Titanium Feedstock Review
About TZMI

TZMI is a global, independent consulting and publishing company with offices in Australia, the US, Europe, Africa and China. The strength of TZMI’s consulting services stems from extensive practical experience in the mineral sands, titanium dioxide and coatings industries and from a comprehensive database, which has been built up over many years.

TZMI has proven expertise gained from our consultants having many years of direct operating experience in the industry in chief executive, senior operational, analytical and marketing roles.

TZMI’s publications and data services support the consulting activities and ensure up-to-date, high quality and comprehensive data, analysis and information across the mineral sands, zircon and TiO₂ pigment industries.

TZMI provides operational and technical expert advice on many areas including:

- Mergers and acquisitions
- Market assessments and industry analysis
- Due diligence
- Pre-feasibility studies incl. preliminary capital and operating cost estimation
- Competitive cost analysis and benchmarking
- Technical reviews and audits
- Resource assessments
- Physical separation test work
- Flowsheet development
- Customised data analysis and reporting

Associated Companies

- Ferrex Consultants
  Market consultants in Ferrous Metallics.
- Allied Mineral Laboratories
  Resource assessment and flowsheet development for mineral sands, iron ore and other heavy mineral deposits.
TZMI’s locations

TZMI has offices located in:
• Australia
• The US
• Netherlands
• South Africa
• China
TZMI multi-client work

- **Mineral Sands Annual Review**
  Published June 2011

- **Mineral Sands Report**
  PDF report - released monthly

- **TiO₂ Pigment Industry Report**
  PDF report - released quarterly with monthly data updates

- **TiO₂ Pigment Annual Review**
  Published May 2011

- **Titanium Feedstock Market Dynamics: Outlook to 2018**
  Published December 2010

- **Titanium Feedstock Producers: Comparative Cost Study**
  Published July 2010
  Next edition July 2011

- **Global Pigment Producers: Comparative Cost Study**
  Published March 2011

- **The Global Zircon Industry**
  Published December 2009
  Next edition October 2011

- **TZMI Data Reports**
  - TiO₂ Feedstock Matrix – published annually
  - Zircon Trade Matrix – published annually
  - Zircon Quarter-to-Quarter published quarterly
Presentation objectives

- Overview of the titanium minerals value chain.
- What are the causes of stress in the value chain?
- How long will it continue?
- The implications for titanium sponge producers.
Titanium minerals value chain - overview

Mining Operations
- Ilmenite + Rutile

Feedstock Products
- Chloride
  - Ilmenite
  - Rutile
  - Synthetic Rutile
  - Chloride Slag
  - UGS
- Sulfate
  - Ilmenite
  - Sulfate Slag

Titanium sponge
- TiCl$_4$

Intermediates
- Plastics
- Paper
- Coatings

Finished TiO$_2$
Value chain – demand summary

- **Mining**
  - Moderate under supply

- **Feedstocks**
  - Moderate under supply

- **TiO₂**
  - Slight under supply

- **End Markets**
  - Soft markets

- **Ti Metal**
  - Slight over supply

- **End Markets**
  - Slight over supply
Important facts about titanium feedstocks

- These feedstocks are mined – often from remote locations.
- Many world class mines have depleted over the last 4 years after decades in operation.
- Time from mine discovery to production generally exceeds 6 years (and often a decade or longer).
- Chloride feedstocks (which supply Ti sponge plants) – in nearly all cases – are beneficiated, meaning a longer value chain / supply chain.
- Beneficiation processes require significant capital investment.
What fueled the under-supply situation?

…in short, lack of investment due to poor economic performance & outlook for the sector

Total volume of titanium feedstocks and zircon under investigation as new projects

'000 TiO$_2$ units & '000 tonnes

Source: TZMI database

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Source: TZMI database
Feedstock sourcing process

1. Global TiO₂ and Ti Metal demand forecast
2. Production Forecast to match demand forecast
3. Total TiO₂ unit requirements (from feedstocks)
4. Contract negotiations
5. New contract requirements
6. Feedstock enterprise models
7. Arbitrage evaluations
8. New feedstock commitments
9. Legacy contract commitments

Production Forecast to match demand forecast is connected to Total TiO₂ unit requirements (from feedstocks) and New contract requirements is connected to Feedstock enterprise models. Legacy contract commitments is connected to both New contract requirements and New feedstock commitments.
**TiO₂ pigment demand development – the competitor**

**Regional demand forecast: ‘10-’15F**

**First 5 months of 2011 – global demand up 5%:**

- ME&A below trendline: regional instability, inflation
- NA below trendline: housing, economy slowing; low Q4 expectations
- Central Europe well above trendline: Turkey (+43%), Russia (+44%)
- WE above trendline
- C&SA well above trendline,
- Asia-Pacific on trendline, but China slowing H2
Important Titanium sponge feedstocks

**Chl. Ilmenite** 60-65% TiO$_2$
- Only used by DuPont

**Chl. Slag/ UGS** 85-95% TiO$_2$
- Able to be used by all global producers

**Synthetic rutile** 89-95% TiO$_2$
- Used by most global producers

**Rutile** 94.5-96.5% TiO$_2$
- Used by most global producers

“High grade” chloride feedstocks
Heat map: feedstocks to titanium sponge industry

<table>
<thead>
<tr>
<th></th>
<th>Ilmenite++</th>
<th>Slag</th>
<th>Synthetic rutile</th>
<th>UGS</th>
<th>Rutile</th>
<th>Other</th>
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<tbody>
<tr>
<td>% 2010 Chloride Supply</td>
<td>19.4</td>
<td>32.8</td>
<td>18.3</td>
<td>9.2</td>
<td>19.0</td>
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<td>% of Supply used to produce Ti Sponge</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>5</td>
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<td>0</td>
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<tr>
<td>% of Ti Sponge feedstock supply</td>
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<td>38</td>
<td>10</td>
<td>8</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>5-year Supply outlook</td>
<td>Tight</td>
<td>Tight</td>
<td>Very tight</td>
<td>Very tight</td>
<td>Very tight</td>
<td>Loose</td>
</tr>
</tbody>
</table>

*Rutile, Slag markets are of greatest concern*

** Captive ilmenite used by titanium sponge producers
Current market realities for feedstocks

- All titanium feedstock supply remains tight, markets are in deficit and there is strong demand for both ilmenite and high TiO$_2$ feedstocks.
- Global TiO$_2$ pigment demand is higher than anticipated during 1H 2011, at around 5%pa. Inventories are very low.
- Spot feedstock prices up dramatically during 2011 thus far.
- Feedstock inventory levels are low, “just-in-time” for most products.
Summary

- Sulfate feedstocks and sulfate TiO\textsubscript{2} pigment producers poised to gain share over the next 3-4 years.
- Chloride feedstock under-supply to persist through 2014.
- Titanium sponge producers will need to “fight for” feedstocks to secure supply in the future.
- Further stress in the value chain with TiO\textsubscript{2} likely under-supplied through 2013.
- Costs to produce TiCl\textsubscript{4} could (will likely) rise dramatically unless there is a global recession.
Thank you

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