

**ILMENITE<sup>1</sup>**(Data in thousand metric tons of contained TiO<sub>2</sub>, unless otherwise noted)

**Domestic Production and Use:** Two firms produced ilmenite concentrate from heavy-mineral sands operations in Florida and Virginia, and one firm produced ilmenite in California as a byproduct of sand and gravel production. Domestic ilmenite production data was withheld to avoid revealing company proprietary data. Based on average prices, the value of U.S. ilmenite and titanium slag consumption in 1997 was about \$280 million. Major coproducts of mining from heavy-mineral deposits are rutile and zircon. About 99% of the ilmenite and slag was consumed by five titanium pigment producers. The remainder was used in welding rod coatings and for manufacturing alloys, carbides, and chemicals.

<b>Salient Statistics—United States:</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997<sup>e</sup></b>
Production	W	W	W	W	W
Imports for consumption <sup>2</sup>	564	584	586	641	601
Exports <sup>e</sup>	7	9	15	7	11
Consumption, reported <sup>2</sup>	889	W	1,010	1,010	1,060
Price, dollars per metric ton:					
Ilmenite:					
Bulk, 54% TiO <sub>2</sub> , f.o.b. Australian ports	63	77	83	87	83
Slag: <sup>e</sup>					
80% TiO <sub>2</sub> , f.o.b. Sorel, Quebec	276	278	244	292	294
85% TiO <sub>2</sub> , f.o.b. Richards Bay, South Africa	330	334	349	353	390
Stocks, mine, distributor and consumer, yearend <sup>2</sup>	218	208	137	267	200
Employment, mine and mill, <sup>3</sup> number	395	400	400	400	400
Net import reliance <sup>4</sup> as a percent of apparent consumption	W	W	W	W	W

**Recycling:** None.**Import Sources (1993-96):** South Africa, 56%; Australia, 28%; Canada, 6%; and other, 10%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Most favored nation (MFN) 12/31/97</b>	<b>Non-MFN<sup>5</sup> 12/31/97</b>
Ilmenite and ilmenite sand	2614.00.6020	Free	Free.
Titanium slag	2620.90.5000	Free	Free.

**Depletion Allowance:** 22% (Domestic), 14% (Foreign).**Government Stockpile:** None.

## ILMENITE

**Events, Trends, and Issues:** The United States relies heavily on imports of ilmenite and titanium slag to satisfy most of its domestic needs. Based on increased production of titanium pigment, domestic consumption of ilmenite and titanium slag concentrates was estimated to have increased 5% compared with 1996. However, owing to an increased reliance on existing inventories, imports of Ilmenite and titanium slag decreased an estimated 6% compared with 1996. Based on export data for all forms of titanium concentrates, exports of ilmenite concentrates were expected to increase significantly compared with 1996.

In Australia, a major mining operation was commissioned at Beenup, Western Australia. Ilmenite from Beenup was used to produce a chloride-grade slag at an existing titanium slag operation in Tyssedal, Norway. In the past, the Tyssedal operation used ilmenite from the Tellnes, Norway, mine to produce a sulfate-grade slag. At full production, the Tyssedal operation was expected to produce up to 200,000 tons of chloride-grade slag. The titanium slag producer in Sorel, Quebec, commissioned a project to upgrade its sulfate-grade slag to chloride-grade slag. Initial capacity of the upgrade plant was reported to be 200,000 tons per year. In the United States, a mining operation was commissioned at the Old Hickory deposit near Richmond, VA. Initial capacity was expected to be up to 100,000 tons per year of ilmenite (59% to 60% TiO<sub>2</sub>), 3,500 tons per year of a higher grade feedstock (85% TiO<sub>2</sub>), and 30,000 tons per year of zircon.

Exploration and development of titanium mineral deposits continued in 1997. These activities were most evident in Australia, Canada, India, Indonesia, Kenya, Mozambique, Russia, South Africa, Ukraine, the United States, and Vietnam. Producers continued efforts to develop higher grade concentrates.

### **World Mine Production, Reserves, and Reserve Base:**

	Mine production		Reserves <sup>6</sup>	Reserve base <sup>6</sup>
	1996	1997 <sup>e</sup>		
United States	W	W	8,000	59,000
Australia	1,150	1,190	33,000	88,000
Brazil	58	55	18,000	18,000
Canada (slag)	760	720	31,000	36,000
China	83	83	30,000	41,000
Egypt	—	—	—	1,700
Finland	—	—	1,400	1,400
India	162	162	30,000	38,000
Italy	—	—	—	2,200
Madagascar	—	—	—	19,000
Malaysia	135	138	—	1,000
Norway (ilmenite and slag)	338	225	40,000	40,000
South Africa (slag)	842	850	63,000	63,000
Sri Lanka	33	16	13,000	13,000
Ukraine	53	53	5,900	13,000
Other countries	5	5	1,000	1,000
World total (rounded)	73,620	73,500	270,000	440,000

**World Resources:** Ilmenite supplies about 90% of the world's demand for titaniferous material. World ilmenite resources total about 1 billion tons of titanium dioxide. Major resources occur in Australia, Canada, China, India, New Zealand, Norway, South Africa, Ukraine, and the United States.

**Substitutes:** Rutile and synthetic rutile were extensively used to produce titanium dioxide pigment.

<sup>e</sup>Estimated. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>See also Rutile and Titanium and Titanium Dioxide.

<sup>2</sup>Includes titanium slag from Canada, Norway, and South Africa and leucosene from Australia.

<sup>3</sup>Includes operating employees shown under Rutile, subject to the same footnoted comments.

