ILMENITE¹

(Data in thousand metric tons of contained TiO₂, 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 1998 was about \$334 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.

Salient Statistics—United States:	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998°</u>
Production	W	W	W	W	W
Imports for consumption ²	584	586	641	651	605
Exports ^e	9	15	7	11	39
Consumption, reported ²	W	1,010	1,010	1,060	1,120
Price, dollars per metric ton:					
Ilmenite, bulk, 54% TiO ₂ , f.o.b. Australian ports	77	83	87	83	77
Slag: ^e					
80% TiO ₂ , f.o.b. Sorel, Quebec	278	244	292	294	338
85% TiO ₂ , f.o.b. Richards Bay, South Africa	334	349	353	390	385
Stocks, mine, distributor and consumer, yearend ²	208	137	267	234	248
Employment, mine and mill, ³ number	400	400	400	400	450
Net import reliance ⁴ as a percent of					
reported consumption	W	64%	50%	63%	49%

Recycling: None.

Import Sources (1994-97): South Africa, 54%; Australia, 31%; Canada, 5%; and other, 10%.

<u>Tariff</u> : Item	Number	Normal Trade Relations (NTR) <u>12/31/98</u>	Non-NTR⁵ <u>12/31/98</u>
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.

Events, Trends, and Issues: Global production of total ilmenite and slag in 1998 is estimated to have increased 9% compared with that of 1997. Domestic consumption of ilmenite and titanium slag concentrates in 1998 was estimated to have increased 7% compared with that of 1997. Although the United States relies heavily on imports of ilmenite and titanium slag to satisfy most of its domestic needs for titanium mineral feedstock, 1998 imports of these concentrates decreased significantly.

In 1998, several projects to expand the availability of chloride-grade slag feedstock were underway. In Norway, the Tinfos slag operation was in the process of converting its ilmenite feedstock source material so as to allow for the production of chloride-grade slag. Shipments of chloride-grade slag from the upgraded slag plant at Sorel, Canada began in the first quarter 1998. In South Africa, an expansion project was underway at Namakwa to double capacity through the addition of a second slag furnace.

ILMENITE

In Australia, two of the world largest mineral sands producers planned to merge their two companies. If completed, the merger would improve recovery rates and extend the mine life of some reserves by processing of minerals at more efficient plants. Operational difficulties at the newly commissioned operation at Beenup has resulted in limited production of ilmenite feedstock. In the first half of 1998, the Beenup operation produced less than 30% of its 600,000-ton-per-year nameplate capacity. Initially, ilmenite from Beenup was scheduled to supply one-half of the feedstock requirements for the Tinfos slag operation in Norway. The shortfall has been reported to have been met with material from India.

Exploration and development of titanium mineral deposits continued in 1998. In the United States, deposits under examination included Camden, TN, Escalante, UT, Powderhorn, CO, and Okefenokee, GA. Canadian deposits under investigation included Shubenacadie River Basin, Nova Scotia, and Pipestone Lake, Manitoba. In Australia, investigations were ongoing at Broken Hill, Spring Hill, and Twelve Mile, New South Wales; Goondicum, Western Queensland; Ouyen, Victoria; and a large portion of the Murray Basin in New South Wales, Victoria, and South Australia. South African exploration and development investigations were ongoing at Bothaville. In preparation of a full feasibility study, a metallurgical study was completed for the Kwale mineral sands project in Kenya.

World Mine Production, Reserves, and Reserve Base:

	Mine	Mine production		Reserve base ⁶
	<u>1997</u>	<u>1998°</u>		
United States	W	W	13,000	59,000
Australia	1,270	1,400	⁷ 81,000	⁷ 118,000
Brazil	54	54	18,000	18,000
Canada (slag)	680	768	31,000	36,000
China	85	85	30,000	41,000
Egypt	_	—		1,700
Finland	_	—	1,400	1,400
India	162	178	30,000	38,000
Italy	—	—		2,200
Madagascar	_	—		19,000
Malaysia	92	92		1,000
Norway (ilmenite and slag)	338	338	40,000	40,000
South Africa (slag)	842	935	63,000	63,000
Sri Lanka	10	16	13,000	13,000
Ukraine	133	53	5,900	13,000
Other countries	5	5	1,000	1,000
World total (rounded)	⁸ 3,660	⁸ 4,000	327,000	460,000

<u>World Resources</u>: Ilmenite supplies about 90% of the world's demand for titanium minerals. 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 used extensively to produce titanium dioxide pigment.

