

# **The ERMS SR Process:**

## **Advantages and Opportunities**

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# Key Mineral Processing Technologies:

Developed by Austpac to treat mineral sands

- ERMS SR      Roasts and leaches ilmenite to produce high grade synthetic rutile (“SR”)
  - EARS      Converts iron chlorides in spent leach liquors into hydrochloric acid and iron pellets
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- Direct Reduced Iron      Simple fluid bed process to reduce iron oxide to iron metal
  - Fine Mineral Agglomeration      Fluid bed process to agglomerate fine minerals

# ERMS SR Process



# ERMS SR Process

## Advantage #1

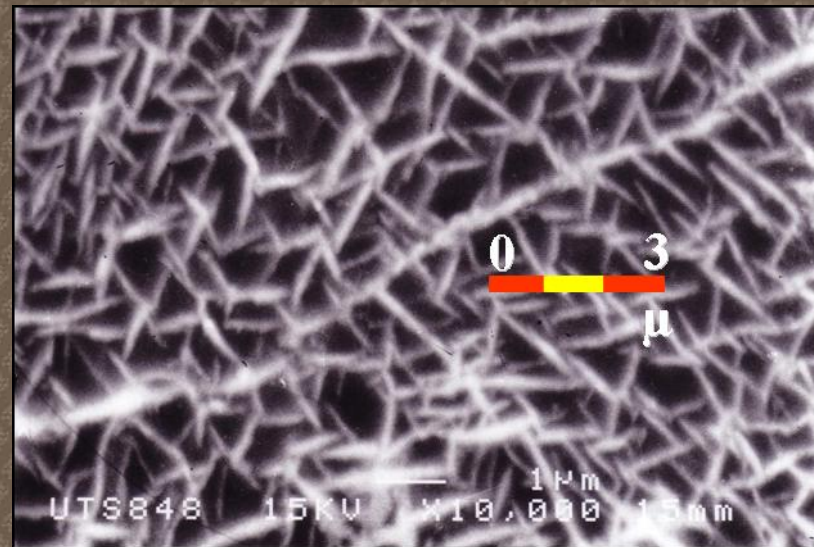
### Two valuable products:

- Ultra-high grade synthetic rutile  
*(for chloride pigment & metal production)*
- Iron metal pellets (DRI) for smelting to steel  
*(not fine oxide waste)*

# ERMS SR

## Chemical Analysis

<b>TiO<sub>2</sub></b>	<b>97.0%</b>
<b>Fe<sub>2</sub>O<sub>3</sub></b>	<b>0.55%</b>
<b>SiO<sub>2</sub></b>	<b>0.57%</b>
<b>Al<sub>2</sub>O<sub>3</sub></b>	<b>0.17%</b>
<b>Cr<sub>2</sub>O<sub>3</sub></b>	<b>0.01%</b>
<b>CaO</b>	<b>&lt;0.01%</b>
<b>MgO</b>	<b>0.02%</b>
<b>MnO</b>	<b>0.01%</b>
<b>U+Th</b>	<b>&lt;10ppm</b>



# Metallising EARS iron oxide

- **Fluid bed reduction of EARS iron oxide pellets to iron; a new DRI process developed in batch test work**
- **Continuous pilot scale unit built to prove the process prior to larger scale implementation**
- **Process will be incorporated into EARS section of the Demonstration Plant**

# Pilot Scale Metalliser



# EARS Iron Pellets (DRI)

## Chemical Analysis

<b>Fe</b>	<b>89.7%</b>
<b>FeO</b>	<b>6.00%</b>
<b>TiO<sub>2</sub></b>	<b>0.16%</b>
<b>SiO<sub>2</sub></b>	<b>0.18%</b>
<b>Cr<sub>2</sub>O<sub>3</sub></b>	<b>0.08%</b>
<b>CaO</b>	<b>0.03%</b>
<b>MgO</b>	<b>1.18%</b>
<b>MnO</b>	<b>2.29%</b>
<b>V<sub>2</sub>O<sub>5</sub></b>	<b>0.84%</b>
<b>P<sub>2</sub>O<sub>5</sub></b>	<b>0.007%</b>



