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TITANIUM

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TITANIUM

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Gross world consumption of titanium mineral concentrates increased by 3% compared with that of 2004, and production increased by 8% (Mineral Sands Report, 2006a). The industry continued the development of new heavy-mineral mine capacity, with most development projects centered in Australia. U.S. consumption of titanium mineral concentrates fell by about 11% compared with that in 2004. The closure of one titanium dioxide (TiO_2) plant in Mississippi in September, resulting from damage sustained by Hurricane Katrina, contributed to the decline in consumption. Imports continued to supply a significant portion of U.S. reported titanium concentrate consumption. Australia was the leading import source of ilmenite and rutile, and South Africa was the leading import source for titanium slag.

Global consumption of TiO_2 pigment was estimated to be 4.8 Mt, a 3.7% increase compared with consumption in 2004 (Mineral Sands Report, 2006b). According to U.S. Geological Survey (USGS) survey data, domestic consumption of TiO_2 pigment fell by 3% compared with that of 2004.

Domestic shipments of titanium mill products increased by 25%, while consumption of titanium in steel and other alloys increased by 7% compared with those of 2004. Increased demand for titanium used in titanium metal and steel production exceeded the available supply of scrap and production capacity for new metal. Prices for titanium metal products continued to rise in 2005 because of increased demand for commercial aircraft and military hardware. Because of strong demand for titanium in aerospace applications, U.S. titanium sponge producers announced plans to increase production capacity. Sales of titanium sponge from the National Defense Stockpile (NDS) exhausted U.S. Government stocks of the material by yearend.

Legislation and Government Programs

The Defense National Stockpile Center (DNSC) continued the sale of titanium sponge held in the NDS. In January, the DNSC awarded about 1,130 metric tons (t) (2.5 million pounds) of titanium sponge to the following companies for $19 million: AlloyWorks LLC, Global Titanium Inc., Keywell LLC, Specialty Metal Products Co. Inc., and Wogen Titanium Ltd. (Defense National Stockpile Center, 2005a). In March, 680 t (1.5 million pounds) of titanium sponge was awarded to Cronimet Group, Galt Alloys Inc., and Reading Alloys Inc. for $1.5 million (Defense National Stockpile Center, 2005b). In November, the DNSC awarded 680 t of sponge to RMI Titanium Co., Specialty Metal Products, and Titanium Metals Corp. (Timet) for $16 million. The November sale exhausted the DNSC's inventory of sponge (Defense National Stockpile Center, 2005c).

The Defense Advanced Research Projects Agency (DARPA) continued to fund work on its Titanium Initiative whose objective is to develop revolutionary processes for the low-cost extraction of titanium metal from oxide ores. DARPA's Titanium Initiative included electrolytic processes similar to those that reduced the cost of aluminum from that of a precious metal to an everyday material (Defense Advanced Research Projects Agency, 2006§[1]).

Production

Mineral Concentrates.—Titanium mineral concentrates of economic importance include ilmenite, leucoxene, rutile, synthetic rutile, and titaniferous slag. Mining of titanium minerals is usually performed using surface methods. Dredging and dry mining techniques are used for the recovery of heavy minerals. Gravity spirals are used to separate the heavy-minerals suite, while magnetic and high-tension separation circuits are used to separate the heavy-mineral constituents. Ilmenite is often processed to produce a synthetic rutile or titaniferous slag. Although numerous technologies are used to produce synthetic rutile, nearly all are based on either selective leaching or thermal reduction of iron and other impurities in ilmenite. Titaniferous slag with a TiO_2 content of 75% to 95% is produced commercially using pyrometallurgical processes.

U.S. mineral concentrate producers were DuPont Titanium Technologies [a subsidiary of E.I. du Pont de Nemours & Co. (DuPont)] and Iluka Resources, Inc. [a subsidiary of Iluka Resources Ltd.]. DuPont's mining operations near Starke, FL, produced a mixed product containing ilmenite, leucoxene, and rutile that was used as a captive feedstock in DuPont's TiO_2 pigment plants. Iluka produced titanium mineral concentrates from its heavy-mineral sand operations at Green Cove Springs, FL, Lulaton, GA, and Stony Creek, VA. Heavy-mineral concentrate from the Lulaton mine was trucked to the dry separation plant at Green Cove Springs. Iluka's Stony Creek operation produced ilmenite concentrate using dry mining techniques.

In December, Iluka announced plans for a staged closure of its Florida and Georgia mining operations beginning in 2006. The closure was attributed in part to financial losses from mining small, thin, and disparate low-grade deposits and rising operating costs. Although the Florida operations had been producing heavy minerals since 1972, the Georgia operations were commissioned in 2004 (Iluka Resources Ltd., 2005§).

Metal.—Commercial production of titanium metal involves the chlorination of titanium-containing mineral concentrates to produce titanium tetrachloride ($TiCl_4$), which is reduced with magnesium (Kroll process) or sodium (Hunter process) to form a commercially pure form of titanium metal. As the metal is formed, it has a porous appearance and is referred to as sponge. Titanium ingot is produced by melting titanium sponge or scrap or a combination of both, usually with various other alloying

[1]References that include a section mark (§) are found in the Internet References Cited section.

elements, such as aluminum and vanadium. Electron beam, plasma, scull, and vacuum-arc melting are the commercial methods used to produce ingot. Titanium mill products are produced from the drawing, forging, and rolling of titanium ingot or slab into products of various sizes and shapes. These mill products include billet, pipe and tube, plate, rod and bar, sheet, strip, and wire. Titanium castings are produced by investment casting and rammed graphite mold casting. Ferrotitanium is usually produced by induction melting of titanium scrap with iron or steel. The two standard grades of ferrotitanium that are normally produced contain 40% and 70% titanium.

U.S. producers of titanium sponge in 2005 were The Alta Group and Timet. Alta's 340-metric-ton-per-year (t/yr) plant in Salt Lake City, UT, produced titanium sponge by the Hunter process and supported the company's production of electronic-grade titanium. Timet's 8,600-t/yr Henderson, NV, plant produced titanium sponge by the traditional Kroll process combined with vacuum distillation (table 2). Data on domestic production of titanium sponge are withheld to avoid disclosing company proprietary data. Of the 85,300 t/yr of domestic ingot capacity, 20% was based on cold hearth technology; the remainder was based on vacuum-arc remelting technology.

In 2005, U.S. production of ingot rose to 48,100 t, a 16% increase compared with that of 2004. Similarly, production of mill products increased by 15% compared with that of 2004 (table 3). U.S. producers of ferrotitanium were Galt Alloys and Global Titanium. Data on production of ferrotitanium were not available.

In July, Allegheny Technologies Inc. (ATI) announced a major expansion of its titanium production capabilities. This expansion would include upgrading and restarting about one-half of ATI's idled titanium sponge facility in Albany, OR. ATI expected a production rate of 3,400 t/yr of titanium sponge from this facility beginning in the first half of 2006. In addition, ATI planned to construct a third plasma arc melt cold-hearth furnace, which was expected to come onstream by late 2006; expand high-value plate products capacity by 25%; and upgrade cold-rolling assets used in producing titanium sheet and strip products. Also included in this titanium capability expansion was a 25% increase across ATI's titanium production system, including increases in vacuum arc remelt capacity, electron beam cold hearth melting capacity, and forging reheat capacity (Allegheny Technologies Inc., 2005§).