<sup>4</sup>Defined as imports - exports + adjustments for Government and industry stock changes.

<sup>5</sup>See Appendix B.

<sup>6</sup>See Appendix D for definitions.

<sup>7</sup>Excludes U.S. production.

**RUTILE<sup>1</sup>**(Data in thousand metric tons of contained TiO<sub>2</sub>, unless otherwise noted)

**Domestic Production and Use:** Rutile was produced at one mine in Florida. At two other mines in Florida, rutile was included in a bulk concentrate containing mostly ilmenite and leucosene. The major coproduct of these mines is zircon. Synthetic rutile was produced at one plant in Alabama. Domestic ilmenite production data was withheld to avoid revealing company proprietary data. The value of U.S. rutile consumption in 1996, including synthetic rutile, was about \$196 million. Two firms, with facilities in Nevada and Oregon, used titanium tetrachloride primarily made from rutile to manufacture titanium. Of 28 consuming firms, mainly in the Eastern United States, 5 companies used 93% of the rutile consumed to produce titanium dioxide (TiO<sub>2</sub>) pigment. Welding-rod coatings and miscellaneous applications, which include fiberglass, titanium metal and welding-rod coatings, consumed about 7%.

<b>Salient Statistics—United States:</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997<sup>e</sup></b>
Production	W	W	W	W	W
Imports for consumption <sup>2</sup>	349	311	295	305	329
Exports <sup>e</sup>	3	4	6	3	5
Shipments from Government stockpile excesses	1	18	17	—	—
Consumption, reported <sup>2</sup>	436	478	439	365	383
Price, dollars per ton of rutile, yearend:					
Bulk, f.o.b. Australian ports	378	420	600	563	530
Stocks, mine, distributor and consumer, yearend	179	141	52	77	80
Employment, mine and mill, <sup>3</sup> number	395	400	400	400	400
Net import reliance <sup>4</sup> as a percent of apparent consumption	W	W	W	W	W

**Recycling:** None.**Import Sources (1993-96):** Australia, 51%; South Africa, 36%; Sierra Leone, 9%; and other, 4%.

<b>Tariff:</b>	<b>Item</b>	<b>Number</b>	<b>Most favored nation (MFN) 12/31/97</b>	<b>Non-MFN<sup>5</sup> 12/31/97</b>
	Rutile concentrate	2614.00.6040	Free	Free.
	Synthetic rutile	2614.00.3000	Free	30% ad val.

**Depletion Allowance:** 22% (Domestic), 14% (Foreign).**Government Stockpile:** None.

## RUTILE

**Events, Trends, and Issues:** Based on increased production of titanium pigment, domestic consumption of rutile concentrates was estimated to have increased 5% compared with 1996. In 1997, imports of all rutile concentrates were estimated to have increased 8% compared with 1996. Although imports of natural rutile decreased 2%, imports of synthetic rutile increased 20% compared with 1996. Increased availability of rutile concentrates caused prices to decrease 6% compared with 1996.

Exploration and development of titanium mineral deposits continued in 1997. These activities were most evident in Africa, Australia, Canada, India, Indonesia, Mozambique, Russia, Ukraine, the United States, and Vietnam. Producers continued efforts to develop higher grade concentrates. In Australia, a synthetic producer completed a project to produce an upgraded product lower in uranium and thorium content. Sierra Leone's loss as a major source of natural rutile continued to affect the global market.

Fewer environmental pollution problems are encountered when pigment is produced from rutile rather than ilmenite. The chloride process, using a rutile feed, generates about 0.2 ton of waste per ton of  $TiO_2$  product; the sulfate process, using ilmenite, generates about 3.5 tons of waste per ton of product. Producing synthetic rutile from ilmenite results in about 0.7 ton of waste, mainly iron oxide, per ton of product. Direct chlorination of ilmenite generates about 1.2 tons of waste, mainly ferric chloride, per ton of  $TiO_2$ .

### **World Mine Production, Reserves, and Reserve Base:**

	Mine production		Reserves <sup>6</sup>	Reserve base <sup>6</sup>
	1996	1997 <sup>e</sup>		
United States	W	W	500	1,800
Australia	171	190	4,300	43,000
Brazil	2	2	40	85,000
India	13	13	6,600	7,700
Italy	—	—	—	8,800
Sierra Leone	—	—	3,100	3,100
South Africa	108	108	8,300	8,300
Sri Lanka	3	2	4,800	4,800
Thailand	3	4	NA	NA
Ukraine	95	95	2,500	2,500
World total (may be rounded)	<sup>7</sup> 395	<sup>7</sup> 414	30,000	170,000

**World Resources:** Identified world resources of rutile (including anatase) total about 230 million tons of contained  $TiO_2$ . Major rutile resources occur in Australia, India, Italy, Sierra Leone, South Africa, and the United States.

**Substitutes:** Ilmenite, titaniferous slag, and synthetic rutile made from ilmenite may be used instead of natural rutile for making pigment, metal, and welding-rod coatings.

<sup>e</sup>Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>See also Ilmenite and Titanium and Titanium Dioxide.

<sup>2</sup>Includes synthetic rutile.

<sup>3</sup>Employment at three sand deposit operations in Florida, which produced either rutile concentrate or a titanium mineral concentrate, where ilmenite and zircon were major coproducts and where employees were not assigned to specific commodities.

<sup>4</sup>Defined as imports - exports + adjustments for Government and industry stock changes.

<sup>5</sup>See Appendix B.

<sup>6</sup>See Appendix D for definitions.

<sup>7</sup>Excludes U.S. production.