

TITANIUM

By Joseph Gambogi

Titanium comprises about 0.62% of the Earth's crust and occurs primarily in the minerals anatase, brookite, ilmenite, leucoxene, perovskite, rutile, and sphene. Elemental titanium, Ti, is a lightweight metal well known for corrosion resistance and its high strength-to-weight ratio. Although titanium is best known for its use as a metal alloy, it is primarily used in the form of titanium dioxide (TiO₂) as a white pigment in paint, paper, and plastics. Other minor uses of titanium minerals include ceramics, chemicals, welding rod coatings, heavy aggregate, and steel furnace flux.

During 1995, the available supply of high-grade titanium minerals was adversely affected by the loss of a major producer of natural rutile in Sierra Leone for an indefinite period and mining difficulties by some producers in Australia. However, global production of titanium concentrates increased moderately compared with that of 1994.

Domestic consumption of titanium dioxide pigment decreased slightly in 1995 while production was nearly unchanged. Global consumption of titanium pigments was estimated to have increased slightly.

Owing to increased demand by the commercial aerospace and certain nonaerospace markets, particularly titanium golf club heads, consumption of all forms of titanium metal increased significantly during 1995. (*See table 1.*)

Legislation and Government Programs

The U.S. Department of Commerce International Trade Administration released the results of antidumping administrative reviews for titanium sponge from Georgia, Russia, and Ukraine. The antidumping finding from Georgia was revoked because it was no longer of interest to domestic interested parties.¹ Georgia was not a producer of titanium sponge but had been included under a previous finding for the former Soviet Union. Preliminary results for Russia and Ukraine upheld the existing antidumping finding of 83.96%. Berezniki Titanium-Magnesium Works (AUISMA), the producer of titanium sponge from Russia under review, was determined to be a nonshipper of titanium sponge to the United States. Shipments during the period of review were made by a reseller of titanium sponge who was not included in the request for review.² The producer of titanium sponge in the Ukraine under review, Zaporozhye Titanium and Magnesium Combine, was determined to be a nonshipper because the sponge entries during the period of review were made under temporary importation bond procedures.³

The Defense Logistics Agency continued its program to dispose of rutile held in the National Defense Stockpile (NDS).

At yearend, only 267 metric tons of rutile were left in the NDS as uncommitted inventory. None of the titanium sponge in the NDS was authorized for disposal. The NDS inventory of titanium sponge was unchanged at 33,400 tons of uncommitted inventory.

Production

Commercial forms of titanium ores and concentrates include ilmenite, leucoxene, rutile, titanium slag, and synthetic rutile. U.S. producers of ilmenite in 1995 were RGC (USA) Mineral Sands, Inc. at Green Cove Springs, FL; E. I. du Pont de Nemours & Co. Inc. DuPont, Starke, FL, both from mineral sands deposits; and P. W. Gillibrand Co., Simi Valley, CA, as a coproduct of its rock, sand, and gravel operations. RGC was the only U.S. producer of natural rutile. Kerr-McGee Chemical Corp. was the sole domestic producer of synthetic rutile at Mobile, AL.

Ferrotitanium was produced by Galt Alloys Inc., Canton, OH, and Shieldalloy Metallurgical Corp., Newfield, NJ. The two standard grades produced were 40% and 70% titanium. Data on production of ferrotitanium were not available.

Titanium sponge metal was produced by Oregon Metallurgical Corp., Albany, OR, and Titanium Metals Corp. of America, Henderson (Timet), NV. Titanium ingot was produced by the two sponge producers and by nine other firms in seven States. About 30 companies are known to produce titanium mill products and castings. Owing to increased demand, production of ingot and mill products increased by 35% and 30%, respectively, compared with 1994 levels. Production of titanium sponge was withheld to avoid disclosing company proprietary data. (*See tables 2 and 3.*)

U.S. producers of titanium dioxide pigments were Du Pont, Kemira, Inc., Kerr-McGee, Louisiana Pigment Co. LP (formerly Kronos Inc.), and SCM Chemicals Inc. U.S. production of TiO₂ pigment in 1995 was nearly unchanged compared with that of 1994. Capacity utilization for the domestic pigment industry was about 93%. (*See tables 4 and 5.*)

Tremont Corp. and IMI Plc. agreed in principle to combine their titanium businesses. The merger would combine Tremont's 75%-owned subsidiary Timet based in Denver, CO, with IMI's wholly owned subsidiaries IMI Titanium Ltd. based in the United Kingdom and its U.S.-based subsidiary IMI Titanium Inc.⁴

Consumption

On a gross weight basis, U.S. reported consumption of TiO₂

in titanium slag and rutile concentrates decreased 3% from the 1994 level. Consumption of ilmenite was withheld to avoid disclosing company proprietary data.

