Industry & Trade Summary

Fluorspar and Certain Other Mineral Substances

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PREFACE

In 1991 the United States International Trade Commission initiated its current *Industry and Trade Summary* series of informational reports on the thousands of products imported into and exported from the United States. Each summary addresses a different commodity/industry area and contains information on product uses, U.S. and foreign producers, and customs treatment. Also included is an analysis of the basic factors affecting trends in consumption, production, and trade of the commodity, as well as those bearing on the competitiveness of U.S. industries in domestic and foreign markets.[1]

This report on fluorospar and certain other mineral substances covers the period 1986 through 1990 and represents one of approximately 250-300 individual reports to be produced in this series during the first half of the 1990s. This is the first summary report published to date on the minerals and metals sector.

[1] The information and analysis provided in this report are for the purpose of this report only. Nothing in this report should be construed to indicate how the Commission would find in an investigation conducted under statutory authority covering the same or similar subject matter.

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INTRODUCTION

This summary covers fluorspar and certain other mineral substances included as part of chapter 25 of the *Harmonized Tariff Schedules of the United States* (HTS). Mineral substances covered by this summary include fluorspar, magnesium sulfates (kieserite and epsom salts), and natural iron oxides (earth colors and natural micaceous iron oxides). Each of these mineral commodities represents a distinct manufacturing group that prepares chemical raw materials or manufactures products by chemical processes which are used by diverse consuming industries; separate sections of this summary address each industry.

Fluorspar is the principal item, accounting for nearly 40 percent of U.S. production of mineral substances, covered by this summary. In total, these commodities were produced by an estimated 10 firms employing somewhat fewer than 1,400 workers. Demand for these products reflects general economic activity in the United States, particularly in certain end-use markets. Fluorspar consumption principally depends on demand by the chemical industry, primarily producers of hydrogen fluoride and hydrofluoric acid. Demand for magnesium sulfates is affected by demand in the pharmaceutical, agricultural, and chemical processing industries. Demand for natural iron oxides relies on demand by the construction and coatings industries. Because of ample domestic reserves, the United States is largely self-sufficient in supplying demand for magnesium sulfates, earth colors, and natural micaceous iron oxides. Conversely, a lack of low-cost domestic reserves makes the United States heavily dependent on imports to meet domestic consumption of fluorspar. Fluorspar imports accounted for 97 percent of all imports in these product categories in 1990. U.S. imports of these mineral substances declined 3 percent in quantity from 530,000 metric tons ($44.3 million) in 1986 to 517,000 metric tons ($56.0 million) in 1990, largely reflecting weak demand in the U.S. economy as the United States entered a period of economic recession during the last half of 1990.

FLUORSPAR

U.S. Industry Profile

Fluorspar is a crystalline, nonmetallic mineral composed principally of calcium fluoride. Most fluorspar produced in the United States comes from underground mines. The ore must be milled to separate the fluorspar from the other components of the ore. Other minerals commonly found in fluorspar ores include calcite, quartz, barite, galena, and sphalerite; some of these minerals have economic value when separated during milling (figure 1 notes the collective end-uses of acid-grade, metallurgical-grade and ceramic-grade fluorspar).

Nearly 90 percent of the acid-grade fluorspar consumed in the United States is used in the manufacture of hydrogen fluoride and hydrofluoric acid. Between 60 and 70 percent of hydrogen fluoride produced is used to manufacture fluorocarbons, principally chlorofluorocarbons (CFCs), with the remainder used to produce other organic and inorganic chemicals. Refrigerants are the major end-use for fluorocarbons, followed by such other uses as blowing agents in plastic foam production, as fluorides for the aluminum industry, and as aerosol propellants. Hydrofluoric acid is used in the manufacture of alkylate, an ingredient in high-octane fuel for aircraft and automobiles and in steel pickling operations.

Virtually all fluorspar produced in the United States is acid-grade, produced by multistage froth flotation. Mined ore is crushed and ground to proper size. In the initial flotation process all free floating fluorspar is removed and sent for further cleaning. The remaining fluorspar is sent through a rougher flotation circuit and then processed through a cleaner flotation circuit. The product may then be reground and sent through one or more cleaning circuits to recover finer grades of fluorspar.

Two distinctly different commercial products of fluorspar contain less than 97 percent by weight of calcium fluoride. Metallurgical-grade is in either gravel or lump form, and ceramic-grade is finely ground. Metallurgical-grade fluorspar is generally described on the basis of "effective" versus "actual" calcium fluoride content. Most domestic material ranges from 60 to 70 percent effective calcium fluoride, whereas imported material frequently contains over 80 percent effective calcium fluoride. Ceramic-grade material usually ranges from 88 to 96 percent calcium fluoride, by weight.

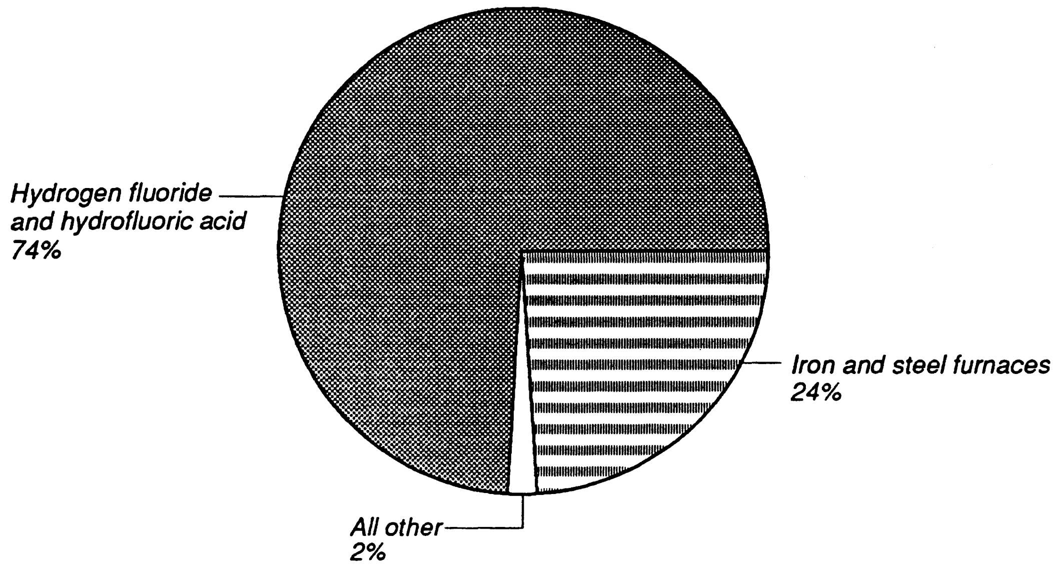
Metallurgical-grade fluorspar is used primarily as a fluxing agent[1] in basic open-hearth furnaces, electric furnaces, and oxygen steelmaking furnaces to thin the slag[2] and to facilitate passage of the impurities from the molten metal into the slag. In both basic oxygen and electric furnaces, about 6 pounds of fluorspar are required per ton of steel produced, compared with 9 pounds in an average open-hearth furnace. There is no satisfactory substitute for fluorspar in its major metallurgical applications.

Ceramic-grade fluorspar is used mainly in the manufacture of opaque and flint glass, as a flux in ferroalloys, and as an ingredient in welding rod coating compositions, in white and buff-colored clay bricks, and in vitreous enamels for coating household metal articles and appliances, such as refrigerators and stoves. Ceramic-grade fluorspar is also used in the manufacture of fiber glass, disposable glass containers, and zinc smelting.

[1] A fluxing agent is any substance that is introduced into the furnace to absorb mineral impurities or prevent oxide formation.

[2] A substance formed in furnace operations through the combination of a flux with the waste portion of the ore.

Figure 1
U.S. consumption of fluorspar, by end use, all grades, 1990[1]



[1] Excludes fluorspar used in primary aluminum and magnesium production in order to avoid disclosing company proprietary data.

Source: U.S. Bureau of Mines.

Industry Structure

Establishments primarily engaged in mining, milling, or otherwise preparing fluorspar are classified under Standard Industrial Classification (SIC) Code 1479, "Chemical and Fertilizer Mineral Raw Materials Mining, Not Elsewhere Classified." U.S. producers employed an estimated 180 mine and mill production workers in 1990 and produced principally acid-grade fluorspar because of higher consumption levels and prices (see table 1 for world production of fluorspar).

