The ERMS Synthetic Rutile Process

Ultra-high Grade SR by leaching ilmenite with HCl

Intertech TiO2 2003, Miami

February 5, 2003

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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

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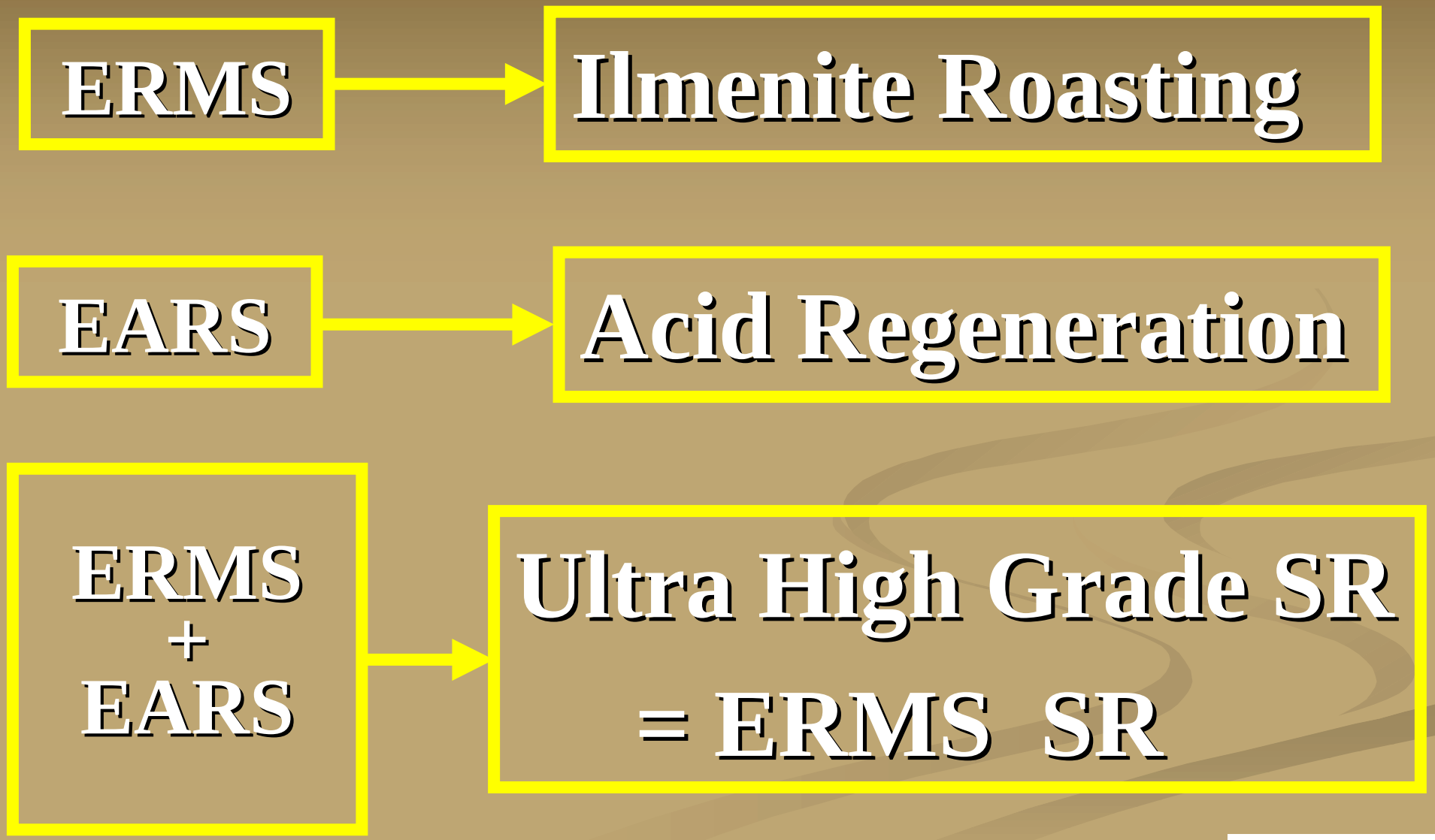
AUSTPAC'S Technologies & Know-How

- **ERMS** – **E**nhanced **R**oasting and **M**agnetic **S**eparation
- **EARS** – **E**nhanced **A**cid **R**egeneration **S**ystem
- **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.)



