetramine is produced by two firms with plants in Delaware and Massachusetts, and it is also imported from Japan. Chlorinated isocyanurates are produced by two other firms with plants in Illinois, Massachusetts, and West Virginia, and they are also imported from Japan.

During 1966-69, U.S. imports of triazine compounds other than melamine averaged 7.5 million pounds, valued at $3.6 million, and came principally from Japan, Switzerland, and West Germany (table 2).

Foreign production and trade

Triazine compounds are produced abroad principally in Canada, Japan, and Europe. Production of melamine is most widespread, and many new plants are being built using urea, a widely produced agricultural chemical, as a raw material (item 480.30).

Table 1.--Melamine: U.S. imports for consumption, by principal sources, 1966-69

Source	1966	1967	1968	1969
	Quantity (1,000 pounds)			
Japan	15,473	16,951	21,550	10,037
West Germany	764	4,744	11,910	11,047
United Kingdom	1,512	1,270	485	3,156
Italy	-	-	1,146	4,235
Sweden	378	409	441	1,900
Netherlands	-	25	70	1,010
Canada	196	-	961	641
France	50	1,489	1,850	520
All other	2	160	3	816
Total	18,375	25,048	38,416	33,362
	Value (1,000 dollars)			
Japan	3,328	3,755	4,610	2,082
West Germany	171	943	2,085	1,848
United Kingdom	356	281	93	626
Italy	-	-	160	575
Sweden	76	81	70	272
Netherlands	-	6	10	157
Canada	40	-	185	136
France	9	323	320	79
All other	2	40	4	107
Total	3,982	5,429	7,537	5,882

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

Table 2.--Triazine compounds other than melamine: U.S. imports for consumption, by principal sources, 1966-69

Source	1966	1967	1968	1969
	Quantity (1,000 pounds)			
Japan	2,368	4,818	4,884	4,160
Switzerland	4,112	651	696	931
West Germany	1,218	1,287	2,186	2,176
France	54	120	20	-
All other	51	191	45	46
Total	7,803	7,067	7,831	7,313
	Value (1,000 dollars)			
Japan	874	1,867	1,853	1,526
Switzerland	3,477	694	835	842
West Germany	387	436	699	690
France	14	34	5	-
All other	16	35	10	13
Total	4,768	3,066	3,402	3,071

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

Commodity	TSUS item
Diethanolamine, monoethanolamine, and triethanolamine	425.12

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Ethanolamines are important in both the domestic and international trade of the United States. In 1969, U.S. production exceeded 257 million pounds, and exports exceeded 48 million pounds. Ethanolamine imports are negligible, amounting to only 103,000 pounds, valued at about $19,000 in 1969.

Description and uses

There are three ethanolamines: monoethanolamine (MEA), diethanolamine (DEA), and triethanolamine (TEA). Monoethanolamine, $NH_2C_2H_4OH$, is a colorless, moderately viscous liquid with an ammoniacal odor; diethanolamine, $NH(C_2H_4OH)_2$, is normally a white crystalline solid at room temperature; and triethanolamine, $N(C_2H_4OH)_3$, is a colorless, viscous, hygroscopic liquid with a slight ammoniacal odor. Commercially, the ethanolamines are produced simultaneously by the reaction of ethylene oxide with ammonia at elevated temperatures and pressures. By varying the reaction conditions, it is possible to alter the quantities of MEA, DEA, AND TEA obtained in the process.

Ethanolamines are used as absorbents for acidic gases in petroleum refineries and synthesis gas plants (i.e., petroleum processing), and as intermediates used principally in the manufacture of detergents (surface-active agents), textile chemicals, and cosmetics.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.12	Ethanolamines---	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1969, on ethanolamines (2.4¢ per lb. plus 12 percent ad val.) was 25.3 percent; it was 21.6 percent for the rate in effect on January 1, 1970 (2.1¢ per lb. plus 10 percent ad val.)

U.S. consumption

Apparent U.S. consumption of ethanolamines increased irregularly from about 170 million pounds in 1965 to about 210 million pounds in 1969 (table 1). It is estimated that 60 percent to 70 percent of the annual output of ethanolamines is consumed in the scrubbing of acidic gases--especially in ammonia synthesis--and as an intermediate in the production of detergents, textile chemicals, and cosmetics. Detergents reportedly account for the greatest individual share of the total consumption of ethanolamines.

Trade sources estimate that more than 50 percent of the annual production of monoethanolamine is used in petroleum processing (gas scrubbing), and that more than 50 percent of diethanolamine is used in household (25 percent) and industrial (28 percent) detergents--including textile-scrubbing agents. Triethanolamine is used principally--40 percent--in making mild detergents for shampoos and shaving creams, and another 10 percent is used in making other types of detergents.

U.S. producers

In 1969, six U.S. companies produced ethanolamines at seven plants--four plants in Texas and one each in Kentucky, Louisiana, and Michigan. The companies range from medium size to the largest producers in the chemical industry. Most of the annual U.S. production is sold on the open market; captive use ranged from 17.2 percent to 22.8 percent from 1964 through 1968. Sales data for 1969 are not yet available.

U.S. production

U.S. production of ethanolamines increased irregularly from about 174 million pounds in 1964 to about 258 million pounds in 1969 (table 1), for an overall gain of 48 percent.

During 1964-68, annual production of MEA increased from about 60 million pounds to about 73 million pounds, or by 22 percent; that of DEA increased from about 66 million pounds to about 85 million pounds, or by 31 percent; and that of TEA increased from about 48 million pounds to about 66 million pounds or by 38 percent (table 2). In 1968 MEA accounted for 32.6 percent of the total quantity (34.7 percent in 1964), DEA accounted for 38.0 percent (37.7 percent in 1964), and TEA accounted for 29.4 percent (27.7 percent in 1964). Production statistics on the individual ethanolamines are not yet available for 1969.

U.S. exports

U.S. exports of ethanolamines decreased from 32.0 million pounds, valued at $5.0 million, in 1965, to 30.0 million pounds, valued at $4.6 million, in 1967, then increased to 48.5 million pounds, valued at $5.2 million, in 1969 (table 1). Exports represented 13 to 19 percent of production during 1965-69. Trade sources report that the three ethanolamines have been exported in nearly equal quantities.

The Netherlands and Belgium (where several large U.S. producers have their European facilities) were the principal foreign markets from 1965 through 1969 (table 3). In that period the quantity exported to these countries ranged from 71 percent in 1965 to 57 percent in 1967 and 61 percent in 1969. Japan, Brazil, and Mexico were also important export markets during 1965-69.

U.S. imports

U.S. imports of ethanolamines decreased irregularly from about 903,000 pounds (equivalent to one-half of 1 percent of U.S. production) in 1964 to about 103,000 pounds (equivalent to less than one-tenth of 1 percent of U.S. production) in 1969 (table 1).

Canada was the principal source of such imports in 1968 and 1969, and Japan was the major source in 1967. These countries were also important sources in earlier years, as were the United Kingdom and West Germany.

Table 1.--Ethanolamines: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1964-69

Year	Production	Imports	Exports	Apparent consumption
	Quantity (1,000 pounds)			
1964	173,937	903	1/	1/
1965	200,836	867	32,042	169,661
1966	207,794	514	32,588	175,720
1967	226,818	218	30,017	197,019
1968	223,866	318	31,402	192,782
1969	257,980	103	48,511	209,572
	Value (1,000 dollars)			
1964	2/ 32,341	210	1/	1/
1965	2/ 35,900	186	4,970	32,116
1966	2/ 33,650	92	4,946	28,796
1967	2/ 35,123	41	4,589	30,575
1968	2/ 30,295	86	4,542	25,839
1969	2/ 3/ 34,910	19	5,154	29,775

1/ Not available.
2/ Calculated from the average unit value of sales.
3/ Estimated; 1969 sales data not yet available.

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

Table 2.--Ethanolamines: U.S. production and sales, by types, 1964-68

Year	Production 1/				Sales			
	Mono-ethanol-amine	Dieth-anol-amine	Trieth-anol-amine	Total	Mono-ethanol-amine	Dieth-anol-amine	Trieth-anol-amine	Total
	Quantity (1,000 pounds)							
1964	60,286	65,521	48,130	173,937	48,225	49,043	46,839	144,107
1965	67,474	77,500	55,862	200,836	54,108	52,413	48,517	155,038
1966	70,262	79,246	58,286	207,794	57,581	55,831	57,565	170,977
1967	74,585	85,878	66,355	226,818	59,259	57,978	59,109	176,346
1968	73,017	85,140	65,709	223,866	61,695	58,305	65,383	185,673
	Value (1,000 dollars)							
1964	12,057	11,139	9,145	32,341	9,770	8,165	8,793	26,728
1965	13,495	12,400	10,005	35,900	10,667	8,176	8,865	27,708
1966	12,647	11,094	9,909	33,650	10,538	7,908	10,031	28,477
1967	12,679	11,164	11,280	35,123	9,903	7,517	10,107	27,527
1968	10,222	10,217	9,856	30,295	8,922	6,716	9,595	25,233

1/ Value of production calculated from the average unit value of sales.

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

Table 3.--Ethanolamines: U.S. exports of domestic merchandise, by principal markets, 1965-69 1/

Market	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)				
Belgium	13,310	13,092	8,851	9,587	22,675
Netherlands	9,394	7,615	8,229	8,673	7,073
Mexico	1,370	1,184	7,151	2,185	3,588
Japan	765	1,020	1,197	2,172	1,656
Brazil	821	1,881	1,003	2,278	1,148
All other	6,382	7,796	8,586	6,507	12,371
Total	32,042	32,588	30,017	31,402	48,511
	Value (1,000 dollars)				
Belgium	1,613	1,565	1,082	1,093	1,880
Netherlands	1,394	1,035	1,223	1,278	766
Mexico	240	209	338	319	387
Japan	270	286	274	407	194
Brazil	142	310	151	339	172
All other	1,311	1,541	1,521	1,106	1,755
Total	4,970	4,946	4,589	4,542	5,154

1/ Separate statistics became available on Jan. 1, 1965.

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

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

Commodity	TSUS item
Hexamethylenetetramine--------	425.18

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Hexamethylenetetramine is relatively important to the domestic industry but unimportant to international trade. In 1967, U.S. production exceeded 84 million pounds, whereas exports were reported by trade sources to be nil. Imports of hexamethylenetetramine amounted to 4.9 million pounds, valued at $739,000, in 1967, to 5.8 million pounds, valued at $825,000, in 1968, and to 3.7 million pounds, valued at $501,000,in 1969.

Description and uses

Hexamethylenetetramine (also called metheneamine or hexamine, and abbreviated HMTA) is a colorless, odorless, crystalline compound. It is manufactured by reacting ammonia and formaldehyde and recovering the final product by vacuum crystallization. HMTA is available commercially in technical and NF (National Formulary) grades. Its major industrial use is in the manufacture of phenolic resins, and it is also used in considerable volume in the production of the military explosive cyclonite (nitrated HMTA). Other applications of HMTA include use in fertilizers, as a urinary antiseptic, and as an intermediate in the manufacture of a variety of organic chemicals.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.18	Hexamethylenetetramine	4.5¢ per lb.	2.2¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on dutiable imports entered in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1969 (3.6¢ per pound) on HMTA was 30.7 percent; that of the rate in effect on January 1, 1970 (3.1¢ per pound) was 26.4 percent.

U.S. consumption

Apparent U.S. consumption of HMTA increased from about 43 million pounds in 1964 to about 102 million pounds in 1968. Trade sources report that about 60 percent of the annual output of HMTA is now required by the military for cyclonite (RDX) explosive. Since 1964, HMTA has been consumed in increasing amounts in the production of this explosive. Trade sources believe that consumption of HMTA could decline sharply if the war in Viet-Nam should terminate, as it did after the Korean conflict, when demand dropped from more than 55 million pounds in 1953 to about 20 million pounds in 1955.

In peacetime about 60 percent of the annual output of HMTA is consumed as a catalyst for phenolic resins. This use now accounts for about 35 percent of the annual output of HMTA.

U.S. producers

In 1969, HMTA was reportedly produced by seven U.S. companies at nine plants--three in New Jersey, and one each in Alabama, New Hampshire, New York, North Carolina, West Virginia, and Wisconsin.

U.S. production

U.S. production of HMTA increased from about 42.8 million pounds in 1964 to about 96.8 million pounds in 1968 (see accompanying table), for an overall increase of about 126 percent.

During 1964-68, the sales of HMTA by the producers increased steadily from about 67 percent of production in 1964 to 82 percent in 1967; they decreased to 74 percent in 1968.

U.S. exports

Although no official U.S. export statistics are available for HMTA, U.S. producers report that exports are negligible.

U.S. imports

U.S. imports of HMTA increased irregularly from 611,000 pounds in 1964 to 3.7 million pounds in 1969 (see accompanying table). The data for 1967 and 1968 reflect an upward revision in the official statistics of 3.4 million pounds, valued at $540,000, in 1967, and 102,000 pounds, valued at $16,000, in 1968. These imports had been reported under "explosive substances not specifically provided for" (item 485.50).

Since 1967, Canada has been the principal source of HMTA imports, supplying over 92 percent of the quantity in 1968, and more than 94 percent in 1969. Japan was the principal source of imports in 1966; France, in 1965; and Italy, in 1964. Other sources of imports during 1964-1969 were Belgium, Poland, and West Germany. In recent years, most imports of HMTA have been entered free of duty for Government use. In 1969, imports of HMTA subject to duty amounted to only 310,000 pounds, valued at $36,000 out of total imports in that year of 3.7 million pounds, valued at $501,000.

U.S. imports were equivalent to about 7 percent of the quantity of U.S. production in 1966, and to about 6 percent, in 1967 and in 1968.

Hexamethylenetetramine: U.S. production and imports for consumption, 1964-69

Year	Production		Imports	
	Quantity	Value 1/	Quantity	Value
	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
1964	42,776	7,700	611	67
1965	49,344	8,882	359	43
1966	78,761	14,177	5,504	650
1967	84,255	14,323	2/ 4,903	2/ 739
1968	96,803	14,520	2/ 5,783	2/ 825
1969	3/	3/	3,719	501

1/ Calculated from unit value of sales.

2/ Figures for 1967 reflect an upward revision in the official published statistics of 3,350 thousand pounds, valued at 540 thousand dollars, and those for 1968, of 102 thousand pounds, valued at 16 thousand dollars. These imports were reported under item 485.50.

3/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, U.S. Production and Sales; imports compiled from official statistics of the U.S. Department of Commerce, except as noted.

Note.--Production statistics do not include minor quantities of HMTA used for medicinal purposes, because publication would disclose the operations of the individual producer.

Commodity	TSUS item
Mono-, di-, tri-(methyl-, ethyl-, propyl-, and butyl)monoamines	425.20

Note.-For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. consumption of methyl, ethyl, propyl, and butyl amines is valued at more than $30 million a year and is supplied almost entirely by domestic production.

Description and uses

The chemicals covered by this summary are among the simplest organic nitrogenous compounds. They are alkyl amines derived from ammonia (NH_3) by the replacement of one, two, or three of its hydrogen atoms with an alkyl radical containing one (methyl), two (ethyl), three (propyl), or four (butyl) carbon atoms. Commercially, mono-, di-, and tri-alkyl amines are produced simultaneously by the reaction between ammonia and an alcohol. The products formed vary with the ratio of the reactants and the operating conditions. The compounds having a lower molecular weight are toxic, flammable gases; those having a higher molecular weight are less toxic liquids. Like ammonia, these compounds are all water-soluble bases which readily neutralize acids. They are used primarily in the synthesis of more complex organic nitrogenous intermediates and finished compounds.

Methyl amines, the most important group, are used as intermediates for numerous chemicals with widely varied applications. Dimethylamine, the largest item in the group, is used for making the solvents dimethylformamide and dimethylacetamide, the rocket fuel 1,1-dimethylhydrazine, and a dehairing agent for hides--dimethylamine sulfate, as well as for herbicides, fungicides, insecticides, surface-active agents, and rubber accelerators. Monomethylamine is used for making the insecticide 1-naphthyl N-methylcarbamate and for surface-active agents. Trimethylamine is used for choline feed additives.

Ethylamines are used to make rubber accelerators, insecticides, herbicides, and drugs. Propylamines are used to make surface-active agents and herbicides. Butylamines are used to make protective coatings, rubber accelerators, and drugs.

MONO-, DI-, TRI-(METHYL-, ETHYL-, PROPYL-, AND BUTYL)MONOAMINES

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.20	Mono-, di-, tri-(methyl-, ethyl-, propyl-, and butyl)monoamines.	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production, exports, and imports

Annual U.S. production of the alkyl amines covered by this summary has increased steadily and now exceeds 175 million pounds, valued at $30 million. Two-thirds of the total is sold, and the remainder is consumed captively by the producers. Methylamines, by far the most important type, account for more than 60 percent of the total quantity produced (table 1). Exports, not separately reported in official statistics, are probably larger than imports.

Eleven plants, owned by ten U.S. companies, produce one or more of the alkyl amines. Two of the plants are in West Virginia, and the others are in Florida, Indiana, Kentucky, Michigan, Missouri, Pennsylvania, Tennessee, Texas, and Virginia. The producers generally make one of their raw materials--either ammonia or alcohol. All but two are established and diversified producers of organic chemicals.

U.S. imports are negligible compared with production. During 1964-69, their annual average was only 728,000 pounds, valued at $180,000 (table 2).

Table 1.--Mono-, di-, tri-(methyl-, ethyl-, propyl-, and butyl)monoamines: U.S. production and sales, by selected kind, 1968

Kind	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Methylamines:				
Monomethylamine	21,682	17,844	1,799	$0.10
Dimethylamine	72,749	35,571	4,216	.12
Trimethylamine	19,745	14,327	1,521	.11
Ethylamines: Diethylamine	7,045	-	-	-
Propylamines:				
Mono-n-propylamine	441	122	78	.64
Diisopropylamine	3,390	2,323	557	.24
Di-n-propylamine	9,417	9,100	2,865	.31
Butylamines:				
Mono-n-butylamine	1,477	1,062	457	.43
Di-n-butylamine	3,493	2,005	657	.34
Diisobutylamine	3,674	-	-	-

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

Table 2.--Mono-, di-, tri-(methyl-, ethyl-, propyl-, and butyl)monoamines: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
West Germany	579	383	338	299	293	415
Japan	19	81	176	101	385	456
France	14	122	-	-	28	1/
Canada	-	-	183	106	111	-
All other	20	239	7	1/	4	7
Total	632	825	704	506	821	878
	Value (1,000 dollars)					
West Germany	173	108	93	73	61	83
Japan	11	13	20	18	74	102
France	23	54	-	-	7	1
Canada	-	-	20	11	7	-
All other	9	54	10	3	17	36
Total	216	229	143	105	166	222

1/ Less than 500 pounds.

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

Commodity	TSUS item
Ethylureas, methylolureas, octamethylpyrophosphoramide, and other acyclic amides	425.22
Imides	425.24

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Annual U.S. production of amides and imides is somewhat less than 200 million pounds. The major part of production is consumed by the producers in the manufacture of other products. Compared with production, total U.S. imports are small--only 11.0 million pounds, valued at $3.9 million, in 1969. Imports of individual chemicals, however, frequently supply a significant share of U.S. consumption.

Description and uses

Amides are organic compounds in which an amino group ($-NH_2$, -NHR, or $-NR_2$) has theoretically replaced a hydroxyl group in an acid radical. Imides are organic compounds in which an imino group (=NH or =NR) has theoretically replaced two hydroxyl groups in two acid radicals (as from a dibasic acid). By contrast, simple amines and imines are linked to nonacidic radicals. Cyclic ureides of certain hydroxy acids may be regarded as imides, e.g., the five- and six-membered heterocyclic compounds hydantoin and uracil. Amides derived from fatty acids are used principally as surface-active agents and are discussed in volume 4:9 (items 465.15 to 465.20). Thioamides are provided for in item 425.36.

Amides are derived from the reaction of an acid, acid anhydride, or acyl halide with ammonia, hydrazine, or an amine or by the hydrolysis of a nitrile. Imides are usually derived from dibasic acids.

Fewer than 50 amides and imides are important commercially. These compounds are used for many different purposes. Acrylamide is polymerized to products which are used as flocculants in mining and waste treatment, in chemical grout, and in paper finishes. Azobisformamide is used as a chemical blowing agent to impart a spongelike texture to vinyl plastics. Cyanoacetamide is used as an intermediate in the synthesis of other chemicals, such as vitamins and barbiturates. N,N-Dimethylformamide is a strong solvent for industrial processes, such as extraction of butadiene and spinning of acrylic and polyurethane fibers. Dimethylolurea (also known as 1,3-bis(hydroxymethyl)urea) is

used as an intermediate in the synthesis of resins for crease-resistant cotton fabrics. Octamethylpyrophosphoramide and phosphamidon are used as systemic insecticides and acaricides. Other amides and imides are used as solvents for chemical reactions, as selective extractants, and as intermediates in the synthesis of other chemicals and chemical products, such as dyes, plastics, agricultural chemicals, textile finishes, and medicinals.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.22	Ethylureas, methylolureas, octamethylpyrophosphoramide and other acyclic amides	10.5% ad val.	5% ad val.
425.24	Imides	10.5% ad val.	5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production, imports, and exports

Sales of amides and imides by U.S. producers in 1968 were estimated at 50 million pounds, valued at $25 million. Production was several times greater than sales because a substantial part of production was consumed by producers in further manufacture--either as a solvent for fiber production or as an intermediate in the synthesis of plastics or medicinals. Statistics are available for the production of only one compound--2,2'-azobisformamide--which totaled 4.2 million pounds, valued at $4.5 million, in 1968.

About 25 U.S. firms produced one or more amides in 1968, and about five firms produced imides in substantially smaller volume. Large, di-

versified producers of organic chemicals accounted for the bulk of production, but many very small companies produced a variety of less important items.

U.S. imports of amides and imides increased rapidly from 2.8 million pounds, valued at $0.9 million, in 1964, to 11.0 million pounds, valued at $3.9 million, in 1969 (see accompanying table). Japan was the principal source of such imports. U.S. exports, which are not separately reported in official statistics, are probably small.

Although imports of amides and imides are much smaller than U.S. production, imports of certain individual compounds supplied a significant share of U.S. purchases of such compounds. Imports have included more than a score of compounds, such as acrylamide, 1,1'-azobisformamide, and cyanoacetamide from Japan, 1,3-bis(hydroxymethyl)urea from West Germany, phosphamidon from Switzerland, butylacrylamide from Italy and West Germany, and N,N-dimethylformamide from Canada and Japan.

The Tariff Commission has completed an investigation under section 201(a) of the Antidumping Act, 1921, as amended, to determine whether a domestic industry was being or was likely to be injured, or prevented from being established by reason of the importation of azobisformamide from Japan. In this investigation the Commission determined that injury had occurred to a domestic industry as a result of such importation. 1/

1/ See U.S. Tariff Commission, Azobisformamide From Japan, TC Publication 153, 1965 (processed).

Amides and imides: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Japan	1,079	2,157	2,591	2,805	5,543	6,269
Switzerland	7	1	50	1/	58	974
Italy	30	87	21	239	561	680
Canada	658	57	66	284	937	1,747
West Germany	933	434	1,701	806	1,045	1,060
United Kingdom	17	43	46	213	194	60
All other	45	14	318	218	23	197
Total	2,769	2,793	4,793	4,579	8,371	10,987
	Value (1,000 dollars)					
Japan	402	752	719	881	1,922	1,848
Switzerland	26	20	57	2	64	750
Italy	37	60	15	243	438	577
Canada	73	9	16	64	181	345
West Germany	201	82	189	152	229	228
United Kingdom	17	19	34	149	135	49
All other	168	5	57	261	152	68
Total	924	947	1,087	1,752	3,121	3,865

1/ Less than 500 pounds.

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

Commodity	TSUS item
Methyl ethyl ketoxime----------	425.26

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Annual U.S. consumption of methyl ethyl ketoxime amounts to about 3 million pounds. Imports have been increasing and now account for about a third of the supply.

Description and uses

Methyl ethyl ketoxime (also known as butanone oxime) is used as an antioxidant to prevent skin formation on surface coatings during storage. It is derived from methyl ethyl ketone (item 427.62), a petrochemical, and hydroxylamine (item 423.00), an inorganic chemical. Production of the oxime consumes about 1 percent of the production of the ketone.

U.S. Tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.26	Methyl ethyl ketoxime	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Comment

U.S. production increased from 2.1 million pounds, valued at $1.7 million, in 1961 to a peak of 2.8 million pounds, valued at $2.1 million, in 1964 (see accompanying table) and then declined slowly. The decline since 1964 has been accompanied by a reduction in the number of producers from five to two.

U.S. imports increased rapidly from 66,000 pounds, valued at $34,000, in 1964 to 1.2 million pounds, valued at $387,000, in 1968; they have supplied a growing share of U.S. consumption. Japan and the United Kingdom were the principal sources, followed by West Germany and the Netherlands.

Methyl ethyl ketoxime: U.S. production and imports for consumption, by principal sources, 1964-68

Year	Production	Imports from--				
		All countries	Japan	United Kingdom	West Germany	Netherlands
	Quantity (1,000 pounds)					
1964	2,760	66	33	33	-	-
1965	2,735	346	170	153	22	1
1966	1/	607	99	258	108	142
1967	1/	1,018	464	307	167	78
1968	1/	1,188	870	32	214	70
	Value (1,000 dollars)					
1964	2/2,070	34	15	19	-	-
1965	2/1,668	179	77	87	15	3/
1966	1/	281	42	125	52	62
1967	1/	404	167	137	72	27
1968	1/	387	266	10	84	26
	Unit value (per pound) 4/					
1964	$0.75	$0.51	$0.45	$0.57	-	-
1965	.61	.52	.45	.57	$0.65	$0.39
1966	1/	.46	.43	.48	.48	.44
1967	1/	.40	.36	.45	.43	.35
1968	1/	.33	.31	.31	.40	.37

1/ Not available.
2/ Computed from unit value of sales.
3/ Less than $500.
4/ Unit value of imports computed from unrounded figures.

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

Commodity	TSUS item
N-Methyl-2-pyrrolidone----	425.28
2-Pyrrolidone----------	425.34
N-Vinyl-2-pyrrolidone, monomer and polymer-----	425.38

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Annual U.S. imports of the pyrrolidone compounds covered here are valued at less than $1 million and are much smaller than the output of the sole U.S. producer.

Description and uses

2-Pyrrolidone (also known as pyrrolidinone) is a heterocyclic compound with a five-member saturated ring having four carbon atoms and one nitrogen atom. It is obtained from ammonia and butyrolactone which is a derivative of the high-pressure ethynylation of acetylene. Most of it is consumed by the producer in the synthesis of other chemicals, and the remainder is used as a solvent. N-Methyl-2-pyrrolidone is a stable, noncorrosive solvent, miscible with many other organic solvents and with water. It is used in gas recovery and as a solvent for agricultural chemicals, and chemical reactants, and in a number of resins. Most of the N-vinyl-2-pyrrolidone monomer produced is further polymerized, but some is used as a component of adhesives and lubricating oils. Poly-N-vinyl-2-pyrrolidone (also known as PVP) is the most important item covered by this summary. It has many applications, such as in film-forming components for hair dressings and sprays, in the clarification of beer and other beverages, and as an additive in inks, adhesives, and dyes.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.28	N-Methyl-2-pyrrolidone--	12.5% ad val.	6% ad val.
425.34	2-Pyrrolidone----------	12.5% ad val.	6% ad val.
425.38	N-Vinyl-2-pyrrolidone, monomer and polymer---	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967. On the last item (425.38) shown above, the compound rate of duty in effect on December 31, 1969, was equivalent to 16.6 percent ad valorem, based on imports in 1969.

U.S. production and imports

The pyrrolidone compounds covered by this summary are all produced by one U.S. company. U.S. production is much larger than imports, but no statistics are available for publication. Imports--practically all from West Germany--increased rapidly from 768,000 pounds, valued at $403,000, in 1964 to 1.6 million pounds, valued at $880,000, in 1967, and then declined to 1.3 million pounds, valued at $920,000, in 1969. The most important items imported in 1969 were N-vinyl-2-pyrrolidone, and and N-methyl-2-pyrrolidone (See accompanying table)

Pyrrolidone compounds: U.S. imports for consumption, by selected kinds, 1964-69

Kind	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
N-Methyl-2-pyrrolidone	434	706	484	1,033	97	470
2-Pyrrolidone	42	15	7	-	-	10
N-Vinyl-2-pyrrolidone, monomer and polymer	292	433	507	585	816	839
	Value (1,000 dollars)					
N-Methyl-2-pyrrolidone	161	264	176	377	37	175
2-Pyrrolidone	40	15	5	-	-	5
N-Vinyl-2-pyrrolidone, monomer and polymer	202	266	292	503	576	440

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

Commodity	TSUS item
Monosodium glutamate	425.30
Preparations containing over 50 percent by weight of monosodium glutamate	493.42

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The United States is second only to Japan as a producer and exporter of monosodium glutamate and products containing monosodium glutamate. Current U.S. production is about 45 million pounds a year; in 1969, imports totaled 7.8 million pounds, and exports totaled 2.3 million pounds.

Description and uses

"MSG"--as it is commonly known--is the monosodium salt of glutamic acid, a dibasic amino acid which occurs naturally in proteins. MSG is used to extend and enhance the natural flavor of foodstuffs. The food processing industry uses MSG as an ingredient of prepared foods such as soups, frozen foods, meat products, condiments and sauces. Institutions (such as hotels, hospitals, and restaurants) use MSG to help maintain the taste of foods which are prepared in large volume. Consumers also buy small packages of MSG at retail, either as the pure chemical or in preparations with other flavors. About the middle of 1970, manufacturers of baby foods discontinued the use of MSG in their products.

MSG was first produced by extraction--usually hydrolysis--from a natural source such as corn or wheat gluten, soybeans, or the residue from beet molasses. In the mid 1950's, fermentation processes were introduced using the reaction of microorganisms on a carbohydrate and nitrogen source. In the 1960's, new synthetic processes were introduced based on petrochemicals such as acrylonitrile or acetic acid.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.30	Monosodium glutamate---	16% ad val.	16% ad val. 1/
493.42	Preparations containing over 50 percent by weight of monosodium glutamate.	16% ad val.	16% ad val. 1/.

1/ Rate of duty not affected by the Kennedy Round trade conference.

The rates, which became effective on July 1, 1963, reflect the final stage of concessions negotiated under the General Agreement on Tariffs and Trade in 1960-61 from the previous rates of 20 percent ad valorem.

U.S. consumption

U.S. consumption of MSG in 1969 amounted to about 54 million pounds, of which over 14 percent was imported material (table 1). Industry sources indicate that 21 percent of the domestic consumption of MSG is in packaged soups; 40 percent is in processed meats and convenience foods; 18 percent is by institutions; 16 percent is direct consumer sales; and 5 percent is exported.

U.S. producers and production

Four companies produced MSG in 1969 in the United States in California, Colorado, Indiana, and Pennsylvania. One is a manufacturer of beet sugar and three are large, diversified chemical companies. Annual U.S. production of MSG was somewhat more than 45 million pounds during 1966-67 (table 1). It increased to 47.6 million pounds in 1968, and to 48.5 million pounds in 1969.

U.S. exports

Official statistics on U.S. exports of MSG have been available only since 1964; these statistics include not only straight MSG but also products containing MSG (table 2). Exports amounted to 1.8 million pounds in 1967, increased to 6.4 million pounds in 1968, and then declined to 2.3 million pounds in 1969. In 1968, Canada, Spain, the United Kingdom, Mexico and Peru, in that order, were the principal markets for U.S. exports of MSG and preparations containing MSG.

U.S. imports

U.S. imports of MSG have increased rapidly from 695,000 pounds, valued at $533,000, in 1964, to 1.8 million pounds, valued at $701,000, in 1966, and 7.8 million pounds, valued at $2.7 million, in 1969 (table 3). Japan has been the principal source, accounting for over 90 percent of imports in 1969. Substantially smaller amounts have come from Taiwan and West Germany. U.S. imports of preparations containing MSG has not exceeded $50,000 annually.

Table 1.--Monosodium glutamate and preparations: U.S. production, exports of domestic merchandise, imports for consumption, and apparent consumption, 1965-69

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production 1/ 2/	Exports 3/	Imports 2/	Apparent consumption	Ration (percent) imports to consumption
	Quantity				
1965	43,121	6,221	671	37,571	1.8
1966	45,727	3,630	1,808	43,905	4.1
1967	45,211	1,803	1,882	45,290	4.2
1968	47,674	6,383	3,577	44,868	7.8
1969	48,503	2,275	7,795	54,023	14.4
	Value				
1965	27,170	2,321	444	25,293	1.8
1966	28,800	1,402	701	28,099	2.5
1967	28,500	818	800	28,482	2.8
1968	29,600	2,228	1,824	29,136	6.3
1969	29,100	822	2,672	30,950	9.2

1/ Value calculated from unit value of sales.
2/ Represents data from monosodium glutamate as such.
3/ Includes monosodium glutamate and preparations containing over 50 percent by weight of monosodium glutamate.

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

Table 2.--Monosodium glutamate and products: U.S. exports of domestic merchandise, by principal markets, 1965-69

Market	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)				
Canada	731	482	576	1,382	874
Mexico	183	297	296	591	473
United Kingdom	380	203	248	645	79
Peru	15	24	47	410	24
Netherlands	317	278	8	40	23
Italy	498	350	14	280	16
Spain	1,683	1,014	132	1,662	11
West Germany	670	106	84	232	7
Switzerland	733	135	-	1	-
All other	1,011	741	398	1,140	768
Total	6,221	3,630	1,803	6,383	2,275
	Value (1,000 dollars)				
Canada	302	231	304	594	359
Mexico	74	118	108	198	156
United Kingdom	131	50	94	207	26
Peru	10	8	19	170	11
Netherlands	118	88	5	12	11
Italy	206	132	9	90	8
Spain	596	438	46	504	4
West Germany	201	29	33	62	2
Switzerland	253	50	-	1/	-
All other	430	258	200	451	245
Total	2,321	1,402	818	2,288	822

1/ Less than $500.

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

Table 3.--Monosodium glutamate 1/: U.S. imports for consumption by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 dollars)					
Japan	688	626	1,058	1,782	3,570	7,128
Taiwan	7	45	670	90	6	575
West Germany	-	-	-	10	-	47
France	-	-	77	-	-	-
All other	-	-	3	-	1	45
Total	695	671	1,808	1,882	3,577	7,795
	Value (1,000 dollars)					
Japan	530	429	496	759	1,821	2,473
Taiwan	3	15	183	27	2	167
West Germany	-	-	-	14	-	17
France	-	-	21	-	-	-
All other	-	-	1	-	1	15
Total	533	444	701	800	1,824	2,672

1/ Includes imports under TSUS item 425.30 only. Imports of preparations containing over 50 percent of MSG under TSUS item 493.42 were valued as follows: 1965, $41,605; 1966, $44,066; 1967, $24,416; 1968, $49,165 and 1969, $26,839. All imports were from Japan and Taiwan.

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

Commodity	TSUS item
Thiourea, thiourea dioxide, and other thioamides; thiocarbamates, thiocyanates, thiurams, and isothiocyanates	425.36

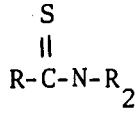
Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

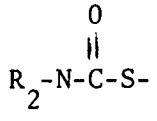
Annual U.S. consumption of thio-nitrogenous compounds, with an estimated value of about $50 million, is growing steadily. Imports supply less than 5 percent of domestic consumption. U.S. exports are believed to be larger than imports.

Description and uses

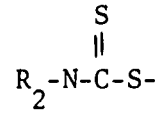
Thio-nitrogenous compounds covered by this summary are ones which contain a nitrogen and a sulfur atom attached to the same carbon atom, as illustrated below:



Thioamides

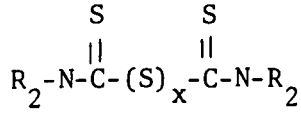


Thiocarbamates



Dithiocarbamates

Thiocyanates



Thiurams

Isothiocyanates

Thiourea and other thioamides are made from calcium cyanamide (item 480.15) and are used widely as corrosion inhibitors in acid solutions for cleaning, pickling, and removing scale and rust from metal surfaces. They are also used as intermediates for the synthesis of pharmaceuticals and diazo types of coatings for chemical-, heat-, or photo-sensitive paper.

Dithiocarbamates are prepared from carbon disulfide, alkylamines, and metallic salts. Thiurams are bis(alkylthiocarbamoyl) sulfides and are prepared by oxidation of the dithiocarbamates. Thiocarbamates and thiurams are widely used as activators for a fast initial cure in

natural and synthetic rubbers. Many are also used as agricultural fungicides and animal repellants for application in orchards and on ornamental plants. Manganese, sodium, and zinc salts of ethylenebis-(dithiocarbamic) acid, in particular, are used as foliage fungicides to prevent rust and blights on potatoes, tomatoes, and other plants. Esters of alkylthiocarbamates are used as preemergence herbicides. Other thio-nitrogenous compounds are of less commercial importance.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.36	Thiourea, thiourea dioxide, and other thioamides; thiocarbamates, thiocyanates, thiurams, and isothiocyanates.	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption, production, imports, and exports

Annual U.S. consumption of thio-nitrogenous compounds is estimated to amount to $50 million and is supplied principally by domestic production. Production consists of fewer than 75 individual products, of which about a dozen were valued at more than $1 million each in 1968. Manganese ethylenebis(dithiocarbamate) is the largest single item in the group, but no statistics on its production are available for publication. Production statistics on other selected thio-nitrogenous compounds in 1964-68 are given in table 1.

Thio-nitrogenous compounds were produced in 1968 by 25 U.S. companies, including several large rubber companies (which produce chemicals primarily for use in their own integrated operations), large

established producers of organic chemicals, and several newer and smaller producers of specialty products.

Annual U.S. imports of thio-nitrogenous compounds, which have been small compared with production, averaged 5.6 million pounds, valued at $1.5 million, during 1965-69. (See annual data in table 2). Imports have included thiourea from Japan, West Germany, and other countries; thiurams from Belgium, France, the Netherlands, the United Kingdom, and West Germany; zinc alkyldithiocarbamates from Belgium, France, Italy, the Netherlands, and other countries; manganese alkyldithiocarbamates from Colombia and the Netherlands; and bismuth, iron, and nickel compounds from the Netherlands.