Ozark-Mahoning Co., operating jointly with Elf Aquitaine (a French oil firm) since 1989, is the leading U.S. producer of fluorspar with three mines and a flotation plant in Illinois, which accounted for virtually all U.S. fluorspar production in 1990. Ozark-Mahoning's annual production capacity is nearly 68,000 metric tons of fluorspar. Ozark-Mahoning's operations are vertically integrated, and virtually all of its mine production is captively consumed in its manufacture of hydrogen fluoride. Small amounts of fluorspar are mined by a handful of small producers in Illinois and Nevada.

The cost of mining fluorspar varies widely depending on method and deposit quality and accounts for 20 to 60 percent of final product cost. Milling costs typically account for 20 to 40 percent of total costs and transportation costs are typically less than 30 percent of total costs. According to industry experts, U.S. producers of fluorspar operate at a cost disadvantage compared with foreign competitors, largely due to the declining quality of domestic fluorspar deposits, which have a lower calcium fluoride content than Mexican or Chinese resources. Technological advancements have not been a major factor in advancing productivity in this industry. In recent years the development of various flotation methods has simplified the separation of fluorspar concentrate from the ore, reducing processing costs; however, this development alone has not enabled the U.S. fluorspar industry to compete effectively against lower cost foreign competition from Mexico and China.

Consumer Characteristics and Factors Affecting Demand

The level of fluorspar production depends significantly on consumption of hydrogen fluoride and hydrofluoric acid,[3] which are the primary fluorinating agents from which all organic and inorganic fluorine-bearing chemicals are produced. The principal consumers of fluorspar are major chemical

[3] Hydrogen fluoride is a fuming gas or liquid with a minimum purity of 99.8 percent. Hydrofluoric acid is hydrogen fluoride in aqueous solution usually ranging from 38 to 70 percent by volume of hydrogen fluoride.

Table 1
Fluorspar: World production and reserves, by countries, 1986-90

(Quantity in metric tons)

Country	*1986*	*1987*	*1988*	*1989*	*1990*[1]	*Share of world production 1990*	*Reserves 1990*
United States	78	70	70	66	60	1	([2])
China	716	716	720	1,700	1,500	30	27,000
France	259	220	230	183	170	3	10,000
Italy	160	162	150	140	100	2	6,000
Kenya	66	60	70	100	90	2	2,000
Mexico	845	908	950	861	600	12	19,000
Mongolia	816	880	880	800	800	16	50,000
South Africa, Republic of	375	349	370	368	320	6	30,000
Spain	331	281	280	180	170	3	6,000
United Kingdom ...	187	154	150	110	100	2	2,000
U.S.S.R	617	617	600	410	400	8	62,000
Other countries ...	917	817	825	813	765	15	25,000
World total	5,367	5,234	5,300	5,731	5,075	100	239,000

[1] *Estimated.*
[2] Withheld due to confidential nature.

Source: U.S. Bureau of Mines.

manufacturers who produce hydrogen fluoride and hydrofluoric acid. Because of environmental regulations restricting their use, the chemical industry has been forced to develop alternatives to CFCs. Gaseous hydrocarbons and carbon dioxide have been substituted for CFCs in aerosol propellants, and hydrocarbons have been substituted for CFCs in plastic foam production. Aqueous cleaning solutions have been developed to substitute for CFCs in the manufacture of refrigerants used to clean printed circuit boards.

A number of environmental factors have adversely affected the development of the U.S. fluorspar mining industry. Consumption of fluorspar by the chemical industry has slowed considerably due to restrictions on the production of CFCs by the Montreal Protocol on Substances that Deplete the Ozone Layer (1987). The Clean Air Act Amendments of 1990[4] includes a section on stratospheric ozone protection that establishes specific phaseout schedules for fluorocarbons. According to the Clean Air Act, U.S. consumption of CFCs must be reduced 30 percent (from 1986 levels) by 1993, 85 percent by 1998, and be completely eliminated by the year 2000. Requirements of both the Montreal Protocol and the Clean Air Act Amendments have already resulted in a reduction in domestic demand for fluorspar, adversely affecting fluorspar mining and processing. Moreover, the development of substitute materials to replace CFCs, such as carbon dioxide, gaseous hydrocarbons, and aqueous cleaning solutions, is expected to further decrease demand for fluorspar. While the Montreal Protocol allows the substitution of hydrofluorocarbons (HFCs), which use significant amounts of fluorspar in production, the protocol regards HFCs as only somewhat less environmentally harmful than CFCs, and consumption of HFCs is due to be phased out by the beginning of the next century.

Environmental restrictions imposed by the Montreal Protocol of 1987 and the U.S. Clean Air Act Amendments (1990) are already negatively affecting global demand for fluorspar and are expected to greatly affect this industry in the future. Some industry experts estimate that the combined effects of the Montreal Protocol and the Clean Air Act Amendments will eventually cause domestic fluorspar consumption to shrink by 50 percent by early in the next century from current levels.

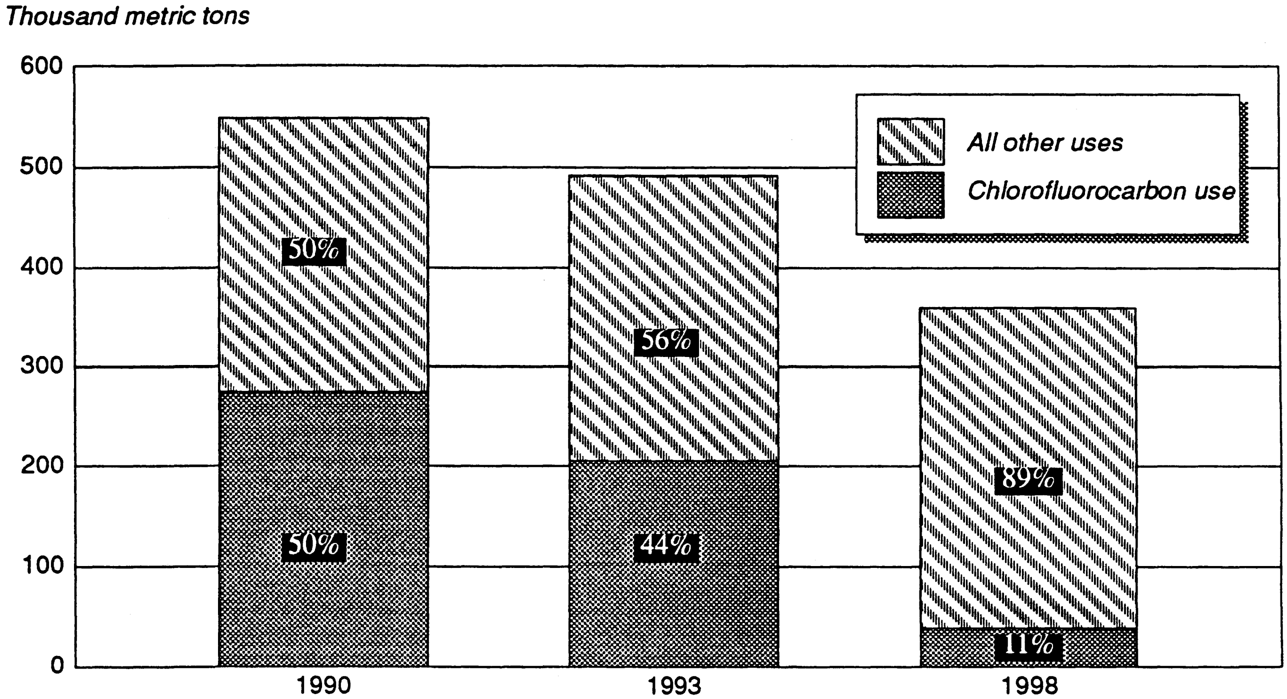
Fluorspar consumption by the steel, aluminum, and uranium industries is not expected to grow sufficiently to compensate for the loss of CFC markets (figure 2).

Foreign Industry Profile

Mexico, at one time the leading world producer of fluorspar, remains the largest supplier to the United States. However, China, which began to produce fluorspar only recently, has displaced Mexico as the world's largest producer and will likely become an increasingly important supplier to the U.S. market due to the high quality of its reserves and the low cost of its product (table 1). As many as 50 different plants or flotation mills in China produce fluorspar. Almost 70 percent of Chinese fluorspar is exported; approximately 70 percent of these exports are destined for Japan. Chinese exports to the United States

[5] Public Law 101-549.

Figure 2
Anticipated level and percentage of total U.S. fluorspar consumption, assuming chlorofluorocarbon limits imposed by Clean Air Act Amendments of 1990, 1993 and 1998[1]



[1] Excludes fluorspar used in primary aluminum and magnesium production in order to avoid disclosing company proprietary data.
Source: Compiled from information supplied by U.S. Bureau of Mines.

accounted for only about 5 percent of total Chinese exports. Mongolia is estimated to be the second largest producer of fluorspar in the world; principal Mongolian export markets in 1990 were the Soviet Union and Eastern Europe.