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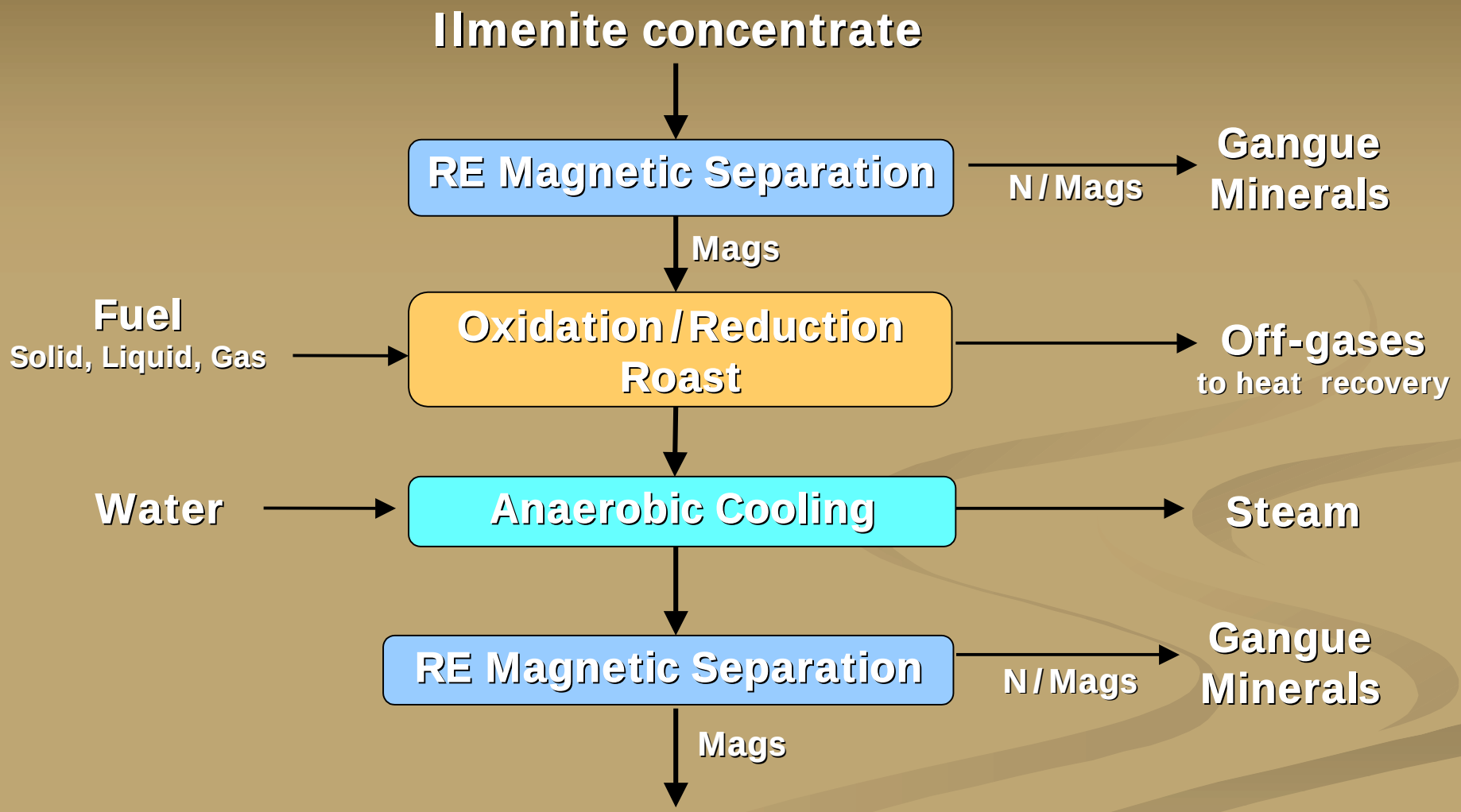
ERMS SR – Roasting

$FeO.TiO_2$ - ilmenite

- Oxidation/reduction roast, >750ºC
- Enhances mag. susceptibility of ilmenite, allows ready separation from gangue minerals
- Conditions ilmenite for rapid leaching in hydrochloric acid
- Renders the TiO_2 insoluble (rutilized)
- Increases the solubility of the iron and other unwanted constituents

ERMS SR Roast



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Ø 500mm Fluid Bed Roaster

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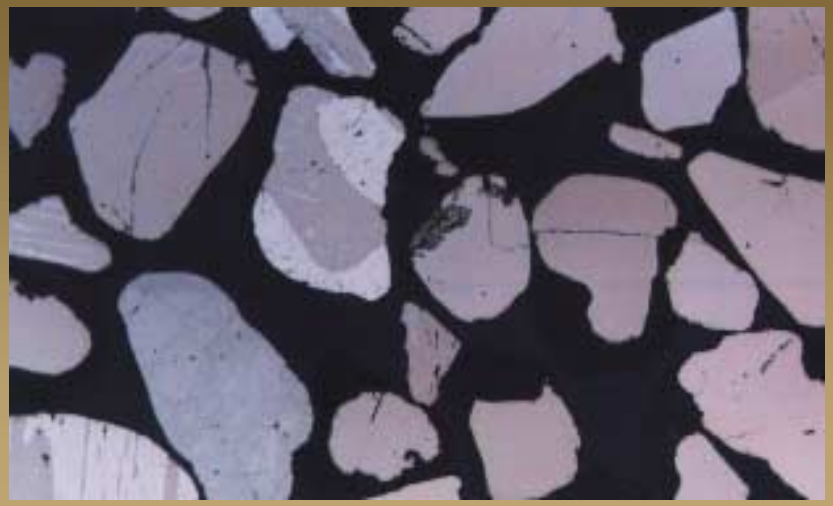
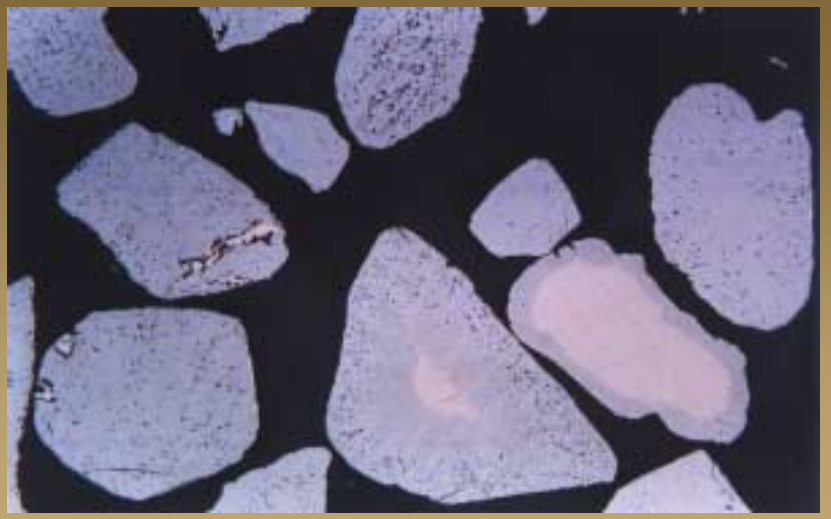
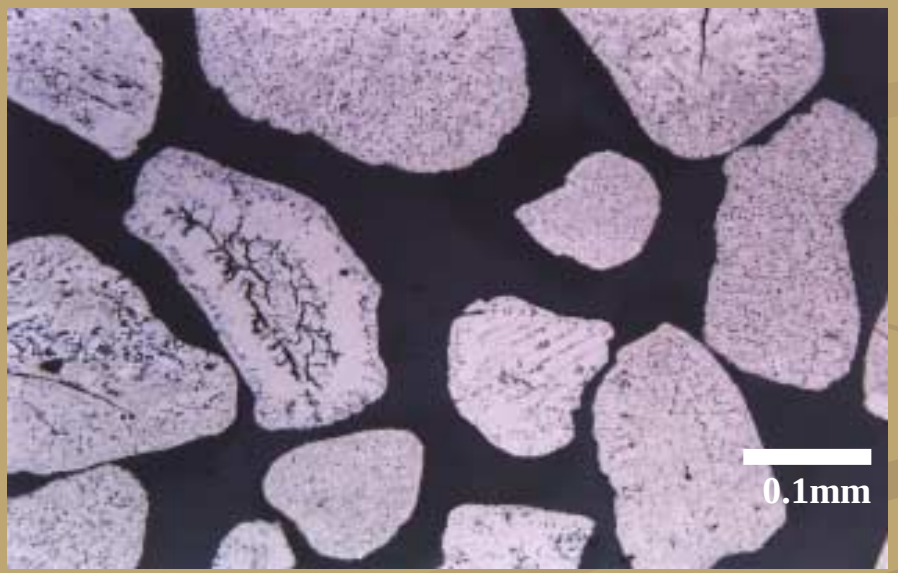