Table 1.--Thio-nitrogenous compounds: U.S. production, by selected kinds, 1964-68

Kind	1964	1965	1966	1967	1968
	Quantity (1,000 pounds)				
Bis(dimethylthiocarbamoyl)disulfide (Tetramethylthiuram disulfide)	1/	7,045	6,731	8,681	8,497
Bis(dimethylthiocarbamoyl)-sulfide (Tetramethylthiuram sulfide)	1/	1,561	1,338	2,251	1,881
Dibutyldithiocarbamic acid, zinc salt	1,424	1,522	1,741	1,555	2,061
Diethyldithiocarbamic acid, zinc salt	1,058	1,262	1,513	1,135	1,897
Dimethyldithiocarbamic acid, ferric salt (Ferbam)	1,838	2,384	1,379	2,331	1,900
Dimethyldithiocarbamic acid, sodium salt	6,618	3,469	5,663	5,483	4,550
Dimethyldithiocarbamic acid, zinc salt	955	1,478	1,736	1,644	1,842
Ethylenebis(dithiocarbamic acid), disodium salt (Nabam)	2,251	2,489	2,053	1,361	2/1,996
Ethylenebis(dithiocarbamic acid), zinc salt (Zineb)	6,664	5.075	4,721	3,055	3,081
	Value (1,000 dollars) 3/				
Bis(dimethylthiocarbamoyl)disulfide (Tetramethylthiuram disulfide)	1/	3,029	2,827	3,559	3,314
Bis(dimethylthiocarbamoyl)-sulfide (Tetramethylthiuram sulfide)	1/	1,264	1,044	1,756	1,448
Dibutyldithiocarbamic acid, zinc salt	1,595	1,431	1,671	1,524	1,958
Diethyldithiocarbamic acid, zinc salt	857	770	893	670	1,176
Dimethyldithiocarbamic acid, ferric salt (Ferbam)	717	930	510	1,026	654
Dimethyldithiocarbamic acid, sodium salt	2,515	1,353	2,605	2,577	1,684
Dimethyldithiocarbamic acid, zinc salt	802	650	816	773	829
Ethylenebis(dithiocarbamic acid), disodium salt (Nabam)	855	946	862	572	899
Ethylenebis(dithiocarbamic acid), zinc salt (Zineb)	2,932	2,284	2,077	1,314	1,263

1/ Not available. 2/ Sales. Production is not available.
3/ Computed from unit value of sales.

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

Table 2.--Thiourea, thiourea dioxide, and other thioamides, thiocarbamates, thiocyanates, thiurams, and isothiocyanates: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Japan	1,552	2,142	2,570	2,418	2,870	3,143
Netherlands	1,374	802	899	706	1,379	1,497
Italy	62	4	1	275	356	689
France	345	102	79	104	172	272
Belgium	190	250	240	117	253	403
West Germany	1,537	1,099	1,157	1,249	1,005	281
United Kingdom	34	11	7	6	57	13
Denmark	5	3	5	7	9	2
All other	5	41	306	202	531	312
Total	5,104	4,454	5,264	5,084	6,632	6,610
	Value (1,000 dollars)					
Japan	289	408	448	594	694	777
Netherlands	509	282	305	229	455	494
Italy	29	1	5	62	83	156
France	95	35	25	33	51	110
Belgium	66	78	70	38	65	102
West Germany	564	364	373	381	313	75
United Kingdom	39	12	8	6	41	15
Denmark	16	7	15	23	27	7
All other	14	28	81	38	185	106
Total	1,621	1,215	1,330	1,404	1,914	1,842

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

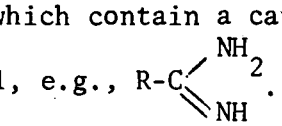
Commodity	TSUS item
Dicyandiamide, guanidine salts and other acyclic amidines:	
Dicyandiamide	425.39
Other	425.41

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. annual requirements of amidines, amounting to 90 million pounds, valued at $10 million, are almost all supplied by imports. Most of the imports originate in the Canadian plant of a large U.S. chemical company.

Description and uses

Amidines are organic compounds which contain a carbon atom attached to both an amine and an imine radical, e.g.,  . Dicyandiamide (also known as dicy and cyanoguanidine) is by far the most important compound in this group. It is produced from calcium cyanamide (item 480.15) which, in turn, is made from calcium carbide. More than three-fourths of U.S. consumption of dicyandiamide goes into the production of melamine (item 425.1)) for use in plastics, where it is meeting increasing competition from both domestic and imported urea-derived melamine. The remainder is used as a catalyst for epoxy resins, to fluidify colloidal solutions, to promote intumescence in surface coatings, and as an intermediate in the synthesis of dyes, medicinals, antioxidants, explosives, and bactericides.

Among the guanidine salts considered here, dodecylguanidine acetate is used as a fungicide for fruit trees, and guanidine carbonate and others are used as intermediates in the synthesis of medicinals, surface-active agents, and curing agents for high polymers.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Dicyandiamide, guanidine salts, and other acyclic amidines:		
425.39	Dicyandiamide---------	10.5% ad val.	Free
425.41	Other----------	10.5% ad val.	5% ad val.

Pursuant to Public Law 90-14, the trade agreement negotiators were authorized to make dicyandiamide free of duty without regard to the staging requirements and it was made free of duty effective January 1, 1968. The rate of duty effective January 1, 1972, for the other amidines, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, is the rate for TSUS item 425.40, which rate had remained unchanged from August 31, 1963 (the effective date of the TSUS), until item 425.40 was replaced by items 425.39 and 425.41 on January 1, 1968.

U.S. consumption and imports

U.S. consumption of amidines approximates imports since domestic production is small. Imports increased from 94 million pounds, valued at $9.5 million, in 1964 to 98 million pounds, valued at $9.9 million, in 1965, and then declined slowly to 81 million pounds, valued at $9.6 million, in 1969 (see accompanying table). The decline was due largely to the replacement of imports of dicyandiamide by imports of melamine (item 425.10) which increased from 18 million pounds in 1966 to 33 million pounds in 1969. Imports of amidines 1969 consisted of 73.3 million pounds of dicyandiamide valued at $7.6 million and 7.5 million pounds of guanidine salts and other acyclic amidines valued at $2.0 million. Most of the imports in both categories are derived from the Canadian plant of an American company.

Foreign production and trade

Canada is the world's largest producer of dicyandiamide, followed by Japan, Norway, East Germany, and West Germany. Smaller producers include France, Sweden, Italy, and Switzerland.

Dicyandiamide, guanidine salts, and other acyclic amidines: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Canada	82,678	88,853	80,939	1/79,237	74,601	75,717
Japan	7,120	5,167	6,782	3,001	2,921	2,970
West Germany	202	277	467	284	350	415
Norway	3,967	4,033	3,620	2,581	3,832	1,472
All other	3	20	26	45	33	260
Total	93,970	98,350	91,834	1/85,148	81,737	80,834
	Value (1,000 dollars)					
Canada	8,076	8,673	7,849	1/ 9,042	8,624	8,886
Japan	827	597	820	378	358	347
West Germany	84	101	202	131	137	166
Norway	444	426	380	271	412	157
All other	44	88	123	194	81	47
Total	9,475	9,885	9,374	1/10,016	9,612	9,603

1/ Includes 4,826 thousand pounds, valued at 1,660 thousand dollars, of guanidine compounds classified under explosives.

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

Commodity	TSUS item
Nitriles not elsewhere enumerated	425.42

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Most of the U.S. production of nitriles is consumed by the producers in further manufacture. U.S. producers' sales in 1968 were estimated at less than $10 million. Imports in that year amounted to $3 million.

Description and uses

Nitriles (also known as cyanides) are organic compounds in which a trivalent nitrogen atom is linked exclusively to a carbon atom. On hydrolysis, they yield carboxy acids. According to the TSUS order of precedence of functions, the provision for nitriles includes not only simple nitriles but also those which contain an acid (or its salt), aldehyde, ketone, alcohol (known as cyanohydrins), ester, epoxide, or ether function or a sulfur, halogen, or metallic atom. It does not include any nitriles which are provided for as amino acids or salts, triazine compounds, amides, imides, thioamides, thiocarbamates, thiocyanates, thiurams, isothiocyanates, or amidines. Acrylonitrile, the most important nitrile, is covered in a separate summary (item 425.02).

Nitriles are produced by the ammoxidation of an alkylene hydrocarbon, by the dehydration of an amide, by the reaction of a primary amine with a hypohalite, or by the reaction of an inorganic cyanide with an alkylene hydrocarbon, halide, ketone, or aldehyde.

Fewer than 50 nitrile compounds are commercially important and they are used for many different purposes. Acetonitrile is obtained as a coproduct (10 to 20 percent in the propylene-ammonia process for producing acrylonitrile); it is used principally as a solvent in the extractive distillation processing of butadiene and isoprene, but also as an intermediate in the synthesis of other chemicals, such as vitamin B_1. Adiponitrile (an intermediate for nylon 6,6) is provided for under item 403.80 if derived from a benzenoid chemical and under 425.42 if obtained from a nonbenzenoid source such as the electrohydrodimerization of acrylonitrile.

2,2'-Azobis(isobutyronitrile) is a polymerization initiator for producing vinyl plastics. Hydracrylonitrile (also known as ethylene cyanohydrin) is an intermediate for acrylonitrile plastics. 2-Methyllactonitrile (also known as acetone cyanohydrin) is an intermediate for methacrylic plastics. Cyanamide is used to make dye assistants, additives for electroplating baths, and nutritional fortifiers. Malononitrile is an intermediate for dyes, amino acids, and medicinals such as barbiturates and vitamins. Other nitriles are used as solvents and as intermediates for medicinals, agricultural chemicals, plastics, and other chemicals.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970 are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.42	Nitriles--------	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production and producers

Sales of nitriles by U.S. producers in 1968 are estimated to have been valued at less than $10 million. Production is many times as large as sales, since the bulk of production is consumed by a few large chemical producers in polymer synthesis. Statistics are publishable for production of only one compound, 2-methyllactonitrile, which totaled 364 million pounds in 1967 and 485 million pounds in 1968. The publication of statistics for the other nitriles could reveal the operations of individual producers.

Fewer than 25 U.S. firms produced one or more nitriles in 1968. Large, diversified producers of organic chemicals accounted for the bulk of production, but many smaller companies produced a variety of other items in smaller quantities (including numerous compounds with

mixed functions).

U.S. imports and exports

U.S. imports of nitriles increased rapidly from 57,000 pounds, valued at $57,000, in 1964 to 12.6 million pounds, valued at $3.9 million, in 1969 (see accompanying table). Imports of malononitrile from Japan and Switzerland have supplied a substantial part of U.S. consumption of this compound. Imports of 2,2'-azobis(isobutyronitrile) from the United Kingdom and Japan have also supplied a significant part of U.S. consumption. Other imports have included cyanamide solution from the Canadian plant of a U.S. producer, acetonitrile from Japan, and methyl cyanoacetate from Switzerland.

U.S. exports are not separately reported in the official statistics, but they are believed to be small.

Nitriles not elsewhere enumerated: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Japan	32	1,225	344	309	946	3,273
Canada	-	977	2,119	2,532	3,043	4,071
Switzerland	1/	1	80	72	59	159
United Kingdom	11	5,307	29	32	143	110
All other	14	2/ 2,726	42	13	1	3/ 4,947
Total	57	10,236	2,614	2,958	4,292	12,560
	Value (1,000 dollars)					
Japan	25	172	274	409	2,127	2,325
Canada	-	145	341	325	406	580
Switzerland	1	3	292	268	469	379
United Kingdom	12	564	23	25	103	73
All other	19	2/ 317	52	43	17	3/ 579
Total	57	1,201	982	1,070	3,122	3,936

1/ Less than 500 pounds.

2/ Includes 2,689 thousand pounds, valued at 285 thousand dollars, from France.

3/ Includes 4,920 thousand pounds, valued at 452 thousand dollars, from the Republic of South Africa.

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

Commodity	TSUS item
Nitrogenous compounds:	
Aldehyde ammonia	425.02
Ethylenediamine	425.14
Nitroparaffins	425.32
Other, not elsewhere enumerated	425.52

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

In 1969, U.S. consumption of the nitrogenous compounds covered in this summary was estimated to be valued at a quarter of a billion dollars and was supplied principally by U.S. production. Imports in 1969 were 3.9 million pounds, valued at $3.5 million. Complete data on exports of these compounds are not available, but exports are considerably larger than imports.

Description and uses (also see last section--Separate comments on four groups of nitrogenous compounds)

The nitrogen-containing compounds covered in this summary are those included in the TSUS which have not been covered in preceding summaries in this volume and which are not covered elsewhere in the TSUS by more specific provisions, such as those for benzenoid compounds (part 1, schedule 4, TSUS) or those based upon end use. Several hundred compounds are included, representing intermediates at various stages of advancement as well as end products; the uses are numerous and varied. Certain groups of related nitrogenous compounds are treated separately in the last section of this summary, these being amines and amino alcohols, heterocyclic compounds, nitrilo acids and salts, and other nitrogen-containing compounds. Within these groups, information is furnished as to a number of individual chemicals.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970), are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Nitrogenous compounds:		
425.02	Aldehyde ammonia------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
425.14	Ethylenediamine-------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
425.32	Nitroparaffins--------	10.5% ad val.	5% ad val.
425.52	Other, not elsewhere enumerated----------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1969, on other nitrogenous compounds not elsewhere enumerated (item 425.52) was 14.6 percent. Imports of aldehyde ammonia and ethylenediamine have been negligible.

U.S. consumption, production, and producers

U.S. consumption of the nitrogenous compounds covered here is somewhat less than domestic production. It is estimated that U.S. production of the nitrogenous compounds covered by this summary totaled about a half billion pounds, valued at a quarter of a billion dollars in 1968. Amines and amino alcohols accounted for more than half of the volume of production.

Several hundred nitrogenous chemicals were produced, but only a few individual compounds were produced by as many as five companies. Statistics on production and sales of many of the most important items cannot be released because publication would reveal the operations of individual companies. Sales of more than 25 individual items each exceeded $1 million.

These chemicals were produced by more than 100 U.S. companies ranging in size from the largest diversified firms in the chemical industry to small specialty manufacturers. Large-volume intermediates,

such as ethylenediamine, were produced by large petrochemical firms which also produced the raw materials from which they were derived. Numerous producers of medicinals and chemical specialties produced more advanced nitrogenous intermediates and finished products from the chemicals purchased from the large petrochemical firms.

U.S. imports

U.S. imports of nitrogenous compounds have been small in relation to U.S. production or exports. Imports have increased steadily--from 2.2 million pounds, valued at $1.5 million, in 1964, to 3.9 million pounds, valued at $3.5 million, in 1969 (table 1)--and have consisted of almost a hundred different chemicals, no one of which was outstanding. Imports have entered from more than a score of countries. In 1969, West Germany, Japan, Switzerland, and France were the principal sources.

U.S. exports

Of the nitrogenous compounds covered here, statistics on U.S. exports are available only for amines (including those in item 425.20) and hydroxyamines. In 1965-69 the combined annual exports of amines (including ethylenediamine) and hydroxyamines more than doubled in volume--increasing from 31.0 million pounds to 84.1 million pounds (tables 2 and 3). In 1969 Argentina was the principal market followed by Belgium and the Netherlands, where several large U.S. producers have their European affiliates. Other important markets were Japan, Canada, and West Germany.

Separate comments on four groups of nitrogenous compounds

Amines and amino alcohols.--Amines are derivatives of ammonia (NH_3) in which one or more of the hydrogen atoms has been replaced by one or more hydrocarbon radicals. They are miscible with many organic solvents, form alkaline solutions in water, and are capable of neutralizing acids.

Alkyl monoamines are produced commercially by the reaction between ammonia and alcohols. The lower alkyl monoamines (methyl, ethyl, propyl, and butyl) are discussed in a separate summary (item 425.20). Alkyl amines which are derived from fats and oils (items 465.15 and 465.20) are also covered separately. The higher alkyl amines covered here are less soluble in water than the lower compounds and more soluble in hydrocarbons. They are used as intermediates in the synthesis of more advanced intermediates and of a variety of finished products, such as dyes, medicinals, rubber-processing chemicals,

agricultural chemicals, flotation reagents, and surface-active agents. About 10 U.S. firms produce the higher alkyl amines. The aggregate production of amines provided for in item 425.52 is substantially less than the production of amines provided for in item 425.20. Important monoamines imported have been 2-ethylhexylamines from West Germany.

Alkylene polyamines are compounds which contain two or more amino groups. Ethyleneamines are a series of compounds produced simultaneously by the reaction between ethylene dichloride and ammonia. Ethylenediamine--which has the lowest molecular weight and is the most important compound in the group--is also obtained in much smaller volume as a byproduct in the manufacture of morpholine and piperazine. It is used in the synthesis of carbamate insecticides, resins for crease-resistant textiles, fungicides, rubber accelerators, polyamide resins for adhesives and coatings, and nitrilo acids. Diethylenetriamine and triethylenetetramine are used to make polyamide resins and to cure expoxy resins. Triethylenetetramine is also used as a lubricating oil additive.

Ethyleneamines are made by three petrochemical firms that are important producers of ethylene dichloride. U.S. exports of ethylenediamine increased from 17.9 million pounds, valued at $5.3 million, in 1964 to 18.5 million pounds, valued at $4.3 million, in 1966 (when trade sources estimated exports at about 40 percent of production) and to 32.8 million pounds, valued at $7.2 million in 1968 (table 2). They decreased to 20.9 million pounds, valued at $4.2 million in 1969. Other ethyleneamines and other alkylene polyamines are produced in much smaller volume than ethylenediamine.

Hexamethylenediamine (also known as 1,6-hexanediamine) is an intermediate for nylon 6,6. Imported hexamethylenediamine has been derived from benzene and therefore is provided for under item 403.80; however, imported material which has been obtained from a nonbenzenoid source (such as butadiene or acrylonitrile) is provided for under item 425.52. U.S. production of hexamethylenediamine totaled 650 million pounds in 1968 and was derived from both benzenoid and nonbenzenoid sources.

Imports of polyamines have included diethylaminoethylamine from Sweden and dimethylaminopropylamine and other polyamines from West Germany but have been small compared with U.S. production.

Amino alcohols, sometimes known as alkanolamines, are bifunctional compounds. Ethanolamines, the most important, are discussed separately (item 425.12). Isopropanolamines, the most important of the group covered here, are derived from the reaction between ammonia and propylene oxide, and are made by two petrochemical firms that also make the ethanolamines and propylene oxide. The isopropanolamines are used to make surface-active agents that are similar in many respects to those made from the ethanolamines but do have greater

solubility in hydrocarbons and better color stability. Other amino alcohols are produced by almost 20 firms and are used as intermediates for a variety of chemicals, such as textile products, surface-active agents, flotation reagents, and medicinals. 2-(2-Aminoethylamino)ethanol (also known as hydroxyethylethylenediamine) is used in the synthesis of heterocyclic imidazole compounds. Aldehyde ammonia (also known as 1-aminoethanol) is of minor importance.

Imports of amino alcohols have included aminopropanol and methylethanolamine from West Germany and other amino alcohols from Canada. Such imports have been small compared with production.

Chloroalkylamines are prepared by treating a substituted amino alcohol with thionyl chloride. They are used as intermediates in the synthesis of medicinals such as antihistamines, analgesics, and tranquilizers. They are produced by about 10 U.S. firms, including several medicinal firms that consume their production in further synthesis. Production of these compounds is substantially smaller than that of any of the amines previously discussed, and prices are substantially higher. Imports have been negligible.

Statistics on U.S. exports of amines and amino alcohols (excluding ethylenediamine and ethanolamines, but including methyl, ethyl, propyl, and butyl amines) are given in table 3. Exports increased from 21.2 million pounds, valued at $10.6 million, in 1965 to 63.2 million pounds, valued at $21.2 million, in 1969.

Heterocyclic compounds.--Heterocyclic compounds covered here are those in which one or more nitrogen atoms are contained in a ring system with carbon atoms. Six-membered heterocyclic rings which contain at least four carbon atoms and have an arrangement of molecular bonds as in the benzene or quinone ring (excepting pyrimidine) are included in part 1 of schedule 4. Other heterocyclic compounds have been discussed in previous summaries in this volume.

Heterocyclic compounds are a particularly versatile group of chemicals with properties between those of the benzenoid and those of the acyclic chemicals. Some heterocyclic rings--such as pyrimidine--occur naturally in animal or vegetable products. Some--such as morpholine--are obtained synthetically by ring closure of acyclic compounds. Some--such as the 5-membered imidazole ring--occur naturally in coal tar and were dutiable under the American selling price provisions prior to the establishment of the TSUS. Almost 100 heterocyclic compounds are produced, but only a few are produced by more than one company.

Morpholine (aso known as tetrahydro-1,4-oxazine) is obtained by the dehydration of diethanolamine. It has the greatest commercial

importance of all of the heterocyclic compounds covered. Morpholine is a moderate base, and is miscible with water and many organic compounds. It is used as a corrosion inhibitor, emulsifier. and solvent, and in the synthesis of rubber accelerators, optical brighteners for laundry products, and chemicals for the diazo type of textile printing. Production of morpholine is shown in the following tabulation of data taken from the U.S. Tariff Commission's annual reports Synthetic Organic Chemicals, United States Production and Sales:

Year	Production	Sales	
		Quantity	Value
	1,000 pounds	1,000 pounds	1,000 dollars
1963	13,216	11,874	5,590
1964	15,102	12,638	6,114
1965	15,831	14,248	6,673
1966	18,889	18,493	8,209
1967	22,913	17,641	7,546
1968	21,386	20,646	7,561

In 1969 morpholine was made in Michigan, Texas, and West Virginia by three of the four petrochemical companies that make diethanolamine. Morpholine has been imported from Japan and West Germany, but imports have been small compared with U.S. production.

Other heterocyclic nitrogenous compounds are used in fungicides, herbicides, textile finishes, flavor enhancers, catalysts, and rubber processing, and as intermediates for medicinals, dyes, plastics, and surface-active agents.

Almost 50 U.S. companies produce one or more heterocyclic compounds. Some are large petrochemical companies that utilize a part of their production of amines and amino alcohols to make more advanced intermediates and specialty products. Others purchase their raw materials from the petrochemical companies and produce more advanced intermediates for use in their finished products, such as dyes or medicinals. Some are relatively small producers of specialty products.

U.S. imports of heterocyclic compounds have come from France, West Germany, the Netherlands, Switzerland, and Japan and have included many compounds which are not made in the United States. Some compounds were intermediates entered by the U.S. affiliates of foreign producers for use in the synthesis of finished products, such as dyes or medicinals. Others were biochemicals (i.e., compounds produced by living organisms) which have high unit values and are used in research.

Nitrilo acids and salts.--The nitrilo acids covered here are compounds which contain a trivalent nitrogen atom attached to three different carbon atoms and also contain three or more acid groups. The most important compounds in the group are ethylenediamine tetraacetic acid (EDTA) and its salts, which are derived from ethylenediamine and chloroacetic acid. The molecular structure of EDTA resembles a claw--$\begin{matrix}HOOC\\HOOC\end{matrix}\!\!>\!NCH_2CH_2N\!<\!\!\begin{matrix}COOH\\COOH\end{matrix}$--which enables it to chelate, or encircle, a metallic ion and hold it in solution. Tetrasodium EDTA, which controls calcium and magnesium salts in hard water, is used in textile processing, as an additive for cleaning preparations, and by the pulp and paper and other processing industries. The iron salt of EDTA is used to add iron to citrus and ornamental plants deficient in iron. (N-Hydroxyethylethylenedinitrilo) triacetic acid, trisodium salt is used to control iron in hard water. Nitrilotriacetic acid, the second most important nitrilo acid, is used as a builder in detergent formulations. It may be derived from ammonia and either chloroacetic acid or hydroxyacetic acid, or from formaldehyde and hydrogen cyanide.

In 1968, nitrilo acids and salts were produced by nine U.S. firms, including a few large firms and several small specialty companies. Production increased rapidly from about 35 million pounds in 1964 to 65 million pounds in 1968 (table 4). Imports of these compounds have been negligible.

Other nitrogenous compounds.--Other nitrogenous compounds include numerous less important chemicals with nitrogenous functions, such as cyanates, isocyanates, oximes, and hydrazones, and azo, azoxy, azido, nitro, and nitroso compounds. Nitroparaffins, which are produced by one U.S. company are used as solvents for resins, in organic synthesis, and as additives for rocket propellants and gasoline. Nitro alcohols are produced by one company and are used in organic synthesis and as solvents. 1-Chloro-2-nitropropane is produced by one company and is used as a fungicide. Trichloronitromethane (also known as chloropicrin) is produced by two companies and is used as a soil fumigant. Amyl nitrates are produced by one company, and are used to improve ignition of diesel fuels. Isocyanate esters are produced by four companies and used as intermediates in chemical synthesis. Dimethylhydrazine is produced by one company and is used as a component of jet and rocket fuels, in photography, and in the synthesis of other chemicals. Diethylhydroxylamine is produced by one company and is used in photographic developers and as an antioxidant and corrosion inhibitor. Butyraldoxime is produced by one company and is used as an anti-skinning agent for paints. It is also imported from the Netherlands and West Germany.

Table 1.--Nitrogenous compounds not elsewhere enumerated: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
West Germany	1,398	1,090	957	1,013	1,983	2,337
Japan	51	45	239	206	264	291
Switzerland	355	517	119	747	512	128
France	18	79	124	80	232	288
Netherlands	53	133	319	379	506	431
Sweden	44	23	115	22	48	279
United Kingdom	30	79	91	288	53	34
Italy	1	1/	1	1	8	5
Canada	234	93	181	74	93	58
Norway	-	63	-	1/	1/	1/
Belgium	7	-	-	25	16	15
All other	-	8	5	32	34	2
Total	2,191	2,130	2,151	2,867	3,749	3,868
	Value (1,000 dollars)					
West Germany	793	721	729	721	1,344	1,832
Japan	157	735	328	438	499	474
Switzerland	278	550	190	658	574	432
France	21	103	258	152	267	409
Netherlands	14	35	123	151	98	136
Sweden	7	4	66	102	186	100
United Kingdom	223	75	76	189	46	74
Italy	4	3	1	5	14	60
Canada	18	13	36	14	15	13
Norway	-	1	-	3	18	5
Belgium	5	-	-	8	14	4
All other	-	54	32	36	27	7
Total	1,520	2,294	1,839	2,477	3,102	3,546

1/ Less than 500 pounds.

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

Table 2.--Ethylenediamine: U.S. exports of domestic merchandise, by principal markets, 1964-69

Market	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Belgium	8,466	5,724	9,625	16,385	17,973	16,692
Netherlands	5,221	1,371	2,204	3,289	4,089	1,463
Colombia	190	600	726	984	966	718
Japan	1,508	1,075	1,017	2,125	1,474	645
Mexico	229	259	298	249	434	441
Canada	1,952	283	320	510	407	328
Brazil	16	-	127	294	491	145
Greece	-	-	3,642	2,202	6,032	-
All other	354	484	566	1,014	944	459
Total	17,936	9,796	18,525	27,052	32,810	20,891
	Value (1,000 dollars)					
Belgium	2,042	1,173	2,033	3,556	3,525	3,041
Netherlands	1,640	430	667	973	1,203	302
Colombia	67	197	269	365	333	247
Japan	574	390	395	719	504	212
Mexico	89	96	104	86	144	145
Canada	786	105	115	180	138	110
Brazil	6	-	46	109	169	42
Greece	-	-	496	300	823	-
All other	143	166	194	350	316	146
Total	5,347	2,557	4,319	6,638	7,155	4,245

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

Table 3.--Amines 1/ and hydroxyamines:2/ U.S. exports of domestic merchandise, by principal markets, 1965-69

Market	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)				
Argentina	4,793	5,630	11,036	8,196	16,928
Netherlands	3,304	3,911	6,685	7,395	10,972
Japan	3,058	3,075	3,724	5,017	4,132
Canada	2,589	3,386	5,301	6,343	7,463
West Germany	711	1,083	484	565	6,412
Belgium	883	1,086	2,418	4,768	7,184
Italy	157	178	274	874	963
Mexico	965	872	2,003	2,178	2,446
United Kingdom	1,572	1,140	1,963	2,169	1,188
France	574	492	370	487	223
All other	2,617	4,365	4,474	5,847	5,339
Total	21,223	25,218	38,732	43,830	63,250
	Value (1,000 dollars)				
Argentina	1,901	2,380	3,904	2,460	5,303
Netherlands	1,455	1,375	1,362	2,987	2,907
Japan	1,912	1,877	2,121	2,563	2,443
Canada	856	1,187	1,666	2,197	2,235
West Germany	931	1,059	690	766	1,909
Belgium	308	547	1,141	2,025	1,688
Italy	207	324	473	877	964
Mexico	255	304	502	595	557
United Kingdom	769	661	1,057	1,077	546
France	629	784	571	569	291
All other	1,385	1,908	2,111	2,709	2,344
Total	10,608	12,406	15,598	18,825	21,187

1/ Does not include ethylenediamine; includes hexamethylenetetramine and the lower alkyl monoamines not covered by this summary.

2/ Does not include ethanolamines.

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

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

Table 4.--Nitrilo acids and salts: U.S. production, by selected kinds, 1964-68

Kind	1964	1965	1966	1967	1968
	Quantity (1,000 pounds)				
(Ethylenedinitrilo)tetraacetic acid (Ethylenediaminetetraacetic acid)	5,706	3,528	1/	1/	3,111
Sodium (diethylenetrinitrilo)pentaacetate	1,541	1,869	1/	1/	1/
Tetrasodium (ethylenedinitrilo)tetraacetate	19,010	19,985	24,773	27,529	27,972
Trisodium (ethylenedinitrilo)tetraacetate	1/	604	473	652	1/
Trisodium (N-hydroxyethylethylenedinitrilo)triacetate)	3,294	3,721	4,187	3,960	5,022
All other	2/ 5,332	2/ 6,057	15,471	26,557	28,794
Total	34,883	35,764	44,904	58,698	64,899
	Value (1,000 dollars)				
(Ethylenedinitrilo)tetraacetic acid (Ethylenediaminetetraacetic acid)	2,111	1,835	1/	1/	1,680
Sodium (diethylenetrinitrilo)pentaacetate	493	598	1/	1/	1/
Tetrasodium (ethylenedinitrilo)tetraacetate	6,876	7,194	9,166	9,085	8,951
Trisodium (ethylenedinitrilo)tetraacetate	1/	272	203	274	1/
Trisodium (N-hydroxyethylethylenedinitrilo)triacetate)	1,548	1,674	1,968	1,505	1,959
All other	2/ 2,228	2/ 2,733	6,625	7,332	5,582
Total	13,256	14,306	17,962	18,196	18,172

1/ Not available.
2/ Includes a small amount of hydroxy acids.
3/ Computed from unit value of sales.

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

Commodity	TSUS item
Acetic acid	425.70

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Acetic acid is the most important organic acid produced in the United States; its output was about 1,740 million pounds in 1968. U.S. imports were 15.2 million pounds in 1968, or equivalent to less than 1 percent of production. Imports in 1969 were 8.8 million pounds. Although official U.S. export statistics for acetic acid have not been available in recent years, exports are believed to be smaller than imports.

Description and uses

This summary covers acetic acid, CH_3COOH, which is a clear, colorless liquid. Acetic acid is obtained from both natural and synthetic sources. Pyroligneous acid liquor is obtained from the destructive distillation of hardwoods and natural acetic acid is recovered from the liquor by distillation or by extraction.

There are several commercial methods for preparing synthetic acetic acid. The two most important are the liquid-phase oxidation of butane and the secondary oxidation of acetaldehyde. These two processes account for more than 90 percent of the domestic output of acetic acid. In Europe, no suitable butane supplies are available at reasonable prices, and European producers have gone to the direct oxidation of naphtha to produce acetic acid. Some producers also obtain acetic acid on a commercial scale by reacting methyl alcohol and carbon monoxide. Trade sources believe that this process will become more important in the next several years. The feasibility of this method depends on the availability of a suitable carbon monoxide stream and also on the scale of the methanol operation, which, to a large degree, will be independent of its use in acetic acid production. Synthetic acetic acid accounts for about 98 percent of the total U.S. production of acetic acid, including substantial quantities of acetic acid which are recovered for reuse from certain manufacturing processes.

Acetic acid is available as glacial acetic acid, 99 to 100 percent by weight, and as commercial acetic acid at strengths of 28, 56, 70, and 80 percent in water solutions. Glacial acetic acid, the most

important commercial form of acetic acid, is sold in a technical grade, a chemically pure grade, and a U.S.P. (United States Pharmacopoeia) grade. It is used mainly in the manufacture of acetic anhydride (item 426.00), which, in turn, is used principally in the production of cellulose acetate (item 493.18). The second most important use for glacial acetic acid is in the production of vinyl acetate (item 428.68). Additional uses for glacial acetic acid include the manufacture of chloroacetic acid and acetic esters and salts. Dilute acetic acid is used chiefly as a solvent, whereas acetic acid of a high degree of purity is used in the manufacture of products such as vitamins and hormones.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.70	Acetic acid--	0.53¢ per lb.	0.265¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1969, on acetic acid (425.70) (0.4¢ per pound) was 9.5 percent; that of the rate in effect on January 1, 1970, (0.35¢ per pound) was 8.4 percent.

U.S. consumption

Apparent U.S. consumption of acetic acid increased from about 1,120 million pounds in 1964 to about 1,753 million pounds in 1968 representing an overall increase of about 56 percent (table 1). This does not include known quantities of acetic acid recovered from the production of cellulose acetate, vinyl acetate, and the like and sold. In 1966, sales of recovered acetic acid amounted to about 76 million pounds. Statistics for 1967 or 1968 on recovered acetic acid may not be published. Of the four companies that sold recovered acetic

acid in 1968, none was also a producer of primary acetic acid.

Acetic acid is the principal source of acetic anhydride which is principally consumed in the manufacture of cellulose acetate. In recent years, about 45 percent of the annual output of acetic acid has been consumed--as acetic anhydride--in the production of cellulose acetate. Acetic acid is used directly in the manufacture of vinyl acetate, which takes about 27 percent of the annual production of acetic acid. At present, its use in vinyl acetate is growing at a faster rate (more than 15 percent a year) than any other market for acetic acid.

U.S. producers

In 1968, six U.S. companies produced primary synthetic acetic acid, in five States. Texas has five plants, Louisiana has two plants, and New Jersey, Pennsylvania, and Tennessee have one plant each. Natural acetic acid was produced by four companies in Michigan and Tennessee each of which had two plants.

Five of the producers of synthetic acetic acid are among the largest in the chemical industry and make a wide variety of chemical products. The remaining producer of synthetic acetic acid also manufactures other chemicals, but is principally a manufacturer of alcoholic beverages. The firms making natural acetic acid derive most of their income from pulp and paper products.

The fact that four of the largest producers of synthetic acetic acid also manufacture cellulose acetate and/or vinyl acetate largely accounts for the high degree of captive use of synthetic acetic acid--from about 75 to 80 percent during 1964-69. Products made from synthetic acetic acid are an important element in the income of synthetic acetic acid producers. Captive use of natural acetic acid is believed to be minor.

U.S. production

U.S. production of synthetic acetic acid increased from about 1,100 million pounds in 1964 to about 1,738 million pounds in 1968, or by about 58 percent. During 1963-65, production of natural acetic acid decreased irregularly from 17.7 million pounds to 17.6 million pounds after reaching a high of 19.4 million pounds in 1964. Separate statistics on production of natural acetic acid have not been publishable since 1965 as it would have revealed the operations of individual producers. Synthetic acetic acid averaged about 98 percent of total U.S. production of acetic acid during 1963-67.

U.S. exports

After 1964, official export statistics on acetic acid were no longer available. U.S. exports of acetic acid amounted to 229,000 pounds in 1963 and 505,000 pounds in 1964. Canada was the principal export market in both years, taking more than 44 percent of the total in 1964.

U.S. imports

U.S. imports of acetic acid increased irregularly from 1.2 million pounds in 1963 to 15.2 million pounds in 1968 before decreasing to 8.8 million pounds in 1969 (table 1). Canada was the principal source of acetic acid imports during the period covered, accounting for the bulk in 1969 (table 2). The Netherlands and the United Kingdom have been important sources of acetic acid imports during 1967 and 1968. Imports have been equivalent to no more than nine-tenth of 1 percent of production in any year from 1963 to 1968.

World production and trade

Not only do Canada, the Netherlands, and the United Kingdom produce acetic acid, but also Belgium, France, Japan, Mexico, and West German, and probably most other industrial nations; however, foreign production of synthetic acetic acid is unlikely to result in major imports to the United States for two reasons: (1) approximately 80 percent of the annual U.S. production is used captively, and (2) the United States has access to low-cost petroleum-based raw materials (i.e., butane, ethylene, and the like) used in the manufacture of synthetic acetic acid.

Table 1.--Acetic acid: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1963-69

Year	Production 1/	Imports	Exports 2/	Apparent consumption 3/
	Quantity (1,000 pounds)			
1963	1,045,575	1,197	229	1,046,543
1964	1,119,386	834	505	1,119,715
1965	1,364,223	9,679	-	1,374,902
1966	1,408,768	7,746	-	1,416,514
1967	1,559,991	14,698	-	1,574,689
1968	1,738,236	15,211	-	1,743,447
1969	4/	8,831	-	4/
	Value (1,000 dollars)			
1963	73,367	109	63	73,413
1964	78,551	64	102	78,513
1965	95,697	547	-	96,244
1966	98,614	561	-	99,175
1967	109,199	962	-	110,161
1968	104,294	721	-	105,015
1969	4/	534	-	4/

1/ Includes natural acetic acid for 1964-65; does not include any recovered acid. Value of production calculated from the unit value of sales.

2/ Official export statistics for acetic acid are not available for the years since 1964.

3/ Exports were assumed to be nil for 1965-68.

4/ Not available.

Source: Production of synthetic acetic acid, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; production of natural acetic acid and imports and exports of all types of acetic acid from official statistics of the U.S. Department of Commerce.

Note.--Where not specified, data are assumed to be glacial acetic acid, essentially 100 percent.

Table 2.--Acetic acid: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Canada	767	8,288	5,626	7,143	7,443	8,813
United Kingdom	1/	1/	-	36	5,516	-
Netherlands	-	-	-	7,105	2,192	16
All other	67	1,391	2,120	414	60	2
Total	834	9,679	7,746	14,698	15,211	8,831
	Value (1,000 dollars)					
Canada	55	468	340	384	384	531
United Kingdom	2/	2/	-	32	236	-
Netherlands	-	-	-	381	93	2
All other	9	79	221	165	8	2
Total	64	547	561	962	721	534

1/ Less than 500 pounds.
2/ Less than $500.