Mexico's declining production of fluorspar is due principally to weak U.S. market demand. Although at least 10 firms in Mexico produce fluorspar, production is dominated by two firms which account for nearly 90 percent of Mexico's production. Acid-grade fluorspar accounts for almost 70 percent of Mexican fluorspar production. Principal export markets are the United States, South America, and Europe. Mexico exports nearly 50 percent of its annual production to the United States.

The average production costs of Mexican and Chinese fluorspar are estimated to be considerably lower than average U.S. production costs, as both Mexico and China benefit from higher-grade deposits and lower milling costs.

U.S. and Foreign Trade Measures

Information on current U.S. tariff rates is included in table 2. There are currently no known U.S. nontariff measures that affect trade in fluorspar. Foreign tariff rates for both HTS subheadings 2529.21.00 and 2529.22.00 range from duty-free on goods exported from the United States to both the EC and Canada to 10 percent ad valorem on goods exported from the United States to Mexico. There are no known nontariff measures affecting U.S. exports of fluorspar to the EC, Mexico, or Canada. (See appendix B for a definition of tariff and trade agreement terms).

U.S. Market

Apparent U.S. consumption of fluorspar declined overall during 1986-90, reflecting declining demand for acid-grade fluorspar because of decreased production of CFCs and recent weakness in the aluminum industry, a significant consumer of fluorspar used in fluorides (table 3).

In 1990, imports accounted for 92 percent of total fluorspar consumption. Mexico supplied nearly 42 percent of U.S. fluorspar imports in 1990, while China supplied nearly 30 percent.

A single U.S. producer captively consumes the overwhelming majority of domestically produced fluorspar for use in the manufacture of hydrofluoric acid. Weakness in demand for CFCs contributed to a 6 percent decline in the mining of fluorspar between 1988 and 1990 (table 3). Imported fluorspar, which

Table 2
Fluorspar: Harmonized Tariff Schedule subheading: description; U.S. col. 1 rate of duty as of Jan. 1, 1991; U.S. exports, 1990; and U.S. imports, 1990

HTS subheading	Description	Col. 1 rate of duty As of Jan. 1, 1991 General	Special[1]	U.S. exports, 1990	U.S. imports, 1990
				Thousand dollars	
2529.21.00	Fluorspar, containing by weight 97 percent or less of calcium fluoride	13.5%[2]	Free (E,IL,J) 5.4% (CA)	705	8,316
2529.22.00	Fluorspar, containing by weight more than 97 percent of calcium fluoride	$2.07 per metric ton	Free (A,CA, E,IL,J)	1,078	45,665

[1] Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: Generalized System of Preferences (A); Automotive Products Trade Act (B); Agreement on Trade in Civil Aircraft (C); United States-Canada Free-Trade Agreement (CA); Caribbean Basin Economic Recovery Act (E); United States-Israel Free Trade Area (IL); and Andean Trade Preference Act (J).
[2] Duty temporarily suspended.

Source: U.S. exports and imports compiled from data of the U.S. Department of Commerce.

Table 3
Fluorspar: U.S. production, exports of domestic merchandise, imports for consumption, and apparent consumption, 1986-90

(Quantity in thousands of metric tons; value in thousands of dollars)

Year	*U.S. production*	*U.S. exports*	*U.S. imports*	*Apparent U.S. consumption*	*Ratio of imports to consumption*
			Quantity		
1986	71	15	502	558	90
1987	64	3	532	593	90
1988	64	3	679	740	92
1989	66	6	655	715	92
1990	60	14	503	549	92
			Value		
1986	([1])	1,801	41,637	([1])	([1])
1987	([1])	340	43,912	([1])	([1])
1988	([1])	382	58,589	([1])	([1])
1989	([1])	818	68,171	([1])	([1])
1990	([1])	1,784	53,981	([1])	([1])

[1] Not available.

Source: Data on U.S. production are from the U.S. Bureau of Mines. Trade data are compiled from official statistics of the U.S. Department of Commerce.

tends to be of higher-grade (higher calcium fluoride content) and of lower cost, has also contributed to declining levels of domestic production. These trends and the development of substitute materials to replace CFCs will contribute to reduced consumption of U.S. fluorspar in the future.

After increasing by 35 percent between 1986 and 1988 to 679,000 metric tons ($58.6 million), imports of fluorspar declined by 26 percent to 503,000 metric tons ($54.0 million) in 1990 (table 4). Nearly 85 percent of all U.S. fluorspar imports in 1990 were of acid-grade fluorspar. Mexico and South Africa were the leading suppliers of fluorspar to the United States during 1986-88, with China emerging in 1989 and 1990 to displace South Africa as the second leading U.S. import supplier. Because imports of fluorspar qualified for duty-free status under temporary duty-free provisions of the tariff schedules, virtually all imports entered the United States duty free in 1990.

Foreign Markets

Because U.S. production of fluorspar is limited by high production costs and low-grade ore deposits, U.S. exports of fluorspar have few markets. However, U.S. producers, facing weak domestic demand, have sought to export inventories of fluorspar to foreign markets (table 5). U.S. exports of fluorspar declined from 15,000 metric tons in 1986 ($1.8 million) to 3,000 metric tons ($0.4 million) in 1988 before rebounding to 14,000 metric tons ($1.8 million) in 1990 as U.S. firms sought to liquidate excess fluorspar inventories. Canada absorbed 78 percent of total U.S. exports of fluorspar in 1990. Nearly 60 percent of all U.S. fluorspar exports in 1990 were of acid-grade fluorspar.

U.S. Trade Balance

The United States experienced a trade deficit in fluorspar products throughout 1986-90, reaching a low of $39.8 million in 1986 and a high of $67.4 million in 1989, as imports from China began to enter the U.S. market in significant quantity.

MAGNESIUM SULFATES

U.S. Industry Profile

Magnesium sulfates ($MgSO_4$) are colorless, crystalline substances formed by the reaction of magnesium hydroxide with sulfur dioxide and air. Magnesium hydroxide is produced in large quantities from seawater by the addition of lime. A form of magnesium sulfate known as kieserite ($MgSo_4H_2O$) occurs as a mineral deposit. Synthetically produced magnesium sulfate is sold as epsom salts ($MgSO_4 7H_2O$). To produce epsom salts, magnesium hydroxide is dissolved in sulfuric acid and is then crystallized. In the United States, small amounts of kieserite are mined in order to produce epsom salts. The two major grades of epsom salts are USP (U.S. Pharmaceutical) grade, primarily used in foods and pharmaceuticals, and Technical and Agricultural grades which are not intended for human consumption or as direct food additives. Although produced similarly, the quality USP grade is derived by using higher purity magnesium compounds and employing precipitation with added magnesium oxide to separate iron, aluminum, and other impurities.

Magnesium sulfates used principally for pharmaceuticals and drug store sales consume approximately 28 percent of total domestic consumption (figure 3). As epsom salts, these products

Table 4
Fluorspar: U.S. imports for consumption, by principal sources, 1986-90

Source	1986	1987	1988	1989	1990
			Quantity (1,000 metric tons)		
Mexico	286	277	308	283	214
South Africa	165	163	175	117	95
China	0	38	86	162	153
All other	51	54	110	93	41
Total	502	532	679	655	503
			Value (1,000 dollars)		
Mexico	23,310	20,805	24,180	26,736	22,404
South Africa	13,947	14,522	17,873	15,173	13,017
China	0	2,857	5,870	14,981	14,315
All other	4,380	5,728	10,666	11,281	4,245
Total	41,637	43,912	58,589	68,171	53,981
			Unit value (per ton)		
Mexico	$81.50	$75.11	$78.25	$94.47	$104.69
South Africa	84.53	89.09	101.55	129.68	137.02
China	-	75.18	68.26	92.48	93.56
All other	85.88	106.07	98.76	121.30	103.54
Average	82.94	82.54	86.29	104.08	107.32