In May, Timet announced that it planned to expand its titanium sponge facility in Henderson. The company expected to complete this expansion by the first quarter of 2007, which will provide the capacity to produce an additional 4,000 t/yr of sponge (Titanium Metals Corp., 2006§). The plant had been idled since 2001.

In September, Honeywell Electronic Materials (a subsidiary of Honeywell International Inc. and parent firm of Alta) announced that it planned to increase production of titanium sponge, although no quantity was specified. Honeywell Electronic Materials produced sodium-reduced titanium sponge at its Salt Lake City, UT, facility for its electronics business. At its Fombell, PA, facility, Honeywell refined titanium sponge for semiconductors into high-purity material that is 99.999% pure with very low metallic impurity and gas levels using a hydride-dehydride process. Honeywell began selling sponge externally to meet growing demand and planned to increase the quantity available (Honeywell Electronic Materials, 2005§).

TiO_2 Pigment.—TiO_2 pigment is produced from titanium mineral concentrates by either the chloride route or the sulfate route. In the chloride process, rutile is converted to $TiCl_4$ by chlorination in the presence of petroleum coke. $TiCl_4$ is oxidized with air or oxygen at about 1,000° C, and the resulting TiO_2 is calcined to remove residual chlorine and any hydrochloric acid that may have formed in the reaction. Aluminum chloride is added to the $TiCl_4$ to assure that virtually all the titanium is oxidized into the rutile crystal structure. In the sulfate process, ilmenite or titanium slag is reacted with sulfuric acid. Titanium hydroxide is then precipitated by hydrolysis, filtered, and calcined. Although either process may be used to produce pigment, the decision to use one process instead of the other is based on numerous factors, including raw material availability, freight, and waste disposal costs. In finishing operations, the crude form of the pigment is milled to produce a controlled distribution of particle size and surface treated or coated to improve its functional behavior in different media. Some typical surface treatments include alumina, organic compounds, and silica.

TiO_2 pigment produced by either process is categorized by crystal form as either anatase or rutile. Rutile pigment is less reactive with the binders in paint when exposed to sunlight than is the anatase pigment and is preferred for use in outdoor paints. Anatase pigment has a bluer tone than rutile, is somewhat softer, and is used mainly in indoor paints and in paper manufacturing. Depending on the manner in which it is produced and subsequently finished, TiO_2 pigment can exhibit a range of functional properties, including dispersion, durability, opacity, and tinting.

U.S. production of TiO_2 pigment in 2005 was 1.31 Mt, 14% less than that in 2004 (table 5). U.S. producers of TiO_2 pigment were DuPont, Kerr-McGee Corp., Louisiana Pigment Co. LP (an NL Industries Inc. and Huntsman Corp. joint venture), and Millennium Inorganic Chemicals Inc. (table 4). TOR Minerals International, Inc. produced a TiO_2 pigment from finely ground synthetic rutile.

Although DuPont's DeLisle, MS, TiO_2 plant escaped major structural damage from Hurricane Katrina's high winds, floodwater significantly damaged process control systems, other electrical and electronic equipment, and plant infrastructure. DuPont expected that repairs would take about 3 months, and the company planned to have the plant running at full capacity by spring 2006 (DuPont Titanium Technologies, 2005). Other TiO_2 plants in the Gulf Coast area were closed in advance of Hurricanes Katrina and Rita, but sustained only minor damage that did not require significant downtime.

Consumption

Mineral Concentrates.—On a gross weight basis, 96% of the domestic consumption of titanium mineral concentrates was used to produce TiO_2 pigment. The remaining 4% was used to produce miscellaneous other products including titanium metal, welding rod coatings, and fluxes. Based on TiO_2 content, domestic consumption of titanium mineral concentrates was 1.39 Mt, a 7% decrease compared with that of 2004 (table 6). Consumption data for titanium concentrates were developed by

the USGS from a voluntary survey of domestic operations. Of the 16 operations canvassed, 10 responded, representing 64% of the consumption data in table 6. Data for nonrespondents were estimated based on prior-year consumption with some adjustments for current-year trends.

Metal.—Titanium metal alloys are used for their high strength-to-weight ratio and corrosion resistance. Driven by demand from the aerospace industry, consumption of titanium sponge and scrap by the domestic titanium industry increased by 31% compared with that of 2004 (table 3). Scrap supplied a calculated 50% of ingot feedstock. Estimated U.S. mill product usage by application was as follows: aerospace, 75%, and nonaerospace uses, 25%. Nonaerospace uses included those in the consumer goods, marine, medical, oil and gas, pulp and paper, and specialty chemical industries.

A significant quantity of titanium in the form of ferrotitanium, scrap, and sponge is consumed in the steel and nonferrous alloy industries. Consumption by the steel industry is largely associated with the production of stainless steels and is used for deoxidation, grain-size control, carbon and nitrogen control, and stabilization typically in interstitial-free, stainless, and high-strength low-alloy steels. Reported domestic consumption of titanium products in steel and other alloys was 11,000 t, a 7% increase compared with that of 2004 (table 7).

TiO_2 Pigment.—In the United States, apparent consumption of TiO_2 pigment was 1.13 Mt, a 3% decrease compared with that of 2004 (table 5). The leading uses of TiO_2 pigment, based on TiO_2 pigment shipments in the United States, were paint and coatings (63%), plastics and rubber (24%), and paper (12%) (table 8). Other uses (1%) included catalysts, ceramics, coated fabrics and textiles, floor coverings, printing ink, and roofing granules.

In the paint and coatings industry, TiO_2 pigment is used in architectural, equipment, and special-purpose applications and is widely used in white and color formulations. The TiO_2 content for paint and coatings varies significantly.

In plastics, TiO_2 pigment provides opacity and acts as a barrier against ultraviolet light degradation. TiO_2 pigment often is introduced as pellets containing up to 50% by weight TiO_2 in a carrier resin; however, liquid and dry concentrates also are used by the industry. The TiO_2 content of plastics normally ranges from 3% to 25% by weight of the finished product. Examples of plastic applications that use TiO_2 pigment include polyethylene bags and vinyl window frames.

TiO_2 pigment in paper products provides opacity and brightness. The paper industry consumes TiO_2 pigment as filler and in coatings. Paper products contain a high percentage of non-TiO_2-base minerals as filler material with the typical TiO_2 content less than 5% of the dry weight of paper. Anatase-grade pigment is preferred in the paper industry because it is less abrasive to papermaking machinery.

Stocks

Insufficient data were available to determine yearend consumer inventories of titanium mineral concentrates and TiO_2 pigment producer stocks. Owing to sales from the DNSC inventory, Government stocks of sponge fell to zero, a 2,510 t decrease compared with those of 2004. Industry stocks of sponge decreased by 43%. Stocks of scrap decreased slightly to 6,900 t, and stocks of ingot increased by 8% compared with those of 2004 (table 3).