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

Commodity	TSUS item
Chloroacetic acid----------	425.72

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Chloroacetic acid is an important chemical in both domestic and international trade. Imports of chloroacetic acid supplied from 19 to 25 percent of the quantity of annual apparent U.S. consumption in 1964-68. During this period, imports increased by more than 49 percent, whereas U.S. production increased by only about 24 percent, and U.S. consumption, by about 35 percent. In 1968, U.S. production exceeded 79 million pounds. Exports are reported to be negligible.

Description and uses

Chloroacetic acid is available commercially in two of its three forms: monochloroacetic acid ($CH_2ClCOOH$) and trichloroacetic acid (CCl_3COOH). The monochloroacetic acid is the more important of the two and hereafter will be referred to simply as chloroacetic acid. Both forms are prepared commercially by reacting chlorine with acetic acid (see separate summary on item 425.70); both are sold as colorless crystals.

Chloroacetic acid is used principally in the production of the herbicides 2,4-dichlorophenoxyacetic acid (or 2,4-D) and 2,4,5-trichlorophenoxyacetic acid (or 2,4,5-T) and in the manufacture of cellulose ethers--especially sodium carboxymethylcellulose (CMC). It is also used in the production of glycine and thioglycolic acid. Trichloroacetic acid is used as a herbicide, as a reagent for detecting albumin, in organic synthesis, and in the manufacture of medicinals.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.72	Chloroacetic acid---	1.25¢ per lb.	0.6¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1968, on chloroacetic acid (item 425.72) (1¢ per pound) was 8.2 percent; that of the rate in effect on January 1, 1969, (0.85¢ per pound) was 6.9 percent.

U.S. consumption

Apparent U.S. consumption of chloroacetic acid increased from about 76 million pounds in 1964 to about 103 million pounds in 1968 (table 1). More than three-fourths of the annual output of chloroacetic acid is consumed in the production of 2,4-D, 2,4,5-T, and CMC.

U.S. production of CMC increased from 44.9 million pounds in 1964 to 60 million pounds in 1968. Production of 2,4-D increased from 53.7 million pounds in 1964 to 79.3 million pounds in 1968 and decreased to 47.1 million pounds in 1969. Production of 2,4,5-T increased from 11.4 million pounds in 1964 to 17.5 million pounds in 1968 and decreased to 5.0 million pounds in 1969. Decreased production of 2,4-D and 2,4,5-T in 1969 is due to governmental restrictions on herbicides suspected of offering any health hazard.

U.S. producers

In 1968 chloroacetic acid was produced by five U.S. companies at five plants situated in Illinois, Michigan, New Jersey, Tennessee, and Virginia. Trichloroacetic acid was also produced by one of the chloroacetic acid manufacturers at a plant in Michigan. Four of the producers are large, diversified members of the chemical industry. The fifth firm also produces other chemicals but probably obtains most of its sales revenue from timber products. The captive use of chloroacetic acid has annually exceeded two-thirds of the total output,

since four of the producers of chloroacetic acid also manufacture the herbicides 2,4-D and 2,4,5-T. One of these four producers, as well as the fifth company, also manufactures CMC.

U.S. production

U.S. production of chloroacetic acid increased from 60 million pounds in 1964 to 79 million pounds in 1968 (table 1). As there is only one producer of trichloroacetic acid, no production statistics for this chemical may be published.

U.S. exports and imports

No official U.S. export statistics are available for chloroacetic acid, but domestic producers report that exports are negligible. U.S. imports of chloroacetic acid have increased from 15.8 million pounds in 1964 to 23.6 million pounds in 1968, or by 49 percent, and they represented from 18 to 25 percent of annual apparent consumption during 1964-68 (table 1). Imports declined in 1969 to 21.3 million pounds.

Imports of chloroacetic acid in recent years have come principally from France, Japan, the Netherlands, and West Germany. France and West Germany accounted for more than two-thirds of the total imports in 1967 and 1969 (table 2).

Foreign production and trade

Chloroacetic acid is produced in most of the industrialized countries of the world such as Canada, Japan and those in Western Europe.

Table 1.--Chloroacetic acid: U.S. production, imports for consumption, and apparent consumption, 1963-69

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production 1/	Imports 2/	Apparent consumption	Ratio (percent) of imports to consumption
	Quantity			
1963	53,550	12,082	65,632	18.4
1964	60,511	15,814	76,325	20.7
1965	71,063	16,600	87,663	18.9
1966	66,094	17,454	83,548	20.9
1967	66,359	22,401	88,760	25.2
1968	79,113	23,594	102,707	23.0
1969	3/	21,327	3/	3/
	Value			
1963	10,174	1,575	11,749	13.4
1964	11,497	2,009	13,506	14.9
1965	13,502	2,154	15,656	13.8
1966	12,558	2,180	14,738	14.8
1967	15,381	2,773	18,154	15.3
1968	11,867	3,558	15,425	23.1
1969	3/	2,611	3/	3/

1/ Data are for monochloroacetic acid only; value of production estimated on the basis of prices listed in trade journals.

2/ May include some data for trichloroacetic acid. 3/ Not available.

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

Table 2.--Chloroacetic acid: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
West Germany	4,195	4,219	5,600	9,195	7,634	7,421
France	8,570	8,953	7,860	6,298	8,227	6,152
Netherlands	1,719	2,208	1,936	4,527	6,262	5,441
Japan	1,330	1,178	2,088	2,381	1,346	1,480
All other	-	42	30	-	125	833
Total	15,814	16,600	17,454	22,401	23,594	21,327
	Value (1,000 dollars)					
West Germany	510	503	714	1,137	1,126	959
France	1,131	1,202	976	762	1,477	710
Netherlands	218	291	259	572	786	661
Japan	150	140	227	302	153	164
All other	-	8	4	-	16	117
Total	2,009	2,154	2,180	2,773	3,558	2,611

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

Commodity	TSUS item
Citric acid	425.74

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The United States, with an estimated annual production of 110 million pounds, is probably the world's foremost consumer, producer, and exporter of citric acid. Annual U.S. exports of the acid are believed to be about 10 million pounds, whereas imports have been meager, amounting to 0.3 million to 0.5 million pounds a year.

Description and uses

Citric acid is the most important of the food acids of commerce. The other food acids--phosphoric acid, item 416.30; lactic acid, item 425.82; and tartaric acid, item 425.94--are either covered in separate summaries or included in the basket summary for certain products derived from benzenoid materials, such as adipic, fumaric, and malic acids (item 403.80).

Citric acid (2-hydroxy-1,2,3-propanetricarboxylic acid) is produced by the mycological fermentation of carbohydrates whereby the mold organism, a strain of aspergillus niger, converts sugar solutions to citric acid. Raw materials for the conversion are beet or cane molasses or corn sugar (dextrose), and the method of fermentation is either a surface fermentation in shallow pans or a submerged fermentation in deep tanks.

Citric acid is a white odorless powder that has a sour but palatable taste. The acid may be anhydrous (without water) or hydrous (containing chemically combined water of hydration) and is marketed in two corresponding U.S.P. (United States Pharmacopoeia) grades. Although the hydrous grade contains less acid per unit of weight, it commands a premium price, probably owing to its greater suitability in certain formulations, principally candies.

In the United States about 70 percent of all citric acid is used in food and beverage preparations, where it serves many purposes, including those as a flavor enhancer, a preservative, and an antioxidant synergist. Another 20 percent is used in numerous industrial applications, principally for the production of citric acid esters and salts, as a pH conditioner for cosmetics, and in metal finishing;

the remainder is used in pharmaceutical products, particularly effervescent powders.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.74	Citric acid-----	8.5¢ per lb.	4.2¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967. Based on imports entered in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31,1969 on citric acid was 36.7 percent; that of the rate in effect on January 1, 1970 was 22.5 percent.

U.S. consumption

Trade sources estimate that U.S. consumption of citric acid increased from 80 million pounds in 1964 to 110 million pounds in 1969, representing an average annual increase of about 6 percent. A recent development that could considerably enhance consumption of citric acid is the possible use of a chemical made from the acid, sodium citrate, as a substitute for phosphates in detergents. Certain factors may preclude this substitution; preliminary indications are that the citrate is only 75 percent as effective, but four times more expensive than the phosphate on a pound-for-pound basis. The citrate, however, would add neither nitrogen nor phosphates to streams and lakes.

U.S. producers

Citric acid is manufactured by two U.S. firms; one is probably the world's largest producer of pharmaceuticals, and the other is a very large multiproduct company that makes chemical and medicinal

products, including remedial preparations. The producers operate three domestic plants, one each in Connecticut, Indiana, and New York. They also directly own or control a number of citric acid plants abroad--in Canada, Israel, Mexico, and the United Kingdom. One of the producers is reportedly constructing a citric acid plant in Ireland.

One producer makes citric acid from beet molasses or corn sugar exclusively by the submerged fermentation method and accounts for about 35 percent of the total domestic production; the other producer makes the acid from beet molasses by the surface, as well as by the submerged fermentation method and accounts for the remainder. The smaller producer is reportedly expanding his production capacity by 50 percent. A substantial portion of the output of both producers is apparently consumed captively.

In the early 1960's, a novel submerged fermentation process was developed that used the less expensive blackstrap molasses as a raw material in a short fermentation cycle. A plant was constructed by a firm that was not previously engaged in the production of citric acid. In 1967, however, that plant was permanently closed because of operational difficulties.

U.S. production, exports, and imports

Data on U.S. production of citric acid are not publishable as there are only two domestic producers, and no data on exports are available. Information from trade sources indicates that the annual U.S. output of citric acid exceeded consumption by about 10 million pounds during 1965-69; the latter quantity is an estimated amount of the acid which was exported annually, imports being nominal. The aggregate output of citric acid is reportedly composed of 90 percent anhydrous grade and 10 percent hydrous grade.

U.S. imports of citric acid, which supplied less than 1 percent of apparent consumption during 1965-69, were as shown in the following tabulation:

Year	Quantity 1,000 pounds	Value 1,000 dollars
1965	524	109
1966	427	79
1967	400	65
1968	415	72
1969	257	48

Belgium supplied the bulk of the U.S. imports of citric acid during this period, and the entire amount in 1969. Other countries that furnished citric acid to the United States during 1965-68 included Japan, Spain, Canada, the United Kingdom, and Israel.

Foreign production and trade

Citric acid is produced abroad by (1) the more highly industrialized nations, such as the member countries of the European Economic Community, the United Kingdom, and Japan, (2) some of the less developed countries, including Israel, Turkey, India, and Mexico, and (3) Communist countries.

Virtually all of the citric acid abroad is made by the mycological fermentation of carbohydrates; some, however, is extracted from citrus juices. The first large-scale submerged fermentation process in the United Kingdom, and probably in Europe, was installed in 1969. The process was developed primarily to use cane molasses as the raw material, but beet molasses or pure sugar can be used equally well. A firm in West Germany is investing $18 million in Puerto Rico to build a citric acid plant which is expected to become operational in early 1971.

Italy is one of the largest producers, as well as a leading exporter of citric acid; the major export markets for the Italian product have been France, Romania, Austria, and Switzerland. Other foreign countries that are net exporters of citric acid include West Germany and Japan. It is reported that in Japan work is being done on a novel product or by-product process for citric acid, production involving its recovery from proteins made from n-paraffins.

Commodity	TSUS item
Formic acid	425.76
Oxalic acid	425.86

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Formic acid and oxalic acid are fairly important organic chemicals in the domestic industry, and are relatively important import commodities at the present time. Exports of both are believed to be small. U.S. production of formic acid was almost 27 million pounds in 1967; that of oxalic acid was about 23 million pounds in 1966. Production data are not publishable for oxalic acid in 1967 or 1968 or for formic acid in 1968.

Description and uses

Formic acid (HCOOH), a colorless corrosive, fuming liquid, is the simplest of the carboxylic acids. It is made by treating sodium formate with sulfuric acid and distilling off the resulting acid. Formic acid may also be obtained by the acid hydrolysis of methyl formate, as a byproduct of the manufacture of acetaldehyde and formaldehyde in hydrocarbon oxidation, and as an extract of sulfite black liquor. Oxalic acid (HOOCCOOH), a transparent, colorless, poisonous crystal, is the simplest of the dicarboxylic acids. It also is produced from sodium formate by conversion to sodium oxalate, which is treated with calcium hydroxide and sulfuric acid to produce oxalic acid. Other sources for the production of oxalic acid are by the oxidation of carbohydrates (e.g., sugars and starches), as a byproduct in the fermentation process of manufacturing citric acid and recently by the direct oxidation of propylene. Sodium formate, the principal raw material for the manufacture of both formic and oxalic acids, is readily obtained by the reaction of carbon monoxide with hot caustic soda. It is also obtained commercially as a byproduct in the manufacture of pentaerythritol.

Formic acid has many industrial uses, the most important of which are the dyeing and finishing of textiles (which take 60 percent of production), leather treatment (which takes 15 percent), and synthesis of other chemicals (15 percent); it is also used in food preservation, silvering glass, and ore flotation. Oxalic acid is used principally in metal and equipment cleaning (27 percent); in the manufacture of other organic chemicals (25 percent); in textile finishing, stripping, and cleaning (23 percent); and in leather tanning and other applications.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.76	Formic acid	2.4¢ per lb.	1.2¢ per lb.
425.86	Oxalic acid	3.8¢ per lb.	1.9¢ per lb.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1968, on formic acid (item 425.76) (2.15¢ per pound) was 24.1 percent; that of the rate of duty on oxalic acid (item 425.86) (3.4¢ per pound) was 28.7 percent. The average ad valorem equivalents of the rates in effect on January 1, 1969, was 21.4 percent for formic acid, and 25.3 percent for oxalic acid.

U.S. consumption

Apparent U.S. consumption of formic acid increased from 21.8 million pounds in 1964 to 30.9 million pounds in 1967 (table 1). During 1964-67, consumption of oxalic acid ranged from 19.6 million pounds in 1965 to 26.5 million pounds in 1966 (table 2). Statistics on production of oxalic acid in 1967 or 1968 are not publishable.

U.S. producers

In 1968 formic acid was produced by three U.S. companies at three plants situated in Illinois, New Jersey, and Texas; four companies produced oxalic acid at four plants--in Connecticut, Illinois, Missouri, and Pennsylvania. Only one company produced both formic and oxalic acid in 1968.

The producers of formic and oxalic acids range in size from medium to the largest members of the chemical industry. These firms

are all highly diversified and produce a variety of chemicals. Neither of these acids accounts for a significant share of the annual sales of any of the producing firms. Captive use of these acids is very small; sales accounted for 86 percent of the production of formic acid in 1967 and for more than 98 percent of the production of oxalic acid in 1966.

U.S. production and exports

U.S. production of formic acid increased from 19.4 million pounds in 1964 to 26.8 million pounds in 1967 (table 1). During 1964-66, annual production of oxalic acid ranged between 19.6 million pounds in 1965 and 22.9 million pounds in 1964 (table 2). Because of the possibility of disclosing the operations of individual producers, 1968 production data for formic acid and 1967 and 1968 production data for oxalic acid may not be published.

Between 1964 and 1967 formic acid had an overall increase in annual production of 38.4 percent, whereas during 1964-66 the annual production of oxalic acid decreased by less than half of 1 percent. The limited number and size of the markets for these two acids will probably restrict their future growth rate to a relatively low level.

Trade sources report that exports of formic acid and oxalic acid are negligible or nil.

U.S. imports

U.S. imports of formic acid accounted for 10.8 to 13.2 percent of annual consumption in 1964-67 (table 1). By contrast, imports of oxalic acid accounted for only 0.6 percent in 1964 before rising sharply to 13.8 percent in 1966 (table 2).

West Germany was the principal source of formic acid imports in 1969, accounting for about 85 percent of the total quantity (table 3). Belgium, the Netherlands, and the United Kingdom were also major suppliers during 1964-69.

Japan has been the principal source of oxalic acid imports in recent years accounting for 47 percent, 35 percent, and 73 percent of the total import quantity in 1967, 1968, and 1969, respectively (table 4). Other major suppliers of oxalic acid in recent years have been Canada and West Germany.

Table 1.--Formic acid: U.S. production, imports for consumption, and apparent consumption, 1964-69

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production 1/	Imports	Apparent consumption	Ratio (percent) of imports to consumption
	Quantity			
1964	19,396	2,420	21,816	11.1
1965	23,657	3,220	26,877	12.0
1966	27,208	3,307	30,515	10.8
1967	26,840	4,088	30,928	13.2
1968	2/	2,012	2/	2/
1969	3/	273	3/	3/
	Value			
1964	2,715	172	2,887	6.0
1965	3,075	240	3,315	7.2
1966	3,537	253	3,790	6.7
1967	2,952	336	3,288	10.2
1968	2/	180	2/	2/
1969	3/	30	3/	3/

1/ Value of production calculated from the unit value of sales.
2/ Not publishable; see section on U.S. production.
3/ Not available.

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

Note.--No official statistics are available for exports; however exports are believed to be very small.

Table 2.--Oxalic acid: U.S. production, imports for consumption, and apparent consumption, 1964-69

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production 1/	Imports	Apparent consumption	Ratio (percent) of imports to consumption
	Quantity			
1964	22,935	132	23,067	0.6
1965	19,573	-	19,573	-
1966	22,854	3,651	26,505	13.8
1967	2/	2,557	2/	-
1968	2/	1,941	2/	-
1969	3/	1,914	3/	-
	Value			
1964	3,211	16	3,227	.5
1965	3,523	-	3,523	-
1966	4,799	584	5,383	10.8
1967	2/	333	2/	-
1968	2/	230	2/	-
1969	3/	228	3/	-

1/ Value of production calculated from the unit value of sales.
2/ Not publishable; see section on U.S. production.
3/ Not available.

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

Note.--No official statistics are available for exports; however, exports are believed to be very small.

Table 3.--Formic acid: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
West Germany	893	618	742	720	529	233
United Kingdom	1/	15	-	1,095	1,020	-
Belgium	320	790	-	-	348	-
Netherlands	1,137	1,704	2,472	2,256	-	-
All other	70	93	93	17	115	40
Total	2,420	3,220	3,307	4,088	2,012	273
	Value (1,000 dollars)					
West Germany	74	56	67	61	48	27
United Kingdom	2/	1	-	100	91	-
Belgium	20	56	-	-	32	-
Netherlands	73	122	178	172	-	-
All other	5	5	8	3	9	3
Total	172	240	253	336	180	30

1/ Less than 500 pounds.
2/ Less than $500.

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

Table 4.--Oxalic acid: US. imports for consumption, by principal sources, 1964, and 1966-69 1/

Source	1964	1966	1967	1968	1969
	Quantity (1,000 pounds)				
Japan	44	1,225	1,210	672	1,401
West Germany	11	1,110	334	289	424
Italy	33	-	-	283	74
Canada	-	531	880	520	-
All other	44	785	133	177	15
Total	132	3,651	2,557	1,941	1,914
	Value (1,000 dollars)				
Japan	5	197	161	76	154
West Germany	1	194	50	37	63
Italy	4	-	-	34	9
Canada	-	69	104	64	-
All other	6	124	18	19	2
Total	16	584	333	230	228

1/ There were no imports of oxalic acid in 1965.

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

Commodity	TSUS item
Lactic acid----------	425.82

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (Pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

More than 90 percent of U.S. consumption of lactic acid--which is believed to have totaled about 12.0 million pounds in 1969 is supplied by domestic production. Consumption increased by about 63 percent in 1960-64, the last years for which official production data are available. The 12.0 million pounds estimated to have been consumed in 1969 was 12 percent more than the quantity consumed in 1964.

Description and uses

The name "lactic acid" is derived from the Latin term for milk, lac. Chemically, lactic acid is 2-hydroxypropionic acid, the primary acid constituent of sour milk; it is formed by the fermentation of the milk sugar (lactose). Lactic acid is a nearly colorless, nonvolatile, syrupy liquid. It is manufactured and traded in food grade, U.S.P. (United States Pharmacopœia) grade, and technical grade in concentrations of 88 percent, 80 percent, 50 percent, and 44 percent lactic acid.

For years lactic acid was produced by fermentation of carbohydrates. The particular raw material used--molasses, glucose, or whey--depended on sources of the producer's raw material; however, U. S. consumption of lactic acid is now largely supplied by a synthetic process based on the hydrolysis of synthetic lactonitrile to produce a water solution of the acid. The acid is shipped in lined tank cars and lined 55-gallon drums and is stored in glass-lined, rubber-lined stainless steel, or aluminum vessels.

Food grade lactic acid is used in the preparation of confectionery, pickles, many dairy products, carbonated beverages, wines, jams, jellies, frozen desserts, beer, sauerkraut, pectin solutions, sausages, and bakery products. An important new and growing use is in the manufacture of a trademarked compound used as an ingredient in bakery mixes. Most of the major baking concerns in the United States are already using this additive.

U.S.P. grade lactic acid is used for pharmaceutical preparations. Technical grade lactic acid is used in tanning leather, in waterproofing cellophane, in "brightening" silk and rayon, in dyeing wool, in the manufacture of plasticizers for many synthetic resins and cellulose derivatives, and in the manufacture of lactic acid derivatives.

Several derivatives of lactic acid are produced commercially. The most important of these are believed to be the fatty acid lactylates, which are used as emulsifiers in bakery products and prepared cake mixes. Other important derivatives are the calcium, sodium, and aluminum salts and the butyl, cetyl, lauryl, and myristyl esters of lactic acid. In addition to their use in food products, these derivatives are used in the manufacture of pharmaceuticals. Butyl lactate is used as a solvent for cellulose compounds and lacquer. Lactic acid derivatives are believed to account for a substantial portion of the total lactic acid consumption.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.82	Lactic acid----	16.0% ad. val.	8.0% ad. val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The column 1 rate of duty from the effective date of the TSUS on August 31, 1963 to December 7, 1965, was 12.5 percent ad valorem; on the latter date, the rate of 16 percent ad valorem became effective pursuant to Public Law 89-241.

U.S. consumption

Prior to 1961 there was little change for some years in U.S. consumption of lactic acid. In 1960, consumption amounted to 6.0 million pounds. An upward trend began in 1961, and by 1963, consumption had increased to 7.5 million pounds. A sharp increase brought apparent consumption to 9.8 million pounds in 1964 and to an estimated 12.0 million pounds in 1969.

The increased consumption in 1961-63 was supplied by increased imports. Beginning with 1964 the increase was supplied by increased domestic production; imports decreased in quantity each year in 1964-67, then increased slightly in 1969 (see accompanying table); they accounted for less than 10 percent of consumption in 1965-69.

The increase in consumption beginning in 1961 has been largely due to the use of lactic acid in making the compound referred to in the section on Description and Uses which is used as a bakery mix ingredient and to other uses for high-grade lactic acid. Consumption is believed to be composed as follows: About 80 percent, food grade; 2 percent, pharmaceutical; and about 18 percent, technical.

U.S. producers

Lactic acid is manufactured in the United States by one large firm operating one establishment in Iowa using a fermentation process, and by a second large firm operating an establishment in Texas using a synthetic process. Both of the firms manufacture lactic acid for sale, and both manufacture many other chemical or food products. The firm operating the establishment using the synthetic process entered the market in December 1963 with a capacity of 10 million pounds a year and has recently increased its capacity by about a third; the establishment using the fermentation process is reported to have an annual capacity of 3 million pounds.

Two other firms, each of which used a fermentation process, discontinued production in 1964.

U.S. production

Prior to 1964, U.S. production of lactic acid had remained almost steady for many years, with an average of 5.4 million pounds a year in 1960-63; however, based on sales statistics, production increased to an estimated 8.1 million pounds in 1964 (the first full year of operation by the producer using the synthetic process) and to more than 11.0 million pounds in 1969. The increase since 1963 is believed to have occurred in all grades of the acid. Very little U.S. production is consumed captively.

U.S. exports and imports

Statistics on U.S. exports of lactic acid are not separately reported. It is believed that exports of lactic acid are smaller than imports.

U.S. imports of lactic acid were 1,562,000 pounds, valued at $460,000, in 1962. They increased to 2,210,000 pounds, valued at $638,000, in 1963, then decreased to 856,000 pounds, valued at $172,000, in 1969 (see accompanying table). The United Kingdom was the largest source of imports in every year during 1964-69. France and the Netherlands were the second and third largest sources in 1964 and Japan and the Netherlands were the second and third largest sources in 1969 (see accompanying table).

Foreign production and trade

During 1964-69 there was a worldwide increase in both consumption and production of lactic acid.

In 1966 Japan began to export lactic acid made by a synthetic process from inexpensive petrochemical raw materials. In 1967 a large facility in France began producing lactic acid from petrochemical feedstocks by a synthetic process. Expansions have also taken place in other countries.

Lactic acid: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
United Kingdom	1,272	722	562	388	437	698
Netherlands	142	50	21	97	137	49
France	173	35	39	24	48	-
Austria	-	1	1	1/	1	1
Japan	20	36	16	28	14	108
West Germany	78	8	4	11	6	1/
All other	7	-	45	1/	-	1/
Total	1,692	852	688	549	643	856
	Value (1,000 dollars)					
United Kingdom	223	98	90	73	75	118
Netherlands	36	14	8	30	42	14
France	38	7	8	5	9	-
Austria	-	3	3	3	6	6
Japan	7	11	4	6	4	31
West Germany	33	5	6	3	2	1
All other	2	-	6	6	-	2
Total	339	138	125	126	138	172

1/ Less than 500 pounds.

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

Commodity	TSUS item
Naphthenic acids	425.84

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

In 1964-68, annual U.S. consumption of naphthenic acids ranged from 30.6 million pounds in 1968 to 41.7 million pounds in 1965; and the share supplied by imports varied from 21 percent in 1964 to 42 percent in 1965. Exports are believed to be very small.

Description and uses

The naphthenic acids of commerce are products which are mixtures of a group of monobasic carboxylic acids which contain 6 to 22 carbon atoms. Naphthenic acids are recovered from petroleum as byproducts when the gas-oil, kerosene, and lubricating-oil fractions of the petroleum are chemically treated to improve their properties.

Naphthenic acids are viscous liquids that are colorless and almost odorless when freshly vacuum-distilled, but develop a dark color and a characteristic odor upon storage.

More than two-thirds of all naphthenic acids consumed are used in the manufacture of paint driers. Naphthenic acids are also used in the manufacture of fungicides, insecticides, lubricants, surface-active agents, incendiary munitions (napalm), and other products.

Naphthenic acids are used as paint driers in the form of iron, zinc, manganese, cobalt, and lead salts (naphthenates). Although calcium and magnesium naphthenates are flatting agents rather than driers, they are also included in this group since, like driers, they are used exclusively in paints and varnishes.

Copper naphthenate and, to a smaller extent, zinc and mercury naphthenates are used as preservatives. Copper naphthenate, which destroys both insects and fungi, protects wood and fabrics from damage by either.

In the field of lubricants, greases are prepared by incorporating naphthenic acid salts (soaps) in a lubricating oil to obtain a lubricant having the desired consistency. Metallic naphthenates such as lead

naphthenate are added to lubricating oils to increase the bearing-load capacity of the oil. In cutting oils, alkali naphthenates are used as emulsifying agents.

The use of napalm during World War II, the Korean war, and the conflict in Viet-Nam is based on the ability of aluminum dinaphthenate to increase the viscosity of gasoline to the point of gel formation. Masses of gelled gasoline, dispersed by a napalm bomb, adhere to structures and form an efficient incendiary munition. This material is also used in flame throwers.

Metal naphthenates compete with pentachlorophenol as wood preservatives and fungicides. In paint driers they compete with metal resinates, octoates, linoleates, and tallates. The market for driers in paints has been adversely affected by the use of latex paints, which do not require the addition of driers.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1969
425.84	Naphthenic acids-----	6.6% ad val.	5% ad val.

The rate effective January 1, 1969, represents the second stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of the five annual stages provided for in the reduction became operative January 1, 1968, and the second stage became effective on January 1, 1969. Further reductions scheduled for years subsequent to 1969 for this item have not become effective. (See footnote 1 to the Staged Rates and Historical Notes to part 2 of schedule 4 of the TSUSA-1970 as shown in appendix A to this volume.) Rates of duty for the individual stages are given in the TSUSA-1970. The rate shown above as existing prior to January 1, 1968, remained unchanged under the TSUS from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption

Apparent U.S. consumption of naphthenic acids (production plus imports) increased from 38.6 million pounds in 1964 to 41.7 million pounds in 1965, then declined to 40.7 million pounds in 1966; to 39.4 million

pounds in 1967 and to 30.6 million pounds, in 1968 (table 1). In 1965 and 1966, unspecified but large amounts of naphthenic acids and derivatives were used in the war effort for the manufacture of preservatives for sand bags, logs, tents, cordage, and wood, and in the manufacture of napalm. From sometime in 1966, Government procurement specifications for the type of napalm currently being manufactured have not called for the use of naphthenic acids. No naphthenic acids are now being used in the manufacture of napalm, although a considerable amount is still being used in preservatives. In peacetime, more than two-thirds of the quantity consumed is used in the manufacture of driers.

In 1965-67, years of unusually high consumption, the additional requirements for naphthenic acids were supplied by increased imports (table 1).

U.S. producers and production

Naphthenic acids are produced in the United States by five petrochemical companies with six establishments situated in California, Texas, and Pennsylvania. All of the firms are large, employing thousands of persons and manufacturing many petroleum and chemical products in addition to naphthenic acids.

Crude naphthenic acids are produced as byproducts of some of the numerous steps in the process of refining crude petroleum. Naphthenic acids are a minor source of income for all of the producers.

U.S. production of naphthenic acids is subject to year-to-year variations determined by the naphthene content of feedstocks of crude oil available to the refineries. Production has been declining for several years. Production amounted to 30.5 million pounds, valued at $3.0 million, in 1964, and then declined to 20.2 million pounds, in 1968 (table 1).

A part of the naphthenic acids produced by domestic producers is not sold as such but is used captively to manufacture naphthenic acid derivatives.

U.S. exports and imports

No statistics on U.S. exports of naphthenic acids are available, but exports are believed to be very small.

U.S. imports of naphthenic acids amounted to 17.4 million pounds, valued at $803,000, in 1965, and decreased to 9.5 million pounds, valued at $979,000, in 1969 (table 2). In 1964-68 the largest source of imports in terms of value each year was the Netherlands Antilles. The

second largest source was Trinidad in every year except 1964 and 1969. Other occasional and minor sources have been Japan, Colombia, Venezuela, West Germany, and the United Kingdom.

Most of the imported naphthenic acids are produced in refineries owned by foreign branches or by foreign affiliates of the importing firms.

Foreign production and trade

The first commercial naphthenic acids were produced in the U.S.S.R. and Romania. Imports from Romania were large until they ceased during World War II, and they have never been resumed. The production potential from the crudes refined in the U.S.S.R., Romania, and Poland is still very large, but little is exported to the rest of the world. The Netherlands Antilles and Trinidad have become the major suppliers of imported naphthenic acids (table 2).

Table 1.--Naphthenic acids: U.S. production, imports for consumption, and apparent consumption, 1964-68

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production	Imports	Apparent consumption	Ratio (percent) of imports to consumption
	Quantity			
1964	30,482	8,098	38,580	21.0
1965	24,365	17,360	41,725	41.6
1966	24,028	16,690	40,718	41.0
1967	24,498	14,911	39,409	37.8
1968	20,210	10,353	30,563	33.8
	Value			
1964	2,957	737	3,694	19.9
1965	2,558	803	3,361	23.9
1966	2,499	1,573	4,072	38.6
1967	2,548	1,466	4,014	36.5
1968	1/	940	1/	1/

1/ Not available.

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

Note.--No statistics on U.S. exports are available, but exports are assumed to be very small.

Table 2.--Naphthenic acids: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Netherlands Antilles	7,996	6,290	13,951	13,313	8,440	8,080
Trinidad	-	1,927	2,739	1,511	1,892	1,364
All other	102	9,143 1/	-	87	21	100
Total	8,098	17,360	16,690	14,911	10,353	9,444
	Value (1,000 dollars)					
Netherlands Antilles	728	525	1,317	1,314	747	707
Trinidad	-	182	256	141	177	128
All other	9	96	-	11	16	144
Total	737	803	1,573	1,466	940	979

1/ Includes 9,121,000 pounds from Venezuela.

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

Commodity	TSUS item
Gallic acid	425.78
Pyrogallic acid	425.88
Valeric acid	425.96
Organic acids, not elsewhere enumerated.	425.98

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The organic acids covered by this summary are fairly important in domestic industry but not in international trade. U.S. production of these acids exceeded 344 million pounds in 1968; imports that year totaled over 27 million pounds, or about 8 percent of the total U.S. supply. Trade sources indicate that exports of these acids have been negligible.

Description and uses

This summary covers about 50 organic acids 1/ which occur in various physical forms ranging from corrosive liquids to crystalline solids.

The most important domestically produced organic acids covered herein are acrylic, azelaic, butyric, 2-ethylbutyric, 2-ethylhexanoic, glycolic, methacrylic, pelargonic, propionic, and sebacic. Heptanoic

1/ According to the TSUS order of precedence of functions, acids substituted with a nitrogen atom are not included in this summary but are covered under item 425.04. This summary also does not include acetic acid (item 425.70), chloroacetic acid (item 425.72), citric acid (item 425.74), formic acid (item 425.76), lactic acid (item 425.82), naphthenic acid (item 425.84), oxalic acid (item 425.86), tartaric acid (item 425.94), barbituric acid (items 437.36 to 437.40), gluconic acid (item 437.51), glycerophosphoric acid (item 437.54), tannic acid (items 437.68 and 437.69), sulfated or sulfonated fatty acids of animal or vegetable origin (items 465.35 and 465.40), and fatty acids of animal or vegetable origin (490.10 to 490.26). Gallic and pyrogallic acid are the only acids having a benzenoid structure covered in this summary. Other benzenoid acids are covered in items 401.24-409.00. Nonbenzenoid acids (such as adipic, fumaric, maleic and succinic) which are derived from benzenoid raw materials, are covered in items 403.80 and 403.90.

acid (items 425.98 and 907.30) has not been produced domestically but has been imported in substantial quantities in recent years. There are many commercial methods for producing the organic acids covered here, among which are the oxidation of aldehydes or primary alcohols, the hydrolysis of esters and nitriles, and the reaction of Grignard reagents with carbon dioxide.

Organic acids are used as acidifying agents and as intermediate chemicals in organic synthesis. Their corresponding amides, amines, esters, halides, or salts are more frequently used as final products than are the acids themselves.

Acrylic acid monomer is used in the manufacture of synthetic resins and latexes and its esters are used in textile sizing and printing. Azelaic acid esters are used in fluids for hydraulic systems, in lubricants, and in plasticizers for certain synthetic rubbers. Butyric acid is used in the manufacture of pharmaceuticals and its esters are used in synthetic flavor and perfume formulations and in leather tanning. 2-Ethylbutyric acid is used as an intermediate for drugs, dyestuffs, and flavorings. 2-Ethylhexanoic acid is used as a modifying agent for alkyd resins and its metal salts are used as driers for varnishes and enamels. Glycolic acid esters and salts are used in metal-cleaning solutions, in leather tanning, as solvents, and for nonferrous electroplating. Esters of methacrylic acid are used in the production of plastics. Pelargonic acid esters are used in the manufacture of synthetic lubricants for jet aircraft. Propionic acid is used as an intermediate for plastics and its salts are used in pesticides and as fungus inhibitors in bakery products. Sebacic acid is used as an intermediate for alkyd and polyamide resins; its esters are used as plasticizers and synthetic lubricants. Heptanoic acid esters are used to make special jet engine lubricants for military and commercial aircraft. Valeric acid esters also are used to make synthetic lubricants for jet aircraft.

The other acids covered by this summary, including gallic and pyrogallic, are used to a limited extent in a wide variety of domestic industries.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.78	Gallic acid----------	6¢ per lb.	3¢ per lb.
425.88	Pyrogallic acid---------	12¢ per lb.	9¢ per lb. 1/
425.96	Valeric acid----------	Free	Free
425.98	Organic acids, not elsewhere enumerated.	12.5% ad val.	6% ad val. 2/

Except for valeric acid, which has been bound free of duty under the Tariff Act of 1930 and pyrogallic (see footnot 1), the rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1969, on gallic acid (item 425.78) (4.5¢ per pound) was 3.8 percent; it was 3.3 percent for the rate in effect on January 1, 1970 (4¢ per pound). Based on imports in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1969, on pyrogallic acid (item 425.88) (9¢ per pound) was 11.2 percent.

U.S. consumption and production

From 1964 through 1968, production of the acids included in this summary decreased irregularly from about 390 million pounds in 1964 to about 344 million pounds in 1968 after reaching a 5-year high of 502 million pounds in 1967. Annual domestic comsumption is thought to be somewhat greater than production as imports were reported to have

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1/ This rate became effective in the second stage (calendar year 1969) of the Kennedy Round staged rate reductions. Futher reductions scheduled for this item have not become effective. See footnote 1 to Stages Rates and Historical Notes to part 2 of schedule 4 of the Tariff Schedules of the United States Annotated (TSUSA-1970) as shown in appendix A to this volume.

2/ The duty on heptanoic acid included in this item has been suspended since August 31, 1963 (the effective date of the TSUS) for the entire period through December 31, 1970, pursuant to Public Laws 88-93, 89-432, and 91-36 (item 907.30).

exceeded exports.

Each year during 1964 through 1968, more than 80 percent of both, total consumption and total production of the acids covered here consisted of: acrylic acid, azelaic acid, butyric acid, 2-ethylbutyric acid, glycolic acid, methacrylic acid, propionic acid, 2-ethylhexanoic acid, and sebacic acid. In 1968, acrylic acid was the most important acid covered here, accounting for about one-fourth of the total of the 344 million pounds produced.

During 1964-68, production statistics were published annually for only acrylic acid and propionic acid (table 1 and 2). The rapid increase in production of acrylic acid (153 percent, 1964-68) was stimulated by the rapid growth in recent years in the manufacture of surface-coating resins and synthetic fibers, the primary markets for acrylic acid.

U.S. producers

In 1968, there were 39 U.S. producers (36 companies) of the organic acids covered in this summary. The producers ranged in size from from small to the largest in the chemical industry. All the firms produced chemicals other than these acids; none received the major portion of their annual income from the sale of these acids.

Some companies use their entire output of these organic acids captively; others sell all they produce on the open market. Selling prices range from less than 10 cents a pound to many dollars a pound; prices of most acids, however, range between 10 cents and 50 cents a pound.

U.S. exports and imports

No official export statistics on these organic acids are available.

Imports of gallic acid increased regularly, whereas imports of valeric acid have increased irregularly during 1964-69 (table 3). Nearly all imports of gallic acid came from France; virtually all imports of valeric acid came from West Germany, although some of the valeric acid came from the Netherlands in 1968.