Consumption data for titanium concentrates are developed by the U.S. Geological Survey from one voluntary survey of domestic operations. Of the 29 operations canvassed, 23 responded, representing 99.9% of the data in table 6. Data for nonrespondents were estimated based on prior-year consumption levels. (See table 6.)

Reported consumption of titanium in the form of ferrotitanium and scrap in steel and other alloys was 5,910 tons, a 3% decrease from the 1994 level. Carbon, stainless and heat-resisting steels were the largest end-use categories of ferrotitanium and scrap.

Increased ingot production caused titanium sponge and scrap consumption to increase by 25% and 31%, respectively, compared with 1994. Scrap supplied a calculated 52% of ingot feedstock. Increased demand for titanium mill products by the commercial aerospace and nonaerospace markets resulted in a 26% increase in ingot consumption and a 27% increase in mill product shipments. Reported castings shipments decreased by about 11%. Estimated U.S. mill product usage by application was as follows: commercial aerospace, 60%; military aerospace, 15%; and nonaerospace uses, 25%. Nonaerospace uses include those in the specialty chemical, pulp and paper, oil and gas, marine, medical, and consumer goods industries. The largest growth in nonaerospace demand was attributed to demand for titanium golf club heads.

Titanium dioxide pigments account for over 95% of all prime white pigments and are produced as two major types: rutile and anatase pigment. The three largest end uses are paint and coatings, paper, and plastics. Other consuming industries included ceramics, fabrics and textiles, floor coverings, printing ink, and rubber. Apparent domestic consumption of TiO₂ pigments was about 1.08 million tons, 1% less than that in 1994. (See tables 7 and 8.)

Stocks

Based on TiO₂ content, consumer inventories of titanium concentrates decreased 36%. Producer stocks of TiO₂ pigments were about 120,000 tons, a 13% increase from 1994. Industry stocks of sponge decreased 5% while stocks of titanium scrap increased 19%. (See table 9.)

Prices

Published prices for titanium concentrates, pigments, and metal are presented in table 10.

Owing to a decrease in the available supply of natural rutile, prices for rutile concentrates increased significantly in 1995. Concurrently, ilmenite prices increased moderately. Published prices for titanium slag were not available. However, based on the U.S. Customs value of imports, prices for Canadian slag decreased 12% while prices for South African slag increased 4%. Owing to increased demand for titanium mill products in

the commercial aerospace and nonaerospace industries, prices for titanium sponge increased moderately. Prices for titanium pigment were mixed. Anatase pigment prices decreased slightly while rutile pigment prices increased moderately. (See table 10.)

Foreign Trade

The United States is highly import dependent for titanium concentrates. During 1995 the largest import sources of titanium concentrates were Australia, Canada, India, and South Africa. Annual imports of ilmenite and synthetic rutile concentrates increased 41% and 15%, respectively. Meanwhile, imports of natural rutile and titanium slag decreased 14% and 18%, respectively. (See table 12.)

U.S. import reliance extends to titanium metal, primarily in the form of titanium sponge and scrap. Although a significant quantity of imported titanium scrap is consumed by the iron and steel industry, nearly all of the imported sponge is consumed by the titanium industry. Sponge and scrap imports increased significantly in 1995. The leading import sources of titanium sponge were China, Japan, and Russia. The leading import sources of titanium waste and scrap were Japan, Russia, and the United Kingdom. (See tables 11 and 14.)

The United States is a net exporter of titanium pigments although a significant quantity of titanium pigments is imported. During 1995, the leading import sources of titanium pigments were Canada and Germany. Imports of titanium pigments containing more than 80% TiO₂ increased 14%, while imports of titanium oxide and other titanium pigments decreased 8% and 13%, respectively. (See tables 11 and 13.)

World Review

World production of titanium concentrates was estimated to have increased 6% compared with that of 1994. Owing to the loss of Sierra Leone as a major producer of natural rutile, production of rutile decreased 33%. However, increased production of ilmenite and titaniferous slag, primarily from Australia and South Africa, offset the decrease in rutile production. Ilmenite and slag production increased 7% and 20%, respectively. (See table 15.)