Prices

The yearend published price range for bulk rutile mineral concentrates was $460 to $480 per metric ton, compared with $430 to $480 per metric ton in 2004. The yearend price range for bagged rutile concentrates was unchanged at $550 to $650 per ton. Yearend prices of ilmenite concentrates ranged from $75 to $85 per ton (table 10). Published prices for titanium slag were not available. Based on U.S. Customs Service data, yearend unit value of slag imports ranged from $390 to $555 per ton in 2005 compared with $347 to $466 per ton in 2004.

Because of the constrained supply of TiO_2 pigment caused by Hurricane Katrina, yearend published prices for anatase- and rutile-grade pigment increased compared with those of 2004. The Bureau of Labor Statistics producer price index for TiO_2 pigment significantly increased to 164.5 in December 2005 from 146.7 in December 2004 (U.S. Department of Labor, Bureau of Labor Statistics, 2006§).

Because of a significant increase in demand for commercial aircraft and military hardware, prices of titanium metal products rose considerably. The yearend unit value of titanium sponge ranged from $3.46 to $12.22 per pound in 2005, a dramatic increase compared with that of 2004. The yearend price range for titanium scrap also reflected market conditions, increasing to between $4.85 and $5.15 per pound in 2005 from between $3.80 and $4.00 per pound in 2004. The published price increase was substantiated by a 115% increase in the unit value of waste and scrap imports. Increased demand for ferrotitanium by steel producers was reflected in a significant increase in ferrotitanium prices. The published price range for ferrotitanium with 70% contained titanium was $8.50 to $9.50 per pound in 2004 compared with $6.35 to $6.45 per pound in 2004.

Foreign Trade

Mineral Concentrates.—The United States is heavily reliant on imports of titanium mineral concentrates because domestic demand for titanium minerals greatly exceeds domestic production. In 2005, exports of titanium mineral concentrate were 20,900 t, a 140% increase compared with 2004 (table 11). Exports of titanium concentrates are minor relative to imports.

Imports of titanium mineral concentrates include ilmenite, rutile, synthetic rutile, and titaniferous slag. In 2005, the combined value for all forms of titanium concentrate imports increased 9% compared with that of 2004 to $432 million. This increase was owing to increased reliance on titaniferous slag.

In 2005, imports of ilmenite were 154,000 t, a 37% decrease compared with those of 2004. The import sources of ilmenite were Australia (88%) and Ukraine (12%). The closure of sulfate-route TiO_2 pigment capacity in 2004 contributed to the overall decrease in imported ilmenite.

Imports of titaniferous slag were 667,000 t, a 46% increase compared with those of 2004. South Africa (71%) and Canada (25%) were the leading import sources of titanium slag. Of

the total titaniferous slag imports, 4% may be misclassified by country because the country of origin did not produce titaniferous slag.

Imports of natural and synthetic rutile totaled 366,000 t. Australia (53%) and South Africa (38%) were the major import sources of natural and synthetic rutile in 2005. Although imports of natural rutile decreased compared with those of 2004, imports of synthetic rutile increased such that the rutile total increased slightly compared with those of 2004.

Imports of titaniferous iron ore from Canada, classified as ilmenite by the U.S. Census Bureau, decreased by 11% compared with those in 2004. Titaniferous iron ore was used by the steel industry to protect the crucibles of blast furnaces. In this report, imports of titaniferous iron ore from Canada are separated from ilmenite statistics (table 12).

Metal.—Prompted by a tariff classification ruling by U.S. Customs Service, the 2004 Harmonized Tariff Schedule of the United States (HTS) codes used to classify imports of titanium metal were changed. In 2004, the HTS unwrought codes for "Billet" and "Bloom, sheet bars, and slab" were eliminated. In addition, the HTS code for "Other, unwrought" was changed to 8108.20.0091 from 8108.20.0090.

Imports of titanium metal are primarily in the form of unwrought titanium. Kazakhstan (53%), Japan (39%), and Russia (6%) were the leading sources of imported titanium sponge, while Japan (24%), France (17%), the United Kingdom (17%), and Germany (13%) were the leading sources of imported waste and scrap. The leading import sources of titanium ingot were Russia (78%) and Germany (14%). Imports of titanium powder were 126 t, an 11% decrease compared with those of 2004. China (68%) was the major source of titanium powder. Imports of other unwrought forms of titanium increased by 39% compared with those of 2004.

Imports of titanium wrought products and castings are primarily in the form of bar, rod, profiles, and wire (50%) and plate, sheet, strip, and foil (19%). Russia (63%) and Japan (11%) were the major import sources of wrought products and castings. Imports of wrought products and castings increased 4% compared with those of 2004, and exports of wrought products and castings increased by 60%.

Imports of ferrotitanium and ferrosilicon titanium, primarily used in the iron and steel industry, were 16,900 t, a 143% increase compared with those of 2004. Exports of ferrotitanium and ferrosilicon titanium were 3,630 t, a 30% increase compared with those of 2004.

TiO_2 Pigment.—Although Hurricane Katrina hampered production and trade along the Gulf Coast, the United States continued to be a net exporter of TiO_2 pigment. In 2005, exports exceeded imports by a ratio of 1.5 to 1. Exports of TiO_2 pigment were 524,000 t, a 17% decrease compared with that of 2004. About 93% of exports was in the form of finished pigment with more than 80% TiO_2 content.

During 2005, 341,000 t of TiO_2 pigment was imported, a 29% increase compared with 2004 (table 14). The leading import sources of TiO_2 pigment were Canada (31%), China (14%), the United Kingdom (8%), and Germany (7%). Compared with those of 2004, imports of TiO_2 pigment containing more than 80% TiO_2 increased by 25% to 249,000 t, other TiO_2 pigment increased by 23% to 6,600 t, and unfinished TiO_2 (unmixed and not surface treated) increased by 45% to 85,800 t.

World Review

Australia.—Astron Ltd. made plans to proceed with the development of its Donald heavy-mineral sands project in Victoria. Production was scheduled to begin in 2007. Initial mine capacity was expected to be up to 500,000 t/yr of heavy minerals, including 106,000 t/yr of ilmenite and 73,000 t/yr of leucoxene and rutile (Astron Ltd., 2006§).

Australian Zircon NL completed a drilling program at its Mindarie mineral sands project in the western Murray Basin. The deposit was estimated to have 1.6 Mt of measured heavy-mineral resources. Australian Zircon expected to commence production near yearend 2006 (Australian Zircon NL, 2005§).

In December, Bemax Resources NL began mining at the Pooncarie mineral sands project in the Murray Basin. The company planned to begin trucking heavy-mineral concentrate from the Ginkgo mine to the Broken Hill mineral separation plant in 2006. The Ginkgo mine was reported to contain 5.8 Mt of heavy minerals, with a mine life of more than 25 years. During 2005, Bemax upgraded its Bunbury mineral separation plant to allow it to simultaneously process feedstock from its Western Australia (Cable Sands) and Murray Basin operations as well as toll feedstock (Bemax Resources NL, 2006§).

Iluka continued work on the development of heavy-mineral deposits in the Murray and Eucla Basins. In 2004, Iluka had started stockpiling ore for its Douglas project in the Murray Basin, Victoria. By yearend 2005, Iluka had completed mine construction and was preparing to commission the wet concentration plant for the Douglas project. A mineral separation plant located near Hamilton was expected to be completed in mid-2006. In the first year of operation, production was expected to be 180,000 t of rutile and zircon. In the northern Murray Basin, Iluka was in the prefeasibility phase in the development of its Euston and Ouyen deposits. In the Eucla Basin, Iluka continued the delineation of its Ambrosia, Jacinth, and Tripitaka deposits (Iluka Resources Ltd., 2006§).

