

ERMS SR and Related Processes

Application to the Murray Basin

4th Global Mineral Sands Conference

Melbourne - March 25, 2003

Overview

- **Development of Austpac's technologies**
- **The technologies**
 - **ERMS Roasting**
 - **LTR Roasting**
 - **ERMS SR process**
 - **ERMS SR roast**
 - **Ilmenite leaching**
 - **EARS HCL acid regeneration**
- **Benefits and applications**

History

- 1988 - Westport, New Zealand
- 1990 - ERMS Roast (Patented)
- 1992 - EARS HCl Regeneration (Patented)
- **1994 - Present**
 - Refined SR process (roasting, leaching, acid regeneration)
 - Evaluated potential SR projects – India, Murray Basin, others
 - Developed LTR fluid bed roasting know-how
 - Technologies now being commercialized

Newcastle Pilot Plant

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

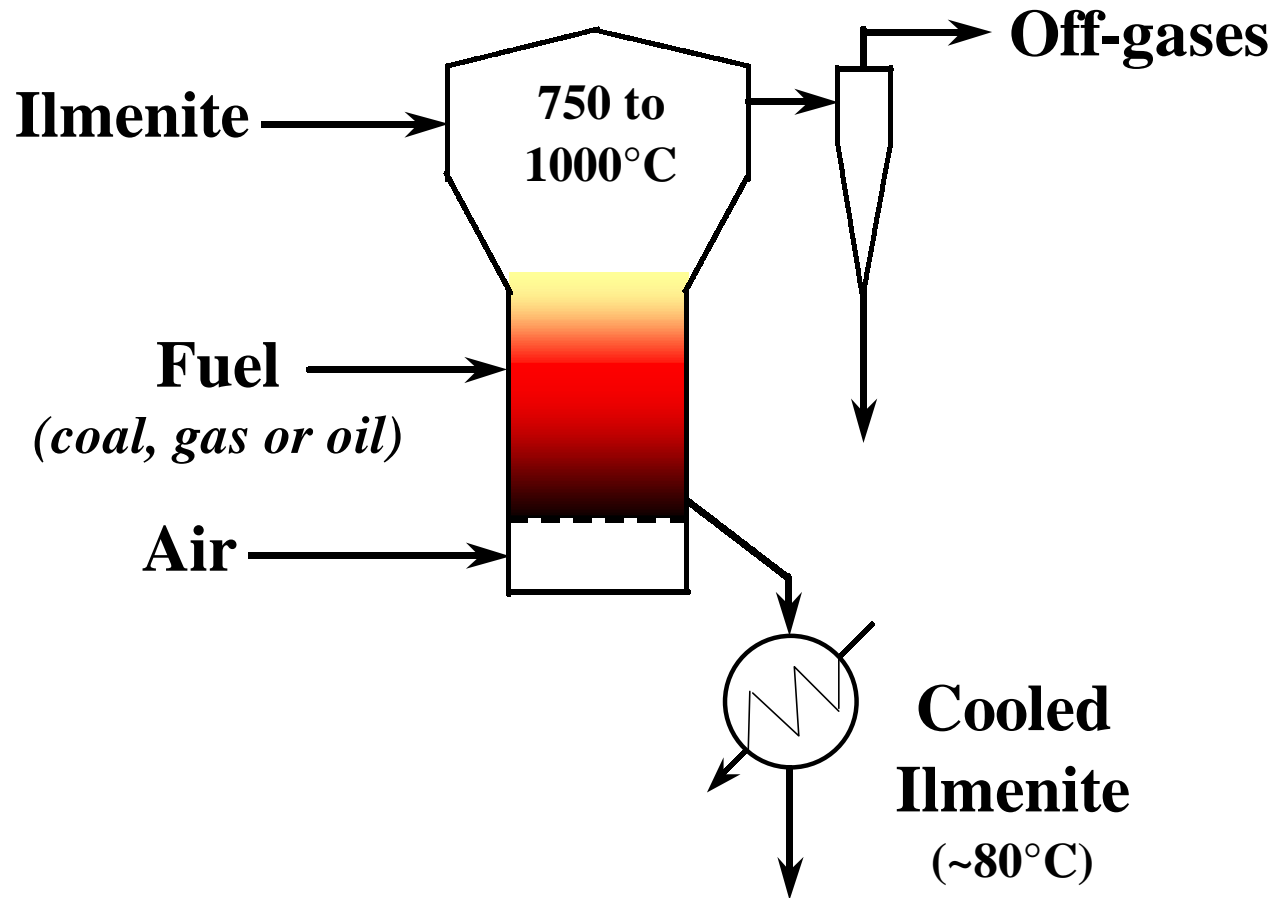


**Over 75 different types of ilmenite
successfully tested**

AUSTPAC'S Technologies & Know-How

- **ERMS⁽¹⁾** – high temp magnetising roast ($>750^{\circ}\text{C}$)^(FB)
 - **LTR** – low temp magnetising roast ($<650^{\circ}\text{C}$)^(FB)
 - **ERMS SR roast** – high temp oxidation/reduction ($<995^{\circ}\text{C}$)^(FB)
 - **HCl leaching** – batch^(FB), continuous⁽²⁾ leach vessels
 - **EARS⁽¹⁾** – regeneration of HCl from Fe chloride^(FB)
- ^(FB)Fluid bed process, ⁽¹⁾Patented, ⁽²⁾Patent pending