Australia.—Westralian Sands opted to proceed with plans to construct a second synthetic rutile plant at its North Capel operation in Western Australia. The new plant is expected to bring the operations capacity up to 230,000 tons per year and should be on-stream by 1997.⁵

Broken Hill Proprietary Co. made plans to proceed with the development of the Beenup deposit in Western Australia. The operation, scheduled to be commissioned in 1996, was expected to produce 600,000 tons per year of ilmenite and 20,000 tons per year of zircon.⁶

Canada.—Tiomim Resources Inc. and the Saudi Arabian development company Shairco made plans to enter into a joint venture to develop the Natashquan mineral sands deposit in Canada. The companies planned to mine the deposit in Quebec, then ship ilmenite and magnetite to the Middle East for the

production of synthetic rutile and metallic iron.⁷

Norway.—RMI Titanium Co. announced that its Permipipe Titanium AS joint venture with Permascand AB would be discontinued. The joint venture was originally formed to produce welded pipe for Norwegian oil and gas projects.⁸ In a separate action, RMI formed an agreement with the Norwegian oil service company Stolt Comex Seaway S.A. to manufacture and install titanium production risers, flow lines, and other titanium subsea tubular systems.⁹

Malaysia.—Tioxide (Malaysia) Sdn. Bhd. made plans to construct an acid neutralization plant to produce a copperas (FeSO₄·7H₂O) byproduct from acid generated at its sulfate-route TiO₂ pigment plant in Telok Kelong. Copperas produced at the new plant was expected to be sold to water treatment facilities in Southeast Asia. In the future, Tioxide plans to expand its byproduct production capacity to include gypsum and carbon dioxide.¹⁰

Japan.—According to the Japan Titanium Society, Japan's titanium sponge and ingot production in 1995 were 16,702 tons and 12,121 tons, respectively. Mill product shipments were 9,134 tons of which 4,592 tons were exported.

In January, an earthquake interrupted production at the Sumitomo SiTix Corp. sponge facility at Amagasaki, Japan. The earthquake temporarily cut off the industrial water supply to the facility. However, the sponge plant was reported to be undamaged.¹¹

Russia.—According to the Interfax news agency, Avisma's titanium sponge production at Berezniki, Russia, for 1995 was nearly double that of 1994 and was 30% to 40% below full capacity. Estimated capacity at the Avisma plant is 35,000 to 40,000 tons per year.¹²

Sierra Leone.—In January, rebel forces overtook Sierra Rutile's mining operations in Sierra Leone. Although Government forces later regained control of the operation, mining operations were suspended indefinitely. With a capacity of 150,000 metric tons per year, the operation was the largest single producer of rutile in the world.¹³

South Africa.—The South African iron and steel producer Iscor Ltd. announced it planned to acquire 35% interest in Australia-based Tigor Ltd. (formerly Minproc Holdings). Tigor and U.S.-based Kerr-McGee, through its wholly owned subsidiary KMCC Western Australia Pty. Ltd., were equal partners in the TiWest Joint Venture. TiWest's operations in Western Australia included a dredging facility at Cooljarloo, mineral separation and synthetic rutile plants at Chandala, and a TiO₂ pigment plant at Kwinana.¹⁴

Outlook

The demand for titanium ores and concentrates is largely driven by the demand for titanium pigments, which in turn follows the growth of the global economy. In the short term, the loss of Sierra Leone as a major supplier of natural rutile is expected to affect the availability and price of high-grade ores and concentrates. However, the development of new deposits and processing technology should provide for moderate growth

over the next decade.

Global demand for TiO₂ pigment is forecast to grow by 3% to 5% over the next several years. Material requirements by the pigment industry point toward an increased reliance on high-grade feedstocks (high-grade ilmenite, rutile, and slag) suitable for use in chloride-route pigment production. In addition, growing concern over the presence of naturally occurring radioactivity in mineral deposits will affect exploration efforts in the coming years.

Historically, demand for titanium metal products has been driven by the commercial and military aerospace markets. After several years of slow growth, demand for titanium metal has increased significantly. This growth should continue over the next few years. In the short term, demand by the commercial aircraft industry is expected to increase significantly. Long-term growth in the demand for titanium metal is expected to be driven by demand from nonaerospace industries. Moderate to significant long-term growth is expected in the following industries: automotive, consumer goods, medical, and military armor.

¹Federal Register. Titanium Sponge From Georgia, Revocation of Antidumping Finding. V. 60, No. 219, Nov. 14, 1995, p. 57219.

²Federal Register. Titanium Sponge From Russia; Preliminary Results of Antidumping Duty Administrative Review. V. 60, No. 186, Sept. 26, 1995, pp. 49576-49577.

