Welcome

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TiPIMC Consulting
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Our Expertise


- Education through Publications & Engagements
  - *Ti Observer™* Insights for Analysts, monthly industry reports
  - TiO2 (Quarterly) and Mineral Sands Price Forecasts (Semi-Annually)
  - Industry Data and Analysis (Import/Export, Historical Pricing, cost analysis)
  - Customized industry and company analysis (Reports and Verbal Consultation)
  - Webinars & Seminars
  - Customized One-on-One or Group Sessions
Mineral Sands: Primary Markets

Titanium Feedstocks
- TiO₂ Pigment (90% + of all feedstock)
- Sulfate
- Chloride
- Titanium Metal
- Titanium Chemicals

End Uses
- TiO₂ Pigment
  - Coatings
  - Plastics
  - Paper
  - Specialties

2018: 7.3MT TiO₂

2018: 1.2MT

Zircon
- Ceramics
  - Tile
  - Sanitary Ware
  - Refractory
  - Foundry
  - Zirconia chemicals

Highly correlated to housing and construction
Correlated to GDP
Fastest Growth in Asia and Developing World
Global Average TiO2 Price History
(at Fx of the day, in US$ pmt)

- Low volatility /Depressed earnings
- Bubble
- Earnings depressed/Feedstock and pigment
- Industry Growth/Prosperity

Indexed to 1Q16 Global Price

Source: Ti-Insights LLC/TiPMC Consulting
Global TiO2 Demand Correlated to GDP

- Quality of Life Product
- No real substitute
- Traditionally grow with global GDP
Regional /Technology Dynamics

2000 DEMAND 3.9M TONNES
- WE 30%
- NA 33%
- AP 24%
- EEMEA 8%
- LA 5%

2010 DEMAND 5.0M TONNES
- WE/North America dominant
- WE 4%
- NA 21%
- AP 40%
- EEMEA 10%
- ME 7%
- EE 4%
- ME 6%

2017 REGIONAL DEMAND 6.2M TONNES
- WE 17%
- NA 16%
- China 26%
- APEC 22%
- LA 8%
- ME 7%
- EE 4%

Source: "Trade Map (or Market Access Map), International Trade Centre, www.intracen.org/marketanalysis" / Ti-Insights

TiO₂ Technology Changes

Asia nearly 50% of demand/Developing Nations growth
Americas/EMEA still majority
WE/North America dominant
Feedstock Driven by Plant Design & Operations

Mined Ores
- Rock Ilmenite
- Sulfate Ilmenite
- Chloride Ilmenite

Beneficiation
- Leucoxene*
- Natural Rutile**
- Synthetic Rutile
- UGS
- Chloride Slag
- Sulfate Slag
- Sulfate Slag

Secondary Beneficiation
- Low Grade Sulfate
- Low Grade Chloride
- High Grade Sulfate
- High Grade Chloride
- Super High Grade Chloride

Consumer
- Chinese Producers
- Chemours Only
- European Plants
- Global Chloride
- Zircon

Increasing TiO₂ Content

*Chemours and welding 
**Ti-metal/welding rods
Worldwide Top Suppliers (Estimated Market Share)

### Feedstock Suppliers
- Chloride High Grade
  - Rio Tinto (Slag)
  - Iluka (Natural Rutile/SR)
  - Tronox (Back Integrated)
  - Eramet (Acquisition)
- Ilmenite
  - Fragmented
  - Multiple Juniors

### Pigment Suppliers
- MNPs – Consolidated
  - Low Capacity Growth
- Chinese
  - Sulfate (Currently)
  - Moving to Chloride/Beneficiation
  - Back-integration
  - Majority of new capacity
Large Volume Reduction
New Projects: Difficult to meet requirements
Decline in Quality Reserves

Estimated quality of mineral sands suites is declining

<table>
<thead>
<tr>
<th>Metric</th>
<th>Trend</th>
<th>Result</th>
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<tbody>
<tr>
<td>HM Grade</td>
<td></td>
<td>Higher mining costs</td>
</tr>
<tr>
<td>Rutile/Zircon assemblage</td>
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<td>Lower margins</td>
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<tr>
<td>Trash/overburden</td>
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<td>Higher mining costs/Capital</td>
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<td>Risk return needed:</td>
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<td>Drain on cash</td>
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<td>Investors/Lenders</td>
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Impact on TiO2 Producers

Numerous Disruptions in High Grade Chloride Production
Inventory low throughout the supply chain (Chemours Exception)

Source: “Trade Map (or Market Access Map), International Trade Centre, www.intracen.org/marketanalysis” and TiPMC Estimates
Growing Trends in Mineral Sands

Chinese Ilmenite Imports

0'000 Tonnes Monthly TiO2

2016 2017 2018

Standard Ilmenite Concentrates

TiO2 Feedstock units from imports is reduced vs. 2017 (stabilize ilmenite prices)

New Projects: Ship Concentrate to China: MSP in country
  Reduce Capital Expenditure
  Keep all minerals in China

Support growing Chinese TiO2 production (Natural Rutile, Chloride Ilmenite, Sulfate Ilmenite)

Sales of other minerals in China (Zircon, Garnet, Rare Earths)

Chinese Beneficiation to chloride feedstocks set to grow
Expansion Plans

- MNPs favor “Value over Volume”
- China: Large plans for chloride (little progress to date)
- Sulfate: “Net Expansion”
  - Larger more sustainable producers expand
  - Smaller/Less environmentally friendly close
**TiO2 Industry Growth Scenarios**

**Estimated Cumulative Capacity Additions (2018 Base)**

- **2019**
- **2020**
- **2021**
- **2022**
- **2023**

**Source:** TiPMC Estimates

- **Chinese Growth Intended on chloride**
  - Import Ilmenite/Beneficiate to chloride slag and SR
  - Limited Success to this point
  - Likely to require Natural Rutile and UGS

- **All growth outside China expected to based on High Grade Chloride Feedstocks**
• TiO2 industry expected to recover in 2019 from recent demand downturn
  ● Recovery in AP
  ● Destocking

• MNPs face challenges to maintain profitability
  ● Pace of Chinese and APEC growth
  ● NA/EU Recession concerns
  ● Feedstocks
  ● “Value over Volume”

• Most new capacity will come from China
  ● Chloride/Sulfate mix to be determined
  ● Back-integration: Beneficiation
  ● Focus on low/mid-grade quality products
Please stay in Touch!

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