THE IMPACT OF FEEDSTOCK SUPPLY ON SPONGE MARKETS 2019/20

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CONSULTANT
About TZMI

TZMI is a global, independent consulting and publishing company with offices in Australia, the US 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 including preliminary capital and operating cost estimation
- Competitive cost analysis and benchmarking
- Technical reviews and audits
- Resource assessments
- Physical separation testwork
- Flowsheet development
- Customised data analysis and reporting
Presentation Outline

- What are titanium metal feedstocks and raw materials?
- Who mines and refines raw materials?
- Today’s supply (and demand)
- Supply (and demand) outlook
- What it means for sponge producers

Base Resources Hydraulic Mining Operations
Source: Base Resources
What are titanium metal feedstocks and raw materials?
How do these minerals enter the supply chain?
Synthetic rutile producers

- Iluka
- Tronox Australia
- China multiple
- Cochin Minerals and Rutile Ltd
- Kerala Metals
- DCW Ltd
- TOR Minerals
- Tronox Australia
- Iluka
- TOR Minerals
## Feedstock choices for use in TiCl₄ production

<table>
<thead>
<tr>
<th></th>
<th>Synthetic Rutile</th>
<th>Upgraded Slag</th>
<th>Chloride Slag</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Availability</strong></td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td><strong>Occurrence</strong></td>
<td>Beneficiated</td>
<td>Beneficiated</td>
<td>Beneficiated</td>
</tr>
<tr>
<td><strong>Ave producer margin</strong></td>
<td>Low</td>
<td>Low</td>
<td>Depends on ilmenite cost/electricity</td>
</tr>
<tr>
<td><strong>TiO₂ content</strong></td>
<td>~90%</td>
<td>~95%</td>
<td>~87-88%</td>
</tr>
<tr>
<td><strong>Radioactivity</strong></td>
<td>Varies</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>Particle size</strong></td>
<td>Medium (ilmenite dependent)</td>
<td>Large</td>
<td>Large</td>
</tr>
<tr>
<td><strong>Waste volume</strong></td>
<td>Medium</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td><strong>Form</strong></td>
<td>Porous Solid (Sponge)</td>
<td>Homogeneous solid</td>
<td>Homogeneous solid</td>
</tr>
<tr>
<td><strong>Beneficiation co-products</strong></td>
<td>Minor</td>
<td>None</td>
<td>Iron</td>
</tr>
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<th>Chloride ilmenite</th>
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<td><strong>Availability</strong></td>
<td>Low-Medium</td>
<td>High</td>
</tr>
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Demand to 2019

Source: TZMI Titanium Feedstock Supply/Demand February, 2019
Demand outlook to 2023

Source: TZMI Titanium Feedstock Supply/Demand February, 2019
Metal makes up a small % of end-use

Demand outlook to 2023 by end-use segments

Source: TZMI Titanium Feedstock Supply/Demand February, 2019
Chloride slag and UGS output to increase

Global chloride slag and UGS: supply

Source: TZMI Titanium Feedstock Supply/Demand February, 2019

Note: Supply profile only reflects existing operations
Chloride slag and UGS output to increase

Global chloride slag and UGS: demand and new and existing supply

'000 TiO₂ units

Source: TZMI Titanium Feedstock Supply/Demand February, 2019
Rutile supply is tight

Global rutile: supply 2013 - 2023

Source: TZMI Titanium Feedstock Supply/Demand February, 2019

Note: Supply profile only reflects existing operations
Rutile supply is tight

Global rutile: demand and new and existing supply 2013 - 2023

‘000 TiO₂ units

Source: TZMI Titanium Feedstock Supply/Demand February, 2019
Chloride ilmenite supply

Global net chloride ilmenite: supply 2013 - 2023

Source: TZMI Titanium Feedstock Supply/Demand February, 2019

Note: supply profile only reflects existing operations. Net chloride ilmenite supply excludes captive sources and chloride ilmenite consumed for titanium slag and SR manufacture.
Chloride ilmenite supply to track demand closely

Global net chloride ilmenite: demand and new and existing supply 2013 - 2023

'000 TiO₂ units

* Volume reflected under consumed for beneficiation excludes captive sources

Source: TZMI Titanium Feedstock Supply/Demand February, 2019
Pricing vs Supply and Demand

Feedstock price and supply surplus 2006 - 2021

Surplus supply* (TiO₂ units)

Source: TZMI Titanium Feedstock Supply/Demand February, 2019

*Note negative numbers indicate a supply deficit, positive numbers indicate a supply surplus
Conclusions

- Feedstock demand for titanium sponge is increasing, particularly for chloride slag and rutile.
- Rutile supply is tight; this may result in:
  - Higher input costs for those using rutile.
  - Increased competition for rutile with pigment producers.
  - Increased competition for slag, UGS and SR as pigment producers switch from rutile.
- The cost of feedstock, labour and energy are the most significant drivers of the variable cost to produce titanium sponge; however, costs may be absorbed further downstream more easily than in the pigment industry.
- Demand for chloride ilmenite dependent on future supply coming online.
  - Failure of new supply to come online may result in pigment producers moving to slag, UGS and SR.
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Thank you