Fluid Bed Roasting



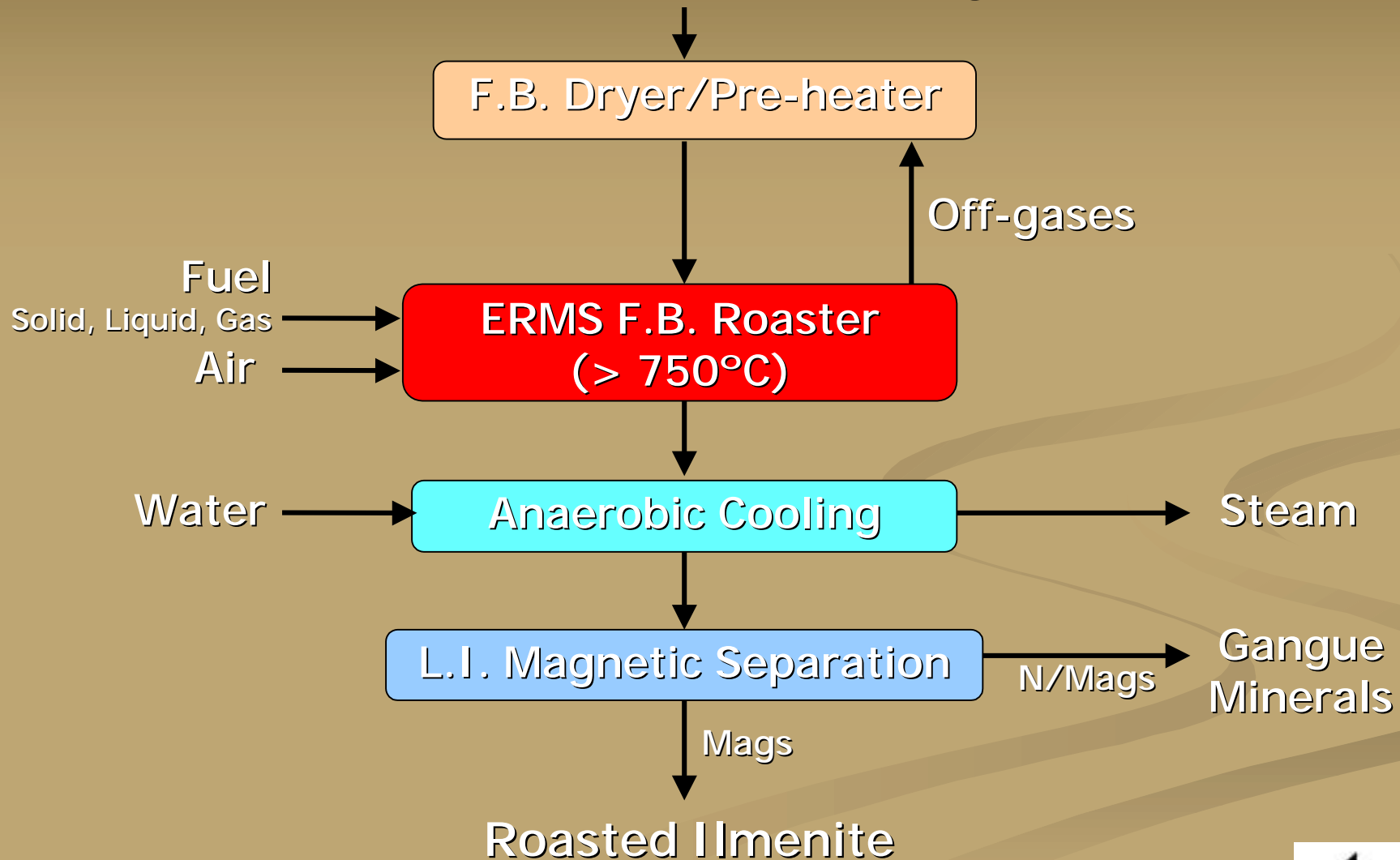
The ERMS Roasting Process

ERMS Roasting

- “High temperature” roast: 750-950°C, 30-60 min
- ERMS controls the O₂ potential in the fluid bed
- Forms a skin of Fe₃O₄ (magnetite) – L.I. mag. sep.
- Effective on fresh and weathered ilmenites
- High ilmenite recovery – generally >95%
- TiO₂ in ilmenite is “rutilized”, thus insoluble in acid – only suitable for slag or chloride process

ERMS Roast

Ilmenite feed (WHIMS Mags)





Ø 500mm Fluid Bed Roaster

ERMIS Roast - Results

Component (%)	Murray Basin (1)		Murray Basin (2)	
	Feed	Product	Feed	Product
TiO ₂	54.9	63.5	60.2	68.3
Fe ₂ O ₃	28.5	34.2	28.5	30.4
Cr ₂ O ₃	1.10	0.18	1.14	0.09
SiO ₂	4.66	0.98	3.11	0.93
Al ₂ O ₃	3.15	0.84	2.02	0.97
P ₂ O ₅	0.25	0.09	0.29	0.06

