The ERMS Synthetic Rutile Process

Ultra-high Grade SR by leaching ilmenite with HCl

Intertech TiO2 2003, Miami

February 5, 2003
Overview

- History of ERMS SR
- Austpac’s technologies
  - ERMS, EARS, LTR, ilmenite leaching
- Details of the ERMS SR Process
- Comparative Benefits of ERMS SR
History

- **1988 - WestPort, New Zealand**
- **1990 - ERMS Roast (Patented)**
- **1992 - EARS HCl Regeneration (Patented)**

- **1994 - Present**
  - Focus on SR
  - Refined processes (roasting, leaching, acid regeneration)
  - Evaluated potential projects – India, Murray Basin, others
  - Now poised for commercialisation
AUSTPAC’S Technologies

- **ERMS** - A high temp. fluid bed roasting process that selectively magnetizes ilmenite

- **EARS** - Two-stage, fluid bed process to regenerate superazeotropic (ie. >20% w/w) hydrochloric acid from iron chloride liquors
Newcastle Pilot Plant

- Fluid Bed Roasting
- Magnetic Separation
- Bulk Leaching
- Fluid Bed Calcination
- F.B. Agglomeration
- Acid Regeneration

Over 75 different types of ilmenite successfully tested
AUSTPAC’S Technologies & Know-How

- **ERMS** – Enhanced Roasting and Magnetic Separation
- **EARS** – Enhanced Acid Regeneration System
- **LTR roast** – low temp (<650°C), fluid bed; sulfate feedstock
- **ERMS SR roast** – hi-temp (>750 °C), fluid bed oxidation/reduction
- **HCl leaching** – batch, continuous (Pat.pend.)
ERMS → Ilmenite Roasting
EARS → Acid Regeneration
ERMS + EARS → Ultra High Grade SR = ERMS SR
ERMS SR – Roasting

FeO₂TiO₂ - ilmenite

- Oxidation/reduction roast, >750°C
- Enhances magnetic susceptibility of ilmenite, allows ready separation from gangue minerals
- Conditions ilmenite for rapid leaching in hydrochloric acid
- Renders the TiO₂ insoluble (rutilized)
- Increases the solubility of the iron and other unwanted constituents
TiO₂ 2003

**ERMS SR Roast**

1. **Ilmenite concentrate**
   - **RE Magnetic Separation**
     - Mags
     - N/ Mags → **Gangue Minerals**
   - **Oxidation/ Reduction Roast**
     - Off-gases to heat recovery
   - **Anaerobic Cooling**
     - Water
     - Steam
   - **RE Magnetic Separation**
     - Mags
     - N/ Mags → **Gangue Minerals**
   - **Roasted Ilmenite**

**Fuel**
- Solid, Liquid, Gas

**Water**

**TiO₂ 2003**

AUSTPAC RESOURCES N.L.
Ø 500mm Fluid Bed Roaster
ERMS SR Leaching

\[ \text{FeO.TiO}_2 + 2\text{HCl} = \text{TiO}_2 + \text{FeCl}_2 + \text{H}_2\text{O} \]

- Strong acid leach (25% HCl)
- \( \text{TiO}_2 \) in rutile form insoluble – not removed
- Iron and other metallic oxide impurities form respective chlorides
- Some silica is also removed
- Original ilmenite grain size is retained
ERMS SR Leach

Roasted Ilmenite

Steam
Leaching
Atmos. Press.,
25% HCl, 105°C
4h

Water
Filtration &
Washing

Fuel
Drying &
Calcining

RE Magnetic
Separation

Magnetic
Gangue

ERMS SR
Leach Vessels at Pilot Plant
Continuous Leach Reactor
(Patents pending)
ERMS Synthetic Rutile