Unroasted Ilmenite



Oxidised Ilmenite



Reduced Ilmenite

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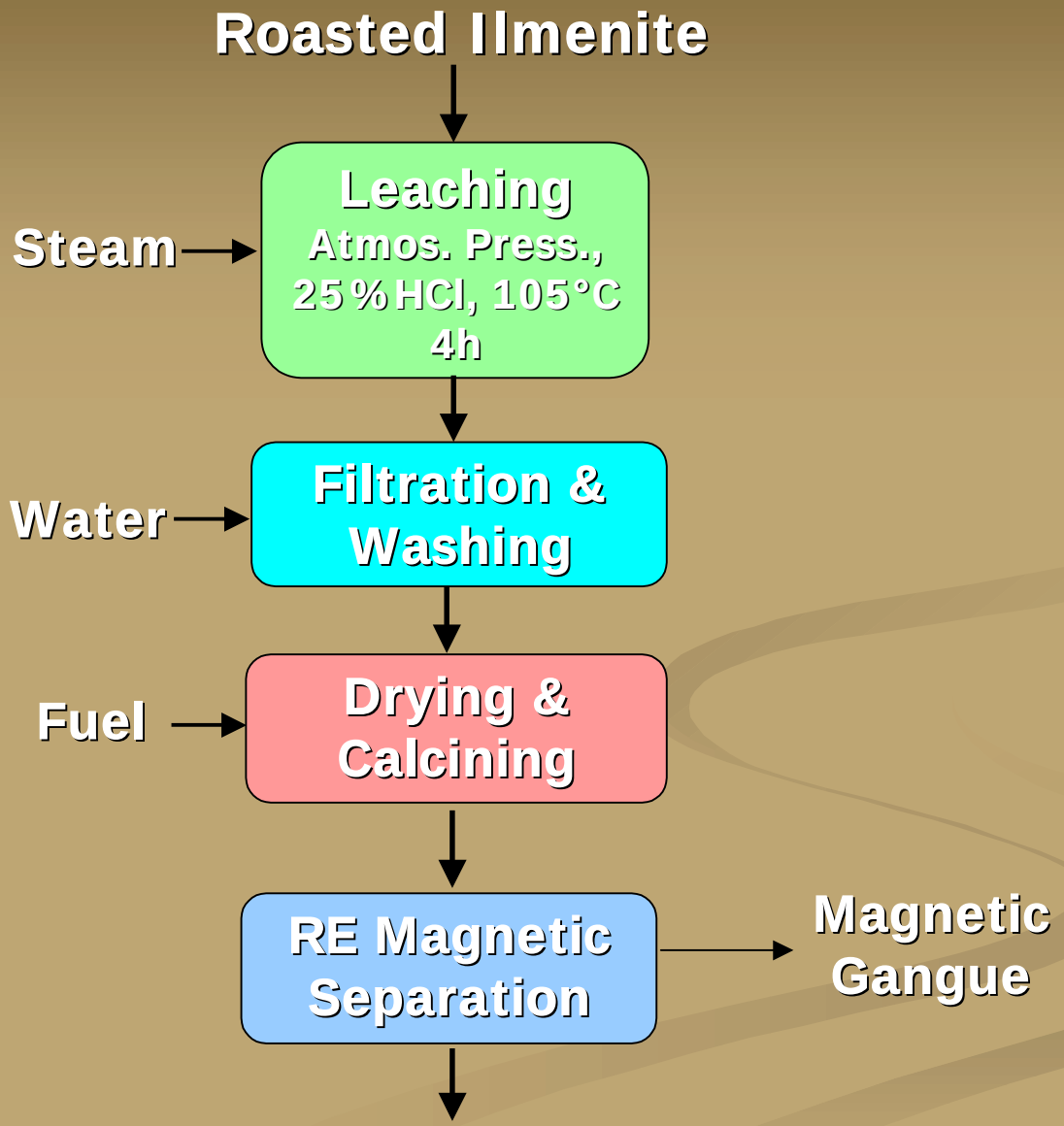
ERMS SR Leaching

$$FeO.TiO_2 + 2HCl = TiO_2 + FeCl_2 + H_2O$$

- Strong acid leach (25% HCl)
- 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