Olympia Resources Ltd. announced the completion of a bankable feasibility study for its Keysbrook mineral sands project, south of Perth. Keysbrook was expected to have a mine life of 11 years (Olympia Resources Ltd., 2005§). Olympia has identified a reserve of 1.2 Mt of heavy minerals at Keysbrook with startup scheduled for 2007 (Olympia Resources Ltd., 2006§).

Canada.—In the first half of 2005, QIT Fer et Titane Inc. (a subsidiary of Rio Tinto plc) completed an expansion of the upgraded titanium slag (UGS) plant at Sorel, Quebec, to 325,000 t/yr. Because of strong demand, QIT announced a further $190 million expansion of the plant's capacity to 375,000 t/yr, which was expected to be completed in 2006 (Rio Tinto plc, 2006§). The UGS plant converts QIT's sulfate-grade slag containing about 80% TiO_2 into a chloride-grade slag containing about 95% TiO_2.

Titanium Corp., Inc. continued efforts to commercialize the recovery of heavy minerals from the oil sands tailings of Syncrude Canada Ltd. in Alberta. In 2005, Titanium Corp. used its pilot facility to optimize the recovery of heavy minerals and

improve product quality. At yearend, the company began a drill core analysis program to quantify the heavy-mineral resource in the oil sands project (Titanium Corp., Inc., 2006§). In August, the company began operating a 12-metric-ton-per-hour portable wet plant that was connected to the oil tailings pipeline. This was the first time that the company had processed live tailings feedstock; earlier tests used sands from the tailing pond area as feedstock (Industrial Minerals, 2005a).

China.—In 2005, China's tremendous industrial demand continued to influence the global titanium industry. According to one industry report, China's demand for feedstocks was more than 1.5 Mt, a significant increase from demand in 2004. China's production of titanium sponge nearly doubled to reach an estimated 9,500 t in 2005 from 4,810 t in 2004 (Mineral Sands Report, 2006c).

Chinese TiO_2 pigment production is primarily based on a large number of sulfate-route plants, each with capacity of 20,000 t/yr or less. Following a 24% growth from 2003 to 2004, China's production of TiO_2 pigment increased to 574 Mt, another 24% increase (Mineral Sands Report, 2006b).

In November, DuPont and the city of Dongying signed a project agreement to construct a TiO_2 plant. Once relevant government approvals are received, the new TiO_2 plant was expected to represent a total investment at Dongying of more than $1 billion. The plant will be wholly owned by DuPont and will be the company's largest single investment project outside the United States. With a planned completion date of 2010, the plant will have an initial capacity of 200,000 t/yr of TiO_2 and will employ approximately 350 workers (E.I. DuPont de Nemours & Co. Inc., 2005§).

In October, Zhonghe Huayuan Titanium Dioxide Co. Ltd. commissioned is third 16,000-t/yr production line, bringing the company's total TiO_2 pigment capacity to 48,000 t/yr. The plant produces rutile-grade pigment (Mineral Sands Report, 2006c).

Fushun Aluminum Plant in Liaoning Province is planning a new plant to produce titanium sponge that was scheduled to be completed by 2010. The new plant was expected to increase the company's capacity to 10,000 t/yr (Zhao, 2005). An initial expansion of the plant's capacity to 5,000 t/yr was announced in 2004.

In November, Timet entered into a joint venture with Xi'an Baotimet Valinox Tubes Co. Ltd. (BAOTIMET) to produce welded titanium tubing in Xi'an. BAOTIMET's production was expected to begin in early 2007 (Titanium Metals Corp., 2006§).

Gambia, The.—Carnegie Corp. Ltd. completed a trial dredge program at the Sanyang heavy-mineral sands deposit. In 2004, the company completed an environmental impact assessment and received approval for its environmental management plan. At yearend 2005, the company was waiting for the approval of the mining lease (Carnegie Corp. Ltd., 2005§). The project is a joint venture with Astron Ltd. and could yield ilmenite, rutile, and zircon as products.

Japan.—According to the Japan Titanium Society, Japan's shipments of titanium sponge in 2005 were 30,600 t, a 16% increase compared with shipments in 2004. Mill product shipments were 18,100 t, a 4% increase from those in 2004 (Roskill's Letter from Japan, 2006b).

Toho Titanium Co. Ltd. planned to increase production of titanium sponge and titanium ingot. By installing a new electron beam furnace, Toho planned to increase ingot production capacity to 16,000 t/yr from 7,000 t/yr by 2008. The furnace will use 5,000 t/yr of scrap and 11,000 t/yr of sponge as ingot feedstock. Production capacity for sponge at the company's Chigasaki plant was expected to increase to 22,000 t/yr by 2011 from the 2005 level of 15,000 t/yr (Roskill's Letter from Japan, 2005). The company had completed a sponge capacity expansion in 2005 to 15,000 t/yr. Sumitomo Titanium Corp. planned to increase sponge production capacity to 24,000 t/yr from 18,000 t/yr by 2006 (Mineral Sands Report, 2005a).

In 2005, TiO_2 pigment production in Japan was estimated to be 260,000 t, a 2% increase from that in 2004. Paint (46%), pigments (22%), plastics (11%), and paper (9%) were the leading consuming industries in the country (Roskill's Letter from Japan, 2006a).

Kenya.—Tiomin Resources Inc. continued the development of its Kwale heavy-mineral sands project located 40 kilometers south of Mombasa. In 2005, Tiomin was pursuing project financing and announced it had secured sales agreements with two Chinese firms for future output from the mine. The construction phase of the project was expected to begin in 2006. When completed, the project was expected to produce about 330,000 t/yr of ilmenite, 75,000 t/yr of rutile, and 40,000 t/yr of zircon (Tiomin Resources Inc., 2005§).

Madagascar.—In August, Rio Tinto announced the approval to fund the development of the Fort Dauphin mineral sands project. The project was being developed by QIT Madagascar Minerals (QMM) [a Malagasy subsidiary of Rio Tinto (80%) and the Government of Madagascar (20%)]. Part of the project requires the construction of a deep sea port funded by public and private interests. Mine production was expected to reach 750,000 t/yr of ilmenite and 25,000 t/yr of zircon. Mining startup was scheduled for 2008. The mine life could extend for 40 years (Rio Tinto plc, 2005§).

Mozambique.—At yearend, Kenmare Resources plc. was midway through the construction phase of its Moma heavy-mineral sands project. Commissioning of the wet and dry separation plants was expected by yearend 2006. Production capacity from the mine was expected to reach 701,000 t/yr of ilmenite, 17,000 t/yr of rutile, and 60,000 t/yr of zircon (Kenmare Resources plc., 2006§).