There were no imports of pyrogallic acid in 1967 or 1968 and only small quantities in 1964-66 and in 1969 (table 3). The United Kingdom was the only named source of imports of pyrogallic acid.

During the period covered, the official statistics for item 425.98, organic acids, not elsewhere enumerated, have annually contained a significant quantity of erroneously reported chemicals--

as much as 30 percent to 40 percent for 1966 and 1967 (about 10 percent in 1968). This was discovered by the Tariff Commission through an analysis of import invoice documents.

Propionic acid has been the most important acid imported under item 425.98 in recent years. Imports exceeded 9.5 million pounds, valued at $660,000 in 1969. West Germany has been the principal source of propionic acid; other major sources have been Belgium, Canada, and the United Kingdom. The second most important product in 1969, was an acid mixture containing several monocarboxylic, straight-chained acids that had an average chain length of seven carbons. Imports of this product exceeded 6.6 million pounds, valued in excess of $1.1 million. West Germany accounted for about 60 percent of these imports; France, about 30 percent; and the Netherlands, the remainder. Alginic acid, bromoacetic acid, camphorsulfonic acid, caproic acid, crotonic acid, dehydroacetic acid, desoxycholic acid, 2-ethylhexoic acid, gibberellic acid, glyoxylic acid, iso-octanoic acid, pelargonic acid, sorbic acid, and thioglycolic acid were among the other important acids entered under item 425.98 in 1969. In recent years, West Germany has been the most important source of imports, and Canada, France, Japan, the Netherlands, Norway, Switzerland, and the United Kingdom also have been major sources of the organic acids covered here.

Imports of heptanoic acid (item 907.30) have increased irregularly from 55,000 pounds, valued at $18,000, in 1964, to 6,383,000 pounds, valued at $1,292,000, in 1969. The three sources of imports of heptanoic acid are France, West Germany, and the Netherlands (table 4). France is the most important, accounting for about 86 percent (quantity and value) in 1967 and about 95 percent (quantity and value) in 1968 and 100 percent in 1969. It appears that the material from the Netherlands and West Germany reported under item 907.30 is a mixture of several monocarboxylic, straight-chained acids with an average over-all chain length of seven carbons.

Table 1.--Acrylic acid: U.S. production and sales, 1964-68

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
1964	32,532	4,369	1,471	$0.34
1965	40,938	7,594	2,162	.28
1966	62,477	11,080	3,180	.29
1967	64,710	14,035	3,771	.27
1968	82,453	16,459	4,467	.27

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

Table 2.--Propionic acid: U.S. production and sales, 1964-68

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
1964	39,117	11,572	1,302	$0.11
1965	31,870	16,801	1,806	.11
1966	36,989	23,786	2,479	.10
1967	43,916	22,479	2,311	.10
1968	38,104	20,442	1,948	.10

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

Note.--These are the only two acids covered by this summary for which complete separate statistics were available annually during the period covered.

Table 3.--Galic acid, pyrogallic acid, and valeric acid: U.S. imports for consumption, 1964-69

Acids	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Gallic	1/	19	20	28	45	204
Valeric	12	20	39	20	188	165
Pyrogallic	1/	1/	2	-	-	1/
	Value (1,000 dollars)					
Gallic	2/	21	29	39	61	241
Valeric	9	16	26	21	46	47
Pyrogallic	1	1	4	-	-	2/

1/ Less than 500 pounds.
2/ Less than $500.

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

Note.--Official statistics for organic acids, not elsewhere enumerated, item 425.98 (other than heptanoic acid which is shown in table 3) are not shown here because they apparently include a large volume of erroneously reported importations and the figures would be misleading.

Table 4.--Heptanoic acid: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
France	55	965	2,239	4,832	7,343	6,383
West Germany	-	-	-	114	625	-
Netherlands	-	553	-	654	219	-
Total	55	1,518	2,239	5,599	8,189	6,383
	Value (1,000 dollars)					
France	18	172	411	902	1,544	1,292
West Germany	-	-	-	22	111	-
Netherlands	-	75	-	107	32	-
Total	18	247	411	1,032	1,658	1,292

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

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

Commodity	TSUS item
Acetic anhydride	426.00

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Acetic anhydride is an important basic chemical in the United States and other countries. U.S. production amounted to 1,747 million pounds in 1969. U.S. imports totaled 47.2 million pounds in 1967; 25.6 million pounds was imported in 1969. Separate export statistics are not available for years since 1964, but exports are believed to be considerably smaller than imports.

Description and uses

Acetic anhydride is a colorless liquid with a strong acetic odor. It is a derivative of acetic acid (item 425.70)--derived by removal of one molecule of water from two acid carboxyl groups. Commercially acetic anhydride is most commonly produced by the addition of ketene (item 427.64) to glacial acetic acid, or by the oxidation of acetaldehyde (item 427.40) (via butane--item 475.15) with air in the presence of manganous acetate or cobalt acetate.

Acetic anhydride which is used in reactions where acetic acid reacts too sluggishly, is preferred to the more active, but expensive, acetyl chloride--an acyl halide (item 427.50). Acetic anhydride is used principally to introduce the acetate radical into organic compounds (i.e., as an acetylating agent). It is also used as a dehydrating agent.

The production of cellulose esters, including cellulose acetate, cellulose acetate-butyrate, and cellulose acetate-propionate, accounts for about 90 percent of the annual U.S. output of acetic anhydride. Cellulose acetate alone accounts for about 75 percent of the total; vinyl acetate, for about 5 percent; and aspirin, for about 1 percent. Acetic anhydride is also used in the production of dyes, perfumes, explosives, and drugs--principally as an acetylating agent.

U.S. tariff treatment

The column 1 rate of duty applicable to imports (see general

headnote 3 in the (TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
426.00	Acetic anhydride-------	1.5¢ per lb.	0.75¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchaged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1969, on acetic anhydride (1.2¢ per pound) was 16.1 percent; that of the rate in effect on January 1, 1970 (1.05¢ per pound) was 14.3 percent.

U.S. consumption

Apparent U.S. consumption of acetic anhydride increased irregularly from 1,400 million pounds in 1964 to about 1,774 million pounds in 1969. Since exports are reported to be small, consumption closely approximates production plus imports.

About three-fourths of the annual output of acetic anhydride is consumed in the manufacture of cellulose acetate. Production of cellulose acetate increased from about 669 million pounds in 1965 to more than 817 million pounds in 1968.

U.S. producers

In 1969, there were five U.S. companies producing acetic anhydride at nine plants in seven states. Three plants were in Texas; the other six were in Maryland, New Jersy, Pennsylvania, South Carolina, Tennessee, and Virginia. The producers are among the largest members of the chemical industry and make a wide range of chemical products. Four of the producers use most of their annual production of acetic anhydride captively in the manufacture of products such as

cellulose acetate, related cellulose compounds, and/or vinyl acetate. The remaining producer sells most of its annual acetic anhydride output.

U.S. production

U.S. production of acetic anhydride increased irregularly from 1,399 million pounds in 1964 to 1,748 million pounds in 1969 (see accompanying table). Sales by producers account for less than 10 percent of production.

U.S. exports

Of the years 1964-69, separate U.S. export statistics on acetic anhydride were available only for 1964. Exports amounted to 556,000 pounds, valued at $41,000, in 1964. Belgium was the principal export market in 1964.

U.S. imports

U.S. imports of acetic anhydride increased irregularly from 1.1 million pounds in 1964 to 47.2 million pounds in 1967, then declined to 25.6 million pounds in 1969 (see accompanying table). Nearly all imports of acetic anhydride have come from Canada.

Industry sources report that the sharp increase in imports that began in 1967 is temporary and does not represent a permanent trend. These sources believe that future imports will decline to the 1-million-pound to 10-million-pound range. Even at their peak in 1967, imports were equivalent to no more than 3 percent of the quantity produced in the U.S. in that year.

Imports from Canada probably represent shipments from a subsidiary or affiliate of a domestic producer.

Acetic anhydride: U.S. production and imports for consumption, 1963-69

Year	Production	Imports
	Quantity (1,000 pounds)	
1963	1,271,527	224
1964	1,399,203	1,113
1965	1,531,738	1,592
1966	1,408,768	8,057
1967	1,559,991	47,201
1968	1,663,776	27,542
1969	1/ 1,747,957	25,639
	Value (1,000 dollars)	
1963	2/ 127,153	24
1964	2/ 139,920	117
1965	2/ 153,174	146
1966	2/ 140,877	662
1967	2/ 155,999	4,273
1968	2/ 166,378	2,307
1969	1/ 2/ 174,796	2,016

1/ Preliminary. 2/ Computed from unit value of sales.

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

Commodity	TSUS item
Valeric anhydride	426.02
Acid anhydrides, not elsewhere enumerated	426.04

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The acid anhydrides covered by this summary are fairly important in the domestic industry but are of little significance in international trade. Exports are nil, since the greater part of domestic output is used captively by the producing firms in the manufacture of other products. U.S. imports are negligible, being equivalent to less than half of 1 percent of annual production.

Description and uses

This summary includes at least five acyclic acid anhydrides, 1/ the most important of which are butyric anhydride and propionic anhydride. Valeric anhydride is not produced domestically. Acetic anhydride is covered in a separate summary (item 426.00).

Acid anhydrides are acid derivatives, usually colorless and liquid, in which one molecule of water has been removed from two acid carboxyl groups. The anhydrides are commercially prepared principally by the condensation of an acid chloride with the sodium salt of the acid or by exchange of an acid with acetic anhydride and distilling off the resulting acetic acid.

1/ According to the TSUS order of precedence of functions, the provision for organic acid anhydrides includes not only simple anhydrides but also those which contain an aldehyde, ketone, alcohol, ester, epoxide, ether, or lactone function, or a halogen, sulfur, or metallic atom. The provision does not include anhydrides which contain a nitrogen atom. Anhydrides, such as maleic anhydride and succinic anhydride, which are derived from benzenoid raw materials, are covered under TSUS item 403.80.

The anhydrides are used in processes in which the corresponding acids react too slowly. For many purposes, they are preferred to the more reactive acyl halides (see separate summary, item 427.30) because of their lower cost. Butyric anhydride is used in the manufacture of various butyrates, drugs, and tanning agents. Propionic anhydride is used as an esterifying agent for fats, oils, and cellulose; as a dehydrating medium for nitrations and sulfonations; and in the production of alkyd resins, dyestuffs, and pharmaceuticals.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Acid anhydrides:		
426.02	Valeric----------	Free	Free 1/
426.04	Other----------	12.5% ad val.	6% ad val.

1/ Duty-free status not affected by the trade conference.

The rate effective January 1, 1972 for item 426.04 represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption and production

From 1964 through 1968, both the U.S. consumption and production of the acid anhydrides covered herein increased by more than 60 percent, but neither exceeded 150 million pounds in any year during this period. Butyric anhydride accounted annually for half, or more, of both U.S. consumption and production. Propionic anhydride had increased to about 25 percent of both consumption and production, by 1968.

U.S. producers

In 1968, there were two companies manufacturing the acyclic acid anhydrides covered here; they are among the largest companies in the

chemical industry and are highly diversified. They operate plants in both the United States and abroad.

From 1964 through 1968, about 99 percent of the annual production of the acid anhydrides was used captively by the producers in the manufacture of other products. Sales of the acid anhydrides are, therefore, a negligible percentage of the producers' total annual sales.

U.S. exports

Official export statistics are not available for the acid anhydrides; however, because 99 percent of U.S. production is used captively, exports must be a negligible part of production.

U.S. imports

Imports for consumption of valeric anhydride and other acid anhydrides not elsewhere enumerated for 1965-69 are given in the following tabulation:

Year	Quantity 1,000 pounds	Value 1,000 dollars
1965----------	188	36
1966----------	183	32
1967----------	141	38
1968----------	19	20
1969----------	475	69

Imports of valeric anhydride have been small and sporadic--only 4,000 pounds, valued at $3,591, from West Germany in 1965 and 242,298 pounds, valued at $33,739, from Canada in 1969. Japan and West Germany have been the principal sources of the other anhydrides--Japan supplied 70 percent and 79 percent of the total quantity imported in 1967 and 1968, respectively, and West Germany supplied almost 98 percent in 1969. Other sources of imports of other anhydrides have been Canada, France, the Netherlands, and the United Kingdom.

Commodity	TSUS item
Calcium acetate, crude	426.10
Calcium citrate (lime citrate)	426.12
Calcium oxalate	426.14
Calcium salts of organic acids, not elsewhere enumerated	426.18

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The organic calcium salts of propionic, citric, formic, naphthenic, 2-ethylhexanoic, lactic, and acetic acids are not especially important in either international or domestic trade. U.S. production in 1968 amounted to about 22 million pounds, valued at about $3.6 million, with calcium propionate the most important chemical. U.S. imports of calcium salts in 1969 totaled 4.7 million pounds, valued at $581,000, and over 90 percent of them came from the United Kingdom.

Description and uses

The more important calcium salts of organic acids covered in this summary are calcium propionate, calcium formate, calcium naphthenate, and calcium 2-ethylhexanoate. Of lesser importance are calcium citrate, calcium acetate, and calcium decanoate. Of very minor importance are calcium mercaptoacetate, calcium malonate, ferrous calcium citrate, calcium resinate, and calcium oxalate. Except for calcium resinate and calcium naphthenate, all of the calcium salts covered herein are acyclic in structure. Calcium salts of fatty acids are covered in part 13 of schedule 4 of the TSUS; calcium salts in the form of lignin extracts, since December 7, 1965, have been provided for under TSUS item 465.92. (See U.S. tariff treatment section).

Organic calcium salts are either crystalline or amorphous powders ranging from colorless to milky white. Organic calcium salts are usually prepared synthetically by reacting an acid with the calcium base.

Calcium propionate is widely used in the United States as an antifungal agent in bread. Calcium formate is employed in the manufacture of aldehydes. Calcium citrate (lime citrate) is used in medicine, in dietary supplements, and in the manufacture of citric acid. Calcium

lactate is used in both human and veterinary medicines and in the manufacture of foods and beverages. Calcium 2-ethylhexanoate is used in making metallic soaps. Calcium naphthenate is used in waterproofing compositions, adhesives, wood fillers, grafting waxes, cements, varnishes, and color lakes. Calcium acetate (crude) is used in the manufacture of acetates; as a mordant in the dyeing and printing of textiles, a resin stabilizer, and an additive to calcium soap lubricants; and in the tanning and curing of hides. The crude grade of calcium acetate is not used in the manufacture of acetic acid.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
426.10	Calcium acetate, crude.	0.25¢ per lb.	0.2¢ per lb. 1/
426.12	Calcium citrate------	3.5¢ per lb.	1.7¢ per lb.
426.14	Calcium oxalate------	4¢ per lb.	3.2¢ per lb. 1/
426.18	Calcium salts of organic acids, not elsewhere enumerated. 2/	10.5% ad val.	5% ad val.

1/ This rate became effective in the second stage (calendar year 1969) of the Kennedy Round staged rate reductions. Further reductions scheduled for this item have not become effective. See footnote 1 to Staged Rates and Historical Notes to part 2 of schedule 4 of the TSUSA-1970 as shown in appendix A to this volume.

2/ Prior to Dec. 7, 1965, the effective date of Public Law 89-241, imports of calcium salts in the form of lignin extract were classified under TSUS item 426.18. They are now provided for under item 465.92.

The rates effective January 1, 1972, represent the final stages of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1,1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. trade

U.S. production of calcium salts of organic acids has increased steadily and is estimated for 1968 at almost 25 million pounds, valued at $5 million. Production and sales of three items, as published in the Tariff Commission's report, Synthetic Organic Chemicals, United States Production and Sales, 1968, are as follows:

Item	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Calcium 2-ethylhexanoate	1,213	458	168	$0.37
Calcium naphthenate	1,707	1,630	532	.33
Calcium propionate	13,693	10,227	2,235	.22

Statistics for other calcium salts cannot be published as to do so might reveal the operations of individual producers.

In 1968, almost 25 U.S. firms produced one or more of the salts covered here, but many of the individual salts were produced by only one or two companies.

No official statistics on exports are available but exports are believed to be very small.

U.S. imports for consumption of calcium salts of organic acids for 1965-69 are given in the following tabulation:

Year	Quantity	Value
	1,000 pounds	1,000 dollars
1965	15,541	494
1966	3,675	315
1967	3,715	355
1968	4,159	430
1969	4,734	582

Excluding the very large amounts of lignin extract imported from Canada in 1965, the largest supplies of these calcium salts have come to the United States from the United Kingdom. In 1966-68, imports of calcium salts, in order of importance, consisted of calcium formate from West Germany and the United Kingdom, calcium naphthenate from the United Kingdom, calcium acetate from the Netherlands, and calcium alginate from Norway.

Commodity	TSUS item
Copper acetate and subacetate----	426.28
Copper naphthenate----------	426.32
Organic copper salts, not elsewhere enumerated--------	426.34

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. consumption of the organic copper salts covered in this summary does not exceed 4 million pounds annually. Annual exports of these salts are probably considerably smaller than U.S. consumption. Imports in recent years have been small and variable.

Description and uses

The products covered by this summary are copper acetate and subacetate (item 426.28), copper naphthenate (item 426.32), and other nonbenzenoid 1/ copper salts not elsewhere enumerated (item 426.34). In 1968, there were about six copper salts, not elsewhere enumerated, which were produced domestically.

Copper naphthenate is the only one of the nonbenzenoid copper salts included here which is commercially important. This salt is prepared from a solution of cupric sulfate and an aqueous solution of sodium naphthenate. Copper naphthenate is used almost exclusively as a fungicide in the protection of wood, cloth fiber, canvas, and rope.

The other copper salts covered here are used in a variety of applications among which are: Catalysts; conditioning agents in cements, paints, and plastics; lubricants; fungicides; and mordants in the dyeing and printing of fabrics.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general

1/ The benzenoid copper salts are covered separately (see items 401.02 to 407.85). Nonbenzenoid copper salts of fatty acids and those which contain a nitrogen atom are covered in separate summaries.

headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
426.28	Copper acetate and subacetate----------	1.7¢ per lb. on copper content	1.35¢ per lb. on copper content 1/
426.32	Copper naphthenate--------	1.275¢ per lb. + 10.5% ad val.	0.6¢ per lb. + 5% ad val.
426.34	Other copper salts, not elsewhere enumerated-----	1.275¢ per lb. + 10.5% ad val.	0.6¢ per lb. + 5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the Sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS) through 1967.

Based on imports in 1968, the average ad valorem equivalent of the rate of duty in effect on December 31, 1968, on copper naphthenate (item 426.32) (1.1¢ per pound + 9.4 percent ad valorem) was 15.1 percent; it was 13.6 percent for the rate in effect on January 1, 1969, (1¢ per pound + 8.4 percent ad valorem). There were no imports of copper naphthenate in 1969. Based on imports in 1969, the average ad valorem equivalent of the rate of duty in effdct on December 31, 1969, on copper acetate and subacetate (item 426.28) (1.35¢ per pound on copper content) was 2.7 percent. There were no imports of other copper salts (item 426.34) in 1968 or 1969.

U.S. consumption and production

From 1964 through 1969, neither the consumption nor production of the organic copper salts exceeded 4 million pounds a year. During this period, annual U.S. consumption and production of copper naphthenate, the most important nonbenzenoid copper salt, ranged irregularly from about 1.5 million pounds in 1969 to about 3.5 million pounds in 1967 (see accompanying table). Copper naphthenate has accounted for about 75 percent of both the total consumption and

1/ This rate became effective in the second stage (calendar year 1969) of the Kennedy Round staged rate reductions. Futher reductions scheduled for this item have not become effective. See footnote 1 to the TSUSA-1970, as shown in appendix A to this volume.

production of all nonbenzenoid copper salts.

Increased use of copper naphthenate is restricted principally because of its particular properties of imparting a green color to everything it impregnates and giving a harsh "feel" to treated textiles. Copper naphthenate is one of the oldest organic fungicides still in use and has probably reached its maximum absorption by the U.S. market. The needs of the military in Viet Nam, however, have increased the demand for copper naphthenate as a fungicide.

U.S. producers

In 1968, 14 companies produced organic copper salts in seven states. Five plants were located in New Jersy; three in Ohio; two in Pennsylvania; and one each in California, Illinois, New York, and Tennessee.

Eleven of the 14 producers of organic copper salts are classifiable as small to medium size and would not be considered highly diversified manufacturers. It is quite probable that some of the smaller producers, especially of copper naphthenate, depend upon the sale of these copper salts for a substantial portion of their annual income.

Captive use of the copper salts is negligible since they are primarily finished products, not intermediates. Moreover, the smaller firms, manufacturing only a few types of products, seldom use these chemicals in their own operations. In 1968, the average unit values of the copper salts included herein ranged from less than 30 cents to over $1.00 per pound.

U.S. exports

No official U.S. statistics on exports of organic copper salts are available; exports are probably considerably smaller than domestic production, but somewhat larger than imports.

U.S. imports

Official import statistics had been available only for copper acetate and subacetate before the TSUS became effective on August 31, 1963. From 1964 through 1966 there were no imports of any of the organic copper salts covered here. In 1967 imports of copper

salts, not elsewhere enumerated (item 426.34) 1/ amounted to 22,000 pounds, valued at $10,000, and came in equal quantities from the United Kingdom and West Germany. There were no imports of copper salts under item 426.34 in 1968 or 1969. In 1968, Canada supplied all of the imports of copper naphthenate, which amounted to 55,000 pounds, valued at about $10,600. There were no imports of copper naphthenate in 1967 or 1969. There have been no importsof copper acetate and subacetate (item 426.28) during 1964-68; however, in 1969 imports of copper acetate and subacetate amounted to 4,400 pounds, valued at $2,211--all from the United Kingdom.

1/ Official statistics showing imports of organic copper salts (item 426.34) reflected erroneous reporting of imported anhydrous cupric chloride and cuprous chloride.

Copper acetate and copper naphthenate: U.S. production and sales, 1964-69

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production	Sales		
		Quantity	Value	Unit value
				Per pound
Copper acetate				
1964	171	132	91	$0.69
1965	200	206	127	.62
1966	294	186	135	.73
1967	1/	1/	1/	1/
1968	217	192	162	.84
1969	2/	2/	2/	2/
Copper naphthenate				
1964	1,897	1,860	540	.29
1965	3,268	3,101	902	.29
1966	3,211	3,124	833	.27
1967	3,473	3,385	996	.29
1968	1,718	1,782	464	.26
1969	1,545	1,529	438	.29

1/ May not be published since this might reveal the operations of individual concerns.

2/ Not available.

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

Commodity	TSUS item
Lead acetate	426.36
Lead resinate	426.42
Other lead salts of organic acids not elsewhere enumerated	426.44

Note.--For the statutory description see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. production of the organic lead compounds considered here and for which data are available amounted to 15.6 million pounds and sales were 14.8 million pounds, valued at almost $4 million, in 1967. Imports were 44,500 pounds, valued at $7,400 in 1967; 33,300 pounds, valued at $13,000, in 1968; and 19,000 pounds valued at $19,000 in 1969. Export statistics are not reported separately in official statistics, but exports are probably small.

Description and uses

This summary covers lead acetate and lead resinate, which are specifically mentioned in the TSUS, and all other lead salts of organic acids except lead salts of fatty acids, such as lead stearate and lead oleate, which are covered in part 13 of schedule 4. The most important organic lead salts included under item 426.44 are lead naphthenate lead 2-ethylhexanoate, lead formate, and lead neodecanoate. Lead acetate is a white crystalline solid which is made by dissolving lead monoxide (litharge) in strong acetic acid. It is usually available in the trihydrate form (sugar of lead). It is used in the manufacture of other lead salts, as a mordant in dyes, as a drier in paints, and in the lead coating of metals. Lead 2-ethylhexanoate, lead naphthenate, lead neodecanoate, and lead resinate are metallic soaps whose principal use is in driers for paints and varnishes. They are made by reacting the appropriate acid with caustic soda to form an alkali soap and then treating the alkali soap with a water solution of a lead salt. Lead formate is made from formic acid and litharge, and has limited use in the manufacture of specialized rubber compounds. Other lead salts of organic acids included in this summary are of minor importance.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Lead salts of organic acids:		
426.36	Acetate----------	1.25¢ per lb.	1¢ per lb. 1/
426.42	Resinate----------	1.5¢ per lb.	1.2¢ per lb. 1/
426.44	Other----------	15% ad val.	7.5% ad val.

1/ This rate became effective in the second stage (calendar year 1969) of the Kennedy Round staged rate reductions. Further reductions scheduled for this item have not become effective. See footnote 1 to Staged Rates and Historical Notes to Part 2 of schedule 4 of the TSUSA-1970, as shown in appendix A to this volume.

The rate for item 426.44 effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade; the first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged under the TSUS from August 31, 1963 (the effective date of the TSUS), through 1967. The ad valorem equivalent of the specific rates of duty in effect during 1968 based on imports in that year were 0.5 percent for lead acetate and 11.0 percent for lead resinate.

U.S. production and producers

U.S. production of organic lead salts is estimated on the basis of data reported to the Tariff Commission at 15.6 million pounds in 1967. Sales were approximately 14 million pounds, valued at about $4 million. Specific data are available for only two organic lead salts. Production of lead naphthenate in 1966 was 14.3 million pounds; in 1967, it was 13.4 million pounds; and in 1968 it was 17.0 million pounds (table 1). Domestic output of lead 2-ethylhexanoate has remained steady at about 200,000 pounds per year during the period 1964-67 but rose to 824,000 pounds in 1968.

In 1968, production of lead acetate was reported to the Tariff Commission by three companies; lead 2-ethylhexanoate was reported by eight companies; lead formate and lead resinate were reported by one company each; lead naphthenate was reported by 12 companies; and lead neodecanoate, by two companies. The companies producing organic lead salts range in size from small to medium. Producing plants are located in California, Illinois, New Jersey, Ohio, and Pennsylvania.

U.S. imports and exports

U.S. imports of organic lead salts in 1964 amounted to 42,365 pounds, valued at $6,699, and were all of lead acetate principally from the United Kingdom and West Germany (table 2). Imports in 1966 amounted to 65,021 pounds, valued at $12,129, and again consisted of lead acetate from the United Kingdom and West Germany. Total U.S. imports of organic lead salts in 1969 amounted to 28,725 pounds, valued at $19,062. Of this total, 13,365 pounds, valued at $17,067, was lead acetate (item 426.36) from Mexico and Sweden; and 15,360 pounds, valued at $1,995, was other lead salts (item 426.44) from Argentina. Exports of organic lead salts are believed to be negligible.

Lead salts of organic acids are not important items in domestic or international trade.

Table 1.-- Lead naphthenate and lead 2-ethylhexanoate: U.S. production and sales, 1964-68

Item	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
		1964		
Lead naphthenate	12,903	12,305	2,709	$0.22
Lead 2-ethylhexanoate	274	227	96	.42
		1965		
Lead naphthenate	12,796	11,014	2,602	.24
Lead 2-ethylhexanoate	227	178	68	.38
		1966		
Lead naphthenate	14,267	12,621	2,841	.23
Lead 2-ethylhexanoate	241	231	86	.37
		1967		
Lead naphthenate	13,370	12,239	2,876	.23
Lead 2-ethylhexanoate	187	221	85	.38
		1968		
Lead naphthenate	17,037	14,672	2,999	.20
Lead 2-ethylhexanoate	824	960	407	.42

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

Table 2.-- Lead salts of organic acids: U. S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (pounds)					
United Kingdom	24,200	20,400	37,800	25,200	31,669	-
West Germany	11,000	35,304	27,221	1,920	540	-
All other	7,165	-	-	17,403	1,102	1/28,725
Total	42,365	55,704	65,021	44,523	33,311	28,725
	Value					
United Kingdom	$4,219	$3,754	$7,135	$3,696	$6,983	-
West Germany	1,953	6,793	4,994	859	3,614	-
All other	527	-	-	2,839	2,360	1/19,062
Total	6,699	10,547	12,129	7,394	12,957	19,062

1/ Includes 7,968 pounds, valued at $16,520, from Mexico and 15,360 pounds, valued at $1,995, from Argentina.

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

Commodity	TSUS item
Organic nickel salts:	
Acetate	426.58
Formate	426.62
Other, not elsewhere enumerated	426.64

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. consumption of organic nickel salts, estimated at about 500,000 pounds in 1968, is supplied chiefly by U.S. producers. Exports are believed to be negligible; imports in 1968 supplied about 2 percent of domestic consumption. Organic nickel salts are of little importance in domestic or international trade.

Description and uses

This summary covers nickel acetate, nickel formate, and organic nickel salts not elsewhere enumerated, including nickel citrate, nickel oxalate, and nickel naphthenate. Nickel formate is made by the addition of sodium formate to a nickel sulfate solution. Other nickel salts of organic acids are similarly prepared by the reaction between nickel sulfate and the sodium salts of the respective acids. Organic nickel salts may also be prepared by fusing nickel hydroxide or the basic carbonate with the appropriate organic acid. Nickel acetate, the most important of the organic nickel salts, is used as a mordant in textile dyeing and in nickel plating. Nickel formate is used as a reagent in the formation of nickel catalysts. Nickel oxalate is also used to some extent for this purpose. Nickel oleate and nickel stearate, the most common nickel soaps, are covered in part 13 of schedule 4. Most of the remaining nickel salts have limited industrial applications, but some are used in experimental and research activities.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970 are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Nickel salts:		
426.58	Acetate----------	10.5% ad val.	5% ad val.
426.62	Formate----------	10.5% ad val.	5% ad val.
426.64	Other----------	10.5% ad val.	5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production and consumption

No official statistics on U.S. production of organic nickel salts are available, but production in 1968, based on data reported to the Tariff Commission is estimated at more than 500,000 pounds. U.S. consumption is approximately equivalent to U.S. production. Five companies reported production of organic nickel salts to the Tariff Commission in 1968. The producing plants are situated in New Jersey, New York, and Ohio.

U.S. exports and imports

U.S. exports of organic nickel salts are not reported separately in the official statistics; however, exports are believed to be negligible. Data on imports of organic nickel salts have been reported separately in the official statistics since August 31, 1963, the effective date of the TSUS. Annual aggregate imports of all organic nickel salts were irregular during 1964-69 (see accompanying table). Imports totaled 73,000 pounds, valued at $24,000 in 1964; they rose to 120,000 pounds, valued at $34,000, in 1966. By 1968, imports had declined to 7,000 pounds, valued at $3,000, but rose to 37,000 pounds valued at $40,000 in 1969. West Germany and Italy have been the chief sources of imports of organic nickel salts; occasional imports have come from Finland, France, Belgium, and the United Kingdom.

In addition to the countries mentioned above, Canada, Japan, and Switzerland probably produce organic nickel salts, but international trade in these products is not important.

Organic nickel salts: U.S. imports for consumption by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
West Germany	28	25	2	2	-	22
France	-	2	3	-	-	3
Italy	14	11	21	14	7	4
United Kingdom	-	2	-	1	-	-
Finland	31	2	92	-	-	-
Belgium	-	-	2	-	-	-
All other	-	-	-	-	-	8
Total	73	42	120	17	7	37
	Value (1,000 dollars)					
West Germany	13	11	1	2	-	30
France	-	2	3	-	-	3
Italy	5	5	11	6	3	2
United Kingdom	-	2	-	1/	-	-
Finland	7	1/	17	-	-	-
Belgium	-	-	2	-	-	-
All other	-	-	-	-	-	5
Total	24	20	34	8	3	40

1/ Less than $500.

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

Note.--Imports of nickel formate (item 426.62) were reported only for 1967.

Commodity	TSUS item
Crude tartars:	
Calcium tartrate	426.16
Argols and wine lees	426.74
Finished tartrates:	
Tartaric acid	425.94
Tartar emetic	426.72
Potassium bitartrates:	
Cream of tartar	426.76
Other	426.77
Rochelle salt	426.82
Sodium bitartrate	426.92

Note.—For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Finished tartrates are produced either from crude tartars obtained from wineries or as a byproduct of other chemical operations. The United States is a small producer; domestic consumption is supplied mostly by imports, with exports being nominal or nil.

Description and uses

This summary covers the crude tartars and finished tartrates specifically provided for in the TSUS. Mention is also made of finished calcium tartrate, which is covered by a miscellaneous provision for calcium salts of organic acids not elsewhere enumerated (item 426.18).

Crude tartars are obtained as residual products of winemaking; they are the raw materials for the finished tartrates or they may be used as potash fertilizers. Crude tartars, however, are produced in quantities far exceeding demand, and their value is negligible compared with that of the wines from which they originate. Thus the crudes have, for the most part, presented a waste-disposal problem for wineries, particularly domestic wineries.

The crudes are obtained when grape juice or crushed grapes are fermented. As the alcohol content increases, the sparingly soluble tartar salts, potassium bitartrate and calcium tartrate, are precipitated. Some of the precipitated salts adhere to the walls of the vats and are called argols; the remainder settle as a sediment to the bottom of the vats and are called wine lees. Argols are purer than

wine lees since they contain less sediment. The argols contain 50 to 85 percent of potassium bitartrate and 6 to 12 percent of calcium tartrate, whereas the wine lees contain only 20 to 35 percent of potassium bitartate and less than 20 percent of calcium tartrate. Both argols and wine lees can be used to produce the finished tartrates. They are ground, roasted, and then limed to form crude calcium tartrate, which is usually reacted with a mineral acid, such as sulfuric acid, to produce tartaric acid. Alternatively, argols and wine lees may be either treated with antimony oxide to make tartar emetic or with sodium carbonate to form sodium bitartrate or Rochelle salt. Cream of tartar is frequently prepared by combining a Rochelle salt solution with a tartaric acid mother liquor. Finished potassium bitartrate containing, by weight, 90 percent or more of potassium bitartrate (other than cream of tartar), is probably no longer an article of commerce. The finished tartrates are discussed hereafter in this summary in the order of their approximate importance in commerce, namely, tartaric acid, cream of tartar, Rochelle salt, and tartar emetic.

Tartaric acid (2,3-dihydroxysuccinic acid) is a transparent crystalline material with an acid taste. Owing to its molecular asymmetry, tartaric acid rotates a plane of polarized light and has different reactivities with stereoisomers. The tartaric acid of commerce is the dextro-optical isomer; it is used by some manufacturers as an optically active chemical reagent for the purification of certain materials, particularly pharmaceuticals. In earlier years, tartaric acid was extensively used in baking powders and soft drinks; however, the tartar-type baking powders have met increasing competition from the less expensive phosphate-type baking powders, and tartaric acid has now been almost wholly displaced as an acidulant in effervescent beverages by citric acid (item 425.74). Thus, at present tartaric acid is used chiefly in the production of pharmaceuticals, such as chloramphenicol and choline bitartrate; it is also used as a sequestrant and as a photographic reagent.

Cream of tartar, more accurately called potassium bitartrate, is a white crystalline material with a slight acid taste. It is used in commerce principally in pharmaceuticals; it is also used in the dyeing of wool, in galvanic tinning of metals, and, to a lesser extent, as an ingredient of certain specialty baking powders. Baking powders made with cream of tartar generally have a low degree of efficiency since the carbon dioxide is liberated during the mixing of the dough or batter, leaving only the entrapped air for expansion.

Rochelle salt, or potassium sodium tartrate, is a transparent efflorescent crystalline material or a white powder (owing to moisture adsorption) having a saline taste. Rochelle salt is used in medicine as a mild cathartic and in preparing effervescent powders, such as Seidlitz powder. It is also used in foods, particularly as an emulsifying agent in the production of certain processed cheeses; other uses of Rochelle salt include the plating of chrome and the silvering of

mirrors.

Tartar emetic, or potassium antimony tartrate, is either a transparent efflorescent crystalline material or a white powder having a sweetish, metallic taste. Tartar emetic is used mainly in medicine--in small doses, as an expectorant in cough syrups, and in larger doses as an emtic or vomitive; it is also used as a textile and leather mordant.

Sodium bitartrate and calcium tartrate are white crystalline powders; the former is employed in effervescent mixtures, and the latter is used in c tain food preparations.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Crude tartars:		
426.16	Calcium tartrate------	Free	Free 1/
426.74	Argols and wine lees--	Free	Free 1/
	Finished tartrates:		
425.94	Tartaric acid---------	6¢ per lb.	3¢ per lb.
426.72	Tartar emetic---------	6¢ per lb.	3¢ per lb.
	Potassium bitartrates:		
426.76	Cream of tartar-------	3.125¢ per lb.	3.125¢ per lb.
426.77	Other-----------------	2.5¢ per lb.	1.2¢ per lb.
426.82	Rochelle salt---------	5¢ per lb.	2.5¢ per lb.
426.92	Sodium bitartrate-----	10.5% ad val.	5% ad val.

While crude tartars are duty free, all finished tartrates are dutiable. The duty-free status of crude tartars was provided for in the Tariff Act of 1930 as originally enacted and has been bound since January 1, 1948, as a concession granted by the United States in the General Agreement on Tariffs and Trade (GATT).

Except for the duty on cream of tartar, the rates on all finished tartrates reflect reductions negotiated under the GATT in the Kennedy Round. The rates effective January 1, 1972, represent the final stages of concessions granted by the United States in the sixth round of trade negotiations under the GATT. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume.

1/ Duty-free status not affected by the trade conference.

The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Base on imports in 1969, the average ad valorem equivalents of the rates of duty in effect on December 31, 1969, and on January 1, 1970, are as follows:

TSUS item	Commodity	Ad valorem equivalent of the rate of duty in effect on-- Dec. 31, 1969	Jan. 1, 1970
425.94	Tartaric acid	15.2 percent	13.3 percent
426.74	Tartar emetic	9.3 percent	7.7 percent
426.76	Cream of tartar 1/	11.9 percent	11.9 percent
426.82	Rochelle salt	19.6 percent	17.2 percent

In 1964 the U.S. Tariff Commission completed investigations on tartaric acid (investigation No. TEA-225(b)-3) and cream of tartar (investigation No. TEA-225(b)-4) under section 225(b) of the Trade Expansion Act of 1962. As a result of these investigations, the Commission recommended that cream of tartar be reserved from the sixth round of trade-agreement negotiations.

U.S. producers

Crude tartars are produced by U.S. wineries in the course of their operations, but are disposed of as waste. The finished tartrates are produced domestically by two firms, neither of which is engaged in winemaking. The producers are large and diversified; they manufacture a wide variety of inorganic and organic chemicals and apparently make the finished tartrates as a byproduct of some of these chemical operations. Sales of finished tartrates by these firms account for only a nominal portion of their profits.

The optimum production of finished tartrates from crude tartars is an integrated operation; these chemicals are closely related and inter-dependent in their manufacture. At the present time however, no domestic producer utilizes integrated operations to achieve such economies.