TiO₂ 2003
<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>TiO$_2$</td>
<td>97.50%</td>
</tr>
<tr>
<td>Fe$_2$O$_3$</td>
<td>0.82%</td>
</tr>
<tr>
<td>SiO$_2$</td>
<td>0.77%</td>
</tr>
<tr>
<td>Al$_2$O$_3$</td>
<td>0.13%</td>
</tr>
<tr>
<td>Cr$_2$O$_3$</td>
<td>0.02%</td>
</tr>
<tr>
<td>CaO</td>
<td>0.02%</td>
</tr>
<tr>
<td>MgO</td>
<td>0.01%</td>
</tr>
<tr>
<td>MnO</td>
<td>0.01%</td>
</tr>
<tr>
<td>U+Th</td>
<td>&lt;15ppm</td>
</tr>
</tbody>
</table>

**ERMS SR**

Typical Chemical Analysis

![Image of material analysis](image-url)
Roasted Ilmenite

Leaching
Atmos. Press.,
25% HCl, 105°C
4h

Filtration &
Washing

Drying &
Calcining

RE Magnetic
Separation

Regenerated 25% HCl

Spent Leach
Liquor

Spent Wash
Liquor

EARS
Acid
Regeneration

Iron
Oxide
Pellets

Fuel
Solid, Liquid,
Gas

Water
Vapour

Steam

Water

Fuel

Solid, Liquid,
Gas
EARS Acid Regeneration

- Spent leach liquor is evaporated in a fluid bed forming dry metal chloride pellets at low temperature (~ 140°C)
- Pyrohydrolysis takes place in a fluid bed roaster at a high temperature (~ 800°C)
  \[ 3\text{FeCl}_2 + 3\text{H}_2\text{O} + 0.5\text{O}_2 = 6\text{HCl} + \text{Fe}_3\text{O}_4 \]
- Makes superazeotropic acid (25% w/w)
- Can use solid, liquid or gaseous fuels
- Metal (iron) oxide is discharged as hard pellets (not dust)
- Hydrochloric acid is recycled to leaching
Pelletization in the EARS Process

Metal Chloride Pellets
\((FeCl_2 \cdot xH_2O)\)

Metal Oxide Pellets
\((Fe_3O_4)\)

2 mm

1 mm
Pyrohydrolysis Roaster
Comparative benefits of ERMS SR
## Ilmenite Upgrading

<table>
<thead>
<tr>
<th>Process</th>
<th>Ilmenite Feedstock</th>
<th>Impurity Removal</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titania Slag</td>
<td>Low TiO₂</td>
<td>None</td>
<td>Power Cost</td>
</tr>
<tr>
<td>Becher SR</td>
<td>High TiO₂</td>
<td>Some Mn</td>
<td>Coal, Fe Oxide</td>
</tr>
<tr>
<td>Benilite SR</td>
<td>Wide range</td>
<td>Mg,Ca,U+Th</td>
<td>Acid, Fe Oxide</td>
</tr>
<tr>
<td>ERMS SR</td>
<td>Wide range</td>
<td>Mn,Mg,Ca, U+Th,V,Cr</td>
<td>None</td>
</tr>
</tbody>
</table>

TiO₂ 2003
Ultra high grade feedstock for TiO₂ pigment and titanium metal
The Environment

- **Solids**
  - Saleable iron oxide pellets

- **Liquids**
  - No liquid effluent, all water recycled

- **Gases**
  - Scrubbed water vapour (steam)
  - Dioxins and Furans – not detectable

- **Energy**
  - Waste heat used to generate electricity for the plant

**ERMS SR is the most environmentally acceptable process**
Technical Advantages of ERMS SR

- Applicable to all grades of ilmenite
- Simple flowsheet, uses standard equipment, cost-effective and low technology risk.
- Completely continuous process
- Able to use solid, liquid or gaseous fuels
- Ultra high quality synthetic rutile product (>97% TiO$_2$)
- Negligible product particle breakdown
- Iron oxide saleable and in the form of easily handled pellets
Commercial Advantages of ERMS SR

- Low capital and operating costs
- Other SR processes use batch operations
- Valuable iron by-product (>95% iron oxide)
- Other SR processes produce fine iron oxide waste with disposal problems
- Very environmentally acceptable process
The future direction

30,000 tpa  ERMS  SR  PLANT