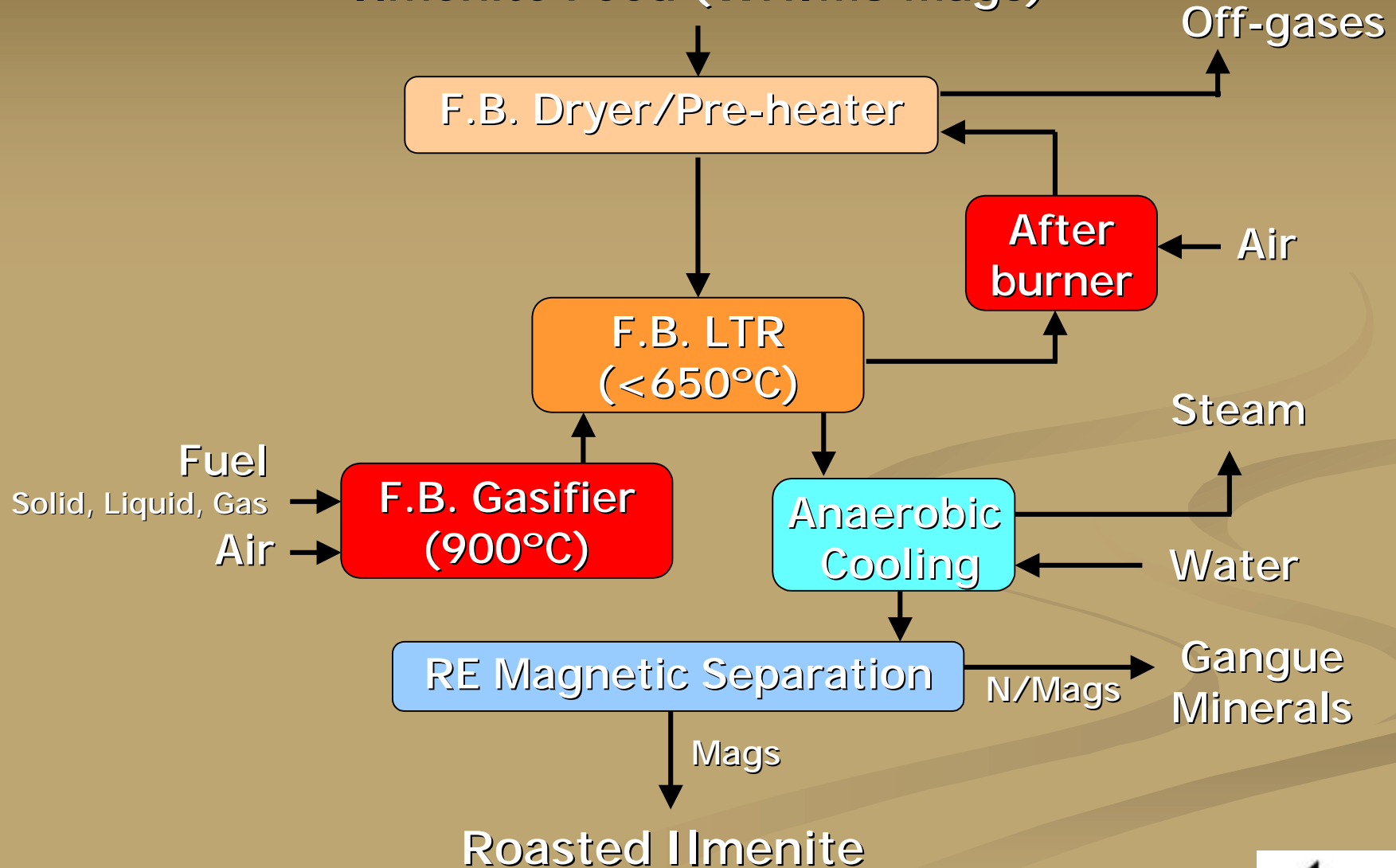
The LTR Roasting Process

LTR Roasting

- “Low temperature” roast: $<650^{\circ}\text{C}$, 20-30 min
- “Homogenizes” iron so $\text{Fe(II)}:\text{Fe(III)} = 3:1$
- High intensity RE drum separation
- Effective on fresh and weathered ilmenites
- High ilmenite recovery – generally $>90\%$
- TiO_2 in ilmenite is not rutilized, thus soluble in acid – suitable for chloride and sulfate process

LTR Roast

Ilmenite Feed (WHIMS Mags)





LTR Roaster

LTR Roast - Results

Component (%)	Murray Basin (3)		Murray Basin (4)	
	Feed	Product	Feed	Product
TiO ₂	55.0	61.5	59.1	63.0