³———. Titanium Sponge From Ukraine; Preliminary Results of Antidumping Duty Administrative Review. V. 60, No. 225, Nov. 22, 1995, pp. 57848-57849.

⁴Tremont Corp. Press Release, Oct. 20, 1995.

⁵Industrial Minerals. Westralian Proceeding With New Synrutile Plant. No. 331, Apr. 1995, p. 9.

⁶———. BHP's Beenup Minsand Project to Go Ahead. No. 329, Feb. 1995, p. 8.

⁷———. Tiomin Mineral Sands Developments. No. 331, Apr. 1995, p. 9.

⁸RMI Company Press Release. June 30, 1995.

⁹American Metal Market. RMI Titanium Joins Norwegian Venture. V. 103, No. 23, Feb. 3, 1995, p. 2.

¹⁰Industrial Minerals. Copperas Plant for Tioxide. No. 337, Oct. 1995, p. 19.

¹¹Platt's Metals Week. Two Japanese Ti Producers Recovering From Earthquake. V. 66, No. 4, Jan. 23, 1995, p. 8.

¹²———. Avisma/Berezniki Doubles Titanium Sponge Output. V. 67, No. 5, Jan. 29, 1996, p. 3.

¹³Mining Journal. Sierra Leone's Mines Evacuated. V. 324, No. 8311, Jan. 27, 1995, pp. 57, 59.

¹⁴Industrial Minerals. Iscor to Acquire Share in Tigor. No. 337, Oct. 1995, p. 9.

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TABLE 1
SALIENT TITANIUM STATISTICS 1/

(Metric tons unless otherwise specified)

	1991	1992	1993	1994	1995
United States:					
Ilmenite concentrate:					
Imports for consumption	214,000	295,000	301,000	336,000	473,000
Consumption 2/	738,000	685,000	694,000	W	W
Titanium slag:					
Imports for consumption	408,000	537,000	476,000	472,000	388,000
Consumption	341,000	539,000	546,000	583,000	582,000
Rutile concentrate, natural and synthetic:					
Imports for consumption	240,000	317,000	371,000	332,000	318,000
Consumption	369,000	461,000	465,000	510,000	480,000
Sponge metal:					
Production	13,400	W	W	W	W
Imports for consumption	612	684	2,160	6,470	7,560
Consumption	13,600	14,200	15,100	17,200	21,500
Price, Dec. 31, per pound	\$4.50-\$5.00	\$3.50-\$4.00	\$3.50-\$4.00	\$3.75-\$4.25	\$4.24-\$4.50
Titanium dioxide pigment:					
Production	992,000	1,140,000	1,160,000	1,250,000	1,250,000
Imports for consumption	166,000	169,000	172,000	176,000	183,000
Consumption, apparent 3/	936,000	1,000,000	1,030,000	1,090,000 r/	1,050,000
Price, Dec. 31, cents per pound:					
Anatase	99	99	99	94-96	92-96
Rutile	99	92-95	92-95	92-94	99-1.03
World production:					
Ilmenite concentrate 4/	3,360,000 r/	3,720,000 r/	3,750,000 r/	3,570,000 r/	3,810,000 e/
Rutile concentrate, natural 4/	460,000 r/	436,000 r/	445,000 r/	469,000 r/	312,000 e/
Titaniferous slag	1,510,000	1,640,000	1,550,000	1,510,000	1,810,000 e/

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.

1/ Data are rounded to three significant digits; except prices.

2/ Includes consumption to produce synthetic rutile.

3/ Production plus imports minus exports plus stock decrease or minus stock increase.

4/ Excludes U.S. production data to avoid disclosing company proprietary data.

TABLE 2
U.S. TITANIUM METAL PRODUCTION CAPACITY IN 1995 1/

Company	Plant location	Yearend capacity (metric tons)	
		Sponge	Ingot 2/
Howmet Corp., Titanium Ingot Div.	Whitehall, MI	--	2,300
A. Johnson Metals Corp.	Morgantown, PA	--	2,300 3/
Lawrence Aviation Industries Inc.	Port Jefferson, NY	--	1,400
Oregon Metallurgical Corp. (Oremet)	Albany, OR	6,800	7,300
RMI Co.	Niles, OH	--	16,300
Teledyne Allvac	Monroe, NC	--	7,300
Teledyne Wah Chang Albany	Albany, OR	--	900
Titanium Hearth Technologies of America	Morgantown, PA	--	4,500
Titanium Metals Corp. of America	Henderson, NV	22,700	13,600
Viking Metallurgical Corp.	Verdi, NV	--	2,300 3/
Wyman-Gordon Co.	Worcester, MA	--	3,200 4/
Total		29,500	61,400

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Based on 7-day-per-week full production. Includes 55,400 tons vacuum-arc double-triple melt, of which triple melt generally ranged from 10% to 30%. The remaining 6,000 tons was single melt (electron-beam and plasma) capacity.