In March, BHP Billiton Ltd. acquired Australia-based WMC Resources Ltd. The acquisition brought BHP's interest in the Corridor Sands project in southern Mozambique to 90%. In 2005, BHP was reviewing and updating previously conducted feasibility studies prior to making a decision whether to move into the feasibility phase during 2006. BHP also held a 100% interest in the TiGen heavy-minerals project in Moebase. A prefeasibility study was completed for the TiGen project, and market studies were being examined to determine when the project should move into the feasibility phase (BHP Billiton plc, 2005§).

Poland.—In July, Zakłady Chemiczne Police S.A. completed an initial public offering that raised $46.2 million. The company also awarded a contract for the first phase of upgrading its pigment production facilities. By mid-2008, capacity at the TiO_2 pigment plant was expected to increase to 65,000 t/yr from 40,000 t/yr (Mineral Sands Report, 2005b).

Russia.—United Kingdom-based Aricom plc was developing the Kuranakh ilmenite and iron ore deposit in the Amur region,

where it expects to start production in late 2007. Production from Kuranakh was expected to be 240,000 t/yr of ilmenite concentrate and a minimum of 660,000 t/yr of iron ore in the form of titanomagnetite concentrate. Aricom entered into conditional offtake agreements in January with China National Gold Corp. that would supply a total of at least 3.3 Mt titanomagnetite concentrate during 5 years and at least 360,000 t of ilmenite concentrate during 1½ years to the Chinese company once production begins. A definitive feasibility study by Vnipiprom Technologiya for mine development was expected to be completed in the first quarter of 2006. Aricom continued to examine options to develop a TiO_2 processing plant (Aricom plc, 2006§).

GMK Norilsk Nickel's plans to mine titanium have run into a serious obstacle because the ores in the company's titanium deposits are radioactive. The technology for purifying the ores would add significantly to the cost of the project; therefore, Norilsk Nickel is unlikely to be able to start developing these deposits in 2006 as planned. Several years ago, Norilsk Nickel acquired licenses for subsurface development at two titanium ore deposits—Yugo-vostochnaya Gremyakha (Murmansk Region, ilmenite-magnetite ore) and Tsentralnoe (Tambov Region, titanium-zirconium ore). The company had planned to mine raw materials for the production of TiO_2 (Kommersant, 2005§).

Senegal.—Mineral Deposits Ltd. (MDL) made plans to relocate its Australia-based dredge and wet concentration plant to its Grande Côte heavy-mineral sands project. The project is located within the Senegal-Mauritania Basin along the northwestern coast of Senegal, south of St. Louis. MDL hoped to commence production in 2007 with a mine capacity of about 75,000 t/yr of zircon and 14,000 t/yr of leucoxene (Mineral Deposits Ltd., 2005§).

Sierra Leone.—In March, the President of Sierra Leone announced the reopening of Sierra Rutile Ltd. mining operation in Moyamba. The operation has been idle since 1995 when civil unrest caused the mine to close. At that time, the mine provided about one quarter of the world's production of natural rutile (Sierra Leone, Office of the President, 2005§).

South Africa.—Australia-based Kumba Resources Ltd. acquired the outstanding 40% interest in the heavy-mineral producer Ticor SA. In 2005, Ticor's heavy minerals operation near Empangeni, KwaZulu-Natal Province, produced 377,000 t of ilmenite, an 18% decrease compared with output in 2004; 134,000 t of chloride slag, a 40% increase from that in 2004; and 30,000 t of sulfate slag, a 25% decrease from that in 2004 (Kumba Resources Ltd., 2006§).

Namakwa Sands improved recovery and raised rutile and zircon production at the Namakwa Sands heavy-mineral sands operation near Brand se Baai. In 2005, Namakwa Sands began an expansion project to increase rutile output by 26% and zircon production by 20%. Namakwa Sands is wholly owned by Anglo American plc (Anglo American plc, 2006§).

Vietnam.—Avireco USA LLC established a joint venture with Viet-My Mineral Co. and Mineral Development Co. No. 6 (Lidisaco) (a subsidiary of Vietnam Mineral Resource Department) to construct a TiO_2 plant in Binh Thuan Province. Construction of the plant was expected to begin in 2006, with initial production capacity of 5,000 t/yr, increasing to 10,000 t/yr. The plant was expected to use Altair Nanotechnologies Inc.'s hydrochloride pigment process technology (Industrial Minerals, 2005b). Vietnam also planned to begin embargoing exports of ilmenite, beginning in 2008.

Outlook

During the next decade, mineral development projects currently underway are expected to ensure an adequate supply of titanium mineral feedstock. An abundance of new chloride-grade mineral feedstock projects and increased demand for sulfate-grade mineral feedstock may delay the development of some projects. For the foreseeable future, China will play an important role in the production and consumption of minerals and pigment. China's double-digit expansion in sulfate-route TiO_2 production capacity should stimulate mineral exploration and development of sulfate-grade mineral feedstock in China and throughout the world.

The drop in domestic TiO_2 pigment production caused by Hurricane Katrina in 2005 is expected to be reversed in 2006. Global TiO_2 pigment production in 2006 is expected to increase by 3% compared with that of 2005. Global TiO_2 pigment consumption growth in 2006 is expected to fall at the high end of the long-term growth rate of 2% to 4% per year.

During the next several years, titanium metal producers from around the globe will be increasing titanium sponge capacity significantly through the expansion of existing facilities in China, Japan, and Russia and the addition of new operations in China and the United States. Numerous government and private industry programs are working to commercialize lower cost methods for producing titanium metal. At least one of these methods should reach commercialization during the next 2 or 3 years. By 2008, domestic and global sponge capacities are expected to reach 31,000 t/yr and 142,000 t/yr, respectively. Growth in commercial aircraft and defense applications is expected to drive demand for titanium metal over the long term.

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TABLE 1
SALIENT TITANIUM STATISTICS[1]

		2001	2002	2003	2004	2005
United States:						
Ilmenite and titaniferous slag:						
Imports for consumption	metric tons	1,060,000	840,000	804,000	701,000	822,000
Consumption[2]	do.	1,180,000	1,300,000	1,300,000	1,480,000	1,290,000 e
Rutile concentrate, natural and synthetic:						
Imports for consumption	do.	325,000	390,000	427,000	360,000	366,000
Consumption	do.	483,000	487,000	489,000	445,000	424,000 e
Sponge metal:						
Imports for consumption	do.	13,300	10,700	9,590	11,900	15,800
Consumption	do.	26,200	17,300	17,100	21,200	26,100
Price, yearend[3]	dollars per pound	3.58	3.64	2.72-3.95	3.55-6.44	3.46-12.22
Titanium dioxide pigment:						
Production	metric tons	1,330,000	1,410,000	1,420,000	1,540,000	1,310,000
Imports for consumption	do.	209,000	231,000	240,000	264,000	341,000
Consumption, apparent	do.	1,100,000 [4]	1,110,000 [4]	1,070,000 [4]	1,170,000 [5]	1,130,000 [5]
Price, December 31:						
Anatase	dollars per pound	0.92-0.94	0.85-0.95	0.85-0.95	0.90-0.95	0.95-1.00
Rutile	do.	1.00-1.09	0.85-0.95	0.85-0.90	0.90-0.95	0.95-1.00
World, production:						
Ilmenite concentrate[6]	metric tons	5,130,000 r	5,470,000 r	5,720,000 r	5,640,000	5,840,000
Rutile concentrate, natural[7]	do.	421,000	446,000	361,000	353,000	369,000
Titaniferous slag	do.	2,040,000	1,870,000	1,880,000	1,880,000 r	1,880,000 e

eEstimated. rRevised.