Fe ₂ O ₃	28.6	35.4	31.8	34.3
Cr ₂ O ₃	1.17	0.28	1.30	0.24
SiO ₂	4.03	0.82	0.61	0.63
Al ₂ O ₃	2.99	0.72	1.17	0.84
P ₂ O ₅	0.30	0.09	0.13	0.12

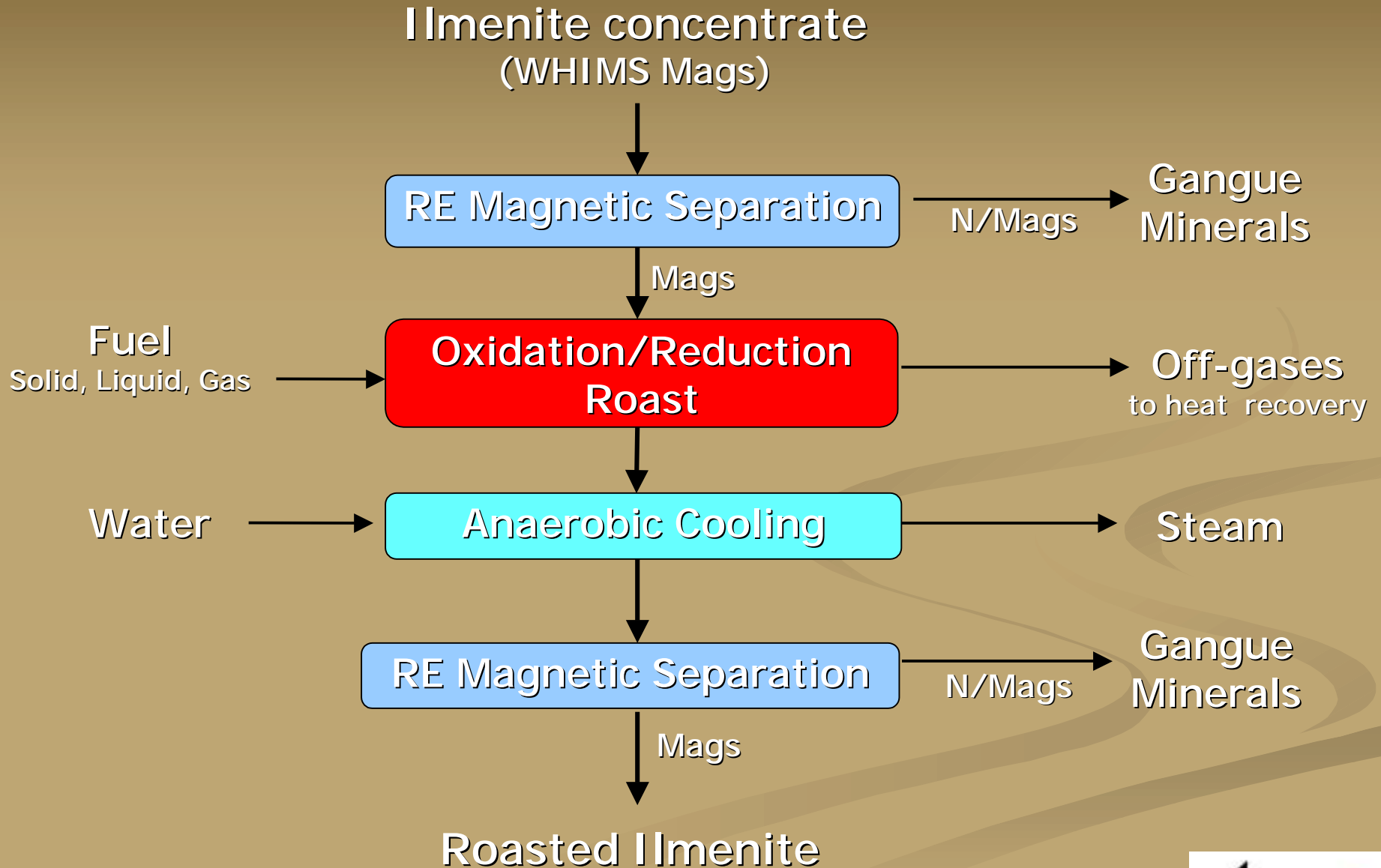
The ERMS SR Process

ERMS SR – Roasting

FeO/Fe₂O₃.TiO₂ - ilmenite

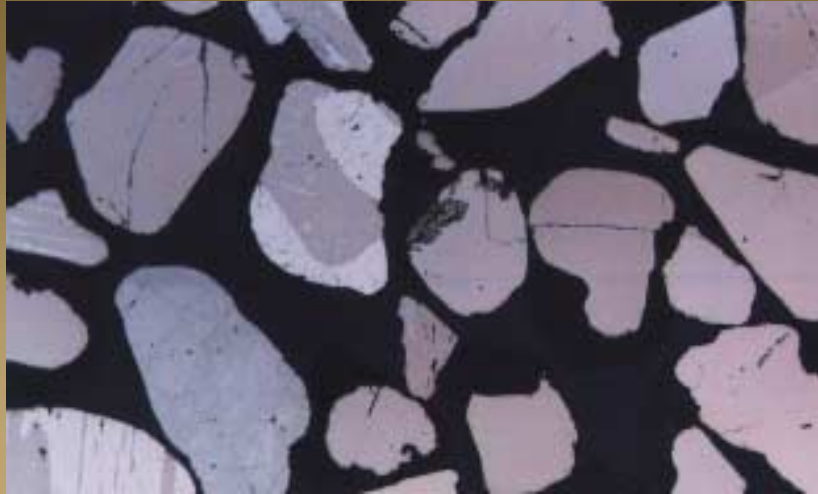
- Oxidation/reduction roast, >750°C
- Enhances mag. susceptibility of ilmenite, allows ready separation from gangue minerals
- Conditions ilmenite for rapid leaching in hydrochloric acid
- Renders the TiO₂ insoluble (rutilized)
- Increases the solubility of the iron and other unwanted constituents