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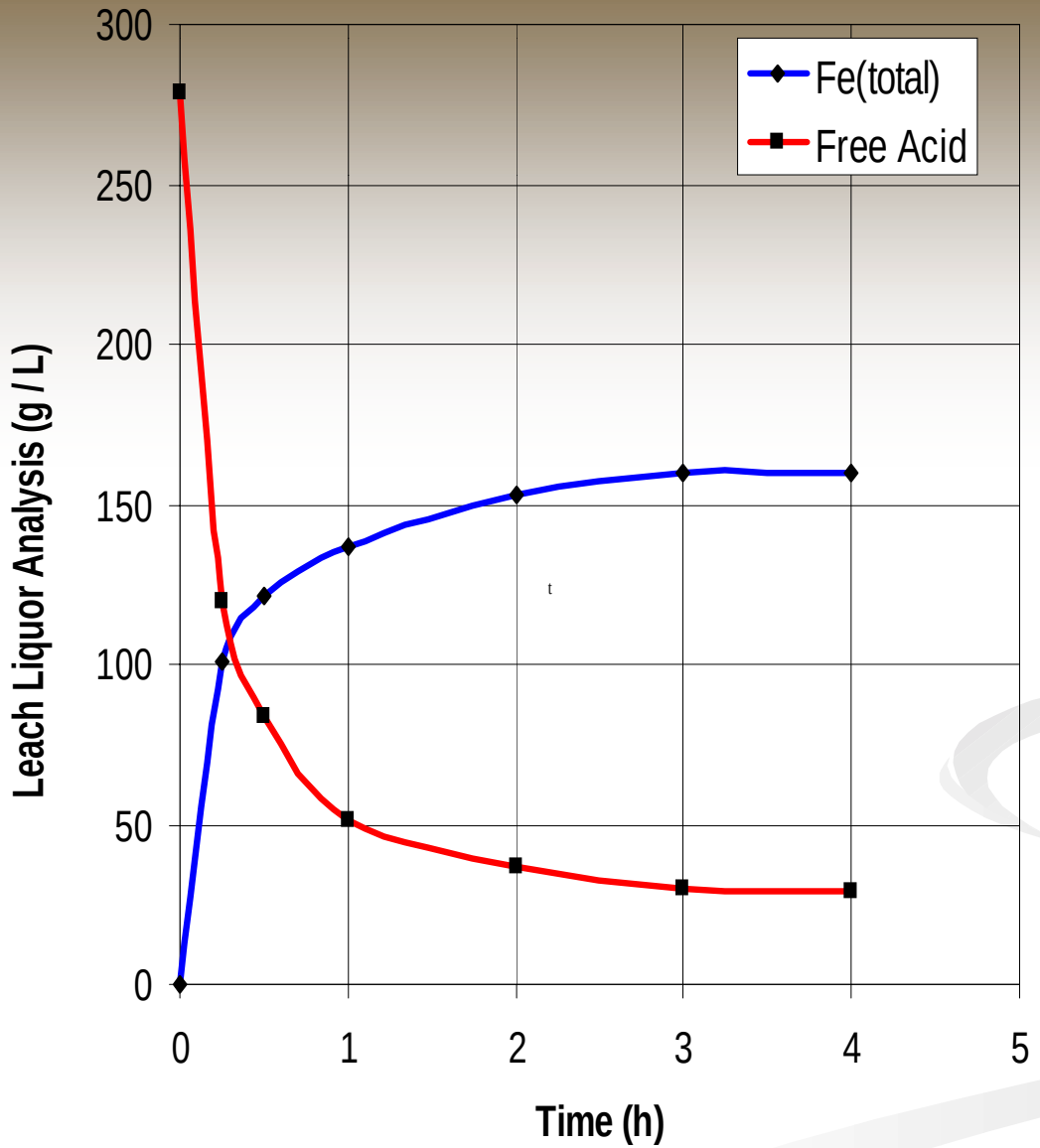
Ilmenite Leaching



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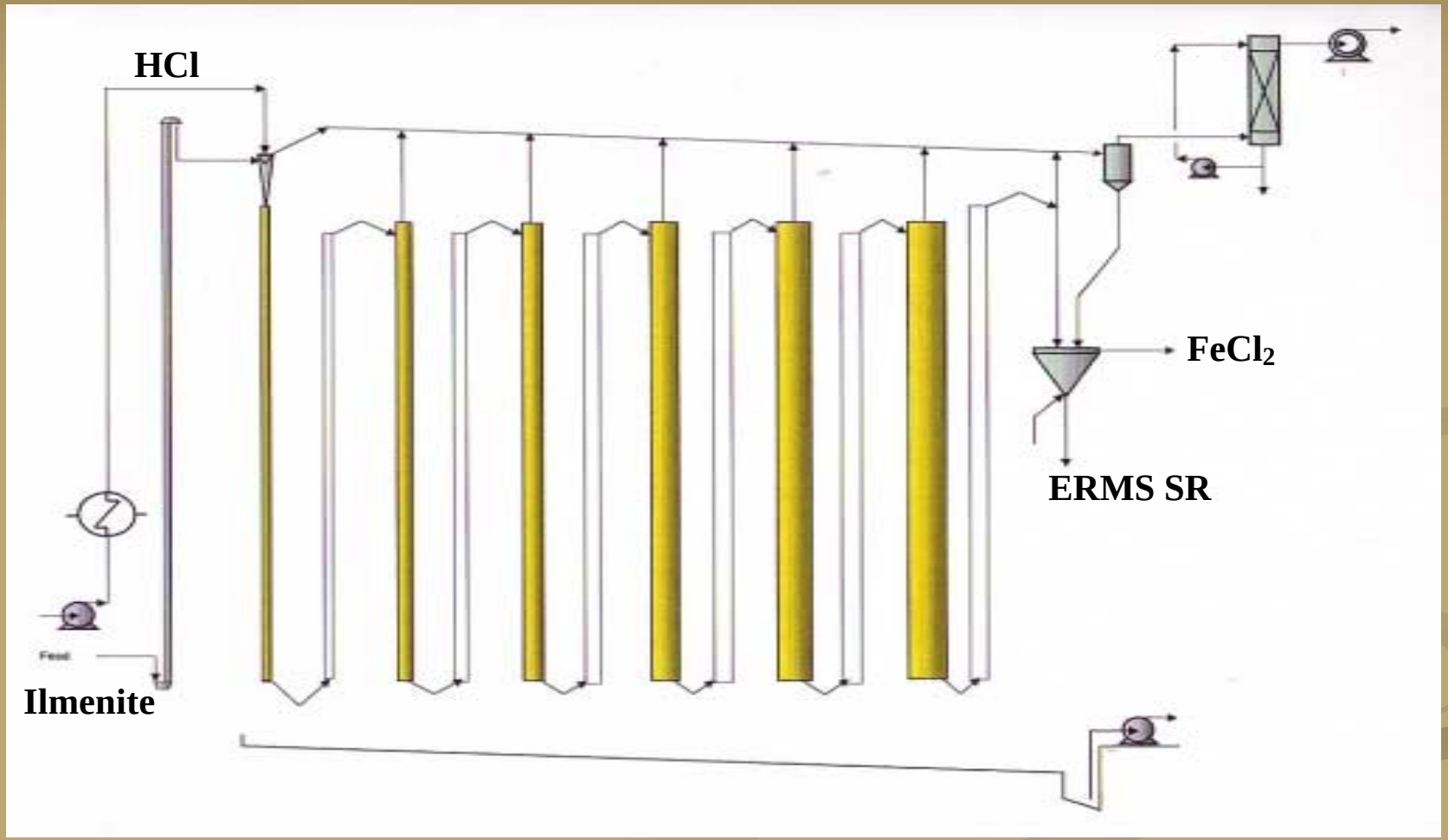
Leach Vessels at Pilot Plant