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

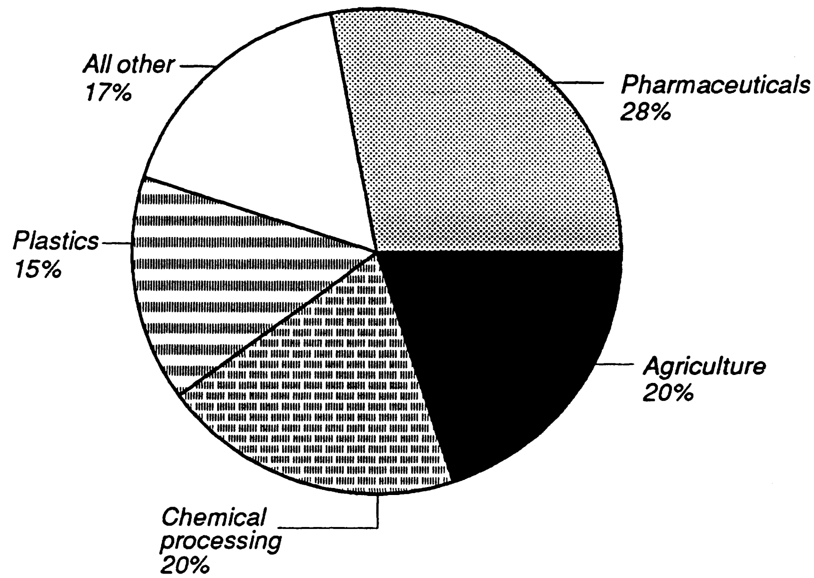
Table 5
Fluorspar: U.S. exports of domestic merchandise, by principal markets, 1986-90

Market	1986	1987	1988	1989	1990
			Quantity (1,000 metric tons)		
Canada	14	2	2	4	11
Dominican Republic	1	([1])	1	([1])	([1])
All other	([1])	1	([1])	2	3
Total	15	3	3	6	14
			Value (1,000 dollars)		
Canada	1,547	216	241	547	1,385
Dominican Republic	245	65	96	35	48
All other	9	59	45	236	351
Total	1,801	340	382	818	1,784
			Unit value (per ton)		
Canada	$110.50	$108.00	$120.50	$136.75	$125.91
Dominican Republic	45.00	156.63	96.00	184.21	255.32
All other	166.67	59.00	168.44	118.00	117.00
Average	120.07	113.33	127.33	136.33	127.43

[1] Less than 500 metric tons.

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

Figure 3
U.S. consumption of magnesium sulfates, by end use, 1990



Source: PQ Corporation.

are used to produce mineral bath solutions, and as a cathartic and analgesic soaking agent for bruises, sprains, local inflammation and insect bites. Epsom salts are also used as a nutrient and a dietary supplement. In agriculture, an area which accounts for 20 percent of consumption, magnesium sulfates are used as a dietary supplement and laxative for cattle, as well as a source of magnesium in fertilizers for citrus fruits, potatoes, apples, tobacco, roses, and other plants. Chemical processing, including the production of high fructose corn syrup (HFCS), figure 3 accounts for about 20 percent of U.S. consumption. The plastics industry, which accounts for approximately 15 percent of magnesium sulfate consumption, uses magnesium sulfates in flame retardant and smoke suppressant applications. In the pulp and paper industry, magnesium sulfates are used to manufacture bleaching agents. Miscellaneous applications include explosives, matches, photographic solutions, coagulant for rubber, refractory bonding, and oxysulfate cements for building materials.

Industry Structure

Virtually all raw material used in the production of magnesium sulfates is sourced domestically; the United States is entirely self-sufficient in the production of magnesium raw materials. Seawater and brine remain the dominant sources for magnesium sulfates. Magnesium sulfates are classified under Standard Industrial Classification (SIC) Code 2819, "Industrial Inorganic Chemicals, Not Elsewhere Classified."

There are two principal U.S. producers of magnesium sulfates, with annual production capacity of about 54,000 metric tons in 1990. Neither firm's operations are integrated, and both produce magnesium sulfates from purchased magnesium compounds. PQ Corp., the largest U.S. producer, distributes epsom salts from its plants in California, Illinois, Kansas, and New Jersey. Giles Chemical Corp. produces nearly 14,000 metric tons of magnesium sulfate annually from its plant in Wayneville, North Carolina. There is no known foreign ownership of U.S. magnesium sulfate production facilities. U.S. plant employment in all firms producing magnesium compounds totaled approximately 650 in 1990. The process technology for producing magnesium sulfate products has not changed significantly during the 1980s. The manufacturing processes used by the United States and Germany, the two dominant producers, are similar.

Consumer Characteristics and Factors Affecting Demand

Demand for magnesium sulfates is dependent primarily on demand for epsom salts by the pharmaceutical, agricultural, and chemical processing industries. In general, this demand is directly related to the general level of economic activity in the U.S. economy. Price is the principal factor influencing demand for epsom salts, since the quality of competing products tends to be uniform. Foreign imports that have gained market share in the United States are generally priced competitively with U.S. goods.

Foreign Industry Profile

Germany remains the principal producer of magnesium sulfates in the world, exporting both kieserite and epsom salts to the United States. Kali & Salz, the leading German producer of magnesium sulfate, is also the world's largest producer of these materials, with combined magnesium sulfate and magnesium chloride production of 1 million metric tons per year. Kali & Salz exports large quantities of both epsom salts and kieserite to the United States and sells its products in virtually the same markets as U.S. manufacturers. Like U.S. manufacturers, Kali & Salz sells most epsom salt as USP-grade food and pharmaceutical products. The strongest U.S. markets for Kali & Salz are located near U.S. ports where the firm can take advantage of favorable ocean freight rates to compete better with the U.S. product on a price basis.

U.S. and Foreign Trade Measures

Information on current U.S. tariff rates is included in table 6. Foreign tariff rates for both HTS subheadings 2530.20.10 and 2530.20.20 range from duty-free on goods exported from the United States to both the EC and Canada to 10 percent ad valorem on goods exported to Mexico.

There are currently no U.S. nontariff measures that affect trade in these products. There are no known nontariff measures affecting U.S. exports of magnesium sulfates to the EC, Mexico, or Canada.

U.S. Market

Consumption of magnesium sulfate is tied very strongly to consumer demand for epsom salts in foods and pharmaceuticals and to demand for fertilizer by the agricultural sector. Demand in these markets is essentially mature, growing at rates consistent with the growth rate of the national economy. One area of larger potential growth is the pulp and paper industry where magnesium sulfates are increasingly used as bleaching agents. However, demand by the pulp and paper industry thus far consumes only 3 percent of all magnesium sulfates produced. Because of the high cost of shipping such a low-value product as epsom salts nationwide, U.S. manufacturers tend to serve local markets from their regional plants. U.S. apparent consumption of magnesium sulfates rose from 68,000 metric tons ($14.1 million) in 1986 to a high of 90,000 metric tons ($17.5 million) in 1988, reflecting strength in demand for traditional end-uses. Consumption declined from 75,000 metric tons ($20.3 million) in 1989 to 68,000 metric tons ($17.6 million) in 1990, partly reflecting weakness in the U.S. economy in 1990 (table 7). Consumption data before and after January 1, 1989, may not be directly comparable because of the conversion of the TSUSA import and Schedule B to the Harmonized System format. However, these changes in the tariff schedule have not affected the data in such a way as to alter consumption patterns during this period.

Reflecting a recession-induced slowdown in pharmaceutical and agricultural demand for epsom salts in 1990, U.S. shipments of magnesium sulfates declined 13 percent between 1989 and 1990 to 55,411 metric tons ($17.4 million) after increasing 36 percent between 1986 and 1989 (table 7). Because most end-use markets for magnesium sulfates are mature in nature, domestic shipments during periods of economic expansion are expected to experience average annual growth rates similar to those experienced during the period 1986-89.

The high cost of shipping magnesium sulfates to internal U.S. markets, relative to final product cost, has served as a limiting factor on the extent of foreign market share in the United States. U.S. imports of magnesium sulfates increased 27 percent between 1986 and 1988 to 28,000 metric tons ($1.6 million) (table 8). Imports between 1989 and 1990 increased slightly to 13,000 metric tons ($0.7 million) in 1990. (Import data may not be comparable due to the conversion of the TSUSA to the HTS classification system during this period.) Germany, the world's leading producer of magnesium sulfates, supplied nearly 90 percent of U.S. imports of magnesium sulfates during 1986-90. Kieserite represented nearly 94 percent of total U.S. imports of magnesium sulfates in 1990.

Foreign Markets

Because of the high cost of shipping magnesium sulfates, relative to final product price, U.S. producers manufacture these products principally for domestic consumption. U.S. exports of magnesium sulfate increased during 1986-88 from $2.7 million in 1986 to $3.3 million in 1988. Exports between 1989-1990 increased from 95 metric tons ($96,000) to 240 metric tons ($393,000) in 1990 (table 9). (Export data may not be comparable due to the conversion of the Schedule B to the HTS classification system during this period.) Exports to Mexico accounted for 84 percent of total U.S. exports in 1990.

U.S. Trade Balance

The U.S. balance of trade in magnesium sulfates increased from a favorable balance of $1.3 million in 1986 to a favorable balance of $1.7 million in 1988. With the conversion to the Harmonized Tariff Schedule on January 1, 1989, new classifications for import and export items resulted in a significant decline in the trade balance in 1990 to a trade deficit of $0.3 million.