ERMS SR Roast

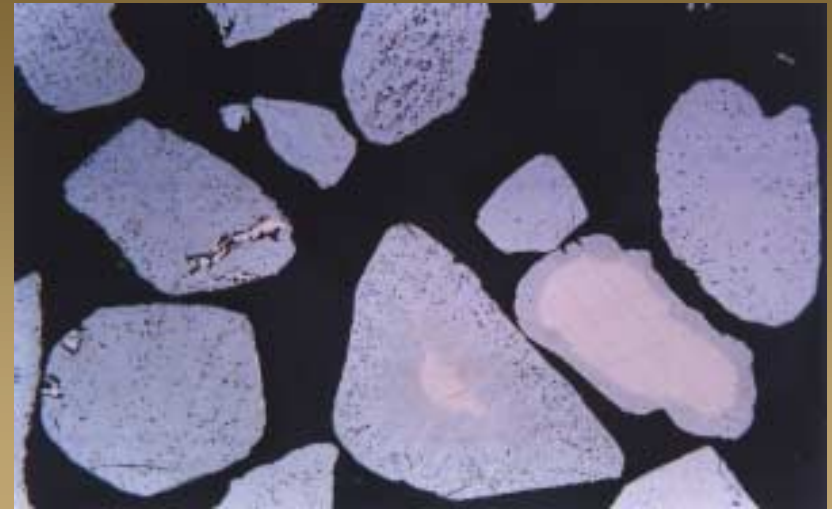




ERMS SR Oxidation - Reduction Roasters



Unroasted Ilmenite

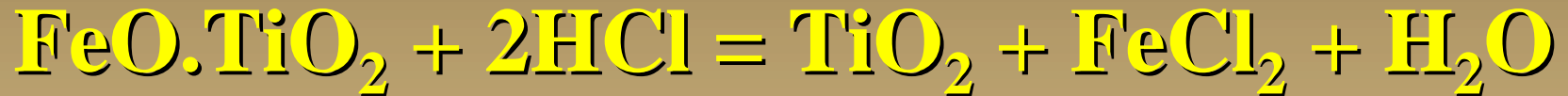


Oxidised Ilmenite



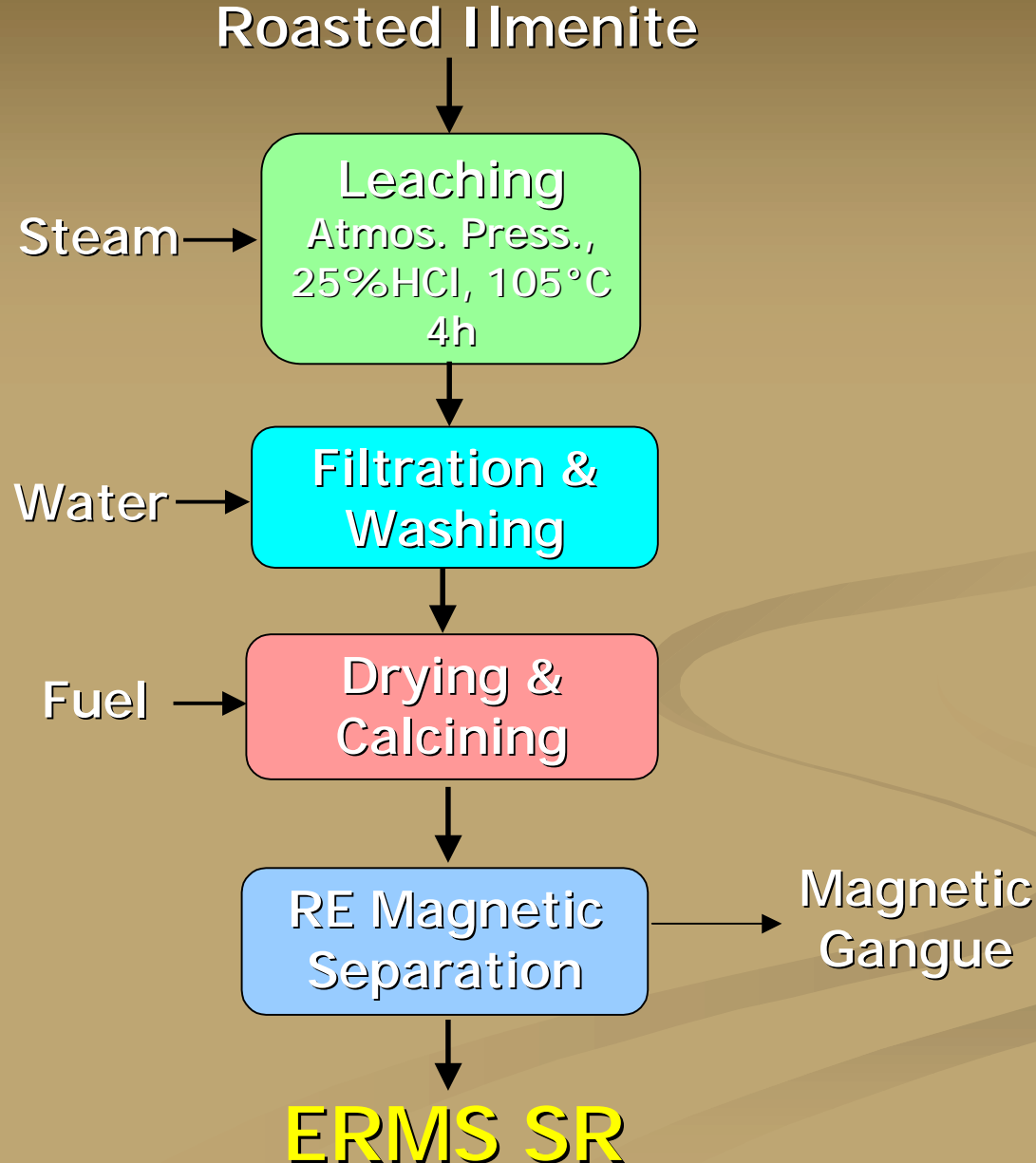
Reduced Ilmenite

ERMS SR Leaching

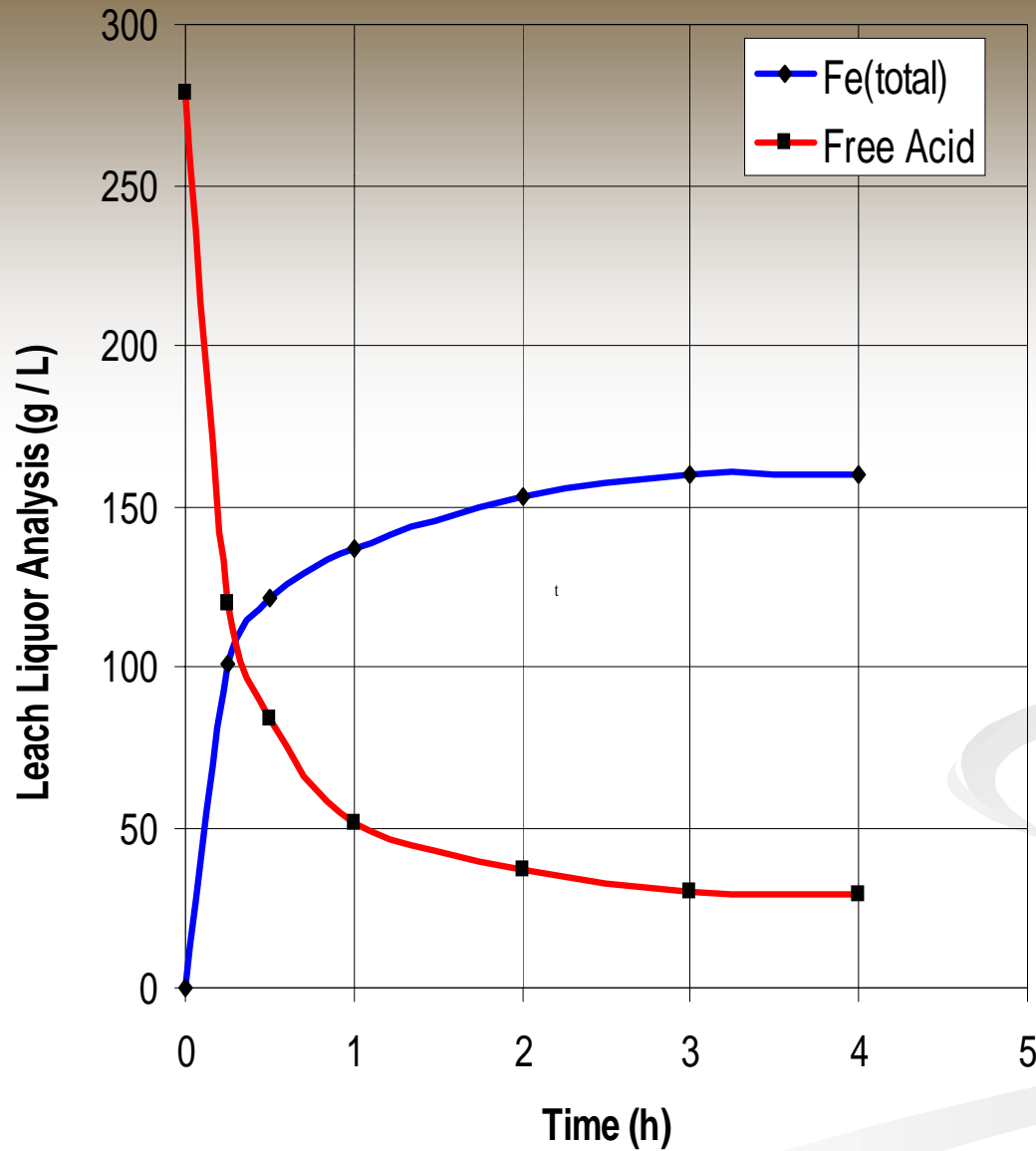


- Strong acid leach (25% HCl)
- TiO_2 in rutile form insoluble – not removed
- Iron and other metallic oxide impurities form respective chlorides
- Some silica is also removed
- Original ilmenite grain size is retained