3/ Single melt only.

4/ Includes 1,400 tons of single melt capacity.

TABLE 3
COMPONENTS OF U.S. TITANIUM METAL SUPPLY AND DEMAND 1/

(Metric tons)

Component	1994	1995
Production:		
Sponge	W	W
Ingot	29,500	39,800
Mill products	17,900	23,300
Exports:		
Sponge	126	225
Other unwrought	297	603
Scrap	4,120	3,420
Ingot, slab, sheet bar, etc.	1,260	1,960
Other articles of titanium	3,850	4,580
Total	9,660	10,800
Imports:		
Sponge	6,470	7,560
Scrap	5,870	11,100
Ingot and billet	1,730	1,880
Other unwrought	723	1,180
Other wrought (mill products)	675	1,600
Other articles of titanium	127	272
Total	15,600	23,600
Stocks, yearend:		
Government: Sponge (total inventory)	33,400	33,400
Industry:		
Sponge	5,570	5,270
Scrap	7,930	9,430
Ingot	3,270	3,560
Other	W	W
Total industry	16,800	18,300
Reported consumption:		
Sponge	17,200	21,500
Scrap	15,700	20,500
Receipts:		
Home	9,090	11,800
Purchased	11,300	18,000
Ingot	24,300	30,600
Mill products (net shipments):	15,600	19,800
Forging and extrusion billet	5,910	8,820
Rod and bar	2,070	2,770
Other 2/	7,670	8,180
Castings (shipments)	540	479

W Withheld to avoid disclosing company proprietary data.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Data for sheet and strip, plate, extrusions (other than tubing), pipe and tubing, and other have been combined to avoid disclosing company proprietary data.

TABLE 4
CAPACITIES OF U.S. TITANIUM DIOXIDE PIGMENT PLANTS ON
DECEMBER 31, 1995 1/ 2/

Company	Plant location	Pigment capacity (metric tons per year)	
		Sulfate process	Chloride process
E. I. du Pont de Nemours & Co. Inc.:	Antioch, CA	--	40,000
	De Lisle, MS	--	245,000
	Edge Moor, DE	--	129,000
	New Johnsonville, TN	--	297,000
Kemira, Inc.	Savannah, GA	54,000	91,000
Kerr-McGee Chemical Corp.	Hamilton, MS	--	114,000
Louisiana Pigment Co. LP	Lake Charles, LA	--	100,000
SCM Chemicals Inc.:	Ashtabula, OH	--	165,000
	Baltimore, MD	66,000	50,000
Total		120,000	1,230,000

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Table does not include Hitox Corp.'s Corpus Christi, TX, production capacity of about 16,400 tons per year of buff TiO₂ pigment that is produced by refining and fine grinding of synthetic rutile.

TABLE 5
COMPONENTS OF U.S. TITANIUM DIOXIDE PIGMENT SUPPLY AND DEMAND 1/

(Metric tons unless otherwise specified)

	1994		1995	
	Gross weight	TiO2 content	Gross weight	TiO2 content
Production 2/	1,250,000	1,180,000	1,250,000	1,180,000
Shipments: 3/				
Quantity	1,370,000	1,260,000	1,330,000	1,210,000
Value thousands	\$2,540,000	\$2,540,000	\$2,540,000	\$2,540,000
Exports	352,000	331,000 e/	342,000	321,000 e/
Imports for consumption	176,000	165,000 e/	183,000	172,000 e/
Stocks, yearend	106,000	99,300 e/	120,000	113,000 e/
Consumption, apparent 4/	1,090,000	1,030,000 e/	1,080,000	1,020,000 e/

e/ Estimated.

1/ Data are rounded to three significant digits.

2/ Excludes production of buff pigment.

3/ Includes interplant transfers.

4/ Production plus imports minus exports plus stock decrease or minus stock increase.

Sources: Bureau of the Census and U.S. Geological Survey.