[1]Data are rounded to no more than three significant digits; except prices.

[2]Excludes consumption used to produce synthetic rutile.

[3]Landed duty-paid unit based on U.S. imports for consumption.

[4]Production plus imports minus exports plus stock decrease or minus stock increase.

[5]Production plus imports minus exports. Excludes stock changes.

[6]Includes U.S. production of ilmenite, leucoxene, and rutile rounded to one significant digit to avoid disclosing company proprietary data.

[7]U.S. production of rutile included with ilmenite to avoid disclosing company proprietary data.

TABLE 2
U.S. TITANIUM METAL PRODUCTION CAPACITY IN 2005[1, 2]

(Metric tons per year)

		Yearend capacity	
Company	Plant location	Sponge	Ingot[3]
Allvac (Allegheny Technologies Inc.)	Albany, OR	--	10,900
Do.	Monroe, NC	--	11,800
Do.	Richland, WA	--	10,000
Alta Group (Honeywell International Inc.)	Salt Lake City, UT	340	--
Howmet Corp. (Alcoa Inc.)	Whitehall, MI	--	3,200
RMI Titanium Co. (RTI International Metals, Inc.)	Niles, OH	--	16,300
Titanium Metals Corp.	Henderson, NV	8,600	12,300
Do.	Morgantown, PA	--	20,000
Do.	Vallejo, CA	--	800
Total		8,940	85,300

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Estimated operating capacity based on 7-day-per-week full production.

[3]Includes electron-beam, plasma, and vacuum-arc-remelting capacity.

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

(Metric tons)

Component	2004	2005
Production:		
Ingot	41,400	48,100
Mill products	26,900 r	30,900
Exports:		
Sponge	2,410	1,910
Waste and scrap	9,760 r	20,600
Other unwrought	1,940 [2]	2,540 [3]
Wrought products and castings[4]	8,300	10,800
Total	22,400	35,800
Imports:		
Sponge	11,900	15,800
Waste and scrap	8,830	12,400
Other unwrought[5]	2,640	3,910
Wrought products and castings	3,590	3,660
Total	26,900	35,800
Stocks, yearend:		
Government, sponge (total inventory)	2,510	--
Industry:		
Sponge	7,660	4,330
Scrap	7,030	6,900
Ingot	3,040	3,270
Consumption, reported:		
Sponge	21,200	26,100
Scrap	18,300 r	25,700
Ingot	34,400	40,100
Shipments:		
Ingot (net shipments)	8,300	9,820
Mill products (net shipments):		
Forging and extrusion billet	6,360	8,110
Plate, sheet, strip	7,940	9,970
Rod, bar, fastener stock, wire	4,570	5,160
Other[6]	196	587
Total	19,100	23,800
Castings (shipments)	W	W
Receipts, scrap:		
Home	7,730	5,490
Purchased	16,500	15,200

rRevised. W Withheld to avoid disclosing company proprietary data. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes billet, bloom, ingot, powder, sheet bar, slab, and other.

[3]Includes ingot, powder, and other. Billet, bloom, sheet bar and slab classified as wright in 2005.

[4]Billet, bloom, sheet bar, and slab classified as wrought in 2005.

[5]Includes ingot, powder, and other.

[6]Data for pipe, tube, and other have been combined to avoid disclosing company proprietary data.

TABLE 4

CAPACITIES OF U.S. TITANIUM DIOXIDE PIGMENT PLANTS ON DECEMBER 31, 2005[1, 2, 3]

(Metric tons per year)

Company	Plant location	Capacity[4]
E.I. du Pont de Nemours & Co. Inc.	De Lisle, MS[5]	--
Do.	Edgemoor, DE	154,000
Do.	New Johnsonville, TN	380,000
Tronox Inc.	Savannah, GA[4]	110,000
Do.	Hamilton, MS	225,000
Louisiana Pigment Co. LP	Lake Charles, LA	146,000
Millennium Inorganic Chemicals Inc.	Ashtabula, OH	220,000
Do.	Baltimore, MD	50,000
Total		1,290,000

-- Zero.

[1]Estimated operating capacity based on 7-day-per-week full production.

[2]Table does not include TOR Minerals International's Corpus Christi, TX, production capacity of about 26,400 metric tons per year (t/yr) of buff that is produced by refining and fine grinding of synthetic rutile.

[3]Data are rounded to no more than three significant digits; may not add to totals shown.

[4]All plants use the chloride process to manufacture TiO_2 pigment.

[5]The 300,000-t/yr De Lisle plant was badly damaged by a hurricane in September 2005. At yearend, the plant was being reconstructed.

TABLE 5

COMPONENTS OF U.S. TITANIUM DIOXIDE PIGMENT SUPPLY AND DEMAND[1]

		2004		2005	
		Gross weight	TiO_2 content	Gross weight	TiO_2 content
Production[2]	metric tons	1,540,000	1,440,000 e	1,310,000	1,220,000 e
Shipments:[3]					
Quantity	do.	1,700,000	1,600,000 e	1,420,000	1,220,000 e
Value	thousands	$3,190,000	XX	$3,110,000	XX
Exports	metric tons	635,000	597,000 e	524,000	493,000 e
Imports for consumption	do.	264,000	248,000 e	341,000	321,000 e
Consumption, apparent[e, 4]	do.	1,170,000	1,090,000	1,130,000	1,050,000

[e]Estimated. XX Not applicable.

[1]Data are rounded to no more than three significant digits.

[2]Excludes production of buff pigment.

[3]Includes interplant transfers.

[4]Production plus imports minus exports. Excludes stock changes.

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

TABLE 6
U.S. CONSUMPTION OF TITANIUM CONCENTRATE[1]

(Metric tons)

	2004		2005[e]	
	Gross weight	TiO_2 content	Gross weight	TiO_2 content
Ilmenite and titaniferous slag:[2]				
Pigment	1,460,000	NA	1,260,000	NA
Miscellaneous[3]	19,300	NA	34,000	NA
Total	1,480,000	1,080,000	1,290,000	994,000
Rutile, natural and synthetic:				
Pigment	418,000	NA	394,000	NA
Miscellaneous[3]	26,700	NA	30,000	NA
Total	445,000	414,000	424,000	394,000
Total concentrate:				
Pigment	1,880,000	NA	1,650,000	NA
Miscellaneous[3]	45,900	NA	64,000	NA
Total	1,920,000	1,490,000	1,720,000	1,390,000

[e]Estimated. NA Not available.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

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

[3]Includes alloys, carbide, ceramics, chemicals, glass fibers, titanium metal, and welding-rod coatings and fluxes.

TABLE 7
U.S. CONSUMPTION OF TITANIUM IN STEEL AND OTHER ALLOYS[1, 2]

(Metric tons)

	2004	2005
Steel:		
Carbon steel	4,180	4,300
Stainless and heat-resisting steel	3,130	3,370
Other alloy steel[3]	1,420	472
Total steel	8,740	8,130
Superalloys	628	1,310
Alloys, other than above	785 [r]	1,460
Miscellaneous and unspecified	53 [r]	54
Grand total	10,200	11,000

[r]Revised.