Continuous Leach Reactor

(Patents pending)



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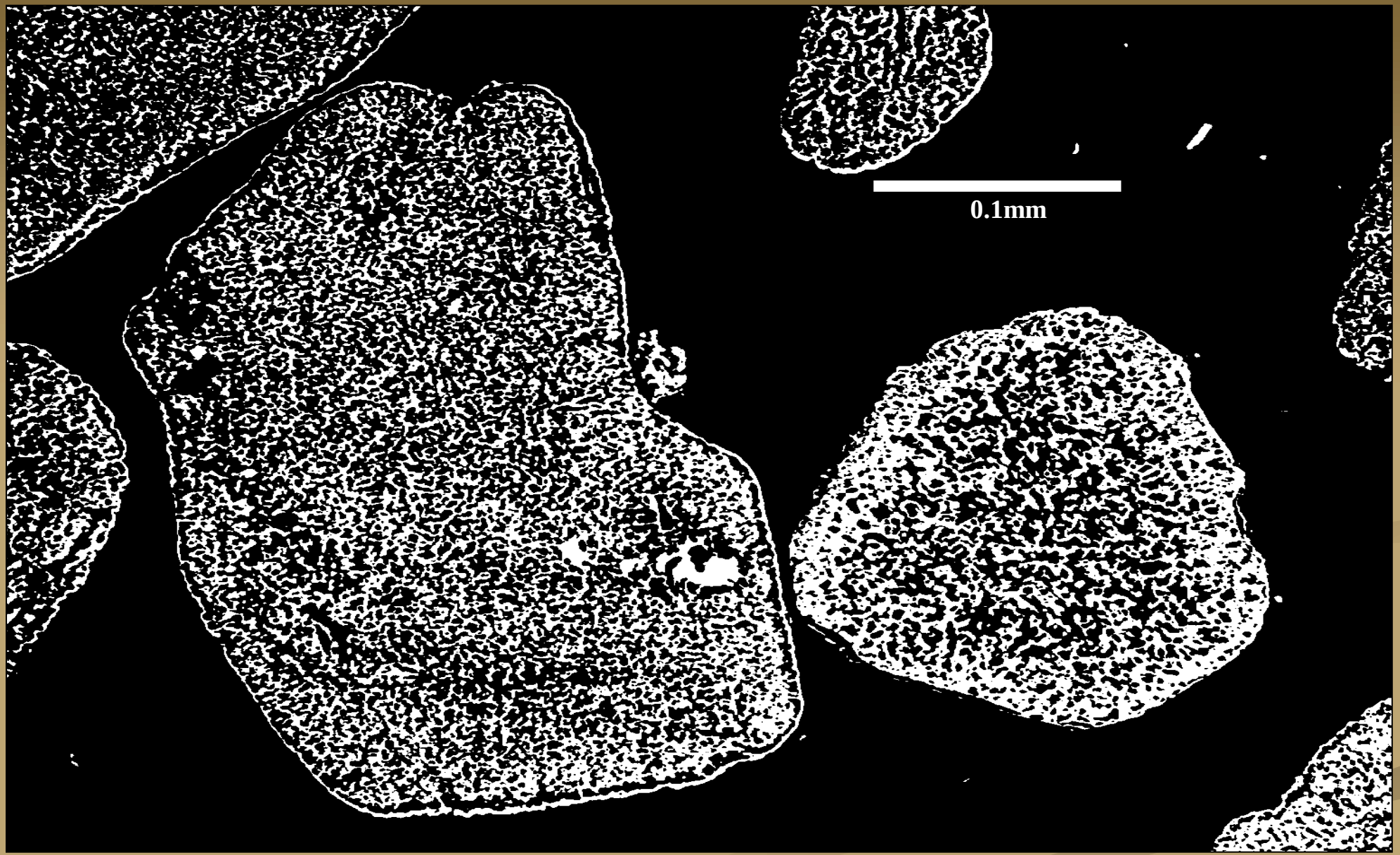