^eEstimated. W Withheld to avoid disclosing company proprietary data.

¹See also Rutile and Titanium and Titanium Dioxide.

²Includes titanium slag from Canada, Norway, and South Africa and leucoxene from Australia.

³Includes operating employees shown under Rutile, subject to the same footnoted comments.

⁴Defined as imports - exports + adjustments for Government and industry stock changes.

⁵See Appendix B.

⁶See Appendix D for definitions.

⁷Increased from 1997 based on data published by the Australian Bureau of Resource Sciences.

⁸Excludes U.S. production.

(Data in thousand metric tons of contained TiO₂, 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 leucoxene. The major coproduct of these mines is zircon. Synthetic rutile was produced at one plant in Alabama. Domestic rutile production data was withheld to avoid revealing company proprietary data. The value of U.S. rutile consumption in 1998, including synthetic rutile, was about \$190 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_2) pigment. Welding-rod coatings and miscellaneous applications, which include fiberglass and titanium metal, consumed about 7%.

Salient Statistics—United States:	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998°</u>
Production	W	W	W	W	W
Imports for consumption ²	311	295	305	311	362
Exports ^e	4	6	3	5	16
Shipments from Government stockpile excesses	18	17	_	_	
Consumption, reported ²	478	439	365	383	410
Price, dollars per ton of rutile, yearend,					
bulk, f.o.b. Australian ports	420	600	563	530	500
Stocks, mine, distributor and consumer, yearend	141	52	77	80	70
Employment, mine and mill, ³ number	400	400	400	400	450
Net import reliance ⁴ as a percent of					
reported consumption	76	90	76	79	87

Recycling: None.

Import Sources (1994-97): Australia, 54%; South Africa, 37%; and other, 9%.

Tariff: Item Number		Normal Trade Relations (NTR) 12/31/98	Non-NTR ⁵	
Dutile concentrate	2614 00 6040		<u>12/31/98</u>	
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: Domestic consumption of rutile concentrates was estimated to have increased 7% compared with 1997. In 1998, imports of all rutile concentrates were estimated to have increased 16% compared with 1997. However, although imports of natural rutile increased 31%, imports of synthetic rutile decreased 3% compared with 1997. Increased availability of rutile concentrates caused prices for natural rutile concentrates to decrease 6% compared with 1997.

In Australia, two of the world largest mineral sands producers planned to merge their two companies. If completed, the merger would improve recovery rates and extend the mine life of some reserves by processing of minerals at more efficient plants. The International Monetary Fund approved a \$16 million loan to support the repair of mining operations in Sierra Leone. Prior to civil strife in 1995, the Sierra Leone operation had been the world's largest single producer of natural rutile.

Exploration and development of titanium mineral deposits continued in 1998. In the United States, deposits under examination included Camden, TN, Escalante, UT, Powderhorn, CO, and Okefenokee, GA. Canadian deposits under investigation included Shubenacadie River Basin, Nova Scotia, and Pipestone Lake, Manitoba. In Australia, investigations were ongoing at Broken Hill, Spring Hill, and Twelve Mile, New South Wales; Goondicum, Western Queensland; Ouyen, Victoria; and a large portion of the Murray Basin in New South Wales, Victoria, and South Australia. South African exploration and development investigations were ongoing at Bothaville. In preparation for a full feasibility study, a metallurgical study was completed for the Kwale mineral sands project in Kenya.

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:

wond mine i roddetion, reserves, and reserve base.						
	Mine production		Reserves ⁶	Reserve base ⁶		
	<u>1997</u>	<u>1998°</u>				
United States	W	W	700	1,800		
Australia	171	190	⁷ 17,000	⁷ 51,000		
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	<u>95</u>	<u>95</u>	2,500	2,500		
World total (may be rounded)	⁸ 395	⁸ 414	43,000	170,000		

World Resources: Identified world resources of rutile (including anatase) total about 230 million tons of contained TiO₂. 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.

^eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

¹See also Ilmenite and Titanium and Titanium Dioxide.

³Employment 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.

⁴Defined as imports - exports + adjustments for Government and industry stock changes.

⁵See Appendix B.

⁶See Appendix D for definitions.

⁷Increase from 1997 based on data published by the Australian Bureau of Resource Sciences.

⁸Excludes U.S. production.

²Includes synthetic rutile.