Table 6
Magnesium sulfates (kieserite and epsom salts): Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1991; U.S. exports, 1990; and U.S. imports, 1990

HTS subheading	Description	Col. 1 rate of duty As of Jan. 1, 1991 General	Special[1]	U.S. exports, 1990	U.S. imports, 1990
				Thousand dollars	
2530.20.10	Kieserite	Free	-	0	612
2530.20.20	Epsom salts (natural magnesium sulfates)	3.7%	Free (A,CA, E,IL,J)	393	37

[1] Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: Generalized System of Preferences (A); Automotive Products Trade Act (B); Agreement on Trade in Civil Aircraft (C); United States-Canada Free-Trade Agreement (CA); Caribbean Basin Economic Recovery Act (E); United States-Israel Free Trade Area (IL); and Andean Trade Preference Act (J).

Source: U.S. exports and imports compiled from data of the U.S. Department of Commerce.

Table 7
Magnesium sulfate (kieserite and epsom salts): U.S. shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1986-90

(Quantity in metric tons; value in thousands of dollars)

Year	U.S. shipments	U.S. exports[1]	U.S. imports[1]	Apparent U.S. consumption	Ratio of imports to consumption
			Quantity		
1986	46,525	(2)	21,989	68,514	32
1987	55,594	(2)	20,113	75,707	27
1988	61,493	(2)	28,189	89,682	31
1989	63,432	95	11,922	75,259	16
1990	55,411	240	12,565	67,736	19
			Value		
1986	15,388	2,690	1,423	14,121	10
1987	19,447	2,327	1,360	18,480	7
1988	19,185	3,276	1,618	17,527	9
1989	19,819	96	572	20,295	3
1990	17,366	393	650	17,623	4

[1] Trade data for 1986-88 were converted from the TSUSA import statistics and Schedule B export statistics to the *Harmonized Tariff Schedules of the United States (HTS)*. Because of the fundamental difference between the HTS classification system and the TSUSA/Schedule B, trade data for 1986-88 may not be directly comparable with HTS trade data for 1989-90.

[2] Not available.

Source: Data on U.S. shipments are from the U.S. Bureau of Mines. Trade data are compiled from official statistics of the U.S. Department of Commerce.

Table 8
Magnesium sulfates (kieserite and epsom salts): U.S. imports[1] for consumption, by principal sources, 1986-90

Source	1986	1987	1988	1989	1990
			Quantity (metric tons)		
Germany	(2)	(2)	(2)	9,776	11,253
Japan	(2)	(2)	(2)	2,130	1,295
All other	(2)	(2)	(2)	16	17
Total	21,989	20,113	28,189	11,922	12,565
			Value (1,000 dollars)		
Germany	(2)	(2)	(2)	492	565
Japan	(2)	(2)	(2)	75	77
All other	(2)	(2)	(2)	5	8
Total	1,423	1,360	1,618	572	650
			Unit value (per ton)		
Germany	(2)	(2)	(2)	$50.33	$50.21
Japan	(2)	(2)	(2)	35.21	59.46
All other	(2)	(2)	(2)	312.50	470.59
Average	$64.71	$67.62	$57.40	47.98	51.73

[1] Country-level detail is only being provided for years in which there are actual trade data under the *Harmonized Tariff Schedules of the United States (HTS)*.

[2] Not available.

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

Table 9
Magnesium sulfates (kieserite and epsom salts): U.S. exports[1] of domestic merchandise, by principal markets, 1986-90

Market	*1986*	*1987*	*1988*	*1989*	*1990*
			Quantity (metric tons)		
Canada	(2)	(2)	(2)	(3)	0
Netherlands	(2)	(2)	(2)	0	0
Japan	(2)	(2)	(2)	(3)	(3)
Mexico	(2)	(2)	(2)	(3)	(3)
All other	(2)	(2)	(2)	(3)	(3)
Total	(2)	(2)	(2)	95	240
			Value (1,000 dollars)		
Canada	(2)	(2)	(2)	3	0
Netherlands	(2)	(2)	(2)	0	0
Japan	(2)	(2)	(2)	33	40
Mexico	(2)	(2)	(2)	46	317
All other	(2)	(2)	(2)	14	36
Total	2,690	2,327	3,276	96	393
			Unit value (per ton)		
Canada	(2)	(2)	(2)	$1,822.60	-
Netherlands	(2)	(2)	(2)	-	-
Japan	(2)	(2)	(2)	18,111.96	$7,432.18
Mexico	(2)	(2)	(2)	1,106.89	1,565.43
All other	(2)	(2)	(2)	1,700.00	1,090.91
Average	(2)	(2)	(2)	1,010.53	1,637.50

[1] Country-level detail is only being provided for years in which there are actual trade data under the *Harmonized Tariff Schedules of the United States (HTS)*.
[2] Not available.
[3] Less than 500 metric tons.

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

NATURAL IRON OXIDES

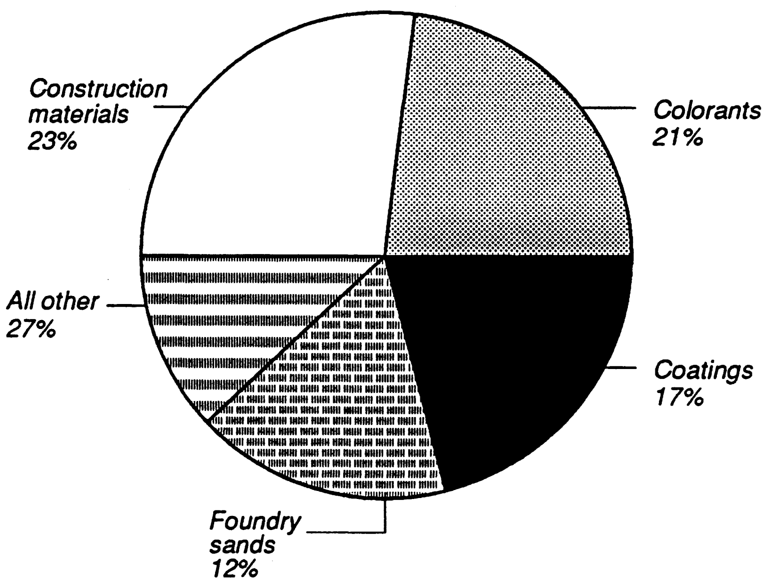
U.S. Industry Profile

Earth colors and natural micaceous iron oxide ores are included under the broad category of natural iron oxides pigment-grade ores. These products are generally distinguished by their relative iron oxide (Fe_2O_3) content. Earth colors, which include ochers, siennas, umbers, Vandyke brown, and natural red and black oxides (produced from hematite and magnetite mineral deposits), have an iron oxide content of less than 85 percent, while natural micaceous iron oxide has an iron oxide content of at least 85 percent. Natural iron oxides are typically mined in either "iron ore mines" or "pigment mines". Iron ore mines are mines whose major product is iron ore for smelting in blast furnaces for use in steel production. Although the majority of U.S. natural iron oxide production is produced in iron ore mines in the form of red iron oxide, or hematite, only 1.5 percent of total production in iron ore mines is concentrated to produce natural iron oxide ore pigment, with the remainder used for steelmaking. Pigment mines are operated solely for the purpose of producing crude ore for pigment production and account for a smaller part of total U.S. natural iron oxide pigment production.

Natural iron oxide ore is typically extracted from underground mines. Mining is done by block caving, and the ore is crushed and screened before being brought to the surface, after which the ore undergoes further crushing, magnetic separation, and flotation to produce a concentrate. The concentrate is then reduced in size through pulverizing. Large agglomerates may be crushed in a hammer mill to produce a finer powder. The resulting powder is then dried or calcined, generally in a rotary kiln. Steam heat is used to dry ocher, sienna, and umber, while higher temperature calcining yields burnt sienna and burnt umber. The powder is finally bagged for distribution.

In 1990, almost 23 percent of natural iron oxide pigment consumed in the United States was used in the production of construction materials, including cement, mortar, preformed concrete, and roofing tiles (figure 4). Another 21 percent of consumption went into colorants for ceramics, glass, paper, plastics, rubber, and textiles; coatings (industrial finishes, lacquers, paints, and varnishes) accounted for 17 percent of all consumption in 1990. Remaining

Figure 4
U.S. consumption of natural iron oxides, by end use, 1990



Source: U.S. Bureau of Mines.

applications include use in foundry sands, animal feed and fertilizers, cosmetics, magnetic tape and ink, and polishing agents.