1/ Cream of tartar (item 426.76) was reserved from the trade agreement negotiations. In recent years there have been no representative imports of potassium bitartrates other than cream of tartar (item 426.77).

U.S. production and consumption

No official statistics on U.S. production of finished tartrates are available. In 1959 the leading domestic producer of finished tartrates discontinued production after the President, on March 14, 1959, declined to increase the rates of duty on imports of tartaric acid and cream of tartar through "escape clause" action. Thus, the bulk of U.S. consumption of tartaric acid and cream of tartar in recent years has been furnished by imports. On the other hand, sizable portions of the consumption of Rochelle salt and tartar emetic and virtually all of the consumption of sodium bitartrate were supplied by domestic production during 1963-68.

U.S. imports and exports

No crude tartars were imported into the United States during 1963-68. In 1969, however, imports of crude calcium tartrate (from West Germany) amounted to 1,000 pounds, valued at $411.

Aggregate U.S. imports of finished tartrates increased from 8.1 million pounds, valued at $2.0 million, in 1964 to 10.5 million pounds, valued at $3.1 million, in 1969 (table 1). During 1964-69, two of the major wine-producing countries of Western Europe--Spain and Italy furnished the great bulk of these imports, and two others--France and West Germany--furnished most of the remainder.

During 1964-69, annual U.S. imports of tartaric acid increased in quantity by about 45 percent and came chiefly from Spain, whereas imports of cream of tartar declined slightly and were supplied largely by Italy. U.S. imports of tartaric acid increased from 4.6 million pounds, valued at $1.2 million, in 1964 to 6.7 million pounds, valued at $2.1 million, in 1969 (table 2). In 1969 Spain supplied 4.1 million pounds, valued at $1.3 million, and accounted for more than 60 percent of the total imports in that year. During 1964-69, U.S. imports of cream of tartar averaged 2.6 million pounds, valued at $618,000. In 1969, Italy furnished 1.7 million pounds, valued at $472,000 (table 3), or 65 percent of the total imports of cream of tartar. Most of the remainder of the imports in 1964-69 were supplied by Spain.

Annual U.S. imports of Rochelle salt fluctuated somewhat and averaged 561,000 pounds during 1964-68, but rose to 995,000 pounds in 1969 (table 4). France and Spain were the principal suppliers of Rochelle salt to the United States; in 1969 they supplied about 90 percent of the total.

U.S. imports of tartar emetic exhibited no trend, but they registered an overall decline from 164,000 pounds, valued at $79,000, in 1964 to 117,000 pounds, valued at $60,000, in 1969 (table 5). During that period, virtually all of these imports were supplied by

Japan and Italy.

There were no U.S. imports of sodium bitartrate during 1963-67 or in 1969; imports--supplied by West Germany and Japan--amounted to 1,880 pounds, valued at $844, in 1968.

There were no appreciable U.S. exports of finished tartrates during 1964-69; the small quantities of exports reported during that period were mostly misclassifications.

Foreign production and trade

The world's major manufacturers of finished tartrates apparently are Spain, Italy, France, West Germany, and Japan. In Spain and Italy the average annual output of tartaric acid, the most important tartrate of commerce, probably exceeds 20 million pounds. Japan is reported to be making some tartaric acid synthetically as well as from natural crudes. Finished tartrates are probably also manufactured in the U.S.S.R., as well as in certain other East European countries, such as Poland and Czechoslovakia.

Although the major producing countries of finished tartrates, with the exception of Japan, have large supplies of crude tartars available from their winemaking operations, only France and Italy are self-sufficient producers. France is a leading supplier of crude tartars to other countries. Some producers of crudes, such as Portugal and Algeria, probably produce little or no finished tartrates It has been reported that Italy imposes an export tax on the crudes and Spain prohibits their exportation.

Table 1.--Finished tartrates: 1/ U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Spain	4,121	3,568	4,661	3,903	4,195	5,385
Italy	2,817	2,638	3,795	3,609	3,605	2,964
France	557	434	584	686	484	790
West Germany	-	-	6	179	807	408
All other	646	619	270	283	177	917
Total	8,141	7,259	9,316	8,660	9,268	10,464
	Value (1,000 dollars)					
Spain	982	895	1,169	1,361	1,167	1,590
Italy	711	680	1,028	1,012	1,018	879
France	132	100	137	171	126	196
West Germany	-	-	3	31	240	134
All other	140	149	82	86	71	274
Total	1,965	1,824	2,419	2,661	2,622	3,073

1/ There were no U.S. imports of sodium bitartrate during 1963-67 and 1969; however, imports of that material amounted to 1,880 pounds, valued at $844, in 1968.

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

Table 2.--Tartaric acid: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Spain	3,192	2,749	3,552	2,995	3,194	4,076
Italy	1,175	1,329	2,047	2,058	1,602	1,064
West Germany	-	-	-	79	806	398
France	198	189	279	346	272	283
All other	2	-	63	-	1/	2/ 855
Total	4,567	4,267	5,941	5,478	5,874	6,676
	Value (1,000 dollars)					
Spain	790	727	935	1,144	938	1,283
Italy	316	361	589	605	487	353
West Germany	-	-	-	24	239	132
France	62	55	81	105	85	96
All other	2	-	18	-	1	242
Total	1,170	1,143	1,623	1,878	1,750	2,106

1/ Less than 500 pounds.
2/ Includes 750,000 pounds, valued at $207,000, from Argentina.

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

Table 3.--Cream of tartar: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Italy	1,328	1,211	1,634	1,383	1,826	1,741
Spain	779	635	765	731	689	908
All other	799	606	155	343	78	27
Total	2,906	2,452	2,554	2,457	2,593	2,676
	Value (1,000 dollars)					
Italy	285	277	390	347	460	472
Spain	165	136	169	178	166	224
All other	170	140	35	66	21	7
Total	620	553	594	591	647	703

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

Table 4.--Rochelle salt: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
France	199	184	300	317	202	480
Spain	150	239	344	178	312	402
Italy	155	38	32	82	62	103
All other	-	-	-	1	10	10
Total	504	461	676	578	586	995
	Value (1,000 dollars)					
France	36	44	54	61	39	93
Spain	27	33	65	39	63	83
Italy	33	8	7	18	15	25
All other	-	-	-	1/	1	2
Total	96	85	126	118	118	203

1/ Less than $500.

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

Table 5.--Tartar emetic: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Japan	1	19	59	60	99	61
Italy	159	59	82	86	116	56
All other	4	-	5	-	-	-
Total	164	78	146	146	215	117
	Value (1,000 dollars)					
Japan	1/	10	31	32	49	31
Italy	77	33	42	42	57	29
All other	2	-	3	-	-	-
Total	79	43	76	74	106	60

1/ Less than $500.

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

Commodity	TSUS item
Ammonium alginate	425.09
Sodium alginate	426.88

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The two products of seaweed (kelp) covered by this summary have numerous and growing uses. While U.S. production is adequate, there are also relatively small imports and some exports in various forms.

Description and uses

Ammonium alginate and sodium alginate are two of the more important hydrophilic colloids that are extracted from several species of kelp (item 192.05) and known generically as algin. They occur in filamentous, granular, or powdered form, are colorless to slightly yellow, and are slowly soluble in water, in which they form a viscous solution.

These alginates are frequently marketed (packed in fiber drums or wooden barrels of various sizes) as white-to-cream-colored, amorphous, odorless, and tasteless powders, as well as in various formulations tailored to specific uses.

The most important general use of algin is in stabilizing and thickening ice cream; it is estimated that, in the United States, algin serves this purpose in more than half of the factory-made ice cream. In chocolate milk, algin serves as a suspending agent for the particles of cacao; in milk puddings, it is a gelling agent. Ammonium and sodium alginates share in these uses. They are also used in other food products, such as processed cheeses and sausage casings. In pharmaceuticals, they are used as emulsifying agents, and in pills and tablets. Industrial applications include boiler compounds; textile printing, sizing, and waterproofing; and beet sugar processing. They are also used in cosmetic creams and lotions.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
425.09	Ammonium alginate--	8.5% ad val.	4.0% ad val.
426.88	Sodium alginate----	10.0% ad val.	6.0% ad val.

The rates effective January 1, 1972, represent the final stages of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate for ammonium alginate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967. The rate for sodium alginate shown above as existing prior to January 1, 1968, had remained unchanged under the TSUS from January 1, 1964, through 1967; from the effective date of the TSUS on August 13, 1963, to December 31, 1963, the rate of duty was 11 percent ad valorem.

U.S. consumption

Although no statistics on U.S. consumption of algin are available, it is believed that annual consumption exceeds 4 million pounds and is valued at $4 million to $8 million. Most of consumption is supplied by domestic production.

U.S. producers and production

A U.S. concern, on the west coast, manufactures alginates from kelp harvested off the Pacific coast. Kelp harvested off the coasts of other countries, which is imported duty free under item 192.05, is also used by this concern. Although the firm manufactures other seaweed products, algin is its major source of income.

No statistics are available on U.S. production of the alginates, but it is believed that annual output exceeds 3.5 million pounds, valued at $4 million to $7 million.

U.S. exports and imports

No official statistics on exports of ammonium and sodium alginates are available; however, exports are believed to be smaller than imports.

U.S. imports of ammonium alginate increased irregularly from 91,000 pounds, valued at $54,000, in 1964 (the first year for which import statistics are available) to 188,000 pounds, valued at $116,000, in 1967, and then declined to 127,000 pounds, valued at $78,000, in 1969 (table 1). Norway was the principal source.

U.S. imports of sodium alginate increased irregularly from 393,000 pounds, valued at $270,000, in 1962 to 825,000 pounds, valued at $574,000, in 1969 (table 2). The United Kingdom was the predominant source throughout 1962-69.

Foreign production and trade

The United Kingdom is the largest overseas producer of algin. Canada, Chile, France, Norway, Denmark, and West Germany also produce commercial quantities.

Table 1.--Ammonium alginate: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Norway	81	140	120	110	71	58
France	-	-	18	36	22	39
All other	1/ 10	-	-	2/ 42	3/	2/ 30
Total	91	140	138	188	93	127
	Value (1,000 dollars)					
Norway	48	83	68	66	42	35
France	-	-	12	25	15	26
All other	1/ 6	-	-	2/ 25	1	2/ 17
Total	54	83	80	116	58	78

1/ All from Denmark.
2/ All from the United Kingdom.
3/ Less than 500 pounds.

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

Table 2.--Sodium alginate: U.S. imports for consumption by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
United Kingdom	514	730	717	270	455	386
Canada	-	-	-	-	145	270
Norway	24	23	42	21	30	89
France	77	62	75	94	70	74
All other	5	3	6	6	25	6
Total	620	818	840	391	725	825
	Value (1,000 dollars)					
United Kingdom	360	330	397	218	345	292
Canada	-	-	-	-	99	177
Norway	15	19	26	16	21	73
France	48	43	52	58	44	49
All other	5	1/	4	4	15	3
Total	428	392	479	296	524	594

1/ Less than $500.

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

Commodity	TSUS item
Sodium formaldehyde sulfoxylate	426.96
Zinc formaldehyde sulfoxylate	427.24

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Sodium formaldehyde sulfoxylate and zinc formaldehyde sulfoxylate are in steady demand for specialized industrial uses, and total U.S. requirements (about 7 million pounds a year) are supplied mainly by domestic producers. Exports are believed to be negligible; imports of zinc formaldehyde sulfoxylate totaled 45,000 pounds in 1969, and those of sodium formaldehyde sufoxylate totaled 11,000 pounds.

Description and uses

The two salts covered by this summary, sodium formaldehyde sulfoxylate and zinc formaldehyde sulfoxylate, are both powerful reducing agents. Sodium and zinc formaldehyde sulfoxylates are prepared by the reaction between formaldehyde and the corresponding hydrosulfite compounds. Because of their powerful reducing action, these salts are valuable for bleaching, vat dye solubilization, and dye removal, and for industrial syntheses involving reduction. Sodium formaldehyde sulfoxylate is incorporated in printing pastes to solubilize vat dyes. It is also used in discharge printing. Zinc formaldehyde sulfoxylate is one of the fastest and most thorough stripping agents available. It is used principally for stripping wool rags and shoddy (reworked wool) in the loose form and for striping acetates, nylon, and woolen or cotton warp fabrics that contain shoddy.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
426.96	Sodium formaldehyde sulfoxylate.	35% ad val.	17.5% ad val.
427.24	Zinc formaldehyde sulfoxylate.	35% ad val.	17.5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production and trade

Sodium and zinc formaldehyde sulfoxylates are made in the United States by two large integrated chemical producers and one relatively small chemical manufacturer. Two of the plants are in New Jersey, and one is in Pennsylvania. These two products represent a substantial portion of total output for the small chemical manufacturer, but only a minor portion for the two integrated companies.

Annual U.S. production of sodium and zinc formaldehyde sulfoxylates ranged from 5 million to 7 million pounds during 1964-68 (table 1). The output of sodium formaldehyde sulfoxylate was three to five times that of zinc formaldehyde sulfoxylate during those years.

U.S. exports of sodium and zinc formaldehyde sulfoxylates are believed to be negligible or nil. Imports of these compounds have been reported separately only since August 31, 1963. Imports of zinc formaldehyde sulfoxylate ranged from 22,000 pounds to 87,000 pounds during 1964-69. In 1969 they amounted to 45,000 pounds, valued at $14,000. All imports except for 49,000 pounds from the United Kingdom in 1968 came from West Germany. No imports of sodium formaldehyde sulfoxylate were reported for 1964-68. However, 11,200 pounds, valued at $4,112 were imported from the United Kingdom in 1969.

Capacity to produce these compounds is known to exist in the United Kingdom, Switzerland, and West Germany. In addition, other foreign countries that have established dye and/or textile industries, such as France and Japan, possess the ability to produce them.

Sodium formaldehyde sulfoxylate and zinc formaldehyde sulfoxylate: U.S. production, 1964-68

Chemical	1964	1965	1966	1967	1968
	Quantity (1,000 pounds)				
Sodium formaldehyde sulfoxylate	4,673	5,466	5,224	4,277	5,542
Zinc formaldehyde sulfoxylate	1,380	1,490	1,248	1,166	895
Total	6,053	6,956	6,472	5,443	6,437
	Value (1,000 dollars) 1/				
Sodium formaldehyde ulfoxylate	1,009	1,317	1,172	1,026	1,330
Zinc formaldehyde sulfoxylate	620	673	578	591	396
Total	1,629	1,990	1,750	1,617	1,726

1/ Calculated from the unit value of sales.

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

Commodity	TSUS item
Sodium acetate	426.86
Sodium citrate	426.94
Sodium formate	426.98
Sodium oxalate	427.02
Sodium salts of organic acids not elsewhere enumerated	427.04

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. production of sodium salts of organic acids in 1968 amounted to more than 130 million pounds, valued at more than $35 million. No statistics on exports are available, but they are believed to be quite small. In 1969, U.S. imports of the sodium salts of organic acids covered here amounted to 6.3 million pounds, valued at $1.1 million. The sodium salts of organic acids are unimportant, either individually or as a group, in international trade. These salts are, however, useful and important to the domestic industry.

Description and uses

The more important of the sodium salts of organic acids covered in this summary are sodium acetate, sodium citrate, sodium formate, sodium sorbate, sodium monochloroacetate, sodium dichloropropionate, sodium methanearsonate, sodium trichloroacetate, sodium isoascorbate, sodium polyacrylate, sodium isopropyl xanthate, and sodium propionate. Most of the salts are prepared by reacting an organic acid with sodium hydroxide or another sodium base.

Sodium chloroacetate is used in the manufacture of sodium carboxymethylcellulose and 2,4-dichlorophenoxyacetic acid, most commonly known as 2,4-D. Sodium sorbate and sodium propionate are used as mold preventives in foods for human use, and the latter is also used in cattle feeds to prevent ketosis. Sodium citrate is utilized in medicine, soft drinks, photography, special cheeses, and electroplating. Sodium formate is used primarily in the manufacture of formic acid, but it is also used as a reducing agent, in the dyeing and printing of fabrics, as a catalyst, and in the manufacture of nickel formate

and sodium oxalate. Sodium acetate is used in the manufacture of copper acetate, acetyl chloride, and cinnamic acid; as a diuretic; as a retardant in vulcanizing neoprene rubbers; as a dehydrating agent; and in weighting cotton and rayon textiles. Sodium dichloropropionate is used as a herbicide for narrow-leafed grasses, whereas sodium methanearsonate is effective in controlling crabgrass. Sodium trichloroacetate also is used as a herbicide and pesticide. Sodium isoascorbate (sodium erythorbate) is used as an antioxidant, and sodium polyacrylate is utilized as a soil conditioner. Sodium isopropyl xanthate is used as a chemical weed killer, as a fortifying agent for certain oils, and as a flotation reagent for the extraction of base and precious metals from ores.

The remaining sodium salts of organic acids covered here have varying degrees of commercial importance. Annual production of many of these chemicals seldom exceeds $1 million to $2 million in value. Among the sodium salts of organic acids not included in this summary are sodium alginate (item 426.88), sodium bitartrate (item 426.92), sodium formaldehyde sulfoxylate (item 426.96), sodium salts of fatty acids (part 13A of schedule 4) and monosodium glutamate (item 425.30).

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Sodium salts:		
426.86	Acetate	10.5% ad val.	5% ad val.
426.94	Citrate	12¢ per lb.	6¢ per lb.
426.98	Formate	2¢ per lb.	1¢ per lb.
427.02	Oxalate	2.5¢ per lb.	1.2¢ per lb.
427.04	Sodium salts not elsewhere enumerated	10.5% ad val.	5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967. Based on imports in 1969, the average ad valorem equivalent of the duty on sodium oxalate in effect on

December 31, 1969 (2 cents per pound) was 8.4 percent. There were no imports of sodium citrate or sodium formate in 1969.

U.S. production and producers

U.S. production of sodium salts of organic acids has increased steadily and is estimated for 1968 at more than 130 million pounds, valued at $35 million. Production and sales of three items, as published in the Tariff Commission's report, Synthetic Organic Chemicals, United States Production and Sales, 1968, are as follows:

Item	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Sodium acetate---------	16,510	15,734	2,573	$0.16
Sodium propionate------	6,854	5,243	1,124	.21
Monosodium methanearsonate------	15,805	14,520	4,347	.30

Statistics for other sodium salts cannot be published as to do so might reveal the operations of individual producers. Many of the individual salts are produced by only one or two companies. In 1968, more than 40 U.S. firms produced one or more of the salts covered here; most of the firms are large diversified chemical producers.

U.S. imports and exports

U.S. imports of sodium salts of organic acids are not large, although they have been increasing in recent years. Imports of sodium acetate increased in 1967, 1968, and 1969, amounting to almost 2 million pounds, valued at $148,000, in 1969. West Germany supplied the bulk of the total imports in that year. Imports of sodium citrate, sodium formate, and sodium oxalate have been very small and irregular. In 1969, imports of all other sodium salts of organic acids (item 427.04) totaled 4.3 million pounds, valued at $973,000. Of this total, West Germany supplied 54 percent (predominantly sodium monochloroacetate), followed by the Netherlands with 34 percent. Other exporters of organic

sodium salts to the United States, in order of importance, were the United Kingdom, Japan, Italy, Canada, Switzerland, Austria, and Belgium. In 1969, imports of all sodium salts covered here amounted to 6.3 million pounds, valued at $1.1 million; this was almost 2 million pounds more than in 1967. U.S. imports of sodium salts of organic acids, as reported by the U.S. Department of Commerce for the years 1965-69, are given in the following tabulation:

Year	Quantity 1,000 pounds	Value 1,000 dollars
1965	2,359	409
1966	2,604	460
1967	4,317	713
1968	6,213	1,070
1969	6,276	1,124

No official statistics on exports are available, but exports are believed to be small.

Foreign production and trade

There are very few published statistics on world trade and production of the sodium salts of organic acids. These chemicals are not important in international trade. Most of the industrially advanced countries (those in Western Europe, and Japan) produce them for use in their domestic industries.

Commodity	TSUS item
Strontium Salts:	
Potassium oxalate----------	427.06
Other; not elsewhere enumerated----------	427.08

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. production of strontium salts, estimated to be about 500,000 pounds a year, supplies the bulk of domestic requirements. U.S. exports of these salts are believed to be negligible. In recent years, annual imports have totaled less than 15,000 pounds.

Description and uses

This summary covers strontium potassium oxalate and organic salts of strontium, such as the acetate, citrate, formate, lactate, oxalate, and tartrate. Strontium acetate and lactate have minor applications in medicine. Strontium oxalate is used in flares and tracer ammunition. The remaining organic strontium salts are of little or no industrial importance.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-70) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Strontium salts:		
427.06	Potassium oxalate-	10.5% ad val.	5% ad val.
427.08	Other----------	10.5% ad val.	5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production and trade

Organic salts of strontium are produced by several U.S. chemical concerns which vary in size from small to large. No single item is produced by more than two or three companies. Owing to the small number of producers, data on domestic production of organic salts of strontium are not reported in official statistics. It is estimated, however, that annual U.S. output is about 500,000 pounds. Producing plants are situated in Michigan, Missouri, New Jersey, Ohio, and Pennsylvania.

U.S. exports are believed to be negligible or nil. U.S. imports have been reported separately only since August 31, 1963, the effective date of the TSUS. Imports of strontium potassium oxalate were reported only for 1964, when they amounted to 11,200 pounds, valued at $1,424, all from the United Kingdom. Imports reported under item 427.08 during 1964-66 were small and consisted of inorganic strontium compounds which, for statistical purposes, should have been reported under item 421.86. There were no imports of organic strontium salts during 1967-69.

Capacity to produce organic strontium salts is known to exist in Mexico, the United Kingdom, and West Germany. In addition, countries with well-established chemical industries, such as Belgium, France, Italy, Japan, and Switzerland, are potential producers.

Commodity	TSUS item
Organic tin salts----------	427.16

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. production of organic tin salts, estimated to be about 400,000 pounds a year, supplies the bulk of domestic requirements. U.S. exports are believed to be negligible. In recent years, annual imports of tin salts have been less than 10,000 pounds. There were no imports in 1968 or 1969.

Description and uses

This summary covers organic tin salts, such as tin acetate, tin oxalate, and tin tartrate. Tin acetate is used in the textile industry to promote exhaustion of dyes. Tin oxalate is used as a coal hydrogenation catalyst, for sensitizing blueprint papers, and in the dyeing and printing of textiles. Tin tartrate is used in the dyeing and printing of fabrics. No substantial amount of the compound concerned is required for these uses. Other organic tin salts have minor industrial applications.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.16	Tin salts--------	12.5% ad val.	6% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior

to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production

Organic tin salts are made by a few U.S. chemical companies, which vary in size from small to large. Producing plants are situated in California, Illinois, Kentucky, New Jersey, New York, and Ohio. Most compounds are generally produced by one company, although some are produced by two or perhaps three. Owing to the limited number of producers of any given compound or combination of organic tin salts, data on domestic production are not reported in official statistics; however, it is estimated that the annual output amounts to about 400,000 pounds.

U.S. exports and imports

U.S. exports are believed to be negligible or nil. Imports have been reported separately only since August 31, 1963, the effective date of the TSUS. During 1964-67, imports were irregular and amounted to less than 8,000 pounds a year (see accompanying table); in 1968 and 1969 there were no imports. For statistical purposes, imports from Japan in 1964 and 1966 should have been reported under another item in the TSUS.

Capacity to produce organic tin salts is known to exist in the countries listed in the accompanying table. In addition, other countries with well-established chemical industries, such as Belgium, France, and Italy, are potential producers and exporters.

Tin salts: U.S. imports for consumption, by sources, 1964-67 1/

Source	1964	1965	1966	1967
	Quantity (pounds)			
Japan	792	-	1,984	2,000
Netherlands	-	-	-	341
West Germany	-	5,257	2,474	-
India	-	-	2,000	-
United Kingdom	4,188	2,305	-	-
Switzerland	-	68	-	-
Total	4,980	7,630	6,458	2,341
	Value			
Japan	$2,109	-	$3,248	$2,330
Netherlands	-	-	-	623
West Germany	-	$20,604	9,685	-
India	-	-	636	-
United Kingdom	7,663	4,732	-	-
Switzerland	-	536	-	-
Total	9,772	25,872	13,569	2,953

1/ There were no imports of tin salts in 1968 or 1969.

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

Commodity	TSUS item
Titanium salts:	
Potassium oxalate	427.18
Other, not elsewhere enumerated	427.20

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. production of titanium salts, estimated to be about 300,000 pounds a year, supplies the bulk of domestic requirements. Exports are believed to be negligible. U.S. imports of titanium potassium oxalate in 1969 amounted to 11,000 pounds, valued at $6,000, and of other salts to 20,000 pounds, valued at $23,000.

Description and uses

This summary covers titanium potassium oxalate and such organic salts of titanium as the acetate, lactate, oxalate, tartrate, and several compound ammonium and sodium salts. Titanium potassium oxalate is used chiefly as a mordant in dyeing but also as a catalyst in the esterification of cellulose. Titanium oxalate is used in the tanning of leather and as a mordant in dyeing. The remaining organic titanium salts have little or no commercial application.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Titanium salts:		
427.18	Potassium oxalate--	15% ad val.	7.5% ad val.
427.20	Other----------	15% ad val.	7.5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade.

The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production

Organic titanium salts are produced regularly by only one U.S. company and intermittently by a few others. One known producer is a large integrated chemical manufacturer whose output of these salts represents a small part of the company's total production. Owing to the small number of producers of these salts, data on domestic production are not reported in official statistics; however, it is estimated that the annual domestic output amounts to about 300,000 pounds.

U.S. exports and imports

U.S. exports of organic titanium salts are negligible or nil. Imports, shown in the accompanying table, have been reported separately only since August 31, 1963, the effective date of the TSUS. During 1964-69, annual imports of titanium potassium oxalate ranged from 10,000 to 20,000 pounds and came from the United Kingdom. The imports reported for Japan in 1965 consisted of titanium dioxide, which was improperly reported under item 427.20. The imports reported from Australia in 1964 were described as rutile flour, and should apparently have been reported under another item in the TSUS. The imports reported from Spain in 1968 consisted of titanium dioxide anatase, which was improperly reported under item 427.20.

Titanium salts: 1/ U.S. imports for consumption, by sources, 1965-69

Source	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)				
Japan	113	-	-	-	12
United Kingdom	14	19	12	18	19
Finland	-	-	-	60	-
Spain	-	-	-	22	-
Total	127	19	12	100	31
	Value (1,000 dollars)				
Japan	17	-	-	-	19
United Kingdom	8	10	7	11	10
Finland	-	-	-	12	-
Spain	-	-	-	3	-
Total	25	11	7	26	29

1/ Includes items 427.18 and 427.20.

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

Commodity	TSUS item
Aluminum salts	426.08
Cerium salts	426.22
Cobalt resinate	426.24
Other cobalt salts	426.26
Lithium salts	426.46
Manganese resinate	426.52
Other manganese salts	426.54
Mercurial salts	426.56
Potassium citrate	426.78
Other potassium salts	426.84
Tellurium salts	427.12
Thorium salts	427.14
Vanadium salts	427.22
Other zinc salts	427.25
All other salts of organic acids	427.28

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The individual salts of organic acids covered in this summary are relatively unimportant commodities, and most of the U.S. consumption is accounted for by domestic production. U.S. production of these salts in 1968 is estimated at 25 million to 30 million pounds, valued at $15 million to $20 million. Although no official statistics are available, exports probably equal or slightly exceed imports. In 1969, imports amounted to 2.4 million pounds, valued at $1.3 million.

Description and uses

This summary covers those salts of organic acids that are not discussed in separate summaries elsewhere 1/ and does not describe an industrially recognized product group. Less than 100 commercial products are covered; none is outstanding. The most important metals from which the salts are derived include: Aluminum, antimony, barium, cadmiun, cerium, cobalt, chromium, iron, lithium, magnesium, manganese, mercury, potassium, silver, zinc, and zirconium. The most important acids from which the salts are derived include: Acetic, alkylxanthic, citric, 2-ethylhexanoic, formic, mercaptoacetic, naphthenic, octanoic, oxalic, and sorbic.

Salts of organic acids have many varied uses. Aluminum salts are used in anti-perspirants and to water-proof, fireproof, and mordant textiles. Cobalt naphthenate, cobalt resinate, and other cobalt salts are used as paint and varnish driers. Iron (ferrous) oxalate is used as a photographic developer. Manganese salts are used as oxidation catalysts, in leather finishing, and in paint and varnish driers. Potassium acetate is used as a reagent intermediate, a dehydrating agent, and in textile conditioning. Potassium sorbate is used to control the growth of mold and yeast in food. Zinc salts are used as mordants, water-proofing agents, driers, wood preservatives, and catalysts. Still other salts are used as catalysts, stabilizers, antioxidants, intermediates, flotation reagents, fire-proofing materials, chemical reagents, buffers, or in the preparation of ceramics or toiletries.

1/ Covered in separate summaries are all salts of acids that have a benzenoid, quinoid, or modified benzenoid structue (pt. 1 of schedule 4), as well as salts of fatty acids of animal and vegetable origin (e.g., linoleic acid, ricinoleic acid, stearic acid), which are covered under items 465.05 to 465.95. Also covered in separate summaries are items 426.10 to 427.20, that is, all salts based on the following metals: Calcium, copper, lead, nickel, sodium, strontium, tin, and titanium. Certain potassium salts (items 426.72 to 426.77), as well as zinc formaldehyde sulfoxylate (item 427.24), are also covered elsewhere. Because of the functional grouping in the TSUS, this summary does not include acid salts w hich contain a nitrogen atom (items 425.00 to 425.52). Salts of barbituric acid and gluconic acid are covered in pt. 3 of schedule 4.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	U.S. concessions granted in 1964-67 trade conference (Kennedy Round)	
			Third stage effective Jan. 1, 1970	Final stage effective Jan. 1, 1972
426.08	Aluminum salts	8.5% ad val.	5.5% ad val.	4% ad val.
426.22	Cerium salts	30% ad val.	21% ad val.	15% ad val.
426.24	Cobalt resinate.	12% ad val.	8% ad val.	6% ad val.
426.26	Other cobalt salts.	12% ad val.	8% ad val.	6% ad val.
426.46	Lithium salts	10.5% ad val.	7% ad val.	5% ad val.
426.52	Manganese resinate.	10% ad val.	7% ad val.	5% ad val.
426.54	Other manganese salts.	14% ad val.	9.5% ad val.	7% ad val.
426.56	Mercurial salts.	18.5¢ per lb. + 12.5% ad val.	12¢ per lb. + 8.5% ad val.	9¢ per lb. + 6% ad val.
426.78	Potassium citrate.	14¢ per lb.	9.8¢ per lb.	7¢ per lb.
426.84	Other potassium salts.	8.5% ad val.	5.5% ad val.	4% ad val.
427.12	Tellurium salts.	10% ad val.	7% ad val.	5% ad val.
427.14	Thorium salts	35% ad val.	24% ad val.	17.5% ad val.
427.22	Vanadium salts	32% ad val.	22% ad val.	16% ad val.
427.25	Other zinc salts.	10.5% ad val.	7% ad val.	5% ad val.
427.28	All other salts of organic acids.	10.5% ad val.	7% ad val.	5% ad val.

The tabulation above shows the column 1 rates of duty in effect prior to January 1, 1968, and modifications therein as a result of concessions granted by the United States in the sixth (kennedy) round of trade negotiations under the General Agreement of Tariffs and Trade. Only the third and final stages of the annual rate modifications are shown above (see the TSUSA-1970 for the intermediate states). The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1968, the ad valorem equivalent of the compound rate of duty in effect on December 31, 1968, for mercurial salts (item 426.56) was 23.3 percent, and all imports came from Belgium. There were no imports under item 426.56 in 1969, and there have been no imports of potassium citrate (item 426.78) in recent years.

U.S. production and exports

In 1968 less than 50 U.S. firms produced one or more of the salts of organic aciss covered here. U.S. production has been growing steadily and is estimated for 1968 at 25-30 million pounds, valued at $15-20 million. The largest individual items for which 1968 production data were publishable include: Cobalt naphthenate (4.0 million pounds), potassium acetate (3.7 million pounds), and cobalt 2-ethylhexanoate (1.2 million pounds) (see accompanying table).

Statistics are not available for exports of the salts of organic acids covered here but such exports are believed to equal or exceed imports.

U.S. imports

During 1964-69, imports of the salts of organic acids covered here increased irregularly, with totals as follows:

Year	Quantity 1,000 pounds	Value 1,000 dollars
1964---------	2,183	356
1965---------	2,154	628
1966---------	2,470	1,166
1967---------	3,170	1,223
1968---------	3,509	1,455
1969---------	2,436	1,288

Imports have entered from more than a dozen countries. In 1969, Japan, West Germany, and the United Kingdom were the principal sources. U.S. imports by selected kind and principal source in 1969 are shown in the following tabulation:

Kind	Quantity	Foreign value	
		Total	By principal sources
	Pounds		
Aluminum salts	169,106	$35,494	West Germany, $26,605; United Kingdom, $8,889.
Cerium salts	200	730	West Germany, $730.
Cobalt salts, n.s.p.f.	22,036	19,151	United Kingdom, $18,678.
Lithium salts	26,951	12,195	Japan, $10,140.
Manganese salts, n.s.p.f.	1,102	1,882	France, $1,882.
Potassium salts, n.s.p.f.	1,242,963	961,018	Japan, $772,360; West Germany, $158,976; United Kingdom, $17,319; France, $10,863.
Zinc salts, n.s.p.f.	24,923	16,710	United Kingdom, $16,710.
Salts of organic acids, n.s.p.f.	949,347	241,831	Mexico, $86,647; United Kingdom, $70,888; Sweden, $60,043; West Germany, $13,729.

Salts of organic acids not elsewhere enumerated: U.S. production and sales, by selected kind, 1968

Kind	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Acetic acid salts:				
Potassium acetate	3,686	3,579	1,059	$0.30
Zinc acetate	669	588	218	.37
Zirconium acetate	334	276	112	.41
Other 1/	6,830	6,876	2,500	.36
2-Ethylhexanoic acid salts:				
Cobalt 2-ethylhexanoate	1,155	1,040	935	.90
Manganese 2-ethylhexanoate	111	121	41	.34
Zinc 2-ethylhexanoate	472	466	222	.48
Other 2/	1,997	1,911	1,411	.74
Naphthenic acid salts:				
Cobalt naphthenate	3,992	3,625	1,899	.52
Manganese naphthenate	1,757	1,594	467	.29
Zinc naphthenate	1,591	1,452	386	.27
Other 3/	1,027	1,055	699	.66
Octanoic acid (Caprylic acid) salts 4/	5/	876	1,181	1.35

1/ Includes acetic acid salts of aluminum, barium, cadmium, chromium, cobalt, magnesium, manganese, mercury, silver, and strontium (which are covered by this summary) as well as salts of calcium, lead, and nickel (which are covered in other summaries).

2/ Includes 2-ethylhexanoic acid salts of aluminum, barium, cadmium, iron, potassium, strontium, and zirconium (which are covered by this summary) as well as salts of copper and nickel (which are covered in other summaries).

3/ Includes naphthenic acid salts of aluminum, barium, cadmium, cerium, iron, lithium, rare earths, and strontium (which are covered by this summary) as well as salts of nickel and sodium (which are covered by other summaries).

4/ Includes octanic acid salts of aluminum, barium, cadmium, and zinc (all of which are covered by this summary).

5/ Not available.

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

Commodity	TSUS item
Acyl halides	427.30

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Acyl halides are of minor commercial importance to domestic industry and of little significance to foreign trade. In 1968, domestic production of the acyl halides exceeded 13 million pounds. Imports of acyl halides in 1969 amounted to 249,000 pounds valued at $96,000. Official export statistics are not available, but exports are believed to be negligible, or nil.

Description and uses

This summary covers acyclic acyl (acid) halides 1/, of which about 15 are now being produced commercially. These compounds are formed by replacing one or more hydroxyl groups of an organic acid molecule by a halogen atom (bromine, chlorine, fluorine, or iodine). Chlorine is the most important halogen being used in the preparation of acyl halides. A few minor acid halides have also been prepared from bromine during the past several years.

Chloroacetyl chloride, decanoyl chloride, lauroyl chloride, and oleoyl chloride are the most important acid halides. Chloroacetyl chloride is used as an intermediate and in the manufacture of chloroacetophenone, a lacrimator. Decanoyl chloride is also used as an intermediate for a polymerization initiator. Lauroyl chloride is used in the manufacture of lauroyl peroxide (40 percent), isothionate surface-active agents (20 percent), sodium n-lauroyl sarcosinate (10 percent), industrial sarcosinates (20 percent), and miscellaneous (10 percent). Oleoyl chloride is used principally as a chemical intermediate. The other acid halides covered here are used mainly as intermediates in the production of dyes, pharmaceuticals, and surface-active agents.

1/ The provision for acyl halides includes not only simple acyl halides but also those which contain an aldehyde, ketone, ester, epoxy ether, acetal or lactone function, or sulfur or metallic atom. This provision does not include acyl halides which contain a nitrogen atom.

The uses of acid halides have been limited by the relatively high cost of production and by the corrosive nature of these materials. In many applications, the lower priced and less corrosive acyclic acid anhydrides have been substituted.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.30	Acyl halides	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption

Statistics on U.S. consumption are not published; however, it may be assumed that the apparent consumption approximates U.S. production, since exports are negligible or nil, and imports have not exceeded 525,000 pounds annually.

The consumption of acid halides in current applications is not likely to increase materially, owing to the relatively high cost of manufacture and to the corrosive properties of these chemicals.

U.S. producers

In 1968, the acid halides included here were produced domestically by 11 companies ranging in size from the smallest to the largest members of the chemical industry. The producing plants are situated principally in the northeastern and midwestern sections of the country.

The captive use of acid halides exceeded 50 percent of production each year from 1963 through 1968.

U. S. production

Until 1968, it was not possible to release total production figures for the acyclic acid halides since publication would have revealed the operations of individual producers. In 1968, U.S. production of all acyclic acid halides amounted to 13.5 million pounds. During the period 1964-68, continuous data have been published for lauroyl chloride only (table 1). Production of lauroyl chloride increased from 9.4 million pounds in 1964 to 10.8 million pounds in 1966, then decreased to 3.4 million pounds in 1969. Production of decanoyl chloride averaged 1.4 million pounds a year during 1966-67 and production of palmitoyl chloride averaged 251,000 pounds a year during 1964-67.

Individually, the acid halides vary in price from less than 30 cents per pound to several dollars a pound; some experimental acid halides cost more than $15 per pound.