ERMS SR Leach



Ilmenite Leaching

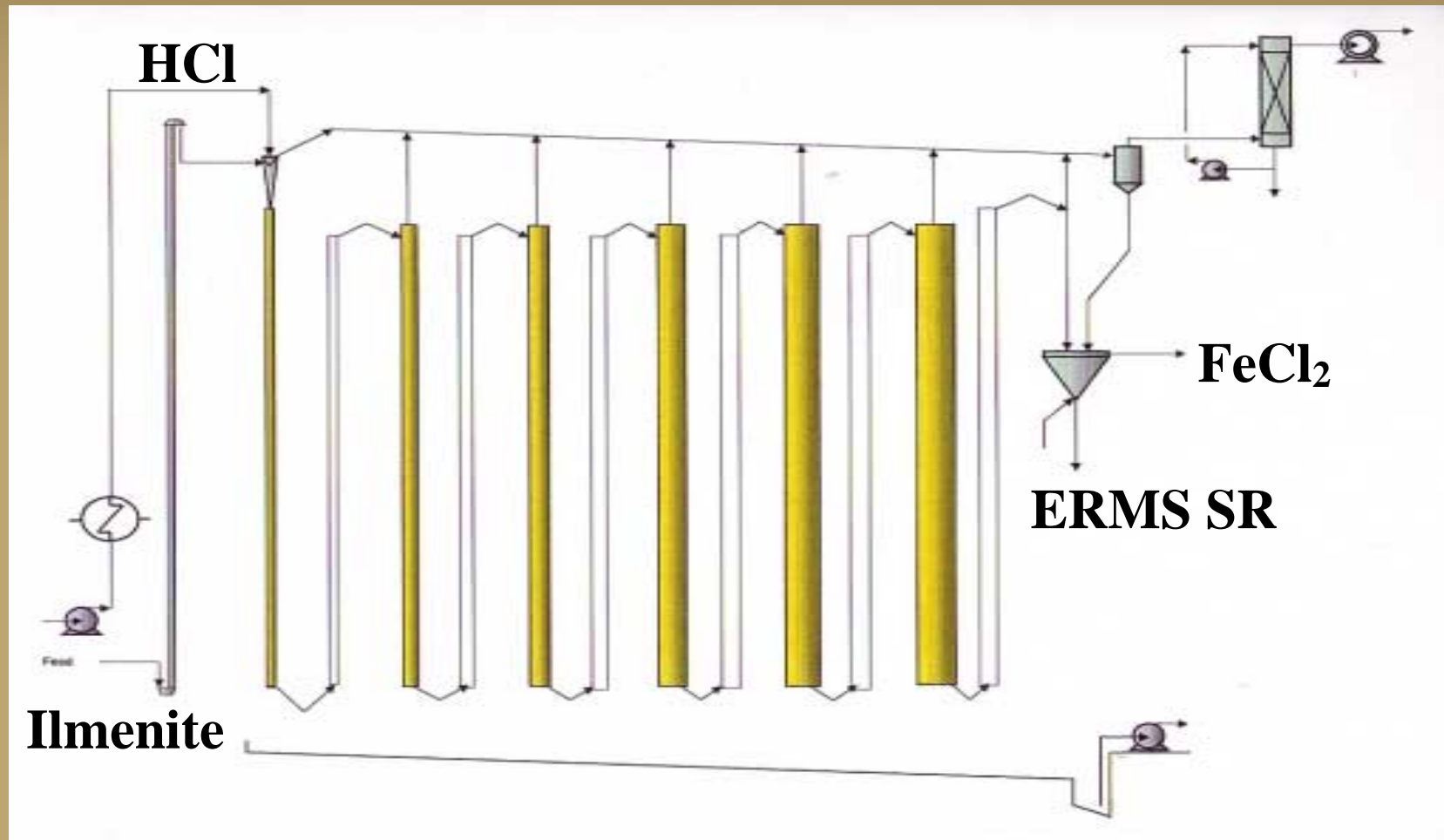


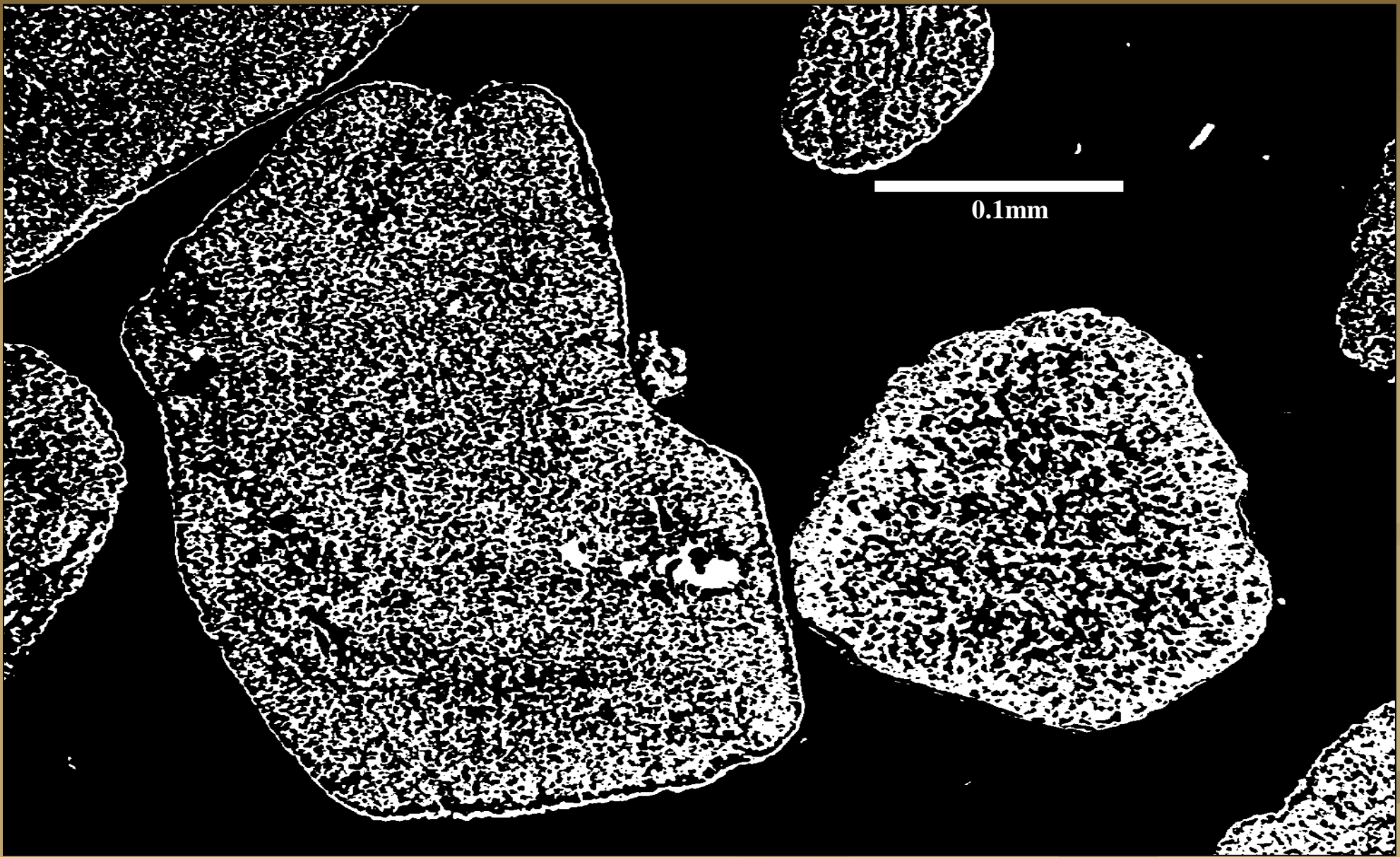


Leach Vessels at Pilot Plant

Continuous Leach Reactor

(Patents pending)



