

TITANIUM

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Demand for titanium products boomed in 2004, growing more strongly than at any time in the past 10 years, creating deficits in feedstock markets. In 2005, demand is probably weakening and significant increases in supply are scheduled for the next two years.

TiO₂ pigment

Titanium dioxide pigment accounts for more than 90% of the consumption of titanium minerals. TiO₂ is the brightest of the white pigments and its main applications are in the manufacture of paint, paper and plastics. Consumption is concentrated in North America and Europe, which account for more than half of the world's demand. But Chinese consumption is growing rapidly.

Global consumption growth accelerated sharply in 2004, rising by more than 7% (according to industry consultants TZ Minerals International Pty Ltd (TZMI), the largest increase in 10 years (2003 consumption was virtually static). In the US, consumption increased by about 8%. But the fastest growth was in China, where consumption increased by about 13%. China now accounts for around 13% of global demand, up from 10% in 2001.

In 2004, restocking by consumers in anticipation of price increases boosted apparent consumption. However, consumption growth in 2005 appears to be slowing – first quarter results of the pigment producers reported little volume growth.

Pigment production growth has been most rapid in China. Almost all pigment plants in China are sulphate plants and the increases have been from small plants that can be commissioned rapidly. Notably, however, DuPont de Nemours & Co is reported to be considering a new chloride plant near the city of Dongying, Shandong Province.

Outside China, there has been little increase in pigment plant capacity, and only limited increases are scheduled. In the US, Kerr McGee Chemical Corp closed its plant in Savannah, Georgia, the last sulphate plant in the US. In Australia, Tiwest, a JV between Kerr McGee and Tior Resources Pty Ltd, plans to increase capacity by about 10,000 t to 120,000 t/y. In the Ukraine, the joint stock company Crimea Titan is expanding output by 2,000 t to 80,000 t/y in 2005, and to 120,000 t/y by 2007, with larger expansions planned for later years.

Limited growth in capacity has resulted in higher utilisation rates, prompting producers to increase prices. Pigment prices have been rising steadily since late 2004, adding more than US\$400/t, or more than 20% to US prices (slightly less in Europe). Prices have continued to rise through the first half of 2005, despite the apparent slower growth in pigment demand.

There are two broad groupings of pigment production technologies that have different operating characteristics and different feedstock requirements: the chloride process and the sulphate process. Plants employing a chloride process consume high TiO₂ content feedstocks such as synthetic rutile and chloride slag. Chloride plants owned by DuPont are

also capable of using certain ilmenites. Alternatively, the sulphate process plants use lower-grade ilmenite and sulphate slags. Most of the growth in world capacity is in plants employing the chloride process. However, production from sulphate plants in China, which predominantly use ilmenite, is also increasing.

Mergers and acquisitions

After the hectic pace of mergers and acquisitions in prior years, the past 12 months have been relatively quiet. Lyondell Chemical Co completed its acquisition of Millennium Chemicals Inc that began in March 2004. Also, Kerr McGee announced plans to spin-off or sell its chemical division, which includes the TiO₂ business. Among feedstock producers, Kumba Resources Ltd of South Africa is bidding for the minorities in Ticor Resources, and BHP Billiton has secured title to the Corridor Sands project in Mozambique, with its acquisition of WMC Resources.

Titanium metal

The titanium metal industry has undergone a dramatic turnaround, repeating the highly volatile cyclical behavior typical of this market. After reaching a ten-year low in 2003, mill product shipments increased by more than 14% in 2004, with growth forecast to continue this year. The main source of growth has been from the aerospace industry, as construction schedules for large commercial aircraft recovers, and the amount of titanium per aircraft also increases. Additional demand growth has come from military applications, increased construction of desalination plants in the Middle East and petrochemical plants in China.

Sponge prices have rocketed from the low in early 2004 of US\$5.70/lb to US\$21/lb in mid 2005, according to *Platt's Metals Week*. Production facilities have responded to the market shift, with a marked expansion in output. Russia's VSMPO, based in the Sverdlovsk region of the Urals, is the world's largest sponge producer and increased production to 20,100 t in 2004, from 15,900 t in 2003. Sumitomo Titanium Corp in Japan returned to full production of 18,000 t/y after closing some furnaces in 2002. Titanium Metals Corp (Timet) announced plans to expand annual sponge production at Henderson, Nevada, US, by 4,000 t by 2007. Current nameplate capacity is 9,500 t/y, but effective capacity is 8,600 t/y. Ukraine's Zaporozhye Titanium-Magnesium Plant (ZTMK) reported an 8% increase in production to 7,500 t in 2004, with further increases expected in 2005 (nameplate capacity of 20,000 t/y).

Feedstocks

Given the surge in demand in 2004, the increase in feedstock supply was much more modest – 2.6% according to TZMI. As a consequence, feedstock markets are in supply deficit. However, the deficits are primarily restricted to high TiO₂ content chloride feedstocks and sulphate-quality ilmenite. Sulphate slags remain over supplied.

In Quebec, QIT-Fer et Titane Inc increased output of concentrated titanium slag using its UGS process by 95,000 t/y through the conversion of under-used sulphate slag capacity. In the US, Iluka Resources Ltd opened a new mine at Lulaton, Georgia. Its concentrate is transported from Lulaton to the company's mineral separation plant at Green Cove Spring, Florida. Additional minor increases came from BeMaX Resources NL's Ludlow operations in Western Australia.

Significant increases in TiO₂ feedstock production have come from India and Vietnam. In India, VV Minerals doubled output of sulphate ilmenite to around 100,000 t/y and in Vietnam

exports of ilmenite increased dramatically in 2004, especially to China. However, the Vietnam Government has announced plans to place an embargo on exports starting in 2008, presumably to encourage the development of a domestic pigment industry.