[1]Includes ferrotitanium, scrap, sponge, and other titanium additives.

[2]Data are rounded to no more than three significant digits; may not add to totals shown.

[3]Includes high-strength low-alloy and tool steel.

TABLE 8
U.S. DISTRIBUTION OF TITANIUM PIGMENT SHIPMENTS,
TITANIUM DIOXIDE CONTENT, BY INDUSTRY[1]

(Percent)

Industry	2004	2005
Paint, varnish, lacquer	53.6	62.7
Paper	16.0	12.1
Plastics[2]	27.2	24.4
Other[3]	3.2	0.8
Total	100.0	100.0

[1]Excludes exports.
[2]Includes rubber.
[3]Includes agricultural, building materials, ceramics, coated fabrics and textiles, cosmetics, food, paper, and printing ink. Also includes shipments to distributors.

TABLE 9
U.S. STOCKS OF TITANIUM CONCENTRATES, DECEMBER 31[1, 2]

(Metric tons)

	2004		2005[e]	
	Gross weight	TiO_2 content	Gross weight	TiO_2 content
Ilmenite and titaniferous slag	416,000	299,000	NA	NA
Rutile, natural and synthetic	75,400	70,000	NA	NA

[e]Estimated. NA Not available.
[1]Data are rounded to no more than three significant digits.
[2]Consumer stocks.

TABLE 10
PUBLISHED PRICES OF TITANIUM PRODUCTS

		2004	2005
Concentrate:			
Ilmenite, free on board (f.o.b.) Australian ports[1]	dollars per metric ton	72-90	75-85
Rutile, bagged, f.o.b. Australian ports[1]	do.	550-650	550-650
Rutile, bulk, f.o.b. Australian ports[1]	do.	430-480	460-480
Titaniferous slag, 80% to 95% TiO_2[2]	do.	347-466	390-555
Metal:			
Sponge[2]	dollars per pound	3.55-6.44	3.46-12.22
Scrap, turnings, unproccessed[3]	do.	3.80-4.00	4.85-5.15
Ferrotitanium, 70% Ti[3]	do.	6.35-6.45	8.50-9.50
Pigment:			
TiO_2 pigment, f.o.b. U.S. plants, anatase[4]	do.	0.90-0.95	0.95-1.00
TiO_2 pigment, f.o.b. U.S. plants, rutile[4]	do.	0.90-0.95	0.95-1.00

[1]Source: Industral Minerals.
[2]Landed duty-paid unit value based on U.S. imports for consumption.
[3]Source: Platts Metals Week.
[4]Source: Chemical Market Reporter.

TABLE 11
U.S. EXPORTS OF TITANIUM BY CLASS[1]

Class	HTS[2]	2004 Quantity (metric tons)	2004 Value (thousands)	2005 Quantity (metric tons)	2005 Value (thousands)
Metal:					
Sponge	8108.30.0000	2,410	$16,800	1,910	$19,800
Scrap		9,760 r	56,000 r	20,600	91,400
Unwrought:					
Billet	8108.20.0045, 8108.90.6010 r	179	4,800	392	18,900
Bloom, sheet bar, slab	8108.20.0060, 8108.90.6020 r	375	7,490	613	14,300
Ingot	8108.20.0030	951	14,400	1,720	32,600
Other	8108.20.0090	430	7,090	820	17,200
Wrought:					
Bar, rod, profile, wire	8108.90.6030, 8108.90.6031 r	3,310	112,000	3,460	174,000
Other	8108.90.8000	4,990	191,000	6,350	288,000
Total metal		22,400	409,000	35,800	656,000
Ferrotitanium and ferrosilicon titanium	7202.91.0000	2,790	7,690	3,630	21,300
Ores and concentrates	2614.00.0000	8,690	3,370	20,900	8,930
Pigment:					
80% or more titanium dioxide pigment	3206.11.0000	576,000	968,000	486,000	955,000
Other titanium dioxide pigment	3206.19.0000	36,900	81,900	24,000	75,900
Unfinished titanium dioxide[3]	2823.00.0000	22,000	35,700	14,500	30,600
Total		635,000	1,090,000	524,000	1,060,000

rRevised.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule of the United States.
[3]Unmixed and not surface treated.

Source: U.S. Census Bureau.

TABLE 12

U.S. IMPORTS FOR CONSUMPTION OF TITANIUM CONCENTRATE, BY COUNTRY[1]

Concentrate and country	HTS[2]	2004 Quantity (metric tons)	2004 Value (thousands)	2005 Quantity (metric tons)	2005 Value (thousands)
Ilmenite:	2614.00.6020				
Australia		120,000	$16,700	135,000	$18,700
South Africa		26,700 [3]	11,700 [3]	--	--
Ukraine		70,000	9,770	19,000	1,670
Vietnam		27,000	2,750	--	--
Total		244,000	40,900	154,000	20,400
Titaniferous slag:	2620.99.5000				
Canada		122,000	56,600	168,000	65,400
South Africa		335,000	135,000	472,000	178,000
Other		97	31	27,000 [3]	10,500 [3]
Total		457,000	192,000	667,000	254,000
Rutile, natural:	2614.00.6040				
Australia		57,100	32,900	35,400	14,600
South Africa		147,000	63,200	137,000	63,200
Ukraine		684	428	5,440	2,510
Other		10,900	3,420	5,970	2,510
Total		216,000	99,900	184,000	83,800
Rutile, synthetic:	2614.00.3000				
Australia		138,000	62,300	158,000	64,100
Malaysia		5,440	2,390	14,300	6,190
Other		78 [r]	71 [r]	9,170 [3]	3,890 [3]
Total		144,000	64,800	182,000	74,200
Titaniferous iron ore, Canada[4]	2614.00.6040	68,700	3,650	61,100	3,560

[r]Revised. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Harmonized Tariff Schedule of the United States.

[3]All or part of these data have been referred to the U.S. Census Bureau for verification.

[4]Includes materials consumed for purposes other than production of titanium commodities, principally heavy aggregate and steel-furnace flux. Titaniferous iron ore from Canada is classified as ilmenite under the HTS.