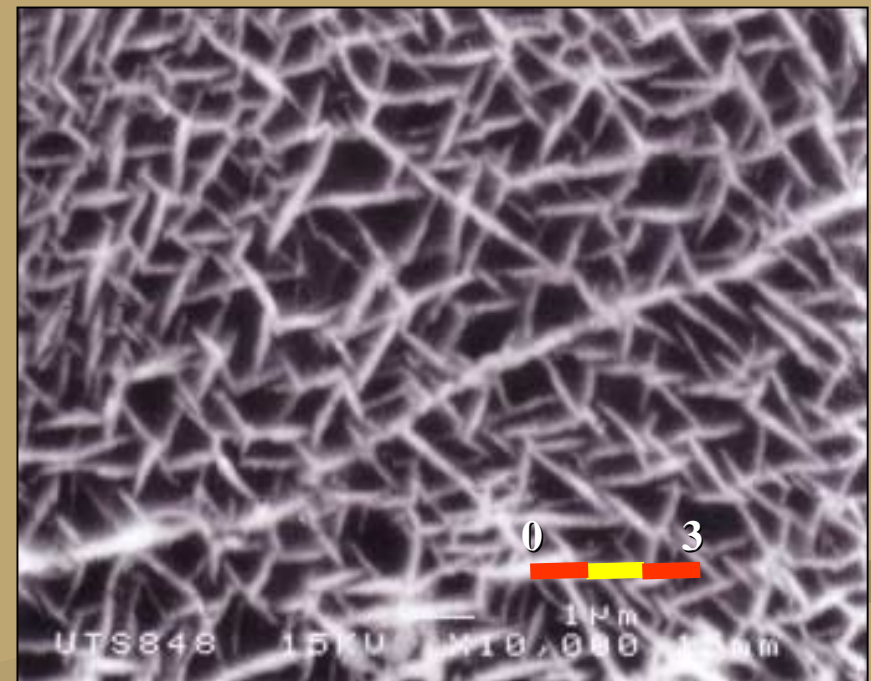


ERMS Synthetic Rutile

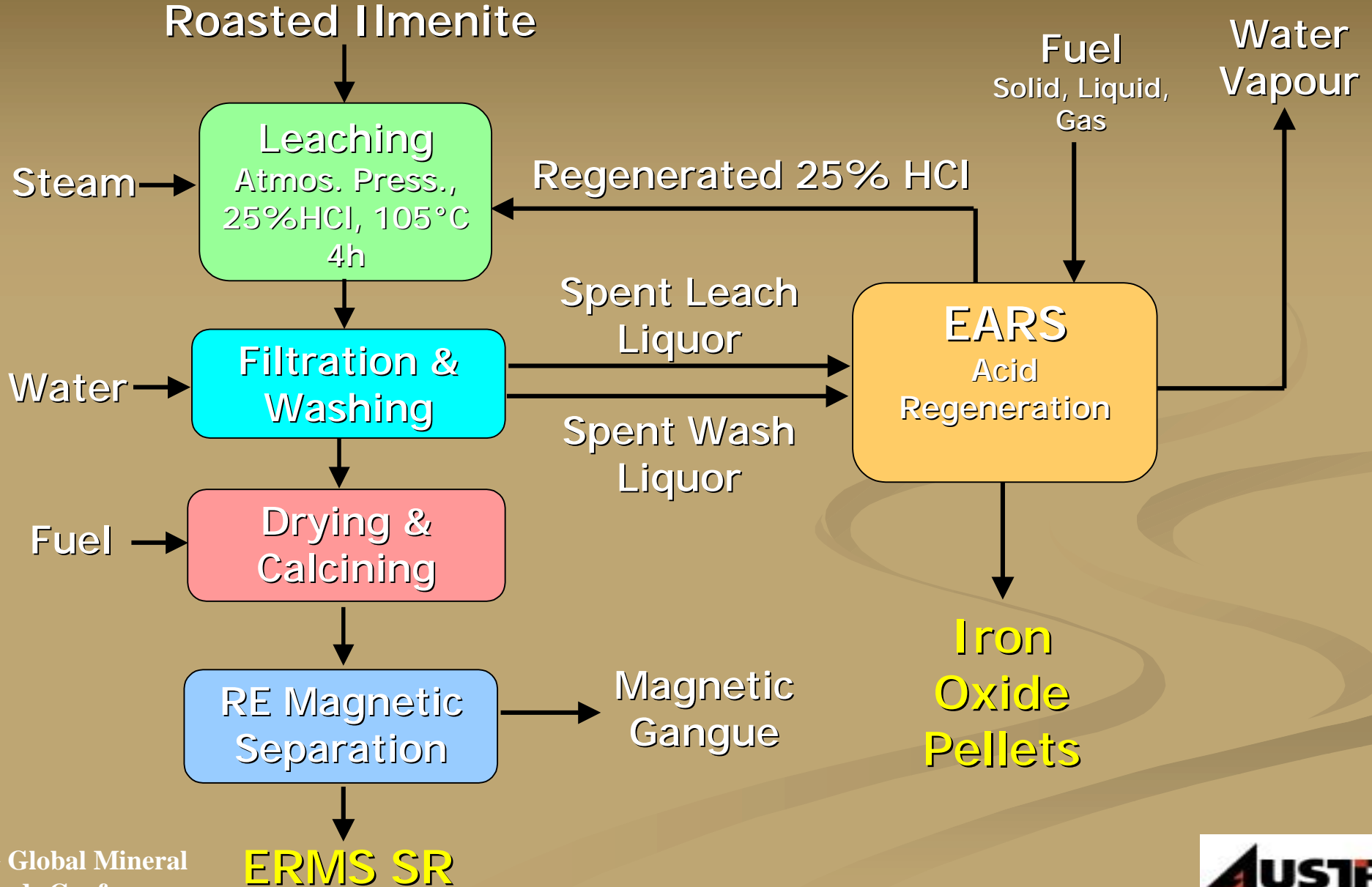
■ TiO_2	97.50%
■ Fe_2O_3	0.82%
■ SiO_2	0.77%
■ Al_2O_3	0.13%
■ Cr_2O_3	0.02%
■ CaO	0.02%
■ MgO	0.01%
■ MnO	0.01%
■ U+Th	<15ppm

ERMS SR

Typical Chemical Analysis



ERMS SR Leach & EARS A.R.