U.S. exports and imports

No official statistics on exports are available, but foreign sales are believed to be negligible, or nil.

Separate statistics on acid halide imports became available only after August 31, 1963, the effective date of the TSUS. Imports have increased irregularly during 1964-69 (table 1). Most of the imports have come from West Germany, which accounted for about 86 percent, 51 percent, and 62 percent, respectively, of the import quantity in 1967, 1968, and 1969 (table 2). France and Italy have also been important sources of imports in recent years.

Table 1.--Acyl halides 1/: U.S. production and imports for consumption, 1964-69

Year	Production 2/	Imports 3/
	Quantity (1,000 pounds)	
1964	9,353	4/
1965	9,526	38
1966	10,756	412
1967	4,418	525
1968	3,432	197
1969	5/	249
	Value (1,000 dollars)	
1964	5,144	4
1965	5,239	14
1966	5,593	203
1967	2,518	273
1968	1,407	72
1969	5/	96

1/ Production data are shown for lauroyl chloride only.
2/ Value of production calculated from unit value of sales.
3/ Official statistics became available on Aug. 31, 1963, the effective date of the TSUS.
4/ Less than 500 pounds.
5/ Not available.

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

Note.--Official export statistics are not available, but exports are believed to be negligible or nil.

Table 2.--Acyl halides: U.S. imports for consumption, by principal sources, 1965-69

Source	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)				
West Germany	35	371	451	100	155
Italy	-	-	2	30	59
France	-	24	70	67	35
All other	3	17	2	-	1/
Total	38	412	525	197	249
	Value (1,000 dollars)				
West Germany	8	182	240	32	52
Italy	-	-	1	10	26
France	-	11	29	30	16
All other	6	10	3	-	1
Total	14	203	273	72	96

1/ Less than 500 pounds.

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

Commodity	TSUS item
Acetaldehyde----------	427.40

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Among the domestically produced aldehydes, acetaldehyde is second in importance only to formaldehyde (item 427.48). The production of acetaldehyde exceeded 1.5 billion pounds in 1968. Imports of 204,000 pounds in 1966 (equivalent to about one-hundredth of 1 percent of production in that year) were the largest during 1964-69. Separate export statistics are not available, but exports are believed to be negligible or nil.

Description and uses

Acetaldehyde (CH_3CHO) is a colorless, low-boiling, flammable liquid which can form explosive peroxides in the presence of air. Like most aldehydes, acetaldehyde is readily oxidized to acid and reduced to alcohol. It also undergoes self-polymerization to form aldol or acetaldol (item 427.42)--a dimer, paracetaldehyde (item 427.54)--a trimer, and metaldehyde (item 427.58)--a tetramer.

At present, most acetaldehyde is produced commercially by the catalytic oxidation of ethyl alcohol in the vapor phase, but production by the one step, liquid-phase catalytic oxidation of ethylene, is becoming increasingly important (i.e., the Aldehyd GmbH process). Smaller quantities of acetaldehyde are made by the vapor-phase or liquid-phase oxidation of butane-propane gas mixtures, and still more limited amounts are obtained as a byproduct of acrylonitrile, glycerine, or neoprene.

The largest individual use for acetaldehyde is in the production of acetic acid (item 425.70) which, in turn, is used primarily in the manufacture of cellulose acetate and vinyl acetate. Other important uses for acetaldehyde are in the production of: butyl alcohol (item 427.74) which is used principally as a solvent--either directly or as the butyl acetate ester; acetic anhydride (item 426.00), the major use of which is in the manufacture of cellulose acetate; trichloroacetaldehyde or "Chloral" (item 427.45) which is used mainly in the manufacture of the insecticide DDT; 2-ethylhexyl alcohol (item 427.98) which is used mainly in the manufacture of the plasticizer, di-(2-ethylhexyl)

phthalate; and pentaerythritol (item 428.32) which is used mainly in the manufacture of protective-coating resins.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.40	Acetaldehyde--------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

There were no reported imports of acetaldehyde in 1968 and no real imports in 1969. The material imported in 1969 had an average unit value of $240 per pound--about 2,400 times as great as the published sale price (9 cents per pound to 10 cents per pound) for domestically produced acetaldehyde.

U.S. consumption

U.S. consumption of acetaldehyde exceeded 1.5 billion pounds in 1968. About 40 to 45 percent of the annual output of acetaldehyde is consumed in the production of acetic acid and acetic anhydride, which, in turn, are used primarily in the manufacture of cellulose acetate and vinyl acetate. The principal market for cellulose acetate is in fiber for wearing apparel, home furnishings, and cigarette filters. Vinyl acetate is consumed mainly in the production of thermoplastic resins used for paints and adhesives and for paper and textile treating. Another 40 percent of acetaldehyde is divided each year between the production of butyl alcohol and 2-ethylhexyl alcohol.

U.S. producers

In 1968, nine producers manufactured acetaldehyde at 15 plants: seven in Texas; two in West Virginia; and one each in California,

Kentucky, Louisiana, New Jersey, Pennsylvania, and Tennessee. The producers are among the largest companies in the chemical industry. One firm is also a large producer of alcoholic beverages.

In recent years, 75 to 90 percent of the annual production of acetaldehyde has been used captively by the producers. Since so much acetaldehyde is used captively, it accounts for very little of the producers' annual income; however, a significant share of their annual sales is probably accounted for by the many products made from acetaldehyde.

U.S. production and exports

U.S. production of acetaldehyde increased steadily from 1.1 billion pounds in 1964 to almost 1.6 billion pounds in 1968 (see accompanying table). Official U.S. export statistics are not available for acetaldehyde; however, exports are believed to be negligible or nil.

U.S. imports

U.S. imports of acetaldehyde have been very small compared with U.S. production. They increased from 26,000 pounds in 1963 to 204,000 pounds in 1966 then declined to a negligible volume from 1967 through 1969. From 1963 to 1965, Japan, Switzerland, and the United Kingdom supplied most of the imports. In 1966, West Germany was the sole supplier. The average unit value of imported acetaldehyde has been substantially higher than that of the domestic product, which may indicate that the imported product is either of research quality or misclassified in the official statistics.

Acetaldehyde: U.S. production and imports for consumption, 1963-69

Year	Production		Imports	
	Quantity	Value 1/	Quantity	Value
	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
1963	2/	2/	26	11
1964	1,058,013	74,061	4	11
1965	1,230,310	73,819	36	7
1966	1,300,450	65,023	204	55
1967	1,408,596	70,430	1	2
1968	1,585,066	79,253	-	-
1969	2/	2/	3/	4/

1/ Calculated from the unit value of sales.
2/ Not available.
3/ Less than 500 pounds.
4/ Less than $500.

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

Commodity	TSUS item
Butyraldehyde	427.44

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The normal and iso forms of butyraldehyde are both of some importance in the domestic industry but of little consequence in international trade. No official production statistics are available for publication, but the annual output of the butyraldehydes in the United States probably did not exceed 500 million pounds in any year during 1964-68. Imports in 1969 exceeded 1.6 million pounds. No official statistics on exports are available, but exports are believed to be negligible.

Description and uses

Butyraldehyde is available commercially in two forms: normal or n-butyraldehyde ($CH_3(CH_2)_2CHO$), and isobutyraldehyde ($(CH_3)_2CHCHO$); both are colorless, flammable liquids. n-Butyraldehyde and isobutyraldehyde are simultaneously produced commercially by the reaction of propylene with carbon monoxide and hydrogen (the Oxo process) and are separated by fractional distillation. n-Butyraldehyde may also be produced by the partial reduction of crotonaldehyde. Isobutyraldehyde may also by produced by the dehydrogenation of isobutyl alcohol.

n-Butyraldehyde is used principally as an intermediate in the manufacture of synthetic resins, rubber accelerators, and plasticizers. It is also used as the starting material for butyric acid and butyric anhydride. Isobutyraldehyde is used as an intermediate for rubber chemicals and plastics, and in the manufacture of corrosion inhibitors and insecticides.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.44	Butyraldehyde--------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1969 on butyraldehyde (2.4¢ per pound plus 12% ad valorem) was 35.9 percent; that of the rate in effect on January 1, 1970 (2.1¢ per pound plus 10 percent ad valorem) was 30.4 percent.

U.S. production, consumption, and producers

Neither the apparent U.S. consumption nor the production of the butyraldehydes exceeded 500 million pounds in any year during 1963-68. Consumption and production of both n-butyraldehyde and isobutyraldehyde have increased irregularly in recent years. In 1968, n-butyraldehyde was produced by three U.S. companies at six plants--four in Texas, and one each in Puerto Rico and West Virginia. Two of these companies also produced isobutyraldehyde. During 1964-68, more than half of the annual production of butyraldehyde was used captively.

U.S. exports and imports

No separate export statistics are available on butyraldehyde, but with the extensive captive use by producers, exports are probably small.

U.S. import statistics for the butyraldehydes first became available after August 31, 1963, the effective date of the TSUS. Imports

in 1964-69, as reported by the U.S. Department of Commerce, were as follows:

Year	Quantity (1,000 pounds)	Value (1,000 dollars)	Unit value (cents per pound)
1964	1,167	143	12.2
1965	1,227	148	12.1
1966	1,166	139	11.9
1967	1,224	146	11.9
1968	1,558	158	10.1
1969	1,678	162	10.3

During 1964-69, Canada was the principal source of imports of butyraldehyde, supplying all in 1966, and 1967, and most in the remaining years. France supplied 5,000 pounds, valued at $2,400, in 1964; Sweden supplied 1,257 pounds, valued at $1,800, in 1965; and West Germany supplied 264,891 pounds, valued at $16,179, in 1968 and 134,640 pounds, valued at $7,950 in 1969.

Commodity	TSUS item
Formaldehyde	427.48
Paraformaldehyde	427.56

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Formaldehyde is the most important of the domestically produced aldehydes, but it is unimportant in international trade. In 1969 U.S. production of formaldehyde was about 4.2 billion pounds and imports amounted to about 2 million pounds. Official export statistics on formaldehyde have not been available since 1964, when about 9.6 million pounds, valued at $737,000, was exported. Exports are believed to be negligible when compared with production but are larger than imports. No U.S. production statistics for paraformaldehyde are available, but production of it is very small compared with that of formaldehyde. Annual imports of paraformaldehyde ranged from negligible amounts to several million pounds during 1964-69. Exports of paraformaldehyde are not separately reported but are believed to be small.

Description and uses

Formaldehyde (HCHO) in the pure, monomeric state is a toxic, colorless gas which readily undergoes self-polymerization. Most formaldehyde is obtained from methanol, either by catalytic oxidation or by oxidation-dehydrogenation. Smaller amounts are produced by the oxidation of hydrocarbon (e.g., butane, propane) gases in the presence of air or oxygen. For ease in handling, formaldehyde is usually sold as an aqueous solution either with or without methanol, the latter acting to stabilize the solution. The usual aqueous formaldehyde solution contains 37 percent formaldehyde by weight and is also known as formalin.

Formaldehyde is used principally as a raw material in the manufacture of phenolic and urea resins. It is also used in the manufacture of melamine resins, acetal plastics, pentaerythritol, hexamethylenetetramine, ethylene glycol, and fertilizers.

Paraformaldehyde is a white solid material which is produced by evaporating an aqueous solution of formaldehyde. It is available commercially in flake or powder form and contains 91 to 95 percent

formaldehyde. Paraformaldehyde, like formaldehyde, is used principally in the manufacture of phenolic, urea, and melamine resins, where its price confines its use to those resins having a high solids content, and are used in special applications such as insulation and lamination of electrical equipment. Paraformaldehyde is also used in the manufacture of disinfectants, fumigants, and fungicides, and in oil well drilling muds.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.48	Formaldehyde-------	0.875¢ per lb.	0.43¢ per lb.
427.56	Paraformaldehyde---	4¢ per lb.	2¢ per lb.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1968, on formaldehyde (0.7¢ per pound) was 22.8 percent; that of the rate in effect on January 1, 1969 (0.6¢ per pound) was 19.5 percent. For paraformaldehyde, the average ad valorem equivalents of the rates of duty in effect on the same dates (3.2¢ per pound and 2.8¢ per pound) were 28.2 percent and 25.2 percent, respectively.

U.S. consumption

Apparent U.S. consumption of formaldehyde, as formalin, increased from about 2.8 billion pounds in 1964 to approximately 4.2 billion pounds in 1969 (see table). About two-thirds of the annual consumption of formaldehyde is accounted for by the phenolic, urea, melamine, and acetal resins, with the phenolic and urea resins representing nearly half of the total annual consumption. From 1964 to 1969, annual production of phenolic resins and urea resins each increased by about 35 percent. The greatest gains in production were for the phenolic and

urea resins with low solids content. The largest combined use for these general purpose resins has been as adhesives in the manufacture of plywood (especially softwood plywood) and particle board. Separate statistics are not available on U.S. consumption of paraformaldehyde.

U.S. producers

In 1969 formaldehyde was produced by 16 companies at 40 plants, which were situated throughout the United States except for the Rocky Mountain region.

All of the formaldehyde producers make at least one of the major products derived from formaldehyde. This accounts for the high degree of captive production of formaldehyde, which ranged from 62 to 65 percent of the annual output during 1964-68. In 1968, paraformaldehyde was produced by two of the firms that also make formaldehyde. It was manufactured at two plants, one in New Jersey and the other in Texas.

U.S. production

U.S. production of formaldehyde, as formalin, increased from about 2,840 million pounds in 1964 to about 4,193 million pounds in 1969 (see accompanying table). This represents an overall increase in annual production of more than 44 percent during this period. Separate production statistics on paraformaldehyde are not available but production increased irregularly from 1964 through 1968.

U.S. exports

Official statistics on U.S. exports of formaldehyde (as an aqueous solution) are available only for 1964, when exports were about 9.7 million pounds, valued at more than $737,000, with Canada receiving two-thirds of the exports. Export statistics since 1964 have been combined with other aldehydes and ketones.

U.S. imports

During 1964-69, imports of formaldehyde declined irregularly from 2.4 million pounds, valued at $81,000, in 1964 to 2.0 million pounds, valued at $61,000 in 1969 (see accompanying table). At no time during the period covered did the quantity of imports of formaldehyde equal one-tenth of 1 percent of production. In 1964-66, and again in 1969, nearly all imports of formaldeyde came from Canada. The United Kingdom accounted for most of the formaldehyde imports in 1967 and 1968.

According to official statistics of the U.S. Department of Commerce, recent imports of paraformaldehyde have been as follows:

Year	Quantity (Thousand pounds)	Value (Thousand dollars)
1966------	2,525	214
1967------	773	53
1968------	2	1/
1969------	45	5

1/ Less than $500.

All the imports of paraformaldehyde in 1966 and nearly all (99 percent plus) in 1967 came from Japan. Canada supplied the small quantity of imports in 1968, and practically all of the imports in 1969.

Foreign production and trade

Formaldehyde is probably produced in every industrialized nation in the world because it is a starting material for so many important intermediate chemicals and finished products. Paraformaldehyde is probably produced on a limited basis in some of the more advanced nations.

It is very unlikely that formaldehyde and paraformaldehyde will become major items of international trade because of the high proportion of captive domestic production for both of these products. Another deterrent to major imports of formaldehyde is its low domestic price which in mid-1969 was less than 4 cents per pound in carload lots, delivered.

Formaldehyde as formalin: U.S. production and imports for consumption, 1964-69

Year	Production		Imports	
	Quantity	Value 1/	Quantity	Value
	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
1964	2,839,884	73,837	2,450	81
1965	3,106,572	93,197	2,673	86
1966	3,712,568	111,377	275	15
1967	3,707,093	111,213	435	37
1968	4,304,608	86,092	158	12
1969	4,192,797	83,855	1,978	61

1/ Calculated from the unit value of sales.

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

Commodity	TSUS item
Furfural	427.52

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Furfural (2-furaldehyde, furfuraldehyde) is an important commodity to the domestic industry, but no production statistics are available, since it is manufactured domestically by only one firm. During 1964-68, U.S. imports of furfural averaged about 27 million pounds per year. There were no imports in 1969. Official export statistics are not available.

Description and uses

Furfural (C_4H_3OCHO) is a colorless to reddish-brown liquid with an odor resembling that of bitter almond. Furfural is made from cellulosic raw materials which contain complex carbohydrates (hemicelluloses) called pentosans. Almost all cellulosic raw materials contain some pentosans, but those most frequently used are corncobs, oat hulls, rice hulls, cottonseed hulls, and bagasse (the residue left after sugar has been extracted from the sugarcane). The manufacture of furfural involves a one-step process in which the selected raw material is mixed with dilute sulfuric acid in the presence of heat and pressure. The pentosans are hydrolized to pentose (a sugar) and water is then removed from the pentose structure to form furfural.

Furfural is principally used in the manufacture of other furan and tetrahydrofuran compounds, such as furfuryl alcohol, tetrahydrofuran, and tetrahydrofuryl alcohol; as a selective solvent for separating saturated from unsaturated compounds in petroleum lubricating oil; as an extractive solvent in the recovery by distillation of butadiene for the manufacture of synthetic rubber; as a decolorizing agent for wood rosin; as a component in resins--especially the phenol-

aldehyde types--and as a resin solvent and wetting agent in the manufacture of abrasive wheels and brake linings.

U.S. tariff treatment

Furfural (item 427.52) is free of duty under the TSUS. Duty-free treatment of furfural was provided for in paragraph 1818, Tariff Act of 1930, as amended by Public Law 695, 83rd Congress, on Aug. 28, 1954, and was bound free pursuant to a concession granted by the United States in the General Agreement on Tariffs and Trade, effective June 30, 1956.

U.S. consumption

Apparent U.S. consumption of furfural was probably between 100 million and 175 million pounds in 1968. Imported furfural supplied most of the raw-material needs of tetrahydrofuran, which through 1968 was the largest single derivative of furfural in the United States. However, the major producer of tetrahydrofuran started using alternate raw materials for this product in 1969. Domestically produced furfural is used chiefly as an intermediate in the manufacture of furfuryl alcohol, as a solvent, and in the manufacture of phenolic resins.

U.S. producers

In 1968, there was only one U.S. producer of furfural. In 1968 furfural was produced at four plants--in Florida, Iowa, Nebraska, and Tennessee. The U.S. producer uses some of its furfural output captively in the production of furfuryl alcohol, tetrahydrofuran, and tetrahydrofurfuryl alcohol.

U.S. production

U.S. production statistics on furfural may not be published because there is only one producer. It is known, however, that the output of furfural is subject to annual fluctuations because production of furfural is dependent on agricultural residues as the starting material. Trade sources reported that in 1968 the total annual U.S. production capacity for furfural was about 150 million pounds.

U.S. exports

Official U.S. export statistics are not available for furfural. The principal export markets are reported to be Belgium and the United Kingdom, where the European affiliates of the U.S. producers are located.

U.S. imports

U.S. imports of furfural during 1964-68 were as follows:

Year	Quantity	Value	Unit value
	Million pounds	Million dollars	cents per pound
1964	29.9	2.7	9.2
1965	20.2	1.9	9.5
1966	24.6	2.6	10.8
1967	33.4	4.3	12.8
1968	21.7	2.5	11.6

All of the imports of furfural, except for about 60,000 pounds in 1965 and about 640,000 pounds in 1966, came from a wholly owned subsidiary of a U.S. firm in the Dominican Republic. These imports were for the most part delivered on a contract basis for use by one domestic company. According to trade sources, this domestic company no longer uses furfural in its operations and ceased its importation late in 1968. For this reason, there were no imports of furfural in 1969. These trade sources indicate future imports of furfural will be negligible because of the development of a more economical process for making tetrahydrofuran.

Commodity	TSUS item
Glyoxal	427.53

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. imports of glyoxal have increased rapidly and amounted to 12.7 million pounds, valued at $1.7 million, in 1969, but were smaller in that year than the production of the sole U.S. producer.

Description and uses

Glyoxal is a yellowish liquid which is usually shipped as a 30- to 40-percent aqueous solution. It is a dialdehyde (OHC-CHO) that reacts with proteins (such as glue) and carbohydrates (such as starches) and, through cross linking of the reactive groups, forms insoluble products. Its greatest use by far, however, is as an intermediate in the synthesis of dihydroxydimethylol ethylene urea, which is widely used in the postcuring of durable-press garments.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) is as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.53	Glyoxal	10.5% ad val.	5.0% ad val.

The rate to become effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption and imports

U.S. consumption of glyoxal has increased rapidly because of the application of this product in permanent-press finishes for textiles. Annual U.S. imports increased almost tenfold during 1964-68, from 1.6 million pounds, valued at $290,000, to 16 million pounds, valued at $2.3 million. They declined to 12.7 million pounds, valued at $1.7 million in 1969 (see accompanying table). France was the principal source of supply, followed by Japan and West Germany.

Glyoxal is produced in the United States by only one firm--a large petrochemical company--at plants in Louisiana and West Virginia. No statistics are available for publication, but production exceeds imports. Exports are believed to be negligible or nil.

Glyoxal: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
France	1,356	2,629	2,806	4,531	10,944	10,130
Japan	-	-	776	720	1,750	2,170
West Germany	198	744	671	1,584	3,353	441
All other	-	22	281	-	1	-
Total	1,554	3,395	4,534	6,855	16,048	12,741
	Value (1,000 dollars)					
France	253	478	576	756	1,659	1,407
Japan	-	-	189	115	237	285
West Germany	37	127	112	224	444	45
All other	-	7	87	-	1/	-
Total	290	612	964	1,095	2,340	1,737

1/ Less than $500.

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

Commodity	TSUS item
Aldehydes:	
Aldol or acetaldol	427.42
Chloracetaldehyde	427.45
Crotonaldehyde	427.46
Paracetaldehyde	427.54
Other, not elsewhere enumerated.	427.58

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Most of the U.S. production of aldehydes not elsewhere enumerated is consumed by the producers in further manufacture. The volume traded is still substantially larger than imports, which totaled 873,000 pounds, valued at $328,000, in 1969.

Description and uses

The aldehydes covered by this summary are organic compounds in which a carbonyl radical is attached to a terminal carbon atom. 1/ Those aldehydes which are produced in largest volume--acetaldehyde, butyraldehyde, formaldehyde (including paraformaldehyde), furfural, and glyoxal--are discussed in other summaries in this volume. Aldehydes which are used principally for the purpose of scenting or of counteracting undesirable odors are provided for as aromatic or odoriferous substances in part 7 of schedule 4 of the TSUS.

The aldehydes discussed here consist of fewer than a score of products of commercial importance; they are derived almost entirely from petrochemical sources. Most aldehydes are highly reactive chemicals easily oxidized to acids, reduced to alcohols, or combined with nitrogenous compounds to give a variety of end products.

1/ According to the TSUS order of precedence of functions, the provisions for aldehydes include not only simple aldehydes but also those which contain a ketone, alcohol, ester, ether, acetal, or lactone function or a halogen, sulfur, or metallic atom. The provisions for aldehydes do not include aldehydes which contain an acid (or its salt) or a nitrogen atom.

Crotonaldehyde, the most important individual compound, is derived from acetaldehyde and converted into the solvent butanol. Crotonaldehyde is used also as an intermediate for dyes, food preservatives, plasticizers, and fungicides.

Acetaldehyde (item 427.40) is a highly reactive chemical which is easily polymerized to less reactive forms covered in this summary, such as the dimer, aldol (also known as acetaldol and 3-hydroxybutyraldehyde), the trimer, paracetaldehyde; and the tetramer, metaldehyde. The polymers are produced in much smaller volume than the monomer. Metaldehyde is used in poison bait for slugs, and the others are used in the synthesis of rubber-processing materials and other chemicals.

Aldehydes containing eight or more carbon atoms (such as octyl and decyl aldehydes) are made by the oxo process from carbon monoxide, hydrogen and a petroleum olefin. The resulting aldehydes are further hydrogenated in the producing plants to alcohols, which in turn are used as solvents or intermediates for plasticizers and surface-active agents.

Acrolein is used in the synthesis of chemicals for textiles, paper, rubber, feed supplements, and plastics. Trichloroacetaldehyde is used for the synthesis of the insecticide DDT. Other aldehydes are used in further synthesis, for embalming fluids and tanning materials, and to insolubilize glues.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.42	Aldol or acetaldol-------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
427.45	Chloracetaldehyde--------	10.5% ad val.	5% ad val.
427.46	Crotonaldehyde-----------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
427.54	Paracetaldehyde----------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
427.58	Other aldehydes, not elsewhere enumerated---	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and Trade.

The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1969, the average ad valorem equivalent of the rate of duty in effect on December 31, 1969 for crotonaldehyde (2.4¢ per pound plus 12% ad valorem) was 12.8 percent, and for other aldehydes not elsewhere enumerated (2.4¢ per pound plus 12% ad valorem) was 18.4 percent.

U.S. production, imports, and exports

The aldehydes covered here are produced by six large U.S. companies. U.S. production of trichloroacetaldehyde totaled 70 million pounds in 1968. No statistics are available for production of the other aldehydes, but most of the production is consumed by the producers in further manufacture. Sales by producers are small and in 1968 totaled less than $10 million. U.S. imports of the aldehydes in this group increased from 499,000 pounds, valued at $672,000, in 1964 to 873,000 pounds, valued at $328,000, in 1969 (see accompanying table). Switzerland was the principal source in 1969, followed by France and the United Kingdom. U.S. exports are believed to be small.

Aldehydes not elsewhere enumerated: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Switzerland	191	305	231	253	232	292
France	200	67	245	229	222	331
United Kingdom	40	36	60	74	109	196
West Germany	1	9	213	311	11	34
Belgium	-	-	-	11	11	11
Netherlands	-	6	12	-	1/	-
All other	67	24	1/	8	-	9
Total	499	447	761	886	585	873
	Value (1,000 dollars)					
Switzerland	567	207	123	170	145	114
France	70	23	81	79	75	111
United Kingdom	17	15	27	25	43	77
West Germany	6	7	57	84	5	11
Belgium	-	-	-	5	4	4
Netherlands	-	2	9	-	2	-
All other	12	9	2/	3	-	22
Total	672	263	297	366	274	328

1/ Less than 500 pounds.
2/ Less than $500.

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

Commodity	TSUS item
Acetone----------	427.60

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Acetone is an important organic chemical to the domestic industry. Production of acetone in the United States in 1969 was 1.51 billion pounds, part of which was used by the producing companies in the manufacture of other products. U.S. imports in 1969 amounted to 86.4 million pounds, valued at $3.0 million, and exports in the same year were 17.8 million pounds, valued at $1.1 million. Acetone is of only moderate importance in international trade.

Description and uses

Acetone, also known as dimethyl ketone and 2-propanone, is the simplest and most important ketone. It is a colorless, flammable liquid and an excellent solvent. Acetone is produced principally by the dehydration of isopropyl alcohol, as a coproduct with phenol in the hydroperoxide cumene process, and in a small amount as a byproduct in the direct oxidation of propane.

The largest use for acetone is in the manufacture of derivative solvents such as methyl isobutyl ketone, diacetone alcohol, and isophorone. Acetone is also used as a solvent for many natural gums and resins, cellulose derivatives, many synthetic resins, smokeless powder, and other products.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.60	Acetone----------	8.5% ad val.	4% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth (Kennedy) round of trade negotiations under the General Agreement on Tariffs and

Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS) through 1967.

U.S. consumption

In 1969, U.S. consumption of acetone totaled 1,576 million pounds. Imports supplied 5.6 percent of the total. Use of acetone by producers for 1966 and 1967, as published by the Business and Defense Services Administration, U.S. Department of Commerce, is given in the following tabulation:

Use	1966	1967
Paint, varnish, and lacquer solvents	16.0	15.9
Methyl methacrylate	17.3	15.8
Methyl isobutyl ketone and carbinol	14.3	14.0
Cellulose acetate solvent	7.8	6.9
Hexylene glycol	4.7	5.4
Pharmaceuticals	3.3	3.2
Bisphenol A	2.5	2.6
Diacetone alcohol	2.4	2.8
Other chemicals	17.3	17.8
Sales to dealers, Government, and foreign buyers	14.4	15.6
Total	100.0	100.0

U.S. producers

In 1969, acetone was produced by 12 companies at 17 plants locations, distributed as follows: Texas, 5; New Jersey, 3; California, 2; and one each in Illinois, Indiana, Kansas, Louisiana, Pennsylvania, Tennessee, and West Virginia. Of the 17 plants, eight produce acetone from isopropyl alcohol; eight produce acetone with phenol from cumene; two produce acetone by the oxidation of hydrocarbons; and one plant location uses both isopropyl alcohol and cumene. U.S. annual capacity was 1.6 billion pounds in 1969 and was expected to increase to 2.2 billion pounds by 1971 with the installation of four new facilities based on cumene.

U.S. production

U.S. production of acetone as reported by the Tariff Commission increased from 1,055 million pounds in 1964 to 1,361 million pounds in 1968 and 1,507 million pounds in 1969 (table 1). About one-fourth of the output in 1968 was used by the producing companies. The output of acetone from isopropyl alcohol has declined from 72.2 percent of the total production in 1964 to 58.7 percent in 1968. All projected increases in production of acetone are based on the acetone-phenol-from-cumene process, and these plants are operated primarily for their phenol rather than for acetone. It is expected that cumene-based acetone production will exceed acetone from isopropyl alcohol by late 1971.

U.S. exports

U.S. exports of acetone have been quite irregular during 1964-68, ranging from 44 million pounds, valued at $3.4 million, in 1964, to 8.7 million pounds, valued at $610,000, in 1966 (table 2). Exports in 1968 and 1969 were 22 million pounds and 18 million pounds, respectively. Japan received more than 90 percent of the U.S. exports of acetone in 1964. Colombia and Japan were the principal markets in 1969.

U.S. imports

During 1964-69, U.S. imports increased about 10 times, to 86.4 million pounds (table 3). In 1967, 85 percent of the acetone imports came from the United Kingdom and Italy. In 1969, all imports came from France and Italy. In both years, Italy furnished over one-half of the imports.

Foreign production and trade

Most of the industrially advanced countries (Japan and those in Western Europe) produce acetone for their own consumption.

Table 1.--Acetone: U.S. production and sales, 1964-69

Year	Production			Sales		
	Total	From isopropyl alcohol	Other	Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
1964	1,054,756	761,154	293,602	672,093	31,997	$0.05
1965	1,124,097	746,879	377,238	741,665	33,999	.05
1966	1,330,178	881,020	449,158	841,222	40,197	.05
1967	1,283,978	792,168	491,810	827,739	42,858	.05
1968	1,360,603	798,902	561,702	1,014,637	49,817	.05
1969	1/ 1,506,819	2/	2/	2/	2/	2/

1/ Preliminary.
2/ Not available.

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

Table 2.--Acetone: U.S. exports of domestic merchandise, by markets, 1964-69

Market	1964	1965	1966	1967	1968	1969
	(Quantity (1,000 pounds)					
Canada	-	2,462	1,283	3,507	2,346	4,267
Venezuela	1,050	402	1,322	2,610	3,900	2,824
Colombia	53	-	982	1,813	2,005	2,707
Japan	39,423	1,187	-	3,107	-	2,243
Australia and New Zealand	1,107	1,390	1,113	8,973	7,267	725
All other	2,449	7,566	3,971	3,156	6,115	4,298
Total	44,082	13,007	8,671	23,166	21,633	17,064
	Value (1,000 dollars)					
Canada	-	127	83	164	133	267
Venezuela	79	29	88	164	254	183
Colombia	4	-	77	117	119	146
Japan	3,089	328	-	157	-	95
Australia and New Zealand	75	67	57	447	328	60
All other	184	567	305	275	420	321
Total	3,431	1,118	610	1,324	1,254	1,072

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

Table 3.--Acetone: U.S. imports for consumption, by principal sources, 1964-69

Source	1964	1965	1966	1967	1968	1969
	Quantity (1,000 pounds)					
Italy	6,664	17,442	35,988	36,988	55,497	81,942
France	-	-	-	4,948	6,413	4,454
Netherlands	-	7,120	1,094	2,302	3,551	-
West Germany	-	3,968	5,691	-	3,280	-
United Kingdom	1,132	-	11,497	16,768	2,213	-
Canada	667	1/	161	-	271	-
Japan	-	-	3,308	2,118	-	-
All other	-	115	-	-	-	-
Total	8,463	28,645	57,680	63,124	71,225	86,396
	Value (1,000 dollars)					
Italy	223	583	1,317	1,681	1,884	2,842
France	-	-	-	173	238	155
Netherlands	-	229	31	115	122	-
West Germany	-	129	1,442	-	108	-
United Kingdom	45	-	684	754	78	-
Canada	27	2/	8	-	20	-
Japan	-	-	181	131	-	-
All other	-	2	-	-	-	-
Total	295	943	3,663	2,854	2,450	2,997

1/ Less than 500 pounds.
2/ Less than $500.

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

Commodity	TSUS item
Ethyl methyl ketone	427.62
Ketones not elsewhere enumerated	427.64

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1970) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. production of the ketones covered in this summary amounted to more than 800 million pounds in 1968. U.S. imports in 1969 of ketones were 47.4 million pounds, valued at $4.8 million, while exports of methyl ethyl ketone in the same year amounted to 29.8 million pounds, valued at $2.7 million. The ketones are important in the domestic industry and of moderate importance in international trade.

Description and uses

Ketones are organic compounds that contain a carbonyl (keto, C=O) group attached to two other carbon atoms. 1/ The principal ketones covered in this summary, in the order of their magnitude of production in 1968, are ethyl methyl ketone, methyl isobutyl ketone, diacetone alcohol, mesityl oxide, diisobutyl ketone, isophorone, and methyl isoamyl ketone. These seven chemicals made up about 98 percent of the total output of ketones in 1968. The remaining 2 percent was accounted for chiefly by ethyl amyl ketone, isobutyl heptyl ketone, acetyl acetone, and acetonyl acetone. Production of smaller quantities of chlorovinyl ethyl acetone, chloroacetone, dihydroxy acetone, methyl amyl ketone, methyl nonyl ketone, and diethyl ketone has been reported for 1968.

Ethyl methyl ketone (more commonly known as methyl ethyl ketone, and also referred to as 2-butanone and MEK) is a colorless, flammable liquid. It is produced commercially either by the dehydrogenation or selective oxidation of sec-butyl alcohol, or by the decomposition of the hydroperoxide of sec-butylbenzene. MEK is available in technical (99 percent) and chemically pure (C.P.) grades. The chief commercial use of MEK is as a solvent for surface-coating preparations based on

1/ According to the TSUS order or precedence of functions, the classification for ketones includes simple ketones and ketones which contain an alcohol, ester, acetal, or lactone function or a halogen, sulfur, or metallic atom. This summary does not include ketones which contain an acid or aldehyde function or a nitrogen atom.

cellulose, acrylic, and vinyl resins. It is also used as a chemical intermediate in the manufacture of methyl isopropenyl ketone, sec-butylamine, and 1,3-diketones, and as a dewaxing agent for lubricating oils.

Methyl isobutyl ketone (4-methyl-2-pentanone, or MIBK) is made commercially by the selective hydrogenation of mesityl oxide, and is available in quantity in a technical (99 percent) grade. MIBK is a good solvent for nitrocellulose, vinyl acetate, and acrylic and alkyd coating resins. It is also a solvent for adhesives, rubber cements, aircraft dopes, and DDT and 2,4-D. As an extractant, MIBK is used in dewaxing mineral oil, refining tall oil, and cleaning metals. It has some use as an intermediate in the manufacture of other chemicals.

Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone) is prepared by the condensation of acetone over a catalyst. It is available commercially in two grades--regular (acetone-free) and technical. Diacetone alcohol has excellent solvent properties. The acetone-free grade is used in castor-oil-based hydraulic fluids. The technical grade is used as a solvent for cellulose, vinyl, and epoxy resins.

The other less-important ketones covered in this summary have uses as solvents and as chemical intermediates, and are of minor importance in relation to the ketones named above.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1970) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.62	Ethyl methyl ketone--	8.5% ad val.	4% ad val.
427.64	Ketones not elsewhere enumerated---	8.5% ad val.	4% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1970, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production and consumption

U.S. consumption of ketones is approximately equal to domestic production since imports and exports are relatively small. U.S. production of the ketones covered in this summary in 1968 was over 800 million pounds, according to information reported to the Tariff Commission. Production of methyl ethyl ketones and methyl isobutyl ketone, the only two ketones for which separate data are published, for 1964-68, are given in the following tabulation:

Year	Methyl ethyl ketone 1,000 pounds	Methyl isobutyl ketone 1,000 pounds
1964	288,934	158,607
1965	317,500	168,864
1966	399,077	198,387
1967	400,424	199,274
1968	451,224	182,090

Consumption of methyl ethyl ketone in 1967 was estimated by trade sources as 375 million pounds, rising to 420 million to 440 million pounds in 1968 and to 450 million pounds in 1969. Promising areas for increased consumption are in the manufacture of terephthalic-acid and in the automotive field as a solvent for external coatings and for the newly developed vinyl films on automobile upholstery.

Consumption of methyl isobutyl ketone is estimated by trade sources as 200 million pounds in 1967, 210 million pounds in 1968, and 230 million pounds in 1969. A slow increase in consumption of MIBK is predicted through 1972. The use of MIBK has been prohibited in California in solvent formulations, to reduce air pollution, thus necessitating a reformulation of these materials, excluding MIBK, which once had a substantial portion of this market.

In 1968, production of 4-hydroxy-4-methyl-2-pentanone (diacetone alcohol) totaled 87.2 million pounds; sales of 31.8 million pounds were valued at $4.0 million. Statistics for production in earlier years are not available.

U.S. producers

Methyl ethyl ketone is produced by six U.S. firms in eight plants, five in Texas, and one each in California, Louisiana, and New Jersey.

Methyl isobutyl ketone is produced by four companies in six plants--in California, Indiana, New Jersey, Tennessee, Texas, and West Virginia. The producers of these two ketones are among the

largest in the chemical field, and ketones constitute only a minor part of their business. The other, less-important ketones covered here are produced by about a dozen companies, including those named above.

U.S. exports

No data on total U.S. exports of the ketones covered in this summary are available. Exports of methyl ethyl ketone in 1965-69 are given in the following tabulation:

Year	Quantity 1,000 pounds	Value 1,000 dollars
1965	29,128	3,105
1966	32,717	3,369
1967	47,246	4,320
1968	33,175	2,974
1969	29,824	2,765

In 1965, the principal export markets were Japan, Australia, the Netherlands, Canada, Venezuela, and the Republic of South Africa. Of the 30 million pounds exported in 1969, the Netherlands received 11.5 million pounds; Japan, 1.2 million pounds, Australia, 3.7 million pounds; the United Kingdom, 1.0 million pounds; the Philippines, 3.1 million pounds; and Brazil, 1.3 million pounds. Exports of methyl isobutyl ketone are estimated by the trade to be about 6 percent of domestic production. Exports of other ketones are probably negligible.