# Steel from EARS Fe Pellets

## Chemical Analysis

<b>C</b>	<b>0.002%</b>
<b>P</b>	<b>0.005%</b>
<b>Mn</b>	<b>0.01%</b>
<b>Si</b>	<b>0.003%</b>
<b>S</b>	<b>0.015%</b>
<b>Ni</b>	<b>0.05%</b>
<b>Cr</b>	<b>0.01%</b>
<b>V</b>	<b>0.001%</b>
<b>Ti</b>	<b>0.003%</b>
<b>Sn</b>	<b>0.001%</b>

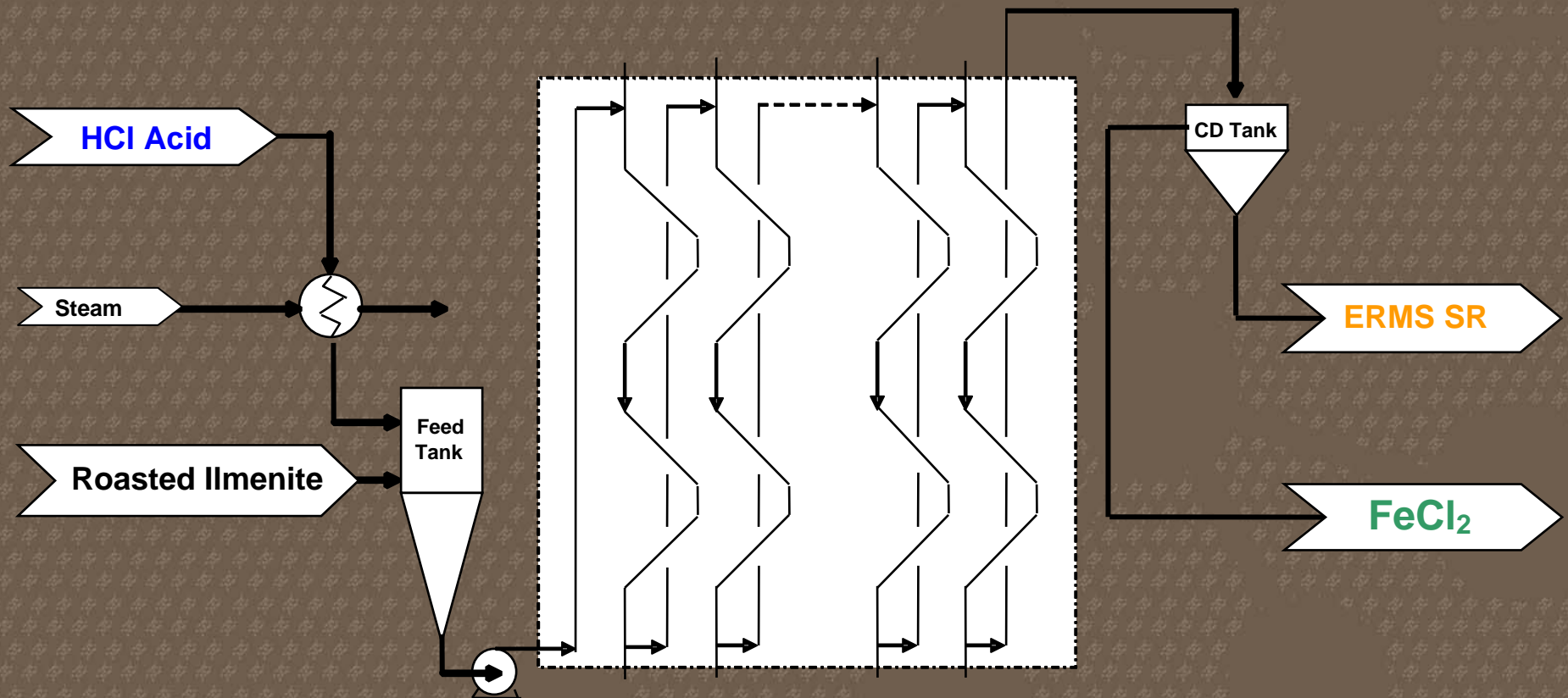


# ERMS SR Process

## Advantage #2

**Continuous operation – therefore lower capital & operating costs**

# Continuous Leach Reactor



# Low Capex:

- Total plant residence time (~8h)
- No ultra high temperature equipment
- Atmospheric pressure operation
- Fully continuous process

# Low Opex:

- PLC control of continuous operation
- Waste heat recovery
- Can utilise cheap fuels (*coal*)
- Produces / uses concentrated acid (*less water to evaporate*)

# ERMS SR Process

## Advantage #3

### Versatile:

- **Non Ore Specific - can treat a range ilmenites**
- **Non Fuel Specific – can use solid, liquid or gaseous fuel (*or a combination of fuels*)**
- **The process can tolerate variation in feed composition without upsetting plant operation**

# ERMS SR Process

## Advantage #4

### Low Environmental Impact:

- Fuel efficient – high revenue per unit of CO<sub>2</sub>

Process	Products (Basis: per tonne chloride feedstock)	Gross Income / tonne CO <sub>2</sub> emitted
Becher SR	~91% TiO <sub>2</sub> SR	138
Ti Slag (thermal power)	~85% TiO <sub>2</sub> Slag + Pig Iron	142
ERMS SR	~97% TiO <sub>2</sub> SR + DRI	257

# ERMS SR Process

## Advantage #4 (cont.)

### Low Environmental Impact:

- **No liquid effluents**
- **Solids**
  - **Gangue minerals in feed to plant returned to mine**
  - **Process solids all saleable (only SR & Fe)**
- **Off-gas streams are thoroughly scrubbed**

# Opportunities

## ➤ ERMS SR

- Production of DRI makes high iron ilmenites (< 49%  $\text{TiO}_2$ ) economically viable
