Xstrata Alloys in Profile

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Keywords: Pyrometallurgy, furnace, Xstrata, ferrochromium, Premus Technology

Abstract – The presentation will give a basic overview of Xstrata Alloys. Included will be a brief history of the Alloys division as well as of each plant within the division. The Xstrata chrome plants utilise a wide variety of production processes, including Xstrata’s Premus process, the Outokumpu process, and the conventional process. Xstrata’s Lion Project is underway, with commissioning expected in the third quarter of 2006. The new smelter will utilize Xstrata’s patented Premus process, and the competitiveness of the Premus process is discussed.
XSTRATA’S RUSTENBURG SMELTER OPERATIONS

Figure 1: Rustenburg Furnace Plant (Left) and Pelletising Plant (Right)

Plant History

Furnaces 1&2 commissioned 130 000 t p.a.
Furnaces 3 commissioned 65 000 t p.a.
ISO 9002
Furnaces 4 commissioned 87 000 t p.a.
ISO 14001
Xstrata purchase CMI – furnaces 5&6 120 000 t p.a.
Recovery upgrade 27 000 t p.a.
ISO9001:2000


Plant Capacity

430 000 ton of Ferrochrome per Annum
- Normal Grade Product and Alternative Grade Product
- Recovery Product (Typical < 3% slag)

6 Furnaces with 220MVA Installed Capacity

Agglomeration Capacity 900 000 ton p.a.
- Blocks 400 000 ton p.a. and Pellets 500 000 ton p.a.

Recovery Plant: 30 000 ton Ferrochrome p.a.

Product Specification (Ferrochrome): 48-52% Cr, 7-8% C, 3-5% Si, 35-37% Fe
XSTRATA’