Industry Structure

Earth colors and natural micaceous iron oxides are classified under Standard Industrial Classification (SIC) Code 2816, "Inorganic Pigments". Producers in this industry are not vertically integrated in the sense that a single company that produces natural iron oxide also produces finished goods, such as paint. Instead, these producers confine themselves to supplying natural oxide pigment to manufacturers. Five companies in the United States mine various grades of natural iron oxide pigments (see table 10 for world production figures). Total employment among firms producing both natural and synthetic crude and finished pigments totaled between 400 and 600 workers in 1990. In 1990 New Riverside Ochre Co. of Georgia mined and shipped ocher; Hoover Color Corp. of Virginia mined sienna, umber, and ocher; and Virginia Earth Pigments Co., also of Virginia, mined umber. Pea Ridge Iron Ore Co., located in Missouri, mines and markets natural black iron oxide produced from magnetite, while Swansea Mine in Arizona shipped minor amounts of micaceous oxide in 1990. Cleveland Cliffs Iron Co. permanently closed its Mather Mine in Michigan in 1979 but continued to ship pigment from its stockpiles. There is no known foreign ownership of U.S. natural iron oxide production facilities.

At one time, virtually the entire U.S. market was supplied by natural iron oxide pigments. At present, nearly 70 percent of this market demand is supplied by synthetic iron oxides. Synthetic iron oxide pigments are produced by chemical-related firms. Due to the increasing availablity of inexpensive synthetic pigments derived largely as byproducts from steel industry pickling operations and steel plant dust, there has been less interest in developing new sources of natural iron oxide pigments. The United States has always been deficient in domestic resources of umber and sienna and, apart from small mining operations in Virginia, is dependent on imports for these supplies. Although the United States has large deposits of hematite, used to produce natural red oxides, most of this material is used to produce iron ore for the steel industry. With the closing of Cleveland Cliff's Mather mine in 1979, the United States is almost entirely dependent on imports for supplies of natural red iron oxides.

Consumer Characteristics and Factors Affecting Demand

The demand for natural iron oxide pigments depends primarily on the level of activity in residential and nonresidential building construction markets and on the demand for paints and coatings, both of which reflect fluctuations in general levels of economic activity. Another factor influencing demand for natural iron oxide pigments is the demand for synthetic iron

Table 10
Natural iron oxide pigments: World mine production, by countries, 1989
(Metric tons)

Country[1]	*1989*[2]
Argentina	900
Austria	9,000
Brazil	6,000
Canada	2,000
Chile	8,300
Cyprus	10,000
France	15,000
Federal Republic of Germany	5,000
India	145,000
Iran	4,300
Italy	800
Pakistan	1,000
Paraguay	250
Republic of South Africa	1,800
Spain	31,000
United States	42,034
Zimbabwe	300
Total	282,684

[1] In addition to the countries listed, other countries, such as China and the U.S.S.R., produced iron oxide pigments but output was not reported.
[2] Estimated.

Source: U.S. Bureau of Mines.

oxide pigments. Synthetic iron oxides have gained in market share over natural iron oxides because of greater product consistency, higher tinting strengths, and greater price competitiveness.

Foreign Industry Profile

Natural iron oxides are produced by nearly 18 countries, with production concentrated among a few countries. India, the world's largest single producer of these products, accounted for 51 percent of reported world production in 1989. The world's largest producer is believed to be the Indian firm of Tiffins Barytes, Asbestos & Paints Ltd, which has the capacity to produce nearly 18,000 metric tons of product, principally red ochre. Approximately 75 percent of Indian production is sold to the domestic market for use in the manufacture of anticorrosion paint and as a pigment for floors and matches. The remaining 25 percent of production is exported principally to Japan, Australia, New Zealand, France, and the United Kingdom. The United States was the world's second leading producer of natural iron oxides in 1989 with 15 percent of reported world production, followed by Spain with 11 percent, France with 5 percent, and Cyprus with 4 percent (table 10).

Natural red iron oxide is produced principally by India and Spain; yellow ocher is produced by Spain, the United States, Brazil, and the Republic of South Africa; sienna is produced by Cyprus and Italy; and Germany is a major producer of Vandyke brown. Austria is the principal producer of natural micaceous iron oxide. China is believed to be a substantial producer of natural iron oxides, but production figures are unavailable.

U.S. and Foreign Trade Measures

Information on current U.S. tariff rates is included in table 11. The foreign tariff rates in 1991 for HTS subheading 2530.30.00 range from duty-free on U.S. exports to both the EC and Canada to 10 percent ad valorem on U.S. exports to Mexico. The tariff rate for HTS subheading 2530.40.00 ranges from duty-free on U.S. exports to Canada to 10 percent ad valorem on U.S. exports to Mexico. The 1991 duty rate on these goods exported from the United States to the EC is 1.8 percent ad valorem.

There are currently no known U.S. or foreign nontariff measures that affect trade in these products.

U.S. Market

U.S. consumption of natural iron oxides mirrored trends in construction activity, increasing during 1986-89 due to strong demand for pigments in construction materials and coatings applications and decreasing in 1990 due to weakened demand. Because of insufficient indigenous resources in certain natural pigments, the United States relies on imports to meet demand. Apparent U.S. consumption of natural iron oxides decreased 21 percent between 1989 and 1990 to 38,000 metric tons, after having increased 11 percent between 1986 and 1988 to 34,000 metric tons (table 12). The ratio of imports to consumption declined from 19 percent in 1986 to 5 percent in 1990, primarily reflecting shifts in export classifications occurring in 1989.

The economic recession in the construction and coatings markets, beginning in 1990, caused U.S. shipments of natural iron oxides to decline 19 percent between 1989 and 1990 to 37,000 metric tons. U.S.

Table 11
Natural iron oxides: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1991; U.S. exports, 1990; and U.S. imports, 1990

HTS subheading	Description	Col. 1 rate of duty As of Jan. 1, 1991 General	Special[1]	U.S. exports, 1990	U.S. imports, 1990
				Thousand dollars	
2530.30.00	Earth colors	Free	-	1,803	1,121
2530.40.00	Natural micaceous iron oxides	5.8%	Free (A,CA, E,IL,J)	261	225

[1] Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: Generalized System of Preferences (A); Automotive Products Trade Act (B); Agreement on Trade in Civil Aircraft (C); United States-Canada Free-Trade Agreement (CA); Caribbean Basin Economic Recovery Act (E); United States-Israel Free Trade Area (IL); and Andean Trade Preference Act (J).

Source: U.S. exports and imports compiled from data of the U.S. Department of Commerce.

Table 12
Natural iron oxides: U.S. shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1986-90
(Quantity in metric tons; value in thousands of dollars)

Year	U.S. shipments	U.S. exports[1]	U.S. imports[1]	Apparent U.S. consumption	Ratio of imports to consumption
			Quantity		
1986	37,183	12,271	6,015	30,927	19
1987	38,803	9,467	5,930	35,266	17
1988	39,711	10,303	4,993	34,401	15
1989	45,575	2,775	4,877	47,677	10
1990	37,071	1,416	1,947	37,602	5
			Value		
1986	(2)	14,490	1,254	(2)	(2)
1987	(2)	14,894	1,372	(2)	(2)
1988	(2)	15,517	958	(2)	(2)
1989	(2)	3,728	1,296	(2)	(2)
1990	(2)	2,063	1,346	(2)	(2)

[1] Trade data for 1986-88 were converted from the TSUSA import statistics and Schedule B export statistics to the *Harmonized Tariff Schedules of the United States (HTS)*. Because of the fundamental difference between the HTS classification system and the TSUSA/Schedule B, trade data for 1986-88 may not be directly comparable with HTS trade data for 1989-90.

[2] Not available.

Source: Data on U.S. shipments are from the U.S. Bureau of Mines. Trade data are compiled from official statistics of the U.S. Department of Commerce.

shipments of crude natural iron oxides increased 23 percent between 1986 and 1989 to 46,000 metric tons due to strong demand in both construction and coatings markets (table 12).

U.S. imports of natural iron oxide were also adversely affected by the economic recession in the construction and coatings markets. These imports declined 60 percent between 1989 and 1990 to 2,000 metric tons ($1.3 million), having suffered a more modest decline of 19 percent between 1986 and 1989 to 5,000 metric tons ($1.3 million) (table 13). (Import data may not be comparable due to the conversion of the TSUSA to the HTS classification system during this period.) Over 90 percent of all items imported in 1990 were earth colors. Cyprus was the leading foreign supplier of natural iron oxides to the United States during 1986-90, supplying 70 percent of total oxides and 85 percent of all earth colors in 1990. The chief supplier to the United States of natural micaceous iron oxides in 1990 was Austria with nearly half of all imports.