TABLE 6
U.S. CONSUMPTION OF TITANIUM CONCENTRATES 1/

(Metric tons)

	Ilmenite 2/ 3/		Titanium slag		Rutile (natural and synthetic) 4/	
	Gross weight	TiO2 content	Gross weight	TiO2 content	Gross weight	TiO2 content
1994:						
Pigments	W	W	583,000	479,000	491,000	460,000
Miscellaneous 5/	1,000	637	(6/)	(6/)	19,800	18,500
Total	W	W	583,000	479,000	510,000	478,000
1995:						
Pigments	W	W	582,000	326,000	453,000	417,000
Miscellaneous 5/	696	236	(6/)	(6/)	27,300	22,300
Total	W	W	582,000	326,000	480,000	439,000

W Withheld to avoid disclosing company proprietary data.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes a mixed product containing rutile, leucoxene, and altered ilmenite.

3/ Includes ilmenite consumed to produce synthetic rutile.

4/ Includes synthetic rutile made in the United States.

5/ Includes alloys, carbide, welding-rod coatings and fluxes, ceramics, chemicals, glass fibers, and titanium metal.

6/ Included with "Pigments" to avoid disclosing company proprietary data.

TABLE 7
U.S. DISTRIBUTION OF DOMESTIC TITANIUM PIGMENT SHIPMENTS, TITANIUM DIOXIDE CONTENT, BY INDUSTRY

(Percent)

Industry	1994	1995
Ceramics	0.2	0.3
Coated fabrics and textiles	.4	.3
Floor coverings	1.0	1.0
Paint, varnish, lacquer	46.7	46.9
Paper	23.8	24.8
Plastics	18.0	17.7
Printing ink	1.5	1.3
Roofing granules	W	W
Rubber	2.1	1.5
Other	6.3	6.2
Total	100.0	100.0

W Withheld to avoid disclosing company proprietary data; included with "Other."

TABLE 8
U.S. CONSUMPTION OF TITANIUM PRODUCTS 1/ 2/
IN STEEL AND OTHER ALLOYS

(Metric tons)

	1994	1995
Carbon steel	2,390	2,340
Stainless and heat-resisting steel	1,930	1,600
Other alloy steel (includes HSLA)	408	733
Tool steel	W	W
Total steel	4,720	4,660
Cast irons	W	W
Superalloys	609	734
Alloys, other than above	456	384
Miscellaneous and unspecified	299	132
Total consumption	6,090	5,910

W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified."

1/ Includes ferrotitanium, titanium scrap, and other titanium additives.

2/ Data are rounded to three significant digits; may not add to totals shown.

TABLE 9
U.S. STOCKS OF TITANIUM CONCENTRATES AND PIGMENT,
DECEMBER 31 1/

(Metric tons)

	1994		1995	
	Gross weight	TiO2 content	Gross weight	TiO2 content
Concentrates:				
Ilmenite 2/	72,700	43,900	98,900	52,500
Titanium slag 2/	135,000	113,000	102,000	84,600
Rutile 2/	140,000 r/	141,000	54,700	52,300
Titanium pigment 3/	106,000	99,300 e/	120,000	113,000 e/

e/ Estimated. r/ Revised.

1/ Data are rounded to three significant digits.

2/ Consumer stocks.

3/ Bureau of the Census. Producer stocks only.

TABLE 10
PUBLISHED PRICES OF TITANIUM CONCENTRATES AND PRODUCTS 1/

	1994	1995
Concentrates:		
Ilmenite, f.o.b. Australian ports	per metric ton	\$74.00-\$80.00
Rutile, bagged, f.o.b. Australian ports	do.	450.00-480.00
Rutile, bulk, f.o.b. Australian ports	do.	410.00-430.00
Titanium slag, 80% TiO2, Canada e/	do.	278.00
Titanium slag, 85% TiO2, South Africa e/	do.	334.00
Metal: Sponge	per pound	3.75- 4.25
Ferrotitanium	do.	1.60- 1.72
Scrap: Turnings, unprocessed	do.	.75- .80
Pigment:		
Titanium dioxide pigment, f.o.b. U.S. plants, anatase	do.	.94- .96
Titanium dioxide pigment, f.o.b. U.S. plants, rutile	do.	.92- .94

e/ Estimated.

1/ Yearend.

Sources: American Metal Market, American Paint and Coatings Journal, Chemical Marketing Reporter, Industrial Minerals (London), Metal Bulletin, Platt's Metals Week, and industry contacts.