- Plant location is not restricted to the resource - can be located near markets / infrastructure

# Summary - ERMS SR

- **Addresses sustainable development principles**
- **High grade feedstock assist pigment producers to:**
  - **lower energy costs**
  - **minimise environmental footprint**
  - **increase plant capacity**

# Other Opportunities

- **Fine Mineral Agglomeration**
- **EARS acid regeneration in Steel Industry**
- **Direct reduction of fine iron ores**

# Fine Mineral Agglomeration

- Fluid bed process - no binders
- Takes the place of calcination of ERMS SR
- Produces hard, spherical particles (100-500 $\mu$ m)
- Particle size is self regulating

## Potential applications:

- Fine grained/refractory Murray Basin deposits, Australia - e.g. WIM 150
- Fine Hi-Ti minerals
- Titania slag fines

# **EARS Acid Regeneration: Application in the Steel Industry**

- **EARS regenerates low cost HCl from waste chloride solutions from steel pickling / galvanizing operations**
- **Transforms iron units now lost as mill scales and dusts into high value electric arc furnace feed**
- **One tonne pickle liquor + two tonnes waste iron oxide = one tonne fresh acid + 1.6 tonnes iron metal**
- **Environmentally sound - recovers/recycles waste acids and oxides produced by steel mills**

# Metallisation and Iron Ore

- Value addition in the iron ore industry:
  - Reduction of magnetite sands to direct reduced iron (DRI)
  - Reduction of low value iron ore fines to high value DRI
- The continuous metallisation unit tested iron ore fines (Pilbara, Australia)
- ERMS SR Demonstration Plant will be used to process bulk iron ore samples
- Significant future potential for process

# Conclusion

**ERMS SR and related processes:  
adding significant value in the  
titanium, steel and iron ore  
industries**