Foreign Markets

Traditionally, the principal U.S. export market for natural iron oxides has been Western Europe, particularly Germany, which between 1986 and 1989 accounted for over 50 percent of total U.S. exports of these products. Canada was the leading destination for U.S. exports of natural iron oxides in 1990. Nearly 93 percent of items exported by the United States in 1990 were earth colors. The Western European market is a major consuming market for world production of earth colors due to the popularity of pigment use in concrete products. Contrary to the situation in the United States, where an almost equal percentage of natural iron oxides produced is consumed by the construction and coatings sectors, in Western Europe the dominant market for these pigments is the construction sector, which absorbs almost 60 percent of all pigments produced. The Canadian market resembles the Western European market more closely, in terms of the relative importance of the construction sector as a consumer of natural iron oxides. Prices paid for natural iron oxides in the United States, Western Europe, and Canada tend to reflect the world price for these products.

Because most U.S. production of natural iron oxides is consumed by domestic industries, the United States has traditionally exported only small amounts of natural iron oxides. Canada absorbed 60 percent of total U.S. exports of natural iron oxides in 1990. U.S. exports of natural iron oxides declined 16 percent between 1986 and 1988 to 10,000 metric tons ($15.5 million) (table 14). Exports between 1989 and 1990 declined 49 percent to 1,400 metric tons ($2.1 million). (Export data may not be comparable due to the conversion of the Schedule B to the HTS classification system during this period.)

U.S. Trade Balance

The U.S. balance of trade in natural iron oxides decreased from a favorable balance of $2.4 million in 1989 to a favorable balance of $0.8 million in 1990. This was largely attributable to a decline in exports during this period.

Table 13
Natural iron oxides: U.S. imports[1] for consumption, by principal sources, 1986-90

Market	1986	1987	1988	1989	1990
	Quantity (1,000 metric tons)				
Cyprus	(2)	(2)	(2)	2	1
Germany	(2)	(2)	(2)	(3)	(3)
All other	(2)	(2)	(2)	3	1
Total	6	6	5	5	2
	Value (1,000 dollars)				
Cyprus	(2)	(2)	(2)	382	305
Germany	(2)	(2)	(2)	495	808
All other	(2)	(2)	(2)	419	233
Total	1,254	1,372	958	1,296	1,346
	Unit value (per ton)				
Cyprus	(2)	(2)	(2)	$191.00	$305.00
Germany	(2)	(2)	(2)	1,882.13	2,126.32
All other	(2)	(2)	(2)	139.67	233.00
Average	$209.00	$228.67	$191.60	259.20	673.00

[1] Country-level detail is only being provided for years in which there are actual trade data under the *Harmonized Tariff Schedules of the United States (HTS)*.
[2] Not available.
[3] Less than 500 metric tons.

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

Table 14
Natural iron oxides: U.S. exports[1] of domestic merchandise, by principal markets, 1986-90

Market	1986	1987	1988	1989	1990
	Quantity (1,000 metric tons)				
Germany	(2)	(2)	(2)	1	(3)
Canada	(2)	(2)	(2)	(3)	1
Japan	(2)	(2)	(2)	1	0
All other	(2)	(2)	(2)	1	(3)
Total	12	9	10	3	1
	Value (1,000 dollars)				
Germany	(2)	(2)	(2)	1,583	22
Canada	(2)	(2)	(2)	707	1,377
Japan	(2)	(2)	(2)	600	0
All other	(2)	(2)	(2)	838	664
Total	14,490	14,894	15,517	3,728	2,063
	Unit value (per ton)				
Germany	(2)	(2)	(2)	$1,583.00	$440.00
Canada	(2)	(2)	(2)	1,699.52	1,377.00
Japan	(2)	(2)	(2)	600.00	-
All other	(2)	(2)	(2)	838.00	1,286.62
Average	$1,207.50	$1,654.89	$1,551.70	1,242.67	2,063.00

[1] Country-level detail is only being provided for years in which there are actual trade data under the *Harmonized Tariff Schedules of the United States (HTS)*.
[2] Not available.
[3] Less than 500 metric tons.

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

APPENDIX A
STATISTICAL TABLES

Table A-1
Fluorspar and certain other mineral substances: U.S. imports[1] for consumption, by principal sources, 1986-90

Source	*1986*	*1987*	*1988*	*1989*	*1990*
	Quantity (1,000 metric tons)				
Mexico	([2])	([2])	([2])	283	214
China	([2])	([2])	([2])	162	153
Republic of South Africa	([2])	([2])	([2])	117	95
Canada	([2])	([2])	([2])	41	22
Germany	([2])	([2])	([2])	10	11
Kenya	([2])	([2])	([2])	5	9
Namibia	([2])	([2])	([2])	0	4
Brazil	([2])	([2])	([2])	0	5
Cyprus	([2])	([2])	([2])	2	1
Japan	([2])	([2])	([2])	2	1
All other	([2])	([2])	([2])	50	2
Total	530	558	712	672	517
	Value (1,000 dollars)				
Mexico	([2])	([2])	([2])	26,736	22,404
China	([2])	([2])	([2])	14,981	14,325
Republic of South Africa	([2])	([2])	([2])	15,173	13,017
Canada	([2])	([2])	([2])	4,697	2,017
Germany	([2])	([2])	([2])	996	1,382
Kenya	([2])	([2])	([2])	459	746
Namibia	([2])	([2])	([2])	0	324
Brazil	([2])	([2])	([2])	0	321
Cyprus	([2])	([2])	([2])	382	325
Japan	([2])	([2])	([2])	82	162
All other	([2])	([2])	([2])	6,534	954
Total	44,314	46,643	61,164	70,039	55,977
	Unit value (per ton)				
Mexico	([2])	([2])	([2])	$94.47	$104.69
China	([2])	([2])	([2])	92.48	93.63
Republic of South Africa	([2])	([2])	([2])	129.68	137.02
Canada	([2])	([2])	([2])	114.56	91.68
Germany	([2])	([2])	([2])	99.60	125.64
Kenya	([2])	([2])	([2])	91.80	82.89
Namibia	([2])	([2])	([2])	-	81.00
Brazil	([2])	([2])	([2])	-	64.20
Cyprus	([2])	([2])	([2])	191.00	325.00
Japan	([2])	([2])	([2])	41.00	162.00
All other	([2])	([2])	([2])	130.68	477.00
Total	$83.61	$83.59	$85.90	104.22	108.27

[1] Country-level detail is only being provided for years in which there are actual trade data under the *Harmonized Tariff Schedules of the United States (HTS)*.
[2] Not available.

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

Table A-2
Fluorspar and certain other mineral substances: U.S. exports[1] of domestic merchandise, by principal markets, 1986-90

Market	*1986*	*1987*	*1988*	*1989*	*1990*
			Quantity (1,000 metric tons)		
Canada	(2)	(2)	(2)	5	12
Mexico	(2)	(2)	(2)	(3)	1
United Kingdom	(2)	(2)	(2)	1	1
France	(2)	(2)	(2)	(3)	(3)
Venezuela	(2)	(2)	(2)	(3)	1
Philippines	(2)	(2)	(2)	(3)	(3)
Taiwan	(2)	(2)	(2)	(3)	1
Australia	(2)	(2)	(2)	(3)	(3)
Germany	(2)	(2)	(2)	1	(3)
Italy	(2)	(2)	(2)	0	(3)
All other	(2)	(2)	(2)	2	(3)
Total	27	12	13	9	16
			Value (1,000 dollars)		
Canada	(2)	(2)	(2)	1,257	2,762
Mexico	(2)	(2)	(2)	220	511
United Kingdom	(2)	(2)	(2)	114	231
France	(2)	(2)	(2)	22	92
Venezuela	(2)	(2)	(2)	4	90
Philippines	(2)	(2)	(2)	90	87
Taiwan	(2)	(2)	(2)	23	62
Australia	(2)	(2)	(2)	96	55
Germany	(2)	(2)	(2)	1,583	22
Italy	(2)	(2)	(2)	0	42
All other	(2)	(2)	(2)	1,233	286
Total	18,981	17,562	19,174	4,642	4,240
			Unit value (per ton)		
Canada	(2)	(2)	(2)	$251.40	$230.17
Mexico	(2)	(2)	(2)	520.09	511.00
United Kingdom	(2)	(2)	(2)	114.00	231.00
France	(2)	(2)	(2)	2,200.00	4,181.82
Venezuela	(2)	(2)	(2)	133.33	90.00
Philippines	(2)	(2)	(2)	2,432.43	1,160.00
Taiwan	(2)	(2)	(2)	1,210.53	62.00
Australia	(2)	(2)	(2)	461.54	207.55
Germany	(2)	(2)	(2)	1,583.00	440.00
Italy	(2)	(2)	(2)	-	10,500.00
All other	(2)	(2)	(2)	616.50	(2)
Average	$703.00	$1,463.50	$1,474.92	516.22	265.00

[1] Country-level detail is only being provided for years in which there are actual trade data under the *Harmonized Tariff Schedules of the United States (HTS)*.
[2] Not available.
[3] Less than 500 metric tons.