Incremental production growth in 2005 is coming from the Tiwest JV in Australia, which plans to increase synthetic rutile production capacity from 220,000 t/y to 240,000 t/y over next two years. In South Africa, production at Namakwa Sands (Anglo American) has been ramping up since the 2003 fire in its mineral separation plant.

Feedstock prices generally firmed during 2004 and in the first half of 2005. This reflects prevailing strong demand and tightening supply. The natural rutile price has increased by about US\$10/t, or 2.5%. Synthetic rutile prices have risen more strongly, up by around 12%, and ilmenite prices have increased by around 8%. Slag prices were generally down however, reflecting the preference for high TiO₂ content chloride feedstocks, and for the sulphate market, a preference for ilmenite over slag.

In the second half of 2005 and 2006, substantially larger supply increases are scheduled. Iluka will begin production from its two Western Australia deposits – Wagerup and Gingin. This will add almost 400,000 t/y of TiO₂ units, mostly as sulphate ilmenite for direct sale to pigment plants, and as chloride ilmenite for conversion into synthetic rutile and for sale to DuPont.

A major source of additional feedstock supply from late 2005 is expected to come from Sierra Rutile Ltd in Sierra Leone. Sierra Rutile produced 150,000 t/y of rutile until 1995 when civil war forced its closure. Initially, one dredge will be re-commissioned in 2006, producing 100,000 t/y of rutile and 15,000 t/y of ilmenite. A second dredge is scheduled to begin production in mid-2007. At full capacity, the operation is expected to produce 200,000 t/y of rutile and 50,000 t/y of ilmenite.

The development of Australia's Murray Basin is continuing, although with some delays because of shortages of plant equipment and labour – a widespread concern for the country's booming mining industry. Full-scale production of heavy mineral concentrate from Douglas (Iluka) is now expected in the third quarter of 2005. Targeted production from phase one of the project is 98,000 t/y of rutile. Phase two, scheduled to commence in 2007, will entail additional production from the KWR site, taking rutile production to around 135,000 t/y. Pooncarie (BeMaX) is on schedule to commence production at the end of 2005, with planned output of 65,000 t/y of rutile and 120,000 t/y of leucoxene.

In northern Mozambique, Kenmare Resources plc's Moma project, will start production in late 2006. Ilmenite production capacity has been increased to 700,000 t/y (previously 615,000 t/y). Rutile production capacity will remain unchanged at 15,000 t/y.

A suite of less advanced projects are also scheduled to start up over the next few years. Goondicum (Monto Minerals Ltd) in Queensland, Australia, will start in the June quarter of 2006, with a capacity of 100,000 t/y of ilmenite (together with feldspar). Tiomin's Kwale project in Kenya has secured an investment agreement with the government to begin construction in late 2005. An offtake agreement for ilmenite has already been signed with Chinese customers. Ticor's Tolara Sands project in Madagascar will be developed as a

source of feed for the existing smelter at Empangeni, South Africa, when current feed supplies are depleted.

Looking further forward, Rio Tinto plc is expected to commit to its project in Madagascar. At capacity, production will be 750,000 t/y of ilmenite, which will be smelted in Canada using spare capacity there.

Natural rutile production: 2001-04 by region

('000t/y TiO₂ units)

	2001	2002	2003	2004
Australia	200	200	170	160
South Africa	120	130	100	100
U.S.	30	20	25	25
Others (*)	30	45	45	50
W.World Total	380	395	340	335

Note: (*) does not include C.I.S.

Source: Smith Barney estimates, TZMI, Company reports, Mines Department reports.

Ilmenite production: 2001-04 by region

('000t/y TiO₂ units)

	2001	2002	2003	2004
Australia	1,200	1,090	1,130	1,300
India	300	300	370	370
USA	310	310	400	370
Malaysia	90	100	100	110
Brazil	50	60	60	65
W.World Total	1,950	2,040	2,370	2,390

Note: Canadian and South African ilmenite production used in slag production omitted.

Source: Smith Barney estimates, TZMI, Company reports, Mines Department reports.

Synthetic rutile production: 2001-04 by region

('000t/y TiO₂ units)

	2001	2002	2003	2004
Australia	610	580	620	620
India	70	70	80	80
USA	180	180	90	0
Other	50	50	40	80
W.World Total	910	880	830	780

Source: Smith Barney estimates, TZMI, Company reports, Mines Department reports.

Titanium dioxide pigment production capacity: 2001-04 by region

('000t/y)

	2001	2002	2003	2004
Americas	1,730	1,730	1,730	1,680

W.Europe	1,440	1,470	1,480	1,480
Japan	340	340	320	320
Australia	180	200	200	200
Others	690	740	1,200	1,400
World Total	4,380	4,480	4,930	5,080

Sources: Smith Barney estimates, USGS, Industry Sources.

**Titaniferous slag production: 2001-04 by region
(^{'000t/y})**

	2001	2002	2003	2004
Canada	790	830	710	690
South Africa	870	820	740	830
Norway	140	140	140	150
W. World Total	1,800	1,790	1,590	1,670

Source: Smith Barney.

**Titanium sponge production capacity: 2001-04 by region
(t/y)**

	2001	2002	2003	2004
U.S.	8,600	8,600	8,600	8,600
Japan	30,700	30,700	30,700	30,700
China	3,000	3,000	3,000	3,000
CIS	100,000	100,000	100,000	100,000
World Total	142,300	142,300	142,300	142,300

Source: Smith Barney estimates, TZMI.