U.S. imports

U.S. imports of methyl ethyl ketone and other ketones are given in the following tabulation for the years 1965-69:

	Methyl ethyl ketone		Other ketones	
Year	Quantity 1,000 pounds	Value 1,000 dollars	Quantity 1,000 pounds	Value 1,000 dollars
1965	8,727	714	5,637	1,125
1966	12,556	936	6,420	1,296
1967	8,837	680	15,097	2,864
1968	18,296	1,261	15,501	2,629
1969	29,662	2,002	17,697	2,737

In 1969, ethyl methyl ketone was imported from West Germany, Japan, Belgium, and France. Imports of other ketones have included methyl isopropyl ketone and methyl isobutyl ketone from West Germany, Belgium and Japan; pregnenolone base (a precursor for synthetic hormones) from Mexico; isophorone from West Germany and the United Kingdom; methyl butanone from West Germany; ethyl acetoacetate from the United Kingdom, West Germany, and Switzerland.

A P P E N D I X A

Tariff Schedules of the United States Annotated (1970): General headnotes and rules of interpretation, and excerpts relating to the items included in this volume.

NOTE: The shaded areas in this appendix cover headnotes and TSUS items not pertaining to summaries in this volume.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

GENERAL HEADNOTES AND RULES OF INTERPRETATION

1. Tariff Treatment of Imported Articles. All articles imported into the customs territory of the United States from outside thereof are subject to duty or exempt therefrom as prescribed in general headnote 3.

2. Customs Territory of the United States. The term "customs territory of the United States", as used in the schedules, includes only the States, the District of Columbia, and Puerto Rico.

3. Rates of Duty. The rates of duty in the "Rates of Duty" columns numbered 1 and 2 of the schedules apply to articles imported into the customs territory of the United States as hereinafter provided in this headnote:

(a) Products of Insular Possessions.

(i) Except as provided in headnote 6 of schedule 7, part 2, subpart E, [and] except as provided in headnote 4 of schedule 7, part 7, subpart A, articles imported from insular possessions of the United States which are outside the customs territory of the United States are subject to the rates of duty set forth in column numbered 1 of the schedules, except that all such articles the growth or product of any such possession, or manufactured or produced in any such possession from materials the growth, product, or manufacture of any such possession or of the customs territory of the United States, or of both, which do not contain foreign materials to the value of more than 50 percent of their total value, coming to the customs territory of the United States directly from any such possession, and all articles previously imported into the customs territory of the United States with payment of all applicable duties and taxes imposed upon or by reason of importation which were shipped from the United States, without remission, refund, or drawback of such duties or taxes, directly to the possession from which they are being returned by direct shipment, are exempt from duty.

(ii) In determining whether an article produced or manufactured in any such insular possession contains foreign materials to the value of more than 50 percent, no material shall be considered foreign which, at the time such article is entered, may be imported into the customs territory from a foreign country, other than Cuba or the Philippine Republic, and entered free of duty.

(b) Products of Cuba. Products of Cuba imported into the customs territory of the United States, whether imported directly or indirectly, are subject to the rates of duty set forth in column numbered 1 of the schedules. Preferential rates of duty for such products apply only as shown in the said column 1. 1/

(c) Products of the Philippine Republic.

(i) Products of the Philippine Republic imported into the customs territory of the United States, whether imported directly or indirectly, are subject to the rates of duty which are set forth in column numbered 1 of the schedules or to fractional parts of the rates in the said column 1, as hereinafter prescribed in subdivisions (c)(ii) and (c)(iii) of this headnote.

(ii) Except as otherwise prescribed in the schedules, a Philippine article, as defined in subdivision (c)(iv) of this headnote, imported into the customs territory of the United States and entered on or before July 3, 1974, is subject to that rate which results from the application of the following percentages to the most favorable rate of duty (i.e., including a preferential rate prescribed for any product of Cuba) set forth in column numbered 1 of the schedules:

(A) 20 percent, during calendar years 1963 through 1964,

(B) 40 percent, during calendar years 1965 through 1967,

(C) 60 percent, during calendar years 1968 through 1970,

(D) 80 percent, during calendar years 1971 through 1973,

(E) 100 percent, during the period from January 1, 1974, through July 3, 1974.

(iii) Except as otherwise prescribed in the schedules, products of the Philippine Republic, other than Philippine articles, are subject to the rates of duty (except any preferential rates prescribed for products of Cuba) set forth in column numbered 1 of the schedules.

(iv) The term "Philippine article", as used in the schedules, means an article which is the product of the Philippines, but does not include any article produced with the use of materials imported into the Philippines which are products of any foreign country (except materials produced within the customs territory of the United States) if the aggregate value of such imported materials when landed at the Philippine port of entry, exclusive of any landing cost and Philippine duty, was more than 20 percent of the appraised customs value of the article imported into the customs territory of the United States.

(d) Products of Canada.

(i) Products of Canada imported into the customs territory of the United States, whether imported directly or indirectly, are subject to the rates of duty set forth in column numbered 1 of the schedules. The rates of duty for a Canadian article, as defined in subdivision (d)(ii) of this headnote, apply only as shown in the said column numbered 1.

(ii) The term "Canadian article", as used in the schedules, means an article which is the product of Canada, but does not include any article produced with the use of materials imported into Canada which are products of any foreign country (except materials produced within the customs territory of the United States), if the aggregate value of such imported materials when landed at the Canadian port of entry (that is, the actual purchase price, or if not purchased, the export value, of such materials, plus, if not included therein, the cost of transporting such materials to Canada but exclusive of any landing cost and Canadian duty) was --

(A) with regard to any motor vehicle or automobile truck tractor entered on or before December 31, 1967, more than 60 percent of the appraised value of the article imported into the customs territory of the United States; and

(B) with regard to any other article (including any motor vehicle or automobile truck tractor entered after December 31, 1967), more than 50 percent of the appraised value of the article imported into the customs territory of the United States.

(e) Products of Communist Countries. Notwithstanding any of the foregoing provisions of this headnote, the rates of duty shown in column numbered 2 shall apply to products, whether imported directly or indirectly, of the following countries and areas pursuant to section 401 of the Tariff Classification Act of 1962, to section 231 or 257(e)(2) of the Trade Expansion Act of 1962, or to

1/ By virtue of section 401 of the Tariff Classification Act of 1962, the application to products of Cuba of either a preferential or other reduced rate of duty in column 1 is suspended. See general headnote 3(e), infra. The provisions for preferential Cuban rates continue to be reflected in the schedules because, under section 401, the rates therefor in column 1 still form the bases for determining the rates of duty applicable to certain products, including "Philippine articles".

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

General Headnotes and Rules of Interpretation

action taken by the President thereunder:

Albania
Bulgaria
China (any part of which may be under Communist domination or control)
Cuba 1/
Czechoslovakia
Estonia
Germany (the Soviet zone and the Soviet sector of Berlin)
Hungary
Indochina (any part of Cambodia, Laos, or Vietnam which may be under Communist domination or control)
Korea (any part of which may be under Communist domination or control)
Kurile Islands
Latvia
Lithuania
Outer Mongolia
Rumania
Southern Sakhalin
Tanna Tuva
Tibet
Union of Soviet Socialist Republics and the area in East Prussia under the provisional administration of the Union of Soviet Socialist Republics.

(f) Products of All Other Countries. Products of all countries not previously mentioned in this headnote imported into the customs territory of the United States are subject to the rates of duty set forth in column numbered 1 of the schedules.

(g) Effective Date; Exceptions - Staged Rates of Duty. 2/ Except as specified below or as may be specified elsewhere, pursuant to section 501(a) of the Tariff Classification Act of 1962 (P.L. 87-456, approved May 24, 1962), the rates of duty in columns numbered 1 and 2 become effective with respect to articles entered on or after the 10th day following the date of the President's proclamation provided for in section 102 of the said Act. If, in column numbered 1, any rate of duty or part thereof is set forth in parenthesis, the effective date shall be governed as follows:

(i) If the rate in column numbered 1 has only one part (i.e., 8¢ (10¢) per lb.), the parenthetical rate (viz., 10¢ per lb.) shall be effective as to articles entered before July 1, 1964, and the other rate (viz., 8¢ per lb.) shall be effective as to articles entered on or after July 1, 1964.

(ii) If the rate in column numbered 1 has two or more parts (i.e., 5¢ per lb. + 50% ad val.) and has a parenthetical rate for either or both parts, each part of the rate shall be governed as if it were a one-part rate. For example, if a rate is expressed as "4¢ (4.5¢) per lb. + 8% (9%) ad val.", the rate applicable to articles entered before July 1, 1964, would be "4.5¢ per lb. + 9% ad val."; the rate applicable to articles entered on or after July 1, 1964, would be "4¢ per lb. + 8% ad val.".

(iii) If the rate in column numbered 1 is marked with an asterisk (*), the foregoing provisions of (i) and (ii) shall apply except that "January 1, 1964" shall be substituted for "July 1, 1964", wherever this latter date appears.

1/ In Proclamation 3447, dated February 3, 1962, the President, acting under authority of section 620(a) of the Foreign Assistance Act of 1961 (75 Stat. 445), as amended, prohibited the importation into the United States of all goods of Cuban origin and all goods imported from or through Cuba, subject to such exceptions as the Secretary of the Treasury determines to be consistent with the effective operation of the embargo.

2/ The purpose of headnote 3(g) was to provide for an effective date for the rates of duty initially contained in the Tariff Schedules of the United States. By Presidential Proclamation 3548 of August 21, 1963, these rates of duty, except as noted in subparagraphs (i), (ii), and (iii) of headnote 3(g), became effective on August 31, 1963.

4. Modification or Amendment of Rates of Duty. Except as otherwise provided in the Appendix to the Tariff Schedules --

(a) a statutory rate of duty supersedes and terminates the existing rates of duty in both column numbered 1 and column numbered 2 unless otherwise specified in the amending statute;

(b) a rate of duty proclaimed pursuant to a concession granted in a trade agreement shall be reflected in column numbered 1 and, if higher than the then existing rate in column numbered 2, also in the latter column, and shall supersede but not terminate the then existing rate (or rates) in such column (or columns);

(c) a rate of duty proclaimed pursuant to section 336 of the Tariff Act of 1930 shall be reflected in both column numbered 1 and column numbered 2 and shall supersede but not terminate the then existing rates in such columns; and

(d) whenever a proclaimed rate is terminated or suspended, the rate shall revert, unless otherwise provided, to the next intervening proclaimed rate previously superseded but not terminated or, if none, to the statutory rate.

5. Intangibles. For the purposes of headnote 1 --

(a) corpses, together with their coffins and accompanying flowers,
(b) currency (metal or paper) in current circulation in any country and imported for monetary purposes,
(c) electricity,
(d) securities and similar evidences of value, and
(e) vessels which are not "yachts or pleasure boats" within the purview of subpart D, part 6, of schedule 6,

are not articles subject to the provisions of these schedules.

6. Containers or Holders for Imported Merchandise. For the purposes of the tariff schedules, containers or holders are subject to tariff treatment as follows:

(a) Imported Empty: Containers or holders if imported empty are subject to tariff treatment as imported articles and as such are subject to duty unless they are within the purview of a provision which specifically exempts them from duty.

(b) Not Imported Empty: Containers or holders if imported containing or holding articles are subject to tariff treatment as follows:

(i) The usual or ordinary types of shipping or transportation containers or holders, if not designed for, or capable of, reuse, and containers of usual types ordinarily sold at retail with their contents, are not subject to treatment as imported articles. Their cost, however, is, under section 402 or section 402a of the tariff act, a part of the value of their contents and if their contents are subject to an ad valorem rate of duty such containers or holders are, in effect, dutiable at the same rate as their contents, except that their cost is deductible from dutiable value upon submission of satisfactory proof that they are products of the United States which are being returned without having been advanced in value or improved in condition by any means while abroad.

(ii) The usual or ordinary types of shipping or transportation containers or holders, if designed for, or capable of, reuse, are subject to treatment as imported articles separate and distinct from their contents. Such holders or containers are not part of the dutiable value of their contents and are separately subject to duty upon each and every importation into the customs territory of the United States unless within the scope of a provision specifically exempting them from duty.

(iii) In the absence of context which requires otherwise, all other containers or holders are subject to the same treatment as specified in (ii) above for usual or ordinary types of shipping or transportation containers or holders designed for, or capable of, reuse.

7. Commingling of Articles. (a) Whenever articles subject to different rates of duty are so packed together or mingled that the quantity or value of each class of articles cannot be readily ascertained by customs officers (without physical segregation of the shipment or the contents of any entire package thereof), by one or more of the following means:

(i) sampling,

(ii) verification of packing lists or other documents filed at the time of entry, or

(iii) evidence showing performance of commercial settlement tests generally accepted in the trade and filed in such time and manner as may be prescribed by regulations of the Secretary of the Treasury,

the commingled articles shall be subject to the highest rate of duty applicable to any part thereof unless the consignee or his agent segregates the articles pursuant to subdivision (b) hereof.

(b) Every segregation of articles made pursuant to this headnote shall be accomplished by the consignee or his agent at the risk and expense of the consignee within 30 days (unless the Secretary authorizes in writing a longer time) after the date of personal delivery or mailing, by such employee as the Secretary of the Treasury shall designate, of written notice to the consignee that the articles are commingled and that the quantity or value of each class of articles cannot be readily ascertained by customs officers. Every such segregation shall be accomplished under customs supervision, and the compensation and expenses of the supervising customs officers shall be reimbursed to the Government by the consignee under such regulations as the Secretary of the Treasury may prescribe.

(c) The foregoing provisions of this headnote do not apply with respect to any part of a shipment if the consignee or his agent furnishes, in such time and manner as may be prescribed by regulations of the Secretary of the Treasury, satisfactory proof --

(i) that such part (A) is commercially negligible, (B) is not capable of segregation without excessive cost, and (C) will not be segregated prior to its use in a manufacturing process or otherwise, and

(ii) that the commingling was not intended to avoid the payment of lawful duties.

Any article with respect to which such proof is furnished shall be considered for all customs purposes as a part of the article, subject to the next lower rate of duty, with which it is commingled.

(d) The foregoing provisions of this headnote do not apply with respect to any shipment if the consignee or his agent shall furnish, in such time and manner as may be prescribed by regulations of the Secretary of the Treasury, satisfactory proof --

(i) that the value of the commingled articles is less than the aggregate value would be if the shipment were segregated;

(ii) that the shipment is not capable of segregation without excessive cost and will not be segregated prior to its use in a manufacturing process or otherwise; and

(iii) that the commingling was not intended to avoid the payment of lawful duties.

Any merchandise with respect to which such proof is furnished shall be considered for all customs purposes to be dutiable at the rate applicable to the material present in greater quantity than any other material.

(e) The provisions of this headnote shall apply only in cases where the schedules do not expressly provide a particular tariff treatment for commingled articles.

8. Abbreviations. In the schedules the following symbols and abbreviations are used with the meanings respectively indicated below:

$	-	dollars
¢	-	cents
%	-	percent
+	-	plus
ad val.	-	ad valorem
bu.	-	bushel
cu.	-	cubic
doz.	-	dozen
ft.	-	feet
gal.	-	gallon
in.	-	inches
lb.	-	pounds
oz.	-	ounces
sq.	-	square
wt.	-	weight
yd.	-	yard
pcs.	-	pieces
prs.	-	pairs
lin.	-	linear
I.R.C.	-	Internal Revenue Code

9. Definitions. For the purposes of the schedules, unless the context otherwise requires --

(a) the term "entered" means entered, or withdrawn from warehouse, for consumption in the customs territory of the United States;

(b) the term "entered for consumption" does not include withdrawals from warehouse for consumption;

(c) the term "withdrawn for consumption" means withdrawn from warehouse for consumption and does not include articles entered for consumption;

(d) the term "rate of duty" includes a free rate of duty; rates of duty proclaimed by the President shall be referred to as "proclaimed" rates of duty; rates of duty enacted by the Congress shall be referred to as "statutory" rates of duty; and the rates of duty in column numbered 2 at the time the schedules become effective shall be referred to as "original statutory" rates of duty;

(e) the term "ton" means 2,240 pounds, and the term "short ton" means 2,000 pounds;

(f) the terms "of", "wholly of", "almost wholly of", "in part of" and "containing", when used between the description of an article and a material (e.g., "furniture of wood", "woven fabrics, wholly of cotton", etc.), have the following meanings:

(i) "of" means that the article is wholly or in chief value of the named material;

(ii) "wholly of" means that the article is, except for negligible or insignificant quantities of some other material or materials, composed completely of the named material;

(iii) "almost wholly of" means that the essential character of the article is imparted by the named material, notwithstanding the fact that significant quantities of some other material or materials may be present; and

(iv) "in part of" or "containing" mean that the article contains a significant quantity of the named material.

With regard to the application of the quantitative concepts specified in subparagraphs (ii) and (iv) above, it is intended that the de minimis rule apply.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

General Headnotes and Rules of Interpretation

Page 6

10. General Interpretative Rules. For the purposes of these schedules --

(a) the general, schedule, part, and subpart headnotes, and the provisions describing the classes of imported articles and specifying the rates of duty or other import restrictions to be imposed thereon are subject to the rules of interpretation set forth herein and to such other rules of statutory interpretation, not inconsistent therewith, as have been or may be developed under administrative or judicial rulings;

(b) the titles of the various schedules, parts, and subparts and the footnotes therein are intended for convenience in reference only and have no legal or interpretative significance;

(c) an imported article which is described in two or more provisions of the schedules is classifiable in the provision which most specifically describes it; but, in applying this rule of interpretation, the following considerations shall govern:

(i) a superior heading cannot be enlarged by inferior headings indented under it but can be limited thereby;

(ii) comparisons are to be made only between provisions of coordinate or equal status, i.e., between the primary or main superior headings of the schedules or between coordinate inferior headings which are subordinate to the same superior heading;

(d) if two or more tariff descriptions are equally applicable to an article, such article shall be subject to duty under the description for which the original statutory rate is highest, and, should the highest original statutory rate be applicable to two or more of such descriptions, the article shall be subject to duty under that one of such descriptions which first appears in the schedules;

(e) in the absence of special language or context which otherwise requires --

(i) a tariff classification controlled by use (other than actual use) is to be determined in accordance with the use in the United States at, or immediately prior to, the date of importation, of articles of that class or kind to which the imported articles belong, and the controlling use is the chief use, i.e., the use which exceeds all other uses (if any) combined;

(ii) a tariff classification controlled by the actual use to which an imported article is put in the United States is satisfied only if such use is intended at the time of importation, the article is so used, and proof thereof is furnished within 3 years after the date the article is entered;

(f) an article is in chief value of a material if such material exceeds in value each other single component material of the article;

(g) a headnote provision which enumerates articles not included in a schedule, part, or subpart is not necessarily exhaustive, and the absence of a particular article from such headnote provision shall not be given weight in determining the relative specificity of competing provisions which describe such article;

(h) unless the context requires otherwise, a tariff description for an article covers such article, whether assembled or not assembled, and whether finished or not finished;

(ij) a provision for "parts" of an article covers a product solely or chiefly used as a part of such article, but does not prevail over a specific provision for such part.

11. Issuance of Rules and Regulations. The Secretary of the Treasury is hereby authorized to issue rules and regulations governing the admission of articles under the provisions of the schedules. The allowance of an importer's claim for classification, under any of the provisions of the schedules which provide for total or partial relief from duty or other import restrictions on the basis of facts which are not determinable from an examination of the article itself in its condition as imported, is dependent upon his complying with any rules or regulations which may be issued pursuant to this headnote.

12. The Secretary of the Treasury is authorized to prescribe methods of analyzing, testing, sampling, weighing, gauging, measuring, or other methods of ascertainment whenever he finds that such methods are necessary to determine the physical, chemical, or other properties or characteristics of articles for purposes of any law administered by the Customs Service.

General statistical headnotes:

1. Statistical Requirements for Imported Articles. Persons making customs entry or withdrawal of articles imported into the customs territory of the United States shall complete the entry or withdrawal forms, as provided herein and in regulations issued pursuant to law, to provide for statistical purposes information as follows:

(a) the number of the Customs district and of the port where the articles are being entered for consumption or warehouse, as shown in Statistical Annex A of these schedules;

(b) the name of the carrier or the means of transportation by which the articles were transported to the first port of unloading in the United States;

(c) the foreign port of lading;

(d) the United States port of unlading;

(e) the date of importation;

(f) the country of origin of the articles expressed in terms of the designation therefor in Statistical Annex B of these schedules;

(g) a description of the articles in sufficient detail to permit the classification thereof under the proper statistical reporting number in these schedules;

(h) the statistical reporting number under which the articles are classifiable;

(ij) gross weight in pounds for the articles covered by each reporting number when imported in vessels or aircraft;

(k) the net quantity in the units specified herein for the classification involved;

(l) the U.S. dollar value in accordance with the definition in Section 402 or 402a of the Tariff Act of 1930, as amended, for all merchandise including that free of duty or dutiable at specific rates; and

(m) such other information with respect to the imported articles as is provided for elsewhere in these schedules.

2. Statistical Annotations. (a) The statistical annotations to the Tariff Schedules of the United States consist of --

(i) the 2-digit statistical suffixes,
(ii) the indicated units of quantity,
(iii) the statistical headnotes and annexes, and
(iv) the italicized article descriptions.

(b) The legal text of the Tariff Schedules of the United States consists of the remaining text as more specifically identified in headnote 10(a) of the general headnotes and rules of interpretation.

(c) The statistical annotations are subordinate to the provisions of the legal text and cannot change their scope.

3. Statistical Reporting Number. (a) General Rule: Except as provided in paragraph (b) of this headnote, and in the absence of specific instructions to the contrary elsewhere, the statistical reporting number for an article consists of the 7-digit number formed by combining the 5-digit item number with the appropriate 2-digit statistical suffix. Thus, the statistical reporting number for live monkeys dutiable under item 100.95 is "100.3520".

(b) Wherever in the tariff schedules an article is classifiable under a provision which derives its rate of duty from a different provision, the statistical reporting number is, in the absence of specific instructions to the contrary elsewhere, the 7-digit number for the basic provision followed by the item number of the provision from which the rate is derived. Thus, the statistical reporting number of mixed apple and grape juices, not containing over 1.0 percent of ethyl alcohol by volume, is "165.6500-165.40".

4. Abbreviations. (a) The following symbols and abbreviations are used with the meanings respectively indicated below:

s. ton	-	short ton
C.	-	one hundred
Cwt.	-	100 lbs.
mg.	-	milligram
M.	-	1,000
bd. ft.	-	board feet
M. bd. ft.	-	1,000 board feet
mc.	-	millicurie
cord	-	128 cubic feet
square	-	amount to cover 100 square feet of surface
sup. ft.	-	superficial foot
oz.	-	ounces avoirdupois
fl. oz.	-	fluid ounce
oz. troy	-	troy ounce
pf. gal.	-	proof gallon

(b) An "X" appearing in the column for units of quantity means that no quantity (other than gross weight) is to be reported.

(c) Whenever two separate units of quantity are shown for the same article, the "v" following one of such units means that the value of the article is to be reported with that quantity.

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

HISTORICAL NOTES

Amendments and Modifications

PROVISIONS	
Gen Hdnte--3(a)(i)	Language "Except as provided in headnote 6 of schedule 7, part 2, subpart E," added; language "except that all articles" deleted and language "except that all such articles" inserted in lieu thereof. Pub. L. 89-805, Secs. 1(a), (c), Nov. 10, 1966, 80 Stat. 1521, 1522, effective date Jan. 1, 1967.
	Language "Except as provided in headnote 4 of schedule 7, part 7, subpart A," added. Pub. L. 89-806, Secs. 2(b), (c), Nov. 10, 1966, 80 Stat. 1523, effective date March 11, 1967.

PROVISIONS	
Gen Hdnte--3(d), (e), (f) and (g)	Headnotes 3(d), (e), and (f) redesignated as headnotes 3(e), (f), and (g), respectively, and new headnote 3(d) added. Pub. L. 89-283, Secs. 401(a), 403, Oct. 21, 1965, 79 Stat. 1021, 1022; entered into force Oct. 22, 1965, by Pres. Proc. 3682, Oct. 21, 1965, 3 CFR, 1965 Supp., p. 68.
Gen Hdnte--6(b)(i)	Language "and containers of usual types ordinarily sold at retail with their contents," added. Pub. L. 89-241, Secs. 2(a), 4, Oct. 7, 1965, 79 Stat. 933, 934, effective date Dec. 7, 1965.

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS

220

Part 1 - Benzenoid Chemicals and Products
- A. Organic Chemical Crudes
- B. Industrial Organic Chemicals
- C. Finished Organic Chemical Products

Part 2 - Chemical Elements, Inorganic and Organic Compounds, and Mixtures
- A. Chemical Elements
- B. Inorganic Acids
- C. Inorganic Chemical Compounds
- D. Organic Chemical Compounds
- E. Chemical Mixtures

Part 3 - Drugs and Related Products
- A. Natural Drugs, Crude or Advanced
- B. Alkaloids, Antibiotics, Barbiturates, Hormones, Vitamins, and Other Drugs and Related Products
- C. Other Drugs

Part 4 - Synthetic Resins and Plastics Materials; Rubber
- A. Synthetic Resins and Plastics Materials
- B. Rubber

Part 5 - Flavoring Extracts; Essential Oils
- A. Flavoring Extracts, and Fruit Flavors, Essences, Esters, and Oils
- B. Essential Oils

Part 6 - Glue, Gelatin, and Related Products

Part 7 - Aromatic or Odoriferous Substances; Perfumery, Cosmetics, and Toilet Preparations
- A. Aromatic or Odoriferous Substances
- B. Perfumery, Cosmetics, and Toilet Preparations

Part 8 - Surface-Active Agents; Soap and Synthetic Detergents
- A. Surface-Active Agents
- B. Soap and Synthetic Detergents

Part 9 - Dyeing and Tanning Products; Pigments and Pigment-Like Materials; Inks, Paints, and Related Products
- A. Dyeing and Tanning Products
- B. Pigments and Pigment-Like Materials
- C. Inks, Paints, and Related Products

Part 10 - Petroleum, Natural Gas, and Products Derived Therefrom

Part 11 - Fertilizers and Fertilizer Materials

Part 12 - Explosives

Part 13 - Fatty Substances, Camphor, Chars and Carbons, Isotopes, Waxes, and Other Products
- A. Fatty Substances
- B. Camphor, Chars and Carbons, Isotopes, Waxes and Other Products
- C. Miscellaneous Medical Supplies

Schedule 4 headnotes:

1. This schedule does not include --
   - (i) any of the mineral products provided for in schedule 5;
   - (ii) metal-bearing ores and other metal-bearing materials, provided for in part 1 of schedule 6; or
   - (iii) metals provided for in part 2 of schedule 6.

2. (a) The term "compounds", as used in this schedule, means substances occurring naturally or produced artificially by the reaction of two or more ingredients, each compound --
   - (i) consisting of two or more elements,
   - (ii) having its own characteristic properties different from those of its elements and from those of other compounds, and
   - (iii) always consisting of the same elements united in the same proportions by weight with the same internal arrangement.

The presence of impurities which occur naturally or as an incident to production does not in itself affect the classification of a product as a compound.

(b) The term "compounds", as used in this schedule, includes a solution of a single compound in water, and, in determining the amount of duty on any such compound subject to duty in this schedule at a specific rate, an allowance in weight or volume, as the case may be, shall be made for the water in excess of any water of crystallization which may have been in the compound.

3. (a) The term "mixtures", as used in this schedule, means substances consisting of two or more ingredients (i.e., elements or compounds), whether occurring as such in nature, or whether artificially produced (i.e., brought about by mechanical, physical, or chemical means), which do not bear a fixed ratio to one another and which, however thoroughly commingled, retain their individual chemical properties and are not chemically united. The fact that the ingredients of a product are incapable of separation or have been commingled in definite proportions does not in itself affect the classification of such product as a mixture.

(b) The term "mixtures", as used in this schedule, includes solutions, except solutions defined as compounds in headnote 2(b) of this schedule.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 2. - Chemical Elements, Inorganic and Organic Compounds, and Mixtures

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		PART 2. - CHEMICAL ELEMENTS, INORGANIC AND ORGANIC COMPOUNDS, AND MIXTURES			
		Part 2 headnotes:			
		1. This part covers chemicals, except those provided for elsewhere in this schedule and those specially provided for in any of the other schedules.			
		2. For the purpose of this part, inorganic compounds including salts are compounds not containing carbon, except carbides and such carbon-containing compounds as inorganic cyanides and cyanates, metallic carbonates, and oxides of carbon which are inorganic in nature.			
		3. For the purpose of this part, organic compounds are compounds containing carbon except such carbon-containing compounds as carbides, inorganic cyanides and cyanates, metallic carbonates, and oxides of carbon.			
		Subpart A. - Chemical Elements			
		Chemical elements in any physical form:			
415.05	00	Bromine	lb.	7¢ per lb.	10¢ per lb.
415.10	00	Cesium, potassium, and sodium	lb.	11.5% ad val.	25% ad val.
415.15	00	Carbon	lb.	4% ad val.	20% ad val.
415.20	00	Chlorine	lb.	7% ad val.	25% ad val.
		Iodine:			
415.25	00	Crude	lb.	Free	Free
415.27	00	Resublimed	lb.	8¢ per lb.	10¢ per lb.
415.30	00	Lithium	lb.	17% ad val.	25% ad val.
415.35	00	Phosphorus	lb.	2.8¢ per lb.	8¢ per lb.
415.40	00	Rubidium	lb.	7% ad val.	25% ad val.
415.43	00	Sulfur	Ton	Free	Free
415.50	00	Other	lb.	7% ad val.	25% ad val.
		Subpart B. - Inorganic Acids			
		Subpart B headnote:			
		1. This subpart covers monobasic, dibasic, and polybasic inorganic acids. Salts and anhydrides of these acids are provided for in subpart C of this part.			
		Inorganic acids:			
416.05	00	Arsenic	lb.	2.1¢ per lb.	3¢ per lb.
416.10	00	Boric	lb.	0.4¢ per lb.	1¢ per lb.
416.15	00	Hydrochloric	lb.	Free	Free
416.20	00	Hydrofluoric	lb.	Free	Free
416.25	00	Nitric	lb.	Free	Free
416.30	00	Phosphoric	lb.	0.8¢ per lb.	2¢ per lb.
416.35	00	Sulfuric	lb.	Free	Free
416.40	00	Tungstic	lb.	20¢ per lb. on tungsten content + 14% ad val.	40¢ per lb. on tungsten content + 40% ad val.
		tungsten content	lb.		
416.45		Other		8.5% ad val.	25% ad val.
	20	Sulfonic acids	lb.		
	40	Other	lb.		

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		Subpart D. - Organic Chemical Compounds			
		Subpart D headnote:			
		1. This subpart does not include any inorganic compounds. Organic compounds in this subpart are arranged according to functional group. Any organic compound which is described in more than one functional group is classifiable in the first group in which it is described.			
		Nitrogenous compounds:			
425.00	00	Acrylonitrile	Lb.....	1.7¢ per lb. + 8.5% ad val.	6¢ per lb. + 30% ad val.
425.02	00	Aldehyde ammonia	Lb.....	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
425.04		Amino acids	.....	8.5% ad val.	25% ad val.
	20	*Methionine*	*Lb.*		
	40	*Other*	*Lb.*		
425.06	00	Amino acid salts	Lb.....	7% ad val.	25% ad val.
425.08	00	3-Amino-1,2,4-triazole	Lb.....	7% ad val.	25% ad val.
425.09	00	Ammonium alginate	Lb.....	5.5% ad val.	25% ad val.
425.10		Cyanuric chloride, melamine, and other compounds containing a triazine ring	.....	7% ad val.	25% ad val.
	20	*Melamine*	*Lb.*		
	40	*Other*	*Lb.*		
425.12	00	Diethanolamine, monoethanolamine, and triethanolamine	Lb.....	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
425.14	00	Ethylenediamine	Lb.....	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
425.18	00	Hexamethylenetetramine	Lb.....	3.1¢ per lb.	11¢ per lb.
425.20	00	Mono-, di-, and tri-(methyl-, ethyl-, propyl-, and butyl)monoamines	Lb.....	7% ad val.	25% ad val.
425.22	00	Ethylureas, methylolureas, octamethylpyrophosphoramide and other acyclic amides	Lb.....	7% ad val.	25% ad val.
425.24	00	Imides	Lb.....	7% ad val.	25% ad val.
425.26	00	Methyl ethyl ketoxime	Lb.....	7% ad val.	25% ad val.
425.28	00	N-Methyl-2-pyrrolidone	Lb.....	8.5% ad val.	25% ad val.
425.30	00	Monosodium glutamate	Lb.....	16% ad val.	25% ad val.
425.32	00	Nitroparaffins	Lb.....	7% ad val.	25% ad val.
425.34	00	2-Pyrrolidone	Lb.....	8.5% ad val.	25% ad val.
425.36	00	Thiourea, thiourea dioxide, and other thioamides; thiocarbamates, thiocyanates, thiurams, and isothiocyanates	Lb.....	7% ad val.	25% ad val.
425.38	00	N-Vinyl-2-pyrrolidone, monomer and polymer	Lb.....	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
		Dicyandiamide, guanidine salts and other acyclic amidines:			
425.39	00	Dicyandiamide	Lb.....	Free	25% ad val.
425.41	00	Other	Lb.....	7% ad val.	25% ad val.
		Other:			
425.42	00	Nitriles	Lb.....	7% ad val.	25% ad val.
425.52	00	Other	Lb.....	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
		Acids:			
425.70	00	Acetic	Lb.....	0.35¢ per lb.	2¢ per lb.
425.72	00	Chloroacetic	Lb.....	0.85¢ per lb.	5¢ per lb.
425.74	00	Citric	Lb.....	5.9¢ per lb.	17¢ per lb.
425.76	00	Formic	Lb.....	1.65¢ per lb.	3¢ per lb.
425.78	00	Gallic	Lb.....	4¢ per lb.	6¢ per lb.
425.82	00	Lactic acid	Lb.....	11% ad val.	35% ad val.
425.84	00	Naphthenic	Lb.....	5% ad val.	25% ad val.
425.86	00	Oxalic	Lb.....	2.65¢ per lb.	6¢ per lb.
425.88	00	Pyrogallic	Lb.....	9¢ per lb.	12¢ per lb.
425.94	00	Tartaric	Lb.....	4.2¢ per lb.	8¢ per lb.
425.96	00	Valeric	Lb.....	Free	Free
425.98	00	Other 1/	Lb.....	8.5% ad val.	25% ad val.
		Acid anhydrides:			
426.00	00	Acetic	Lb.....	1.05¢ per lb.	3.5¢ per lb.
426.02	00	Valeric	Lb.....	Free	Free
426.04	00	Other	Lb.....	8.5% ad val.	25% ad val.