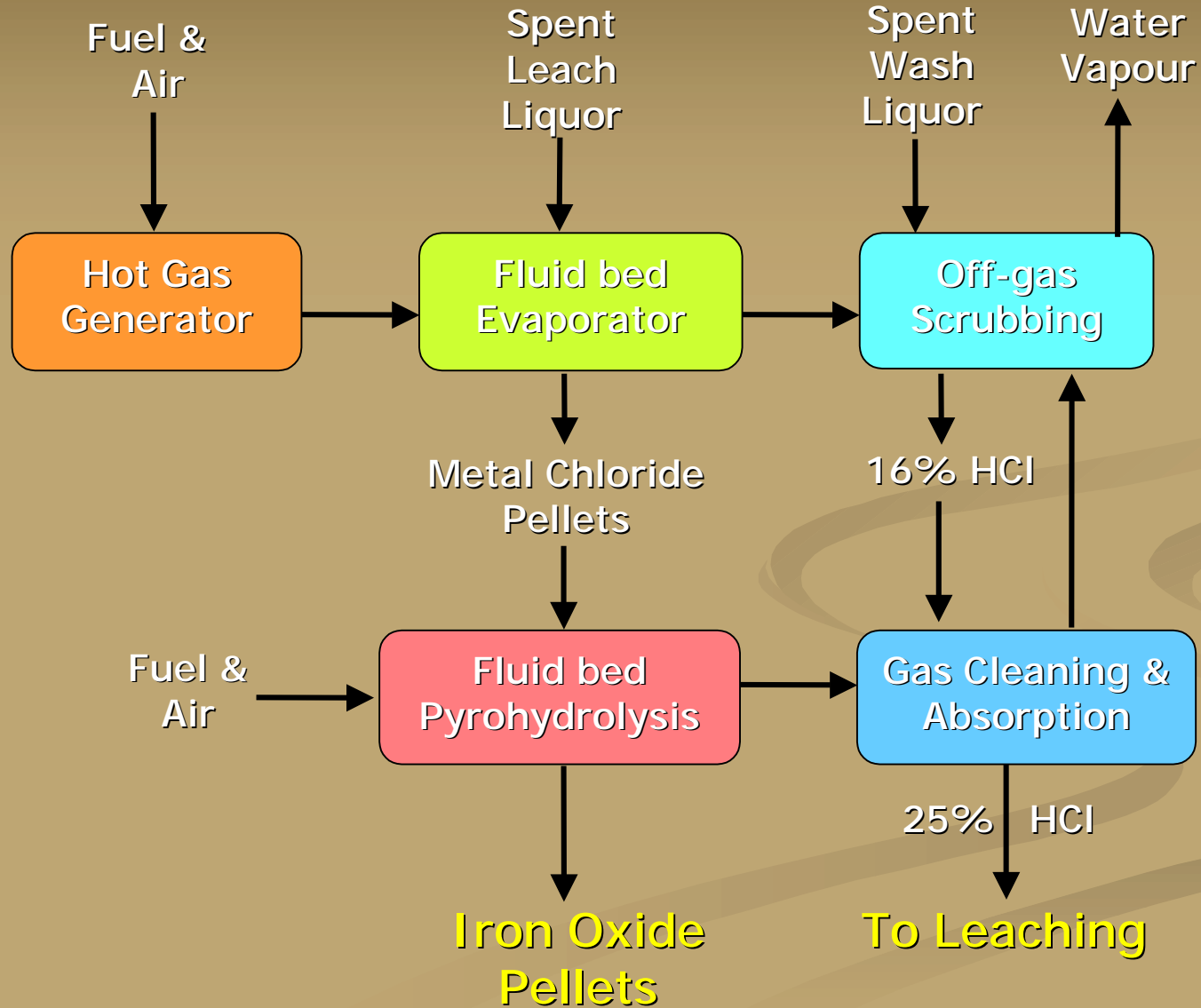
EARS Acid Regeneration

- 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)



- 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



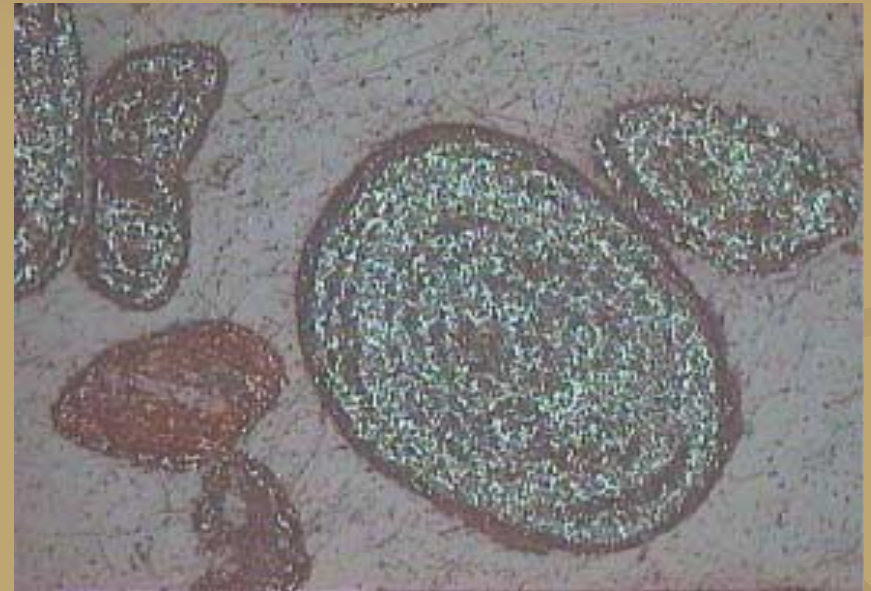
Pelletization in the EARS Process

Metal Chloride Pellets
($\text{FeCl}_2 \cdot x\text{H}_2\text{O}$)



↔
2 mm

Metal Oxide Pellets
(Fe_3O_4)



↔
1 mm



Pyrohydrolysis Roaster



HCl absorption columns

Comparative benefits of ERMS SR

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



BECHER (92 - 94% TiO₂)



ERMS S.R. (97 - 98% TiO₂)



BENELITE (95 - 96% TiO₂)

Ultra high grade feedstock
for TiO₂ pigment and
titanium metal

The Environment

- **Solids**
 - Saleable iron oxide pellets
- **Liquids**
 - No liquid effluents, 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**

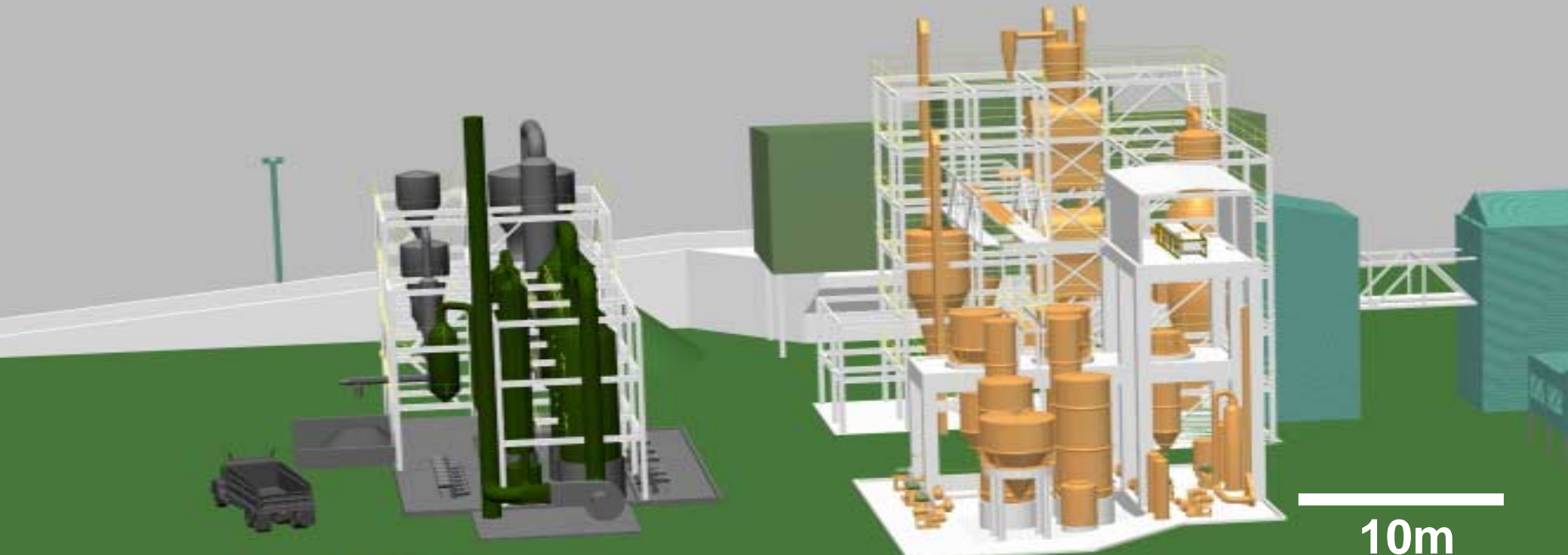
Technical Advantages of ERMS SR

- 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 ($>97\% \text{TiO}_2$)
- 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



**High grade feedstock
for the future**