ERMS Synthetic Rutile

TiO_2 2003

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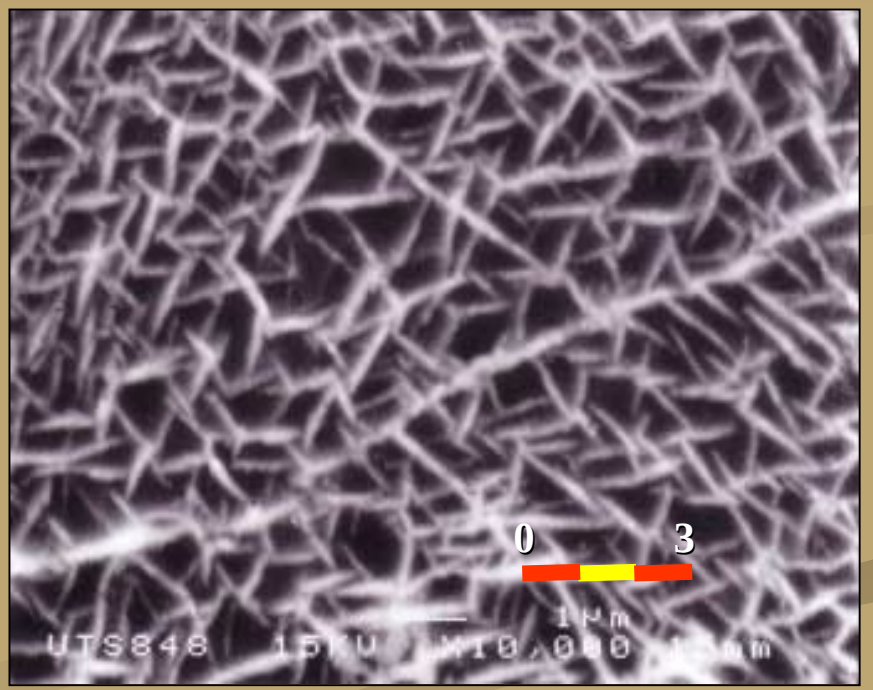
ERMS SR

Typical Chemical Analysis

TiO_2	97.50%
Fe_2O_3	0.82%
SiO_2	0.77%
Al_2O_3	0.13%
Cr_2O_3	0.02%
CaO	0.02%
MgO	0.01%
MnO	0.01%
U+Th	<15ppm



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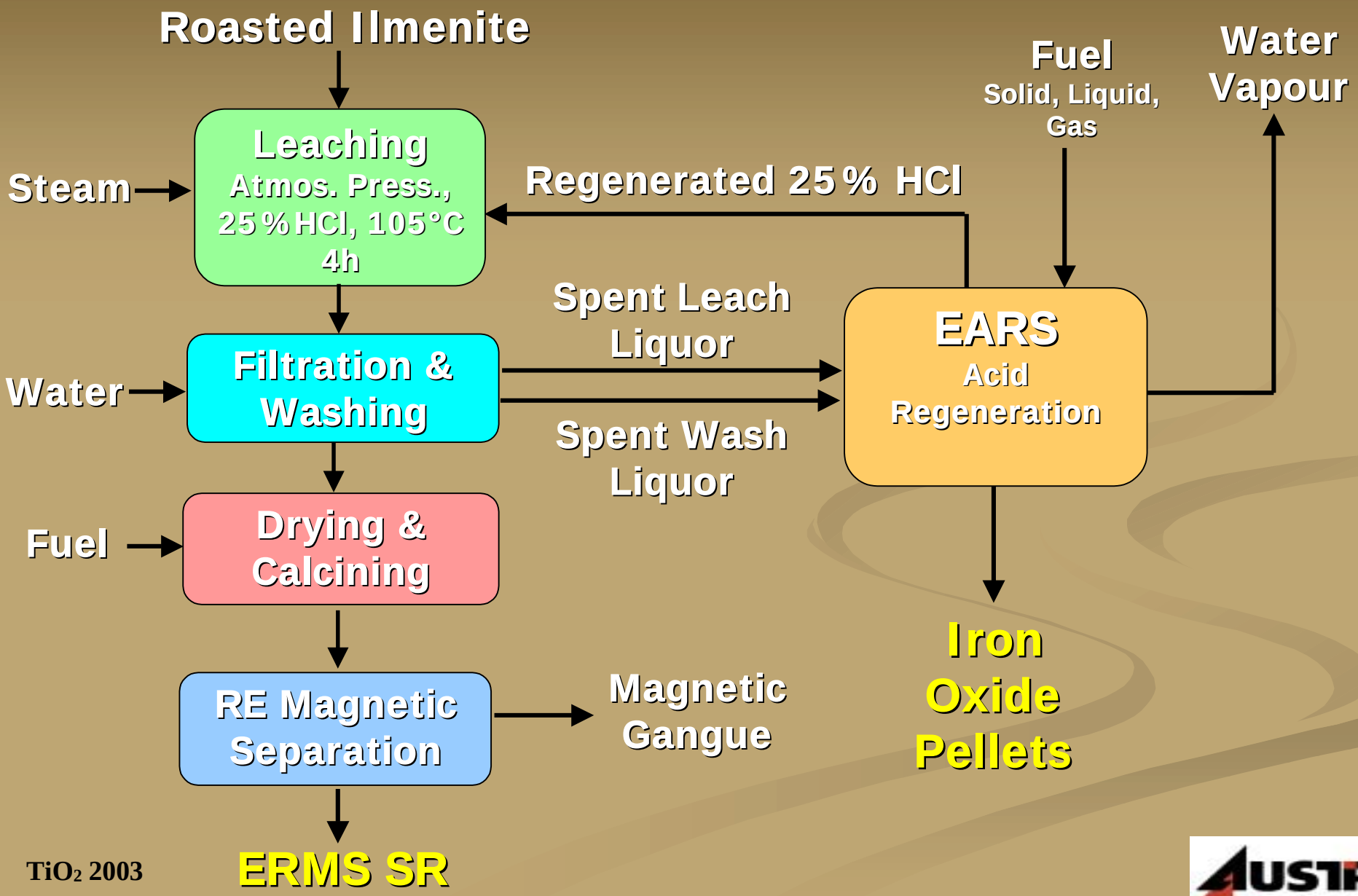
ERMS SR Leach & EARS A.R.