1/ Heptanoic acid is temporarily free of duty by legislation. See Appendix to Tariff Schedules.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

Page 238

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS

4 - 2 - D Part 2. - Chemical Elements, Inorganic and Organic Compounds, and Mixtures

426.08 - 427.28

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		Salts of organic acids:			
426.08	00	Aluminum salts	Lb.	5.5% ad val.	25% ad val.
		Calcium salts:			
426.10	00	Acetate, crude	Lb.	0.2¢ per lb.	1¢ per lb.
426.12	00	Citrate (lime citrate)	Lb.	2.4¢ per lb.	7¢ per lb.
426.14	00	Oxalate	Lb.	3.2¢ per lb.	4¢ per lb.
426.16	00	Tartrate, crude	Lb.	Free	Free
426.18	00	Other	Lb.	7% ad val.	25% ad val.
426.22	00	Cerium salts	Lb.	21% ad val.	35% ad val.
		Cobalt salts:			
426.24	00	Resinate	Lb.	8% ad val.	30% ad val.
426.26	00	Other	Lb.	8% ad val.	30% ad val.
		Copper salts:			
426.28	00	Acetate and subacetate	Lb.	1.35¢ per lb. on copper content	4¢ per lb. on copper content
		copper content	*Lb. v*		
426.32	00	Naphthenate	Lb.	0.8¢ per lb. + 7.3% ad val.	3¢ per lb. + 25% ad val.
426.34	00	Other	Lb.	0.8¢ per lb. + 7.3% ad val.	3¢ per lb. + 25% ad val.
		Lead salts:			
426.36	00	Acetate	Lb.	1¢ per lb.	2.5¢ per lb.
426.42	00	Resinate	Lb.	1.2¢ per lb.	3¢ per lb.
426.44	00	Other	Lb.	10% ad val.	30% ad val.
426.46	00	Lithium salts	Lb.	7% ad val.	25% ad val.
		Manganese salts:			
426.52	00	Resinate	Lb.	7% ad val.	25% ad val.
426.54	00	Other	Lb.	9.5% ad val.	25% ad val.
426.56	00	Mercurial salts	Lb.	12¢ per lb. + 8.5% ad val.	22¢ per lb. + 25% ad val.
		Nickel salts:			
426.58	00	Acetate	Lb.	7% ad val.	25% ad val.
426.62	00	Formate	Lb.	7% ad val.	25% ad val.
426.64	00	Other	Lb.	7% ad val.	25% ad val.
		Potassium salts:			
426.72	00	Antimony tartrate (tartar emetic)	Lb.	4¢ per lb.	6¢ per lb.
		Bitartrate:			
426.74	00	Containing under 90 percent potassium bitartrate by weight (argols)	Lb.	Free	Free
		Containing 90 percent or more potassium bitartrate by weight:			
426.76	00	Cream of tartar	Lb.	3.125¢ per lb.	5¢ per lb.
426.77	00	Other	Lb.	1.75¢ per lb.	5¢ per lb.
426.78	00	Citrate	Lb.	9.8¢ per lb.	14¢ per lb.
426.82	00	Sodium tartrate (Rochelle salts)	Lb.	3.5¢ per lb.	5¢ per lb.
426.84	00	Other	Lb.	5.5% ad val.	25% ad val.
		Sodium salts:			
426.86	00	Acetate	Lb.	7% ad val.	25% ad val.
426.88	00	Alginate	Lb.	7.5% ad val.	25% ad val.
426.92	00	Bitartrate	Lb.	7% ad val.	25% ad val.
426.94	00	Citrate	Lb.	8.4¢ per lb.	12¢ per lb.
426.96	00	Formaldehyde sulfoxylate	Lb.	24% ad val.	35% ad val.
426.98	00	Formate	Lb.	1.4¢ per lb.	2¢ per lb.
427.02	00	Oxalate	Lb.	1.7¢ per lb.	2.5¢ per lb.
427.04	00	Other	Lb.	7% ad val.	25% ad val.
		Strontium salts:			
427.06	00	Potassium oxalate	Lb.	7% ad val.	25% ad val.
427.08	00	Other	Lb.	7% ad val.	25% ad val.
427.12	00	Tellurium salts	Lb.	7% ad val.	25% ad val.
427.14	00	Thorium salts	Lb.	24% ad val.	35% ad val.
427.16	00	Tin salts	Lb.	8.5% ad val.	25% ad val.
		Titanium salts:			
427.18	00	Potassium oxalate	Lb.	10% ad val.	30% ad val.
427.20	00	Other	Lb.	10% ad val.	30% ad val.
427.22	00	Vanadium salts	Lb.	22% ad val.	40% ad val.
		Zinc salts:			
427.24	00	Zinc formaldehyde sulfoxylate	Lb.	24% ad val.	35% ad val.
427.25	00	Other	Lb.	7% ad val.	25% ad val.
427.28	00	All other salts of organic acids	Lb.	7% ad val.	25% ad val.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 2. - Chemical Elements, Inorganic and Organic Compounds, and Mixtures

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
427.30	00	Acyl halides	Lb	7% ad val.	25% ad val.
		Aldehydes:			
427.40	00	Acetaldehyde	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
427.42	00	Aldol or acetaldol	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
427.44	00	Butyraldehyde	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
427.45	00	Chloroacetaldehyde	Lb	7% ad val.	25% ad val.
427.46	00	Crotonaldehyde	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
427.48	00	Formaldehyde (including solutions)	Lb	0.6¢ per lb.	1.75¢ per lb.
427.52	00	Furfural	Lb	Free	Free
427.53	00	Glyoxal	Lb	7% ad val.	25% ad val.
427.54	00	Paracetaldehyde	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
427.56	00	Paraformaldehyde	Lb	2.8¢ per lb.	8¢ per lb.
427.58	00	Other	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
		Ketones:			
427.60	00	Acetone	Lb	5.5% ad val.	20% ad val.
427.62	00	Ethyl methyl ketone	Lb	5.5% ad val.	20% ad val.
427.64	00	Other	Lb	5.5% ad val.	20% ad val.
		Alcohols, monohydric, unsubstituted:			
427.70	00	Allyl	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
427.72	00	Amyl	Lb	2.4¢ per lb.	6¢ per lb.
427.74	00	Butyl	Lb	1.7¢ per lb.	6¢ per lb.
427.82	00	Crotonyl	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
427.84	00	Decyl	Lb	7% ad val.	25% ad val.
427.86	00	Ethyl for nonbeverage purposes	Gal	4.2¢ per gal.	15¢ per gal.
427.88	00	Fusel oil	Lb	2¢ per lb.	6¢ per lb.
427.94	00	Hexyl	Lb	2.1¢ per lb.	6¢ per lb.
427.96	00	Methyl	Gal	10.7¢ per gal.	38¢ per gal.
427.98	00	Octyl	Lb	7% ad val.	25% ad val.
428.04	00	Propargyl	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
428.06	00	Propyl	Lb	2.4¢ per lb.	6¢ per lb.
428.12	00	Other	Lb	7% ad val.	25% ad val.
		Halohydrins:			
428.20	00	Butylene chlorohydrin	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
428.22	00	Ethylene chlorohydrin	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
428.24	00	Propylene chlorohydrin	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
428.26	00	Other	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
		Alcohols, polyhydric (including glycols, polyglycols, diols, and polyols), and esters, ethers, and ether-esters and substituted derivatives of any of the foregoing:			
428.30	00	Butylene glycol and propylene glycol	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
428.32	00	Dipentaerythritol and pentaerythritol	Lb	7% ad val.	25% ad val.
428.34	00	Ethylene glycol	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
		Glycerine:			
428.36	00	Crude	Lb	0.25¢ per lb.	1¢ per lb.
428.38	00	Refined	Lb	0.7¢ per lb.	2¢ per lb.
428.40	00	Glycerine esters and ethers	Lb	7% ad val.	25% ad val.
428.42	00	Polyalcohols, unlisted	Lb	7% ad val.	25% ad val.
		Other:			
428.44	00	Diols and tetrols	Lb	7% ad val.	25% ad val.
428.46	00	Other	Lb	2.1¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

STAGED RATES AND HISTORICAL NOTES

Notes p. 4
Schedule 4,
Part 2

Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002 (con.):

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 --				
		1968	1969	1970	1971	1972
421.60	32% ad val.	28.5% ad val.	25.5% ad val.	22% ad val.	19% ad val.	16% ad val.
421.62	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
421.72	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
421.74	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
421.76	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
421.84	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
421.86	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
421.90	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
422.00	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
422.10	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
422.12	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
422.14	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
422.20	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
422.24	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
422.26	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
422.30	15% ad val.	13% ad val.	12% ad val.	10% ad val.	9% ad val.	7.5% ad val.
422.40	42¢ per lb. on tungsten content + 25% ad val.	37.4¢ per lb. on tungsten content + 22% ad val.	33¢ per lb. on tungsten content + 20% ad val.	28.4¢ per lb. on tungsten content + 17% ad val.	25¢ per lb. on tungsten content + 15% ad val.	21¢ per lb. on tungsten content + 12.5% ad val.
422.44	42¢ per lb. on tungsten content + 20% ad val.	37¢ per lb. on tungsten content + 18% ad val.	33¢ per lb. on tungsten content + 16% ad val.	28¢ per lb. on tungsten content + 14% ad val.	25¢ per lb. on tungsten content + 12% ad val.	21¢ per lb. on tungsten content + 10% ad val.
422.58	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
422.60	32% ad val.	28.5% ad val.	25.5% ad val.	22% ad val.	19% ad val.	16% ad val.
422.62	32% ad val.	28.5% ad val.	25.5% ad val.	22% ad val.	19% ad val.	16% ad val.
422.70	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
422.74 1/	0.65¢ per lb.	0.59¢ per lb.	0.54 per lb.	0.45¢ per lb.	0.38¢ per lb.	0.3¢ per lb.
422.74	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
422.76 1/	0.3¢ per lb.	0.25¢ per lb.	0.24¢ per lb.	0.2¢ per lb.	0.18¢ per lb.	0.15¢ per lb.
422.78	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
422.80	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
422.82	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
422.86 1/	6.25% ad val.	5.5% ad val.	5% ad val.	4% ad val.	3.5% ad val.	3% ad val.
422.92	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
422.94	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
422.96	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
422.98	28% ad val.	25% ad val.	22% ad val.	19.5% ad val.	16.5% ad val.	14% ad val.
423.84	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
423.86	16.5¢ per lb. + 12.5% ad val.	16¢ per lb. + 11% ad val.	14¢ per lb. + 10% ad val.	12.5¢ per lb. + 8.5% ad val.	11.1¢ per lb. + 7% ad val.	9¢ per lb. + 6% ad val.
423.88	20¢ per lb. on molybdenum content + 6% ad val.	18¢ per lb. on molybdenum content + 5% ad val.	16¢ per lb. on molybdenum content + 4.5% ad val.	14¢ per lb. on molybdenum content + 4% ad val.	12¢ per lb. on molybdenum content + 3.5% ad val.	10¢ per lb. on molybdenum content + 3% ad val.
423.92	42¢ per lb. on tungsten content + 20% ad val.	37¢ per lb. on tungsten content + 18% ad val.	33¢ per lb. on tungsten content + 16% ad val.	29¢ per lb. on tungsten content + 14% ad val.	25¢ per lb. on tungsten content + 12% ad val.	21¢ per lb. on tungsten content + 10% ad val.
423.94	32% ad val.	28.5% ad val.	25.5% ad val.	22% ad val.	19% ad val.	16% ad val.
423.96	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.00	2.5¢ per lb. + 12.5% ad val.	2.2¢ per lb. + 11% ad val.	2¢ per lb. + 10% ad val.	1.7¢ per lb. + 8.5% ad val.	1.5¢ per lb. + 7% ad val.	1.25¢ per lb. + 6% ad val.
425.02	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
425.04	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
425.06	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.08	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.09	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.

1/ See footnote 1 at the end of this list of Staged Rates.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

STAGED RATES AND HISTORICAL NOTES

Notes p. 5
Schedule 4,
Part 2

Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002 (con.):

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 --				
		1968	1969	1970	1971	1972
425.10	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.12	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
425.14	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
425.18	4.5¢ per lb.	4¢ per lb.	3.6¢ per lb.	3.1¢ per lb.	2.7¢ per lb.	2.2¢ per lb.
425.20	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.22	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.24	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.26	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.28	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
425.32	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.34	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
425.36	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.38	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
425.39	10.5% ad val.	Free	Free	Free	Free	Free
425.41	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.42	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
425.52	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
425.70	0.53¢ per lb.	0.45¢ per lb.	0.4¢ per lb.	0.35¢ per lb.	0.3¢ per lb.	0.265¢ per lb.
425.72	1.25¢ per lb.	1.1¢ per lb.	1¢ per lb.	0.85¢ per lb.	0.7¢ per lb.	0.6¢ per lb.
425.74	8.5¢ per lb.	7.6¢ per lb.	6.8¢ per lb.	5.9¢ per lb.	5¢ per lb.	4.2¢ per lb.
425.76	2.4¢ per lb.	2.15¢ per lb.	1.9¢ per lb.	1.65¢ per lb.	1.44¢ per lb.	1.2¢ per lb.
425.78	6¢ per lb.	5¢ per lb.	4.5¢ per lb.	4¢ per lb.	3.5¢ per lb.	3¢ per lb.
425.82	16% ad val.	14% ad val.	12.5% ad val.	11% ad val.	9.5% ad val.	8% ad val.
425.84 1/	6.6% ad val.	5.5% ad val.	5% ad val.	4.5% ad val.	3.5% ad val.	3% ad val.
425.86	3.8¢ per lb.	3.4¢ per lb.	3¢ per lb.	2.65¢ per lb.	2.25¢ per lb.	1.9¢ per lb.
425.88 1/	12¢ per lb.	10¢ per lb.	9¢ per lb.	8¢ per lb.	7¢ per lb.	6¢ per lb.
425.94	6¢ per lb.	5.4¢ per lb.	4.8¢ per lb.	4.2¢ per lb.	3.5¢ per lb.	3¢ per lb.
425.98	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
426.00	1.5¢ per lb.	1.35¢ per lb.	1.2¢ per lb.	1.05¢ per lb.	0.9¢ per lb.	0.75¢ per lb.
426.04	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
426.08	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
426.10 1/	0.25¢ per lb.	0.2¢ per lb.	0.2¢ per lb.	0.15¢ per lb.	0.1¢ per lb.	0.1¢ per lb.
426.12	3.5¢ per lb.	3.1¢ per lb.	2.8¢ per lb.	2.4¢ per lb.	2.1¢ per lb.	1.7¢ per lb.
426.14 1/	4¢ per lb.	3.5¢ per lb.	3.2¢ per lb.	2.8¢ per lb.	2.4¢ per lb.	2¢ per lb.
426.18	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
426.22	30% ad val.	27% ad val.	24% ad val.	21% ad val.	18% ad val.	15% ad val.
426.24	12% ad val.	10.5% ad val.	9.5% ad val.	8% ad val.	7% ad val.	6% ad val.
426.26	12% ad val.	10.5% ad val.	9.5% ad val.	8% ad val.	7% ad val.	6% ad val.
426.28 1/	1.7¢ per lb. on copper content	1.5¢ per lb. on copper content	1.35¢ per lb. on copper content	1.15¢ per lb. on copper content	1¢ per lb. on copper content	0.8¢ per lb. on copper content
426.32	1.275¢ per lb. + 10.5% ad val.	1.1¢ per lb. + 9.4% ad val.	1¢ per lb. + 8.4% ad val.	0.8¢ per lb. + 7.3% ad val.	0.7¢ per lb. + 6.3% ad val.	0.6¢ per lb. + 5% ad val.
426.34	1.275¢ per lb. + 10.5% ad val.	1.1¢ per lb. + 9.4% ad val.	1¢ per lb. + 8.4% ad val.	0.8¢ per lb. + 7.3% ad val.	0.7¢ per lb. + 6.3% ad val.	0.6¢ per lb. + 5% ad val.
426.36 1/	1.25¢ per lb.	1.1¢ per lb.	1¢ per lb.	0.8¢ per lb.	0.7¢ per lb.	0.6¢ per lb.
426.42 1/	1.5¢ per lb.	1.3¢ per lb.	1.2¢ per lb.	1¢ per lb.	0.9¢ per lb.	0.7¢ per lb.
426.44	15% ad val.	13% ad val.	12% ad val.	10% ad val.	9% ad val.	7.5% ad val.
426.46	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
426.52	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
426.54	14% ad val.	12.5% ad val.	11% ad val.	9.5% ad val.	8% ad val.	7% ad val.
426.56	18.5¢ per lb. + 12.5% ad val.	16¢ per lb. + 11% ad val.	14¢ per lb. + 10% ad val.	12¢ per lb. + 8.5% ad val.	11.1¢ per lb. + 7% ad val.	9¢ per lb. + 6% ad val.
426.58	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
426.62	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.

1/ See footnote 1 at the end of this list of Staged Rates.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

STAGED RATES AND HISTORICAL NOTES

Notes p. 6
Schedule 4,
Part 2

Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002 (con.):

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 --				
		1968	1969	1970	1971	1972
426.64	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
426.72	6¢ per lb.	5.4¢ per lb.	4.8¢ per lb.	4¢ per lb.	3.5¢ per lb.	3¢ per lb.
426.77	2.5¢ per lb.	2.25¢ per lb.	2¢ per lb.	1.75¢ per lb.	1.5¢ per lb.	1.2¢ per lb.
426.78	14¢ per lb.	12.5¢ per lb.	11.2¢ per lb.	9.8¢ per lb.	8.4¢ per lb.	7¢ per lb.
426.82	5¢ per lb.	4.5¢ per lb.	4¢ per lb.	3.5¢ per lb.	3¢ per lb.	2.5¢ per lb.
426.84	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
426.86	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
426.88	10% ad val.	9% ad val.	8% ad val.	7.5% ad val.	6.5% ad val.	6% ad val.
426.92	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
426.94	12¢ per lb.	10.8¢ per lb.	9.5¢ per lb.	8.4¢ per lb.	7.2¢ per lb.	6¢ per lb.
426.96	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
426.98	2¢ per lb.	1.8¢ per lb.	1.6¢ per lb.	1.4¢ per lb.	1.2¢ per lb.	1¢ per lb.
427.02	2.5¢ per lb.	2.2¢ per lb.	2¢ per lb.	1.7¢ per lb.	1.5¢ per lb.	1.2¢ per lb.
427.04	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.06	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.08	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.12	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.14	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
427.16	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
427.18	15% ad val.	13% ad val.	12% ad val.	10% ad val.	9% ad val.	7.5% ad val.
427.20	15% ad val.	13% ad val.	12% ad val.	10% ad val.	9% ad val.	7.5% ad val.
427.22	32% ad val.	28.5% ad val.	25.5% ad val.	22% ad val.	19% ad val.	16% ad val.
427.24	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
427.25	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.28	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.30	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.40	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
427.42	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
427.44	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
427.45	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.46	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
427.48	0.875¢ per lb.	0.78¢ per lb.	0.7¢ per lb.	0.6¢ per lb.	0.52¢ per lb.	0.43¢ per lb.
427.53	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.54	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
427.56	4¢ per lb.	3.6¢ per lb.	3.2¢ per lb.	2.8¢ per lb.	2.4¢ per lb.	2¢ per lb.
427.58	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
427.60	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
427.62	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
427.64	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
427.66	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
427.72 1/	3¢ per lb.	2.7¢ per lb.	2.4¢ per lb.	2¢ per lb.	1.8¢ per lb.	1.5¢ per lb.
427.74	2.4¢ per lb.	2.2¢ per lb.	2¢ per lb.	1.7¢ per lb.	1.5¢ per lb.	1.2¢ per lb.
427.87	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
427.88	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.89	8¢ per gal.	7.4¢ per gal.	6.8¢ per gal.	6.2¢ per gal.	5.6¢ per gal.	5¢ per gal.
427.92	3¢ per lb.	2.7¢ per lb.	2.4¢ per lb.	2¢ per lb.	1.8¢ per lb.	1.5¢ per lb.
427.94	2¢ per lb.	1.8¢ per lb.	1.6¢ per lb.	1.4¢ per lb.	1.2¢ per lb.	1¢ per lb.
427.96	12.5¢ per gal.	11.4¢ per gal.	10.4¢ per gal.	9.4¢ per gal.	8.4¢ per gal.	7.5¢ per gal.
427.98	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.04	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.

1/ See footnote 1 at the end of this list of staged rates.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

STAGED RATES AND HISTORICAL NOTES

Notes p. 8
Schedule 4,
Part 2

Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 [Kennedy Round], Dec. 16, 1967, 32 F.R. 19002 (con.):

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 --				
		1968	1969	1970	1971	1972
428.42 1/	7.5% ad val.	6.5% ad val.	6% ad val.	5% ad val.	4% ad val.	3.5% ad val.
428.44	7.5¢ per lb. + 12.5% ad val.	6.8¢ per lb. + 11% ad val.	6¢ per lb. + 10% ad val.	5.2¢ per lb. + 8.5% ad val.	4.5¢ per lb. + 7% ad val.	3.8¢ per lb. + 6% ad val.
428.46	2.5¢ per lb. + 12.5% ad val.	2.2¢ per lb. + 11% ad val.	2¢ per lb. + 10% ad val.	1.7¢ per lb. + 8.5% ad val.	1.5¢ per lb. + 7% ad val.	1.2¢ per lb. + 6% ad val.
428.47	14 per lb. + 15% ad val.	9.7¢ per lb. + 13% ad val.	7.4¢ per lb. + 12% ad val.	7.1¢ per lb. + 10% ad val.	3.5¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
428.48	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.52	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.54	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.56	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
430.00	10.5% ad val., but not less than the highest rate applicable to any component compound	9% ad val., but not less than the highest rate applicable to any component compound	8% ad val., but not less than the highest rate applicable to any component compound	7% ad val., but not less than the highest rate applicable to any component compound	6% ad val., but not less than the highest rate applicable to any component compound	5% ad val., but not less than the highest rate applicable to any component compound
432.00	10.5% ad val., but not less than the highest rate applicable to any component material	9% ad val., but not less than the highest rate applicable to any component material	8% ad val., but not less than the highest rate applicable to any component material	7% ad val., but not less than the highest rate applicable to any component material	6% ad val., but not less than the highest rate applicable to any component material	5% ad val., but not less than the highest rate applicable to any component material

1/ In accordance with general note 3(f) to Schedule XX (Geneva - 1967), the rates of duty for this item in the columns headed 1970, 1971, 1972 were to become effective unless the European Economic Community and the United Kingdom had not proceeded with certain reductions provided for in their respective schedules annexed to the Geneva (1967) Protocol to the GATT. These two participants have not so proceeded, and the President has so proclaimed (Pres. Proc. 3950, Dec. 24, 1969, 34 F.R. 20299), effective date January 1, 1970), with the result that the rate of duty in the column headed 1969 will continue in effect unless or until the President proclaims that they have agreed so to proceed. See related footnote 1 to Kennedy Round Staged Rates at the end of schedule 4, parts 3, 4, 5, 7, 8, 9, and 13; schedule 5, part 1; schedule 6, part 2; and schedule 7, parts 2, 9, 12, and 13.

Other Amendments and Modifications

PROVISION

425.39--Item 425.40 (column 1 rate--10.5% ad val.; 425.40 column 2 rate--25% ad val.) deleted and 425.41 items 425.39 and 425.41 and heading immediately preceding item 425.39 added in lieu thereof. Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002, effective date Jan. 1, 1968.

425.82--Column 1 and 2 rates of duty increased from 12.5% ad val. and 25% ad val., respectively, to 16% ad val. and 35% ad val., respectively. Pub. L. 89-241, Secs. 2(a), 22, Oct. 7, 1965, 79 Stat. 933, 938, effective date Dec. 7, 1965.

426.88--Column 1 rate of duty of 11% ad val. reduced to 10% ad val. on Jan. 1, 1964. General headnote 3(g).

PROVISION

428.30--Language "and organic or inorganic acids [except hydrogen cyanide and hydrogen halide acids]" added 428.52 to heading immediately preceding item 428.30. Pub. 428.54 L. 89-241, Secs. 2(a), 22, Oct. 7, 1965, 79 Stat. 428.56 933, 938, effective date Dec. 7, 1965.
428.64
428.66
428.68
428.72

429.80--Item 429.80 (Cellulose compounds: column 1 rate--15¢ per lb., column 2 rate--45¢ per lb.) deleted. Pub. L. 89-241, Secs. 2(a), 24(a), Oct. 7, 1965, 79 Stat. 933, 938, effective date Dec. 7, 1965.

429.85--Item 429.85 (column 1 rate--10.5% ad val., column 2 429.90 rate--25% ad val.) deleted and items 429.85 and 429.95 429.86 added in lieu thereof. Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002, effective date Jan. 1, 1968.

Statistical Notes

PROVISION	Effective date
410.46--	
20--Other (transferred to 410.45(1) & 45).....	Jan. 1, 1967
27--Brit. (transferred from 410.50(pt.).....	do
40--Total.	do
410.54--	
10--Dutch (transferred from 410.50(0 & 40)...Jan. 1, 1968	
40--Other (transferred to 410.56(0).....	do
60--Other.	do

417.15--See Other Amendments and Modifications (item 807.70)
10--Alcohol imported for use in producing alcohol temporarily transferred to 807.1500.....Sept. 1, 1966

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

STAGED RATES AND HISTORICAL NOTES

Notes p. 9
Schedule 4,
Part 2

Statistical Notes--(con.)

PROVISION	Effective date
420.92--	
00--Unit of quantity changed from "lb." to "S. ton" of salt content	Jan. 1, 1964
420.94--	
00--Unit of quantity changed from "lb." to "S. ton"	Jan. 1, 1964
423.00--	
20--Disc.(transferred to 423.00[illegible])	Jan. 1, 1968
80--Disc. do	do
90--Estab.(transferred from 423.00[illegible] & 80)	do
425.04--	
00--Amino acids used as animal feeds and ingredients therefor transferred from 184.7500	Dec. 7, 1965
Disc.(transferred to 425.0420 & 40)	Jan. 1, 1968
20--Estab.(transferred from 425.0400pt)	do
40--Estab. do	do
425.10--	
00--Disc.(transferred to 425.1020 & 40)	Jan. 1, 1966
20--Estab.(transferred from 425.1000pt)	do
40--Estab. do	do
425.39--See Other Amendments and Modifications	
00--Estab.(transferred from 425.4000pt)	Jan. 1, 1968
425.40--See Other Amendments and Modifications	
00--Disc.(transferred to 425.3900 & 425.4100)	Jan. 1, 1968
425.41--See Other Amendments and Modifications	
00--Estab.(transferred from 425.4000pt)	Jan. 1, 1968

PROVISION	Effective date
425.[illegible]--See Other Amendments and Modifications	
425.[illegible]--See Amendments and Modifications (item 907.30)	
42[illegible]--See Other Amendments and Modifications	
42[illegible]--See Other Amendments and Modifications	
42[illegible]--See Other Amendments and Modifications	
42[illegible]--See Other Amendments and Modifications	
42[illegible]--See Other Amendments and Modifications	
42[illegible]--See Other Amendments and Modifications	
42[illegible]--See Other Amendments and Modifications	
42[illegible]--See Other Amendments and Modifications	
42[illegible]--See Other Amendments and Modifications	
42[illegible].72--See Other Amendments and Modifications	
42[illegible]--See Other Amendments and Modifications	
00--Disc.(transferred to 4[illegible] & 4[illegible])	Dec. 7, 19[illegible]
42[illegible]--See Other Amendments and Modifications	
00--Estab.(transferred from 42[illegible]pt)	Jan. 1, 1968
42[illegible]--See Other Amendments and Modifications	
00--Disc.(transferred to 42[illegible] & 42[illegible])	Jan. 1, 1968
42[illegible]--See Other Amendments and Modifications	
00--Estab.(transferred from 42[illegible]pt)	Jan. 1, 1968

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1970)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 13. - Fatty Substances, Camphor, Chars and Carbons, Isotopes, Waxes, and Other Products

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		Subpart B. - Camphor, Chars and Carbons, Isotopes, Waxes, and Other Products			
		Subpart B headnote: 1. For the purposes of this part — (a) the term "crude", in items 493.02, 493.20, and 493.59, has the same meaning as is given for that term in headnote 1(a) of part 3 of this schedule; and (b) the term "advanced" in items 493.04, 493.21, and 493.86, has the same meaning as is given for that term in headnote 1(a) in part 3 of this schedule.			
		Barbasco or cube root, and derris, tuba or tuba root:			
493.01	00	Crude	lb.	Free	Free
493.01	00	Advanced	lb.	Free	10% ad val.
493.10	00	Blackings, powders, liquids, and creams for polishing and cleaning, all the foregoing in immediate containers holding not over 10 pounds each	X	4% ad val.	25% ad val.
		Casein and mixtures in chief value thereof:			
493.15	00	Casein	lb.	Free	Free
493.16	00	Other	lb.	1.5¢ per lb.	4.5¢ per lb.
493.18	00	Cellulose compounds, not specially provided for	lb.	11¢ per lb.	45¢ per lb.
		Camphor:			
		Natural:			
493.20	00	Crude	lb.	2.4¢ per lb.	4¢ per lb.
493.21	00	Advanced	lb.	2.4¢ per lb.	4¢ per lb.
493.22	00	Synthetic	lb.	2.4¢ per lb.	4¢ per lb.
		Chars and carbons:			
493.25	00	Bone char	lb.	14% ad val.	25% ad val.
493.26	00	Decolorizing and gas or vapor absorbing chars and carbons, whether or not activated	lb.	10% ad val.	45% ad val.
493.30	00	Dextrine and soluble or chemically treated starches	lb.	1.125¢ per lb. 1/	4¢ per lb.
493.35	00	Fabrics	lb.	Free	Free
493.40	00	Mineral salts obtained by evaporation from the waters of a designated mineral spring	lb.	Free	Free
493.42	00	Preparations containing over 50 percent by weight of monosodium glutamate	X	16% ad val.	25% ad val.
		Pitch:			
493.45	00	Burgundy	lb.	Free	Free
493.46	00	Marine glue	lb.	11% ad val.	30% ad val.
493.47	00	Wood	lb.	2.4¢ per lb.	4¢ per lb.
493.50	00	Products chiefly used as assistants in preparing or finishing textiles, not specially provided for	lb.	8.5% ad val.	45% ad val.
		Pyrethrum or insect flowers:			
493.53	00	Crude	lb.	Free	Free
493.54	00	Advanced	lb.	1% ad val.	10% ad val.

1/ Rate temporarily increased by proclamation. See appendix to tariff schedules.

A P P E N D I X B

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1969.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1969

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries		First supplier		Second supplier		Third supplier	
	Amount in 1969	Percent change from 1968	Country	Value	Country	Value	Country	Value
Acrylonitrile (p. 3)								
425.00	4	-38	W. Germany	4	-	-	-	-
Amino acids and salts, not elsewhere enumerated (p. 7)								
425.04	5,923	+26	Japan	2,935	France	1,764	W. Germany	779
425.06	672	+4	Japan	520	W. Germany	130	France	7
3-Amino-1,2,4-triazole (p. 11)								
425.08	832	+12	Canada	704	W. Germany	64	France	63
Triazine compounds (p. 15)								
425.1020	5,882	-22	Japan	2,082	W. Germany	1,848	U.K.	626
425.1040	3,071	-10	Japan	1,526	Switzerland	842	W. Germany	690
Ethanolamines (p. 21)								
425.12	19	-78	Canada	9	U.K.	5	W. Germany	4
Hexamethylenetetramine (p. 27)								
425.18	501	-37	Canada	476	France	19	Belgium	4
Mono-, di, tri-(methyl-, ethyl-, propyl-, and butyl)monoamines (p. 31)								
425.20	222	+34	Japan	102	W. Germany	83	Ireland	31
Amides and imides (p. 35)								
425.22	3,843	+23	Japan	1,848	Switzerland	750	Italy	577
425.24	22	+518	France	9	W. Germany	6	Peru	4
Methyl ethyl ketoxime (p. 39)								
425.26	753	+95	Japan	360	Netherlands	121	U.K.	79
Pyrrolidone compounds (p. 43)								
425.28	175	+376	W. Germany	175	-	-	-	-
425.34	5	1/	W. Germany	5	Belgium	3/	-	-
425.38	440	-24	W. Germany	420	Norway	15	Belgium	5
Monosodium glutamate and preparations (p. 47)								
425.30	2,672	+50	Japan	2,473	Taiwan	167	-	-
493.42	27	-45	Japan	25	-	-	-	-
Thio-nitrogenous compounds (p. 53)								
425.36	1,842	-4	Japan	777	Netherlands	494	Italy	156
Dicyandiamide, guanidine salts, and other acyclic amidines (p. 59)								
425.39	7,563	+2	Canada	7,042	Japan	344	Norway	157
425.41	2,039	+20	Canada	1,844	W. Germany	166	Netherlands	20
Nitriles, not elsewhere enumerated (p. 63)								
425.42	3,936	+26	Japan	2,325	Canada	580	Rep. S.Af.	452
Nitrogenous compounds, not elsewhere enumerated (p. 67)								
425.02	2/	-	-	-	-	-	-	-
425.14	9	3/	Canada	9	-	-	-	-
425.32	7	1/	France	7	U.K.	3/	-	-
425.52	3,546	+14	W. Germany	1,823	Japan	474	Switzerland	432

See footnotes at end of table.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1969

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries: Amount in 1969	All countries: Percent change from 1968	First supplier: Country	First supplier: Value	Second supplier: Country	Second supplier: Value	Third supplier: Country	Third supplier: Value
Acetic acid (p. 79)								
425.70	534	-26	Canada	531	Netherlands	2	W. Germany	2
Chloroacetic acid (p. 85)								
425.72	2,611	-27	W. Germany	959	France	710	Netherlands	661
Citric acid (p. 91)								
425.74	48	-33	Belgium	48	-	-	-	-
Formic and oxalic acids (p. 95)								
425.76	30	-83	W. Germany	27	Canada	3	-	-
425.86	228	-1	Japan	154	W. Germany	63	Italy	9
Lactic acid (p. 103)								
425.82	172	+24	U.K.	118	Japan	31	Netherlands	14
Naphthenic acids (p. 109)								
425.84	979	+4	N. Antilles	707	W. Germany	136	Trinidad	128
Organic acids, not elsewhere enumerated (p. 115)								
425.78	-	-	-	-	-	-	-	-
425.88	3/	1/	Japan	3/	-	-	-	-
425.96	47	+1	W. Germany	47	-	-	-	-
425.98	3,948	-22	W. Germany	1,985	U.K.	480	France	425
Acetic anhydride (p. 123)								
426.00	2,106	-9	Canada	2,106	-	-	-	-
Acid anhydrides, not elsewhere enumerated (p. 127)								
426.02	34	1/	Canada	34	-	-	-	-
426.04	35	+71	W. Germany	33	U.K.	1	Canada	-
Calcium salts of organic acids (p. 131)								
426.10	1	1/	W. Germany	1	U.K.	3/	-	-
426.12	-	-	-	-	-	-	-	-
426.14	-	-	-	-	-	-	-	-
426.18	581	+35	U.K.	512	Japan	27	Netherlands	22
Copper salts of organic acids (p. 135)								
426.28	2	1/	U.K.	2	-	-	-	-
426.32	2/	-	-	-	-	-	-	-
426.34	-	-	-	-	-	-	-	-
Lead salts of organic acids (p. 141)								
426.36	17	+94	Mexico	17	Sweden	1	-	-
426.42	2/	-	-	-	-	-	-	-
426.44	2	+86	Argentina	2	-	-	-	-
Nickel salts of organic acids (p. 147)								
426.58	2	-34	Italy	2	-	-	-	-
426.62	30	1/	W. Germany	30	-	-	-	-
426.64	8	1/	Austria	3	France	3	Canada	2

See footnotes at end of table.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1969

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries: Amount in 1969	All countries: Percent change from 1968	First supplier: Country	First supplier: Value	Second supplier: Country	Second supplier: Value	Third supplier: Country	Third supplier: Value
Crude tartars and finished tartrates (p. 151)								
425.94	2,106	+20	Spain	1,283	Italy	353	Argentina	207
426.16	3/	1/	W. Germany	3/	-	-	-	-
426.72	60	-43	Japan	31	Italy	29	-	-
426.74	-	-	-	-	-	-	-	-
426.76	703	+9	Italy	472	Spain	225	France	7
426.77	-	-	-	-	-	-	-	-
426.82	203	+72	France	93	Spain	83	Italy	25
426.92	2/	-	-	-	-	-	-	-
Ammonium alginate and sodium alginate (p. 163)								
425.00	4	-38	W. Germany	4	-	-	-	-
426.88	594	+13	U.K.	292	Canada	177	Norway	73
Sodium formaldehyde sulfoxylate and zinc formaldehyde sulfoxylate (p. 169)								
426.96	4	1/	U.K.	4	-	-	-	-
427.24	14	-49	W. Germany	14	-	-	-	-
Sodium salts of organic acids (p. 173)								
426.86	148	-43	W. Germany	130	Canada	9	U.K.	4
426.94	2/	-	-	-	-	-	-	-
426.98	-	-	-	-	-	-	-	-
427.02	3	1/	Japan	2	W. Germany	1	-	-
427.04	973	+21	W. Germany	315	Netherlands	268	Japan	177
Strontium salts of organic acids (p. 177)								
427.06	-	-	-	-	-	-	-	-
427.08	-	-	-	-	-	-	-	-
Tin salts of organic acids (p. 179)								
427.16	-	-	-	-	-	-	-	-
Titanium salts of organic acids (p. 183)								
427.18	6	-36	U.K.	6	-	-	-	-
427.20	23	+41	Japan	19	U.K.	3	-	-
Salts of organic acids, not elsewhere enumerated (p. 187)								
426.08	35	-30	W. Germany	27	U.K.	9	-	-
426.22	1	1/	W. Germany	1	-	-	-	-
426.24	-	-	-	-	-	-	-	-
426.26	19	-69	U.K.	19	W. Germany	3/	-	-
426.46	12	1/	Japan	10	Canada	2	W. Germany	1
426.52	-	-	-	-	-	-	-	-
426.54	2	+405	France	2	-	-	-	-
426.56	2/	-	-	-	-	-	-	-
426.78	-	-	-	-	-	-	-	-
426.84	961	-14	Japan	772	W. Germany	159	U.K.	17
427.12	-	-	-	-	-	-	-	-
427.14	2/	-	-	-	-	-	-	-
427.22	-	-	-	-	-	-	-	-
427.25	17	+42	U.K.	17	-	-	-	-
427.28	242	+17	Mexico	87	U.K.	71	Sweden	60

See footnotes at end of table.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1969

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries		First supplier		Second supplier		Third supplier	
	Amount in 1969	Percent change from 1968	Country	Value	Country	Value	Country	Value
Acyl halides (p. 193)								
427.30	96	+32	W. Germany	52	Italy	26	France	16
Acetaldehyde (p. 199)								
427.40	3/	1/	Japan	3/	-	-	-	-
Butyraldehyde (p. 203)								
427.44	162	+3	Canada	153	W. Germany	8	Netherlands	1
Formaldehyde and paraformaldehyde (p. 207)								
427.48	61	+393	Canada	55	U.K.	6	-	-
427.56	5	4/	U.K.	3	W. Germany	2	-	-
Furfural (p. 213)								
427.52	2/	-	-	-	-	-	-	-
Glyoxal (p. 217)								
427.53	1,737	-26	France	1,407	Japan	285	W. Germany	45
Aldehydes, not elsewhere enumerated (p. 221)								
427.42	-	-	-	-	-	-	-	-
427.45	6	1/	W. Germany	6	-	-	-	-
427.46	8	1/	W. Germany	8	-	-	-	-
427.54	-	-	-	-	-	-	-	-
427.58	328	+20	Switzerland	114	France	111	U.K.	77
Acetone (p. 225)								
427.60	2,997	+22	Italy	2,842	France	155	-	-
Ethyl methyl ketone and other ketones, not elsewhere enumerated (p. 231)								
427.62	2,002	+59	Japan	1,197	W. Germany	382	France	233
427.64	2,735	+4	W. Germany	1,066	Japan	778	Switzerland	467

1/ No imports for 1968.
2/ No imports for 1969.
3/ Less than $500.
4/ More than 1,000 percent increase.

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

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Schedule	*Volume*	*Title*
1	1	Animals and Meats
1	2	Fish: Fresh, Chilled, Frozen, or Cured
1	3	Fish Products, Shellfish, and Shellfish Products
1	4	Dairy Products and Birds' Eggs
1	5	Live Plants and Seeds
1	6	Cereal Grains, Malts, Starches, and Animal Feeds
1	7	Vegetables and Edible Nuts
1	8	Edible Fruit
1	9	Sugar, Cocoa, Confectionery, Coffee, Tea and Spices
1	10	Beverages
1	11	Tobacco and Tobacco Products
1	12	Animal and Vegetable Fats and Oils
1	13	Hides, Skins, Leather, Feathers, and Miscellaneous Articles of Animal Origin
1	14	Edible Preparations, Natural Resins, and Miscellaneous Articles of Vegetable Origin
2	1	Wood and Related Products I
2	2	Wood and Related Products II
2	3	Paper and Related Products I
2	4	Paper and Related Products II
2	5	Books and Other Printed Matter
3	1	Fibers, Yarns, Waste, and Intermediate Products of Cotton, Other Vegetable Fibers, and Wool
3	2	Fibers, Yarns, Waste, and Intermediate Products of Silk, Manmade Fiber, Metalized, Paper, Certain Hair, and Yarns, N.S.P.F.
3	3	Fabrics, Woven, Knit, Pile, Tufted, and Narrow
3	4	Felts, Batting, Nonwoven Fabrics, Fish Nets, Machinery Belts and Clothing, Hose, Coated Fabrics, and Other Fabrics for Special Purposes
3	5	Textile Furnishings and Apparel
3	6	Cordage, Braids, Elastic Yarns and Fabrics, Trimmings, Packing, Polishing Cloths, Sacks, Labels, Lacings, Rags, and Other Miscellaneous Textile Products
4	2	Inorganic Chemicals I
4	3	Inorganic Chemicals II
4	4	Inorganic Chemicals III
4	6	Organic Chemicals II
4	8	Flavoring Extracts and Essential Oils