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

Table A-3
Fluorspar and certain other mineral substances: U.S. exports of domestic merchandise, imports for consumption, and merchandise trade balance, by selected country and country group, 1986-90[1]

(Million dollars)

Item	*1986*	*1987*	*1988*	*1989*	*1990*
U.S. exports of domestic merchandise:					
Mexico	0	0	0	0	1
People's Republic of China	0	0	0	0	0
Republic of South Africa	0	0	0	0	0
Canada	4	4	3	1	3
Germany	5	3	4	2	0
Kenya	0	0	0	0	0
Namibia	0	0	0	0	0
Brazil	0	0	0	0	0
Cyprus	0	0	0	0	0
United Kingdom	3	2	2	0	0
All other	7	8	9	1	1
Total	19	18	19	5	4
EC-12	11	8	9	2	0
OPEC	0	0	0	0	0
ASEAN	0	0	1	0	0
CBERA	0	0	0	0	0
Eastern Europe	0	0	0	0	0
U.S. imports for consumption:					
Mexico	23	21	24	27	22
People's Republic of China	0	3	6	15	14
Republic of South Africa	14	15	18	15	13
Canadaia	0	1	3	5	3
Germany	1	1	1	1	1
Kenya	0	1	2	0	1
Namibia	0	0	0	0	0
Brazil	0	0	0	0	0
Cyprus	1	1	1	0	0
United Kingdom	0	0	0	0	0
All other	4	5	6	7	0
Total	44	47	61	70	56
EC-12	4	4	8	3	2
OPEC	0	0	0	0	0
ASEAN	0	0	0	0	0
CBERA	0	0	0	0	0
Eastern Europe	0	0	0	0	0
U.S. merchandise trade balance:					
Mexico	-23	-21	-24	-27	-21
People's Republic of China	0	-3	-6	-15	-14
Republic of South Africa	-14	-15	-18	-15	-13
Canada	4	3	0	-4	0
Germany	4	2	3	1	-1
Kenya	0	-1	-2	0	-1
Namibia	0	0	0	0	0
Brazil	0	0	0	0	0
Cyprus	-1	-1	-1	0	0
United Kingdom	3	2	2	0	0
All other	3	3	3	-6	1
Total	-25	-29	-42	-65	-52
EC-12	7	4	1	-1	-2
OPEC	0	0	0	0	0
ASEAN	0	0	0	0	0
CBERA	0	0	0	0	0
Eastern Europe	0	0	0	0	0

[1] Import values are based on customs value; export values are based on f.a.s. value, U.S. port of export. U.S. trade with East Germany is included in "Germany" but not "Eastern Europe."

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

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

APPENDIX B
EXPLANATION OF TARIFF AND TRADE AGREEMENT TERMS

TARIFF AND TRADE AGREEMENT TERMS

The *Harmonized Tariff Schedule of the United States* (HTS) replaced the *Tariff Schedules of the United States* (TSUS) effective January 1, 1989. Chapters 1 through 97 are based on the internationally adopted Harmonized Commodity Description and Coding System through the 6-digit level of product description, with additional U.S. product subdivisions at the 8-digit level. Chapters 98 and 99 contain special U.S. classification provisions and temporary rate provisions, respectively.

Rates of duty in the ***general*** subcolumn of HTS column 1 are most-favored-nation (MFN) rates; for the most part, they represent the final concession rate from the Tokyo Round of Multilateral Trade Negotiations. Column 1-general duty rates are applicable to imported goods from all countries except those enumerated in general note 3(b) to the HTS, whose products are dutied at the rates set forth in ***column 2***. Goods from Armenia, Bulgaria, the People's Republic of China, Czechoslovakia, Estonia, Hungary, Latvia, Lithuania, Moldova, Mongolia, Poland, Russia, the Ukraine and Yugoslavia are currently eligible for MFN treatment. Among articles dutiable at column 1-general rates, particular products of enumerated countries may be eligible for reduced rates of duty or for duty-free entry under one or more preferential tariff programs. Such tariff treatment is set forth in the ***special*** subcolumn of HTS column 1. Where eligibility for special tariff treatment is not claimed or established, goods are dutiable at column 1-general rates.

The ***Generalized System of Preferences*** (GSP) affords nonreciprocal tariff preferences to developing countries to aid their economic development and to diversify and expand their production and exports. The U.S. GSP, enacted in title V of the Trade Act of 1974 and renewed in the Trade and Tariff Act of 1984, applies to merchandise imported on or after January 1, 1976, and before July 4, 1993. Indicated by the symbol "A" or "A*" in the special subcolumn of column 1, the GSP provides duty-free entry to eligible articles the product of and imported directly from designated beneficiary developing countries, as set forth in general note 3(c)(ii) to the HTS.

The ***Caribbean Basin Economic Recovery Act*** (CBERA) affords nonreciprocal tariff preferences to developing countries in the Caribbean Basin area to aid their economic development and to diversify and expand their production and exports. The CBERA, enacted in title II of Public Law 98-67, implemented by Presidential Proclamation 5133 of November 30, 1983, and amended by the Customs and Trade Act of 1990, applies to merchandise entered, or withdrawn from warehouse for consumption, on or after January 1, 1984; this tariff preference program has no expiration date. Indicated by the symbol "E" or "E*" in the special subcolumn of column 1, the CBERA provides duty-free entry to eligible articles the product of and imported directly from designated countries, as set forth in general note 3(c)(v) to the HTS.

Preferential rates of duty in the special subcolumn of column 1 followed by the symbol "IL" are applicable to products of Israel under the ***United States-Israel Free-Trade Area Implementation Act*** of 1985, as provided in general note 3(c)(vi) of the HTS. When no rate of duty is provided for products of Israel in the special subcolumn for a particular provision, the rate of duty in the general subcolumn of column 1 applies.

Preferential rates of duty in the special duty rates subcolumn of column 1 followed by the symbol "CA" are applicable to eligible goods originating in the territory of Canada under the ***United States-Canada Free-Trade Agreement***, as provided in general note 3(c)(vii) to the HTS.

Preferential nonreciprocal duty-free or reduced-duty treatment in the special subcolumn of column 1 followed by the symbol "J" or "J*" in parentheses is afforded to eligible articles the product of designated beneficiary countries under the ***Andean Trade Preferences Act*** (ATPA), enacted in title II of Public Law 102-182 and implemented by Presidential Proclamation 6455 of July 2, 1992 (effective July 22, 1992), as set forth in general note 3(c)(ix) to the HTS.

Other special tariff treatment applies to particular ***products of insular possessions*** (general note 3(a)(iv)), goods covered by the ***Automotive Products Trade Act*** (general note 3(c)(iii)) and the ***Agreement on Trade in Civil Aircraft*** (general note 3(c)(iv)), and ***articles imported from freely associated states*** (general note 3(c)(viii)).

The ***General Agreement on Tariffs and Trade*** (GATT) (61 Stat. (pt. 5) A58; 8 UST (pt. 2) 1786) is the multilateral agreement setting forth basic principles governing international trade among its more than 90 signatories. The GATT's main obligations relate to most-favored-nation treatment, the maintenance of scheduled concession rates of duty, and national (nondiscriminatory) treatment for imported products. The GATT also provides the legal framework for customs valuation standards, "escape clause" (emergency) actions, antidumping and countervailing duties, and other measures. Results of GATT-sponsored multilateral tariff negotiations are set forth by way of separate schedules of concessions for each participating contracting party, with the U.S. schedule designated as schedule XX.

Officially known as "The Arrangement Regarding International Trade in Textiles," the ***Multifiber Arrangement*** (MFA) provides a framework for the negotiation of bilateral agreements between importing and producing countries, or for unilateral action by importing countries in the absence of an agreement. These bilateral agreements establish quantitative limits on imports of textiles and apparel, of cotton and other vegetable fibers, wool, manmade fibers, and silk blends, in order to prevent market disruption in the importing countries—restrictions that would otherwise be a departure from GATT provisions. The United States has bilateral agreements with more than 30 supplying countries, including the four largest suppliers: China, Hong Kong, the Republic of Korea, and Taiwan.