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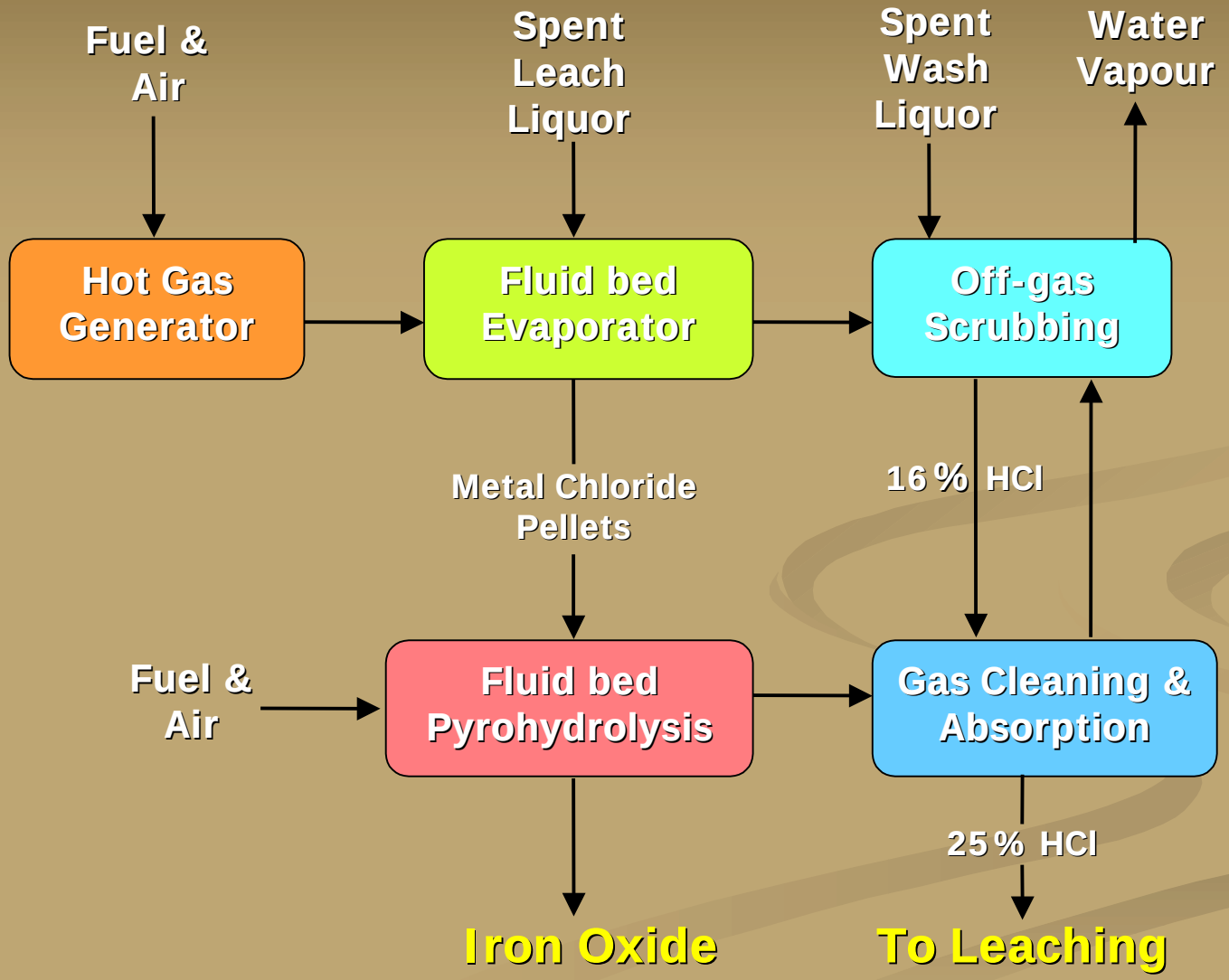
EARS Acid Regeneration

- 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)

$$3FeCl_2 + 3H_2O + 0.5O_2 = 6HCl + Fe_3O_4$$

- 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

EARS Flow Sheet



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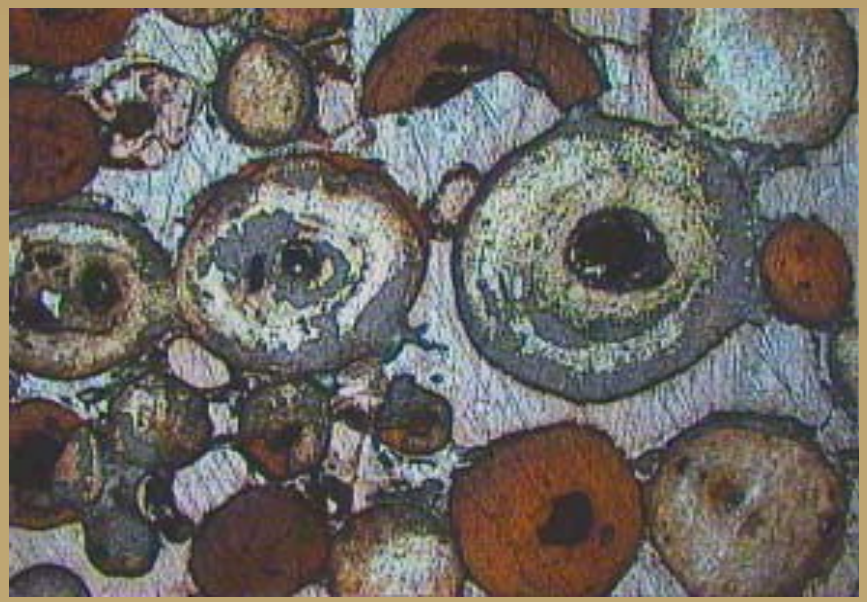
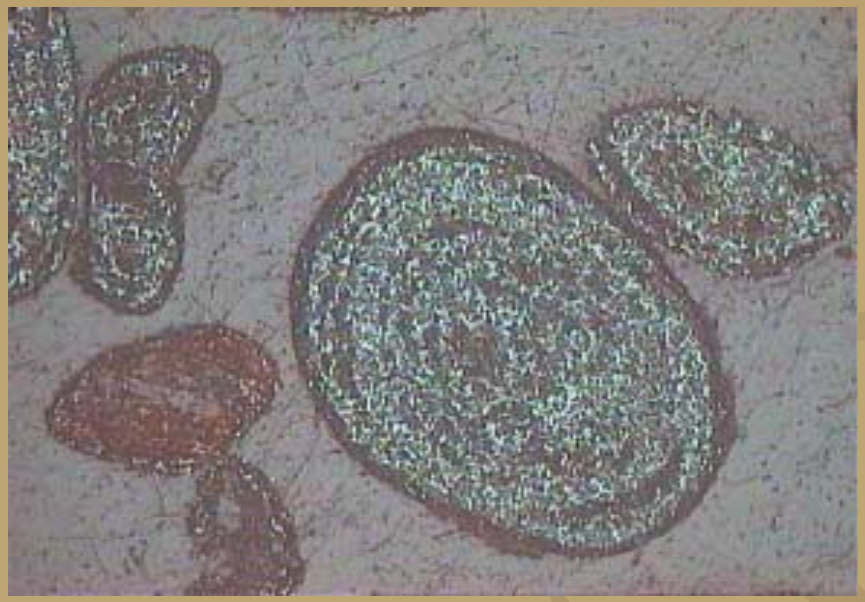
Pelletization in the EARS Process

Metal Chloride Pellets
($FeCl_2.xH_2O$)



2 mm

Metal Oxide Pellets
(Fe_3O_4)



1 mm

Pyrohydrolysis Roaster

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Comparative benefits of ERMS SR

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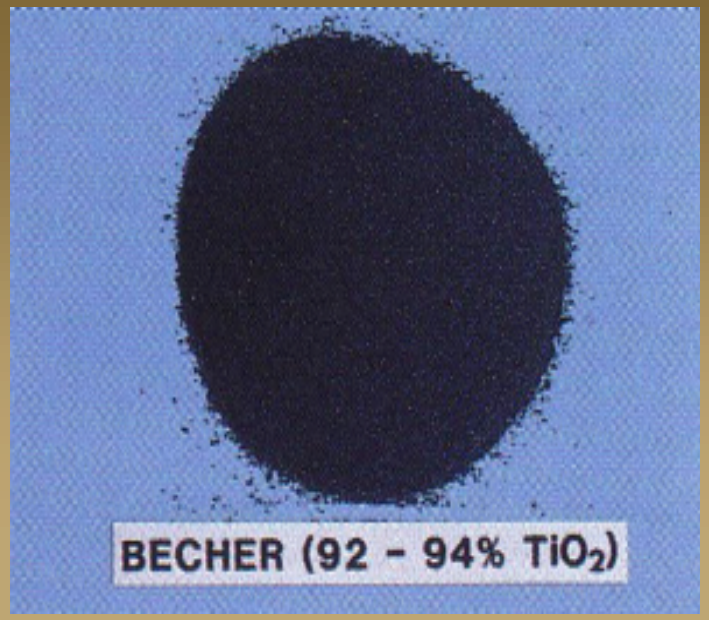
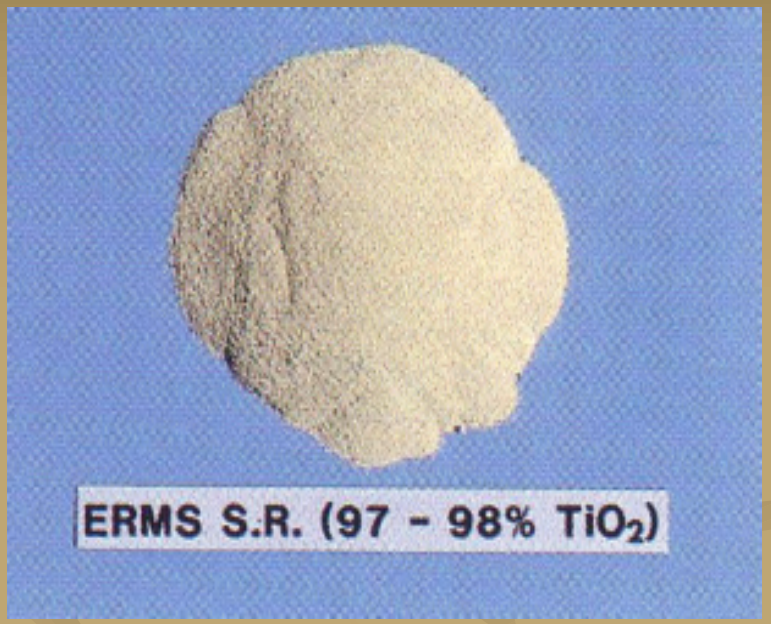
Ilmenite Upgrading

Process	Ilmenite Feedstock	Impurity Removal	Limitations
Titania Slag	Low TiO_2	None	Power Cost
Becher SR	High TiO_2	Some Mn	Coal, Fe Oxide
Benilite SR	Wide range	Mg,Ca,U+Th	Acid, Fe Oxide
ERMS SR	Wide range	Mn,Mg,Ca, U+Th,V, Cr	None

SR Quality





Ultra high grade feedstock for TiO_2 pigment and titanium metal

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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

30,000 tpa ERMS SR PLANT

The future direction