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

TABLE 13

U.S. IMPORTS FOR CONSUMPTION OF TITANIUM METAL, BY CLASS AND COUNTRY[1]

Class and country	HTS[2]	2004 Quantity (metric tons)	2004 Value (thousands)	2005 Quantity (metric tons)	2005 Value (thousands)
Waste and scrap:	8108.30.0000				
Canada		835	$4,690	905	$7,980
France		941	5,190	2,080	33,800
Germany		1,620	13,300	1,640	29,300
Israel		268	1,780	341	4,670
Japan		2,340	12,400	3,010	33,900
Taiwan		641	4,240	637	10,500
United Kingdom		1,210	6,480	2,060	19,700
Other		972	5,520	--	--
Total		8,830	53,600	12,400	162,000
Unwrought:					
Sponge:	8108.20.0010				
Japan		4,600	32,100	6,200	54,900
Kazakhstan[e]		5,670	38,000	8,390	51,400
Russia		1,380	8,180	977	7,140
Ukraine		37	310	239	5,640
Other		168 [r]	1,280	47	648
Total		11,900	79,900 [r]	15,800	120,000
Ingot:	8108.20.0030				
France		--	--	112	4,010
Germany		271	3,320	332	6,720
Russia		1,150	10,300	1,920	26,500
Other		115	1,150	83	1,490
Total		1,530	14,800	2,450	38,700
Powder:	8108.20.0015				
China		107	1,130	86	1,830
Other		35	1,710	40	2,240
Total		142	2,840	126	4,060
Other:	8108.20.0091				
France		271	2,770	238	4,080
Japan		349	2,710	752	12,600
United Kingdom		181	1,930	180	4,330
Other		158	931	164	1,920
Total		959	8,350	1,330	22,900
Wrought products and castings:[3]	8108.90.3030, 8108.90.3060, 8108.90.6010, 8108.90.6020, 8108.90.6030, 8108.90.6031, 8108.90.6045, 8108.90.6060, 8108.90.6075				
Canada		76	3,090	87	4,750
China		49	1,990	215	8,480
Italy		92	2,700	94	3,890
Japan		456	14,600	390	14,700
Russia		2,470	42,900	2,300	47,100
Sweden		78	2,130	71	2,260
United Kingdom		160	13,700	241	12,200
Other		160 [r]	10,400 [r]	264	18,100
Total		3,540	91,500	3,660	111,000
Ferrotitanium and ferrosilicon titanium	7202.91.0000	6,940	21,200	16,900	76,700

[e]Estimated. [r]Revised. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Harmonized Tariff Schedule of the United States.

[3]Includes bar, billet, bloom, castings, foil, pipe, plate, profile, rod, sheet, sheet bar, slab, strip, tube, wire, and other.

Source: U.S. Census Bureau.

TABLE 14
U.S. IMPORTS FOR CONSUMPTION OF TITANIUM PIGMENT, BY COUNTRY[1]

Country	HTS[2]	2004 Quantity (metric tons)	2004 Value (thousands)	2005 Quantity (metric tons)	2005 Value (thousands)
80% or more titanium dioxide pigment:	3206.11.0000				
Australia		3,360	$5,480	3,620	$6,380
Belgium		7,340	10,900	9,990	18,000
Canada		71,800	115,000	73,000	141,000
China		9,190	11,500	29,800	39,600
Finland		9,700	17,700	14,000	27,400
France		4,680	6,900	7,060	11,100
Germany		13,200	23,700	17,600	35,200
Italy		10,100	13,600	9,460	14,700
Japan		6,790	14,800	6,190	15,800
Korea, Republic of		9,100	10,100	7,360	8,860
Mexico		16,400	25,300	13,800	23,700
Netherlands		5,350	8,570	5,310	11,300
Norway		5,630	8,610	4,010	6,840
Singapore		2,240	3,580	2,030	3,820
Slovenia		2,440 r	3,670 r	3,020	4,780
Spain		8,750	12,600	8,800	13,900
United Kingdom		7,770	11,600	27,400	47,100
Other		5,040 r	8,000 r	6,130	8,700
Total		199,000	312,000	249,000	438,000
Other titanium dioxide:	3206.19.0000				
Canada		1,960	7,900	2,680	11,100
China		1,070	1,630	795	2,120
Finland		178	1,880	274	2,820
Germany		547	1,550	1,220	3,800
India		341	913	491	1,490
Japan		436	5,760	390	5,830
United Kingdom		161	3,270	113	2,270
Other		687 r	3,330 r	644	2,230
Total		5,370	26,200	6,600	31,600
Unfinished titanium dioxide:[3]	2328.00.0000				
Belgium		--	--	1,560	3,080
Brazil		88	127	2,030	2,590
Canada		10	37	28,600	14,300
China		10,800	11,600	15,700	21,000
Czech Republic		5,350	8,220	7,810	13,100
France		17,400	24,300	17,100	25,700
Germany		9,980	18,500	5,910	13,000
Korea, Republic of		424	521	1,680	2,320
Poland		580	931	752	1,250
Other		14,600 r	10,500 r	4,720	11,300
Total		59,300	74,800	85,800	108,000
Grand total		264,000	413,000	341,000	578,000

rRevised. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Harmonized Tariff Schedule of the United States.

[3]Unmixed and not surface treated.

Source: U.S. Census Bureau.

TABLE 15

TITANIUM: WORLD PRODUCTION OF MINERAL CONCENTRATES, BY COUNTRY[1, 2]

(Metric tons)

Concentrate type and country	2001	2002	2003	2004	2005[e]
Ilmenite and leucoxene:[3, 4]					
Australia:					
Ilmenite	2,017,000	1,917,000	2,006,000	1,921,000	2,034,000 [5]
Leucoxene	30,000	39,000	57,000	45,000	55,000 [5]
Brazil[6]	144,644 [r]	177,027	120,160 [r]	133,000 [r]	135,000 [p]
China[e]	300,000	750,000	800,000	840,000	900,000
Egypt[e]	125,000	125,000	125,000	125,000	125,000
India[e]	430,000	460,000	500,000	520,000	550,000
Kazakhstan[e]	40,000	50,000	60,000	60,000	60,000
Malaysia	129,750	106,046	95,148	61,471 [r]	70,000
Norway[e]	750,000	750,000	840,000	860,000	860,000
Ukraine	484,500	512,400	420,500	370,000 [e]	370,000
United States[7]	500,000	400,000	500,000 [e]	500,000 [e]	500,000
Vietnam[e]	180,000	180,000	200,000 [r]	200,000 [r]	180,000
Total[8]	5,130,000 [r]	5,470,000	5,720,000 [r]	5,640,000	5,840,000
Rutile:[4]					
Australia	206,000	218,000	173,000	162,000	177,000 [5]
Brazil[6]	2,270	1,878	2,337	3,000 [r]	3,000 [p]
India[e]	19,000	18,000	18,000	19,000	19,000
South Africa[e]	134,000	138,000	108,000	110,000	110,000
Ukraine[e]	60,000	70,000	60,000	60,000	60,000
United States	(9)	(9)	(9)	(9)	(9)
Total	421,000	446,000	361,000	354,000 [r]	369,000
Titaniferous slag:[e, 10]					
Canada	1,010,000	900,000	873,000	863,000 [r]	860,000 [p]
South Africa	1,025,000	973,000	1,010,000	1,020,000	1,020,000
Total	2,040,000	1,870,000	1,880,000	1,880,000 [r]	1,880,000

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table includes data available through July 15, 2006.

[3]Ilmenite is also produced in Canada and South Africa, but this output is not included here because most 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]Small amounts of titanium minerals were reportedly produced in various countries; information, however, is inadequate to make reliable estimates of output levels.

[5]Reported figure.

[6]Excludes production of unbeneficiated anatase ore.

[7]Includes rutile to avoid disclosing company proprietary data. Rounded to one significant digit.

[8]Includes U.S. production, rounded to one significant digit, of ilmenite, leucoxene, and rutile to avoid disclosing company proprietary data.

[9]Included with ilmenite to avoid disclosing company proprietary data.

[10]Slag is also produced in Kazakhstan, Norway,and Russia, but this output is not included under "Titaniferous slag" to avoid duplicative reporting.