TABLE 11
U.S. EXPORTS OF TITANIUM PRODUCTS, BY CLASS 1/

Class	1994		1995	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Metal:				
Sponge	126	\$738	255	\$1,090
Scrap	4,120	7,440	3,420	9,120
Other unwrought:				
Billet	258	5,250	343	5,740
Blooms and sheet bars	630	12,000	1,130	25,500
Ingot	374	5,970	483	7,860
Other	297	4,440	603	7,370
Wrought:				
Bars and rods	863	22,500	2,030	45,700
Other	2,990	108,000	2,560	117,000
Total	9,660	166,000	10,800	219,000
Ores and concentrates	19,000	6,070	32,300	12,000
Pigment and oxides:				
Titanium dioxide pigments	313,000	429,000	306,000	524,000
Titanium oxides	39,300	55,800	36,000	65,600
Total	352,000	485,000	342,000	589,000

1/ Data are rounded to three significant digits, may not add to totals shown.

Source: Bureau of the Census.

TABLE 12
U.S. IMPORTS FOR CONSUMPTION OF TITANIUM CONCENTRATES, BY COUNTRY 1/

Concentrate and country	1994		1995	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Ilmenite:				
Australia	278,000	\$18,600	294,000	\$19,100
India	4,150	2,770	62,100	9,660
Other	53,700	4,860	117,000	5,300
Total	336,000	26,200	473,000	34,000
Titanium slag:				
Canada	44,900	12,500	41,200	11,300
Norway	--	--	--	--
South Africa	413,000	141,000	347,000	121,000
Other	14,400	4,770	--	--
Total	472,000	158,000	388,000	132,000
Rutile, natural:				
Australia	83,600	32,300	61,700	25,200
Sierra Leone	45,300	19,500	10,600	4,040
South Africa	92,700	31,100	114,000	41,600
Other	107	77	5,460	2,780
Total	222,000	82,900	192,000	73,600
Rutile, synthetic:				
Australia	105,000	39,100	122,000	53,900
Malaysia	5,250	2,720	4,940	2,960
Other	1	3	43	26
Total	110,000	40,900	127,000	56,900
Titaniferous iron ore: 2/				
Canada	43,700	2,270	88,400	5,200

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes materials consumed for purposes other than production of titanium commodities, principally heavy aggregated and steel-furnace flux.

Source: Bureau of the Census. Data adjusted by the U.S. Geological Survey.

TABLE 13
U.S. IMPORTS FOR CONSUMPTION OF TITANIUM PIGMENTS, BY COUNTRY 1/

Country	1994		1995	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
80% or more titanium dioxide:				
Belgium	905	\$1,390	792	\$1,230
Canada	44,600	70,000	61,600	102,000
China	2,310	2,190	3,620	3,820
Finland	3,060	5,170	2,430	4,900
France	6,360	9,300	5,560	9,840
Germany	20,000	38,200	21,300	45,700
Japan	6,310	12,100	6,000	13,900
Norway	4,310	6,660	4,400	6,690
Singapore	4,700	6,950	4,450	7,020
United Kingdom	2,670	3,560	1,680	2,770
Other	10,300	14,700	8,950	14,200
Total	106,000	170,000	121,000	212,000
Other titanium dioxide:				
Canada	15,400	23,300	17,000	27,800
France	7,320	9,630	8,120	13,000
Germany	1,740	7,640	1,260	7,140
South Africa	7,960	10,100	6,280	9,760
Spain	2,620	3,530	1,250	2,390
United Kingdom	7,540	11,500	3,300	5,890
Other	4,050 r/	8,130 r/	3,190	7,910
Total	46,600	73,900	40,400	73,900
Titanium oxide:				
Belgium	1,800	2,540	2,610	4,060
Canada	10,100	15,700	8,560	13,700
France	3,720	5,450	6,740	9,550
Germany	2,840	4,710	654	1,160
Norway	895	1,370	68	131
Other	4,370	9,260	3,310	9,410
Total	23,700	39,000	21,800	38,000
Grand total	176,000	283,000	183,000	323,000

r/ Revised.

1/ Data are rounded to three significant digits; may add to totals shown.

Source: Bureau of the Census.

TABLE 14
U.S. IMPORTS FOR CONSUMPTION OF TITANIUM METAL, BY CLASS AND COUNTRY 1/

Class and country	1994		1995	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Unwrought:				
Sponge:				
China	86	\$452	478	\$2,860
Japan	819	5,690	1,140	9,100
Russia	5,460	15,400	5,490	21,200
United Kingdom	94	975	37	205
Other	4	7	415	1,770
Total	6,470	22,500	7,560	35,200
Waste and scrap:				
Canada	214	364	368	1,050
France	307	1,030	364	1,370
Germany	425	1,130	613	2,720
Japan	1,560	5,480	1,830	6,540
Russia	1,140	3,540	3,800	15,600
United Kingdom	1,430	4,560	2,350	9,480
Other	794	2,970	1,780	6,720
Total	5,870	19,100	11,100	43,500
Ingot and billets:				
Russia	377	2,330	918	6,150
United Kingdom	749	9,530	622	7,040
Other	603	3,640	342	5,950
Total	1,730	15,500	1,880	19,100
Powder	79	981	238	1,720
Other: 2/				
United Kingdom	176	504	24	47
Other	469	4,040	917	4,020
Total	644	4,540	941	4,070
Wrought products and castings: 3/				
Japan	320	11,900	455	15,600
Russia	107	1,140	644	10,500
United Kingdom	178	5,490	443	8,870
Other	196	5,140	320	8,300
Total	801	23,700	1,860	43,300

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes blooms, sheet, bars, slabs, and other unwrought.

3/ Includes bars, castings, foil, pipes, plates, profiles, rods, sheet, strip, tubes, wire, and other.

Source: Bureau of the Census.

TABLE 15
TITANIUM: WORLD PRODUCTION OF CONCENTRATES (ILMENITE, LEUCOXENE,
RUTILE AND TITANIFEROUS SLAG), BY COUNTRY 1/ 2/

(Metric tons)

Concentrate type and country	1991	1992	1993	1994	1995 e/
Ilmenite and leucoxene: 3/					
Australia:					
Ilmenite	1,363,000	1,786,000	1,804,000	1,782,000 r/	1,979,000 4/
Leucoxene	18,000	20,000	21,000	35,000	31,000 4/
Brazil 5/	69,064	76,558	90,567	97,439 r/	102,000
China e/	150,000	150,000	155,000	155,000	160,000
India e/	311,537 4/	300,000	320,000	300,000	300,000
Malaysia	336,347	337,744	288,950	115,885	151,680 4/
Norway	625,000	708,000	713,000	826,000 r/	830,000
Portugal e/	40	30	25	20 r/	--
Sierra Leone	60,371	60,331	62,900	47,400 r/	--
Sri Lanka	60,861	33,283	76,930	60,445	60,000
Thailand	17,075	2,967	20,821	1,677 r/	33 4/
Ukraine e/ 6/	XX	250,000	200,000	150,000	200,000
U.S.S.R. 6/ 7/	350,000 e/	XX	XX	XX	XX
United States	W	W	W	W	W
Total	3,360,000	3,720,000	3,750,000	3,570,000 r/	3,810,000
Rutile:					
Australia	201,000	183,000	186,000	233,000 r/	200,000 4/
Brazil	1,094	1,798	1,744	1,911 r/	1,900
India e/	13,635 4/	10,000	13,900	14,000	14,000
Sierra Leone	154,800	148,990	152,000	137,000	--
South Africa e/	77,000	84,000	85,000	78,000	90,000
Sri Lanka	3,085	2,741	2,643	2,410	2,400
Thailand	76	281	87	49 r/	-- 4/
Ukraine e/ 6/	XX	5,000	4,000	3,000	4,000
U.S.S.R. 6/ 7/	9,000 e/	XX	XX	XX	XX
United States	W	W	W	W	W
Total	460,000	436,000	445,000	469,000 r/	312,000
Titaniferous slag: 8/					
Canada 9/	701,000	753,000	653,000	764,000	815,000
South Africa 10/ 11/	808,000	884,000	892,000	744,000 e/	990,000
Total	1,510,000	1,640,000	1,550,000	1,510,000	1,810,000

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." XX Not applicable.

1/ World totals and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through Aug. 22, 1996.

3/ Ilmenite is also produced in Canada and South Africa, but this output is not included here because an estimated 90% of it is duplicative of output reported under "Titaniferous slag," and the rest is used for purposes other than production of titanium commodities, principally steel furnace flux and heavy aggregate.

4/ Reported figure.

5/ Excludes production of unbenevolent anatase ore.

6/ All production in the U.S.S.R. for 1991 came from Ukraine.

7/ Dissolved in Dec. 1991.

8/ Slag is also produced in Norway but is not included under "Titaniferous slag" to avoid duplicative reporting. Beginning in 1990, about 25% of Norway's ilmenite production was used to produce slag containing 75% TiO₂.

9/ Refined sored slag contained 80% TiO₂ in 1990. TiO₂ content in 1991-95 is not reported.

10/ Contains 85% TiO₂.

11/ Excludes 42,000 to 48,000 metric tons of titanium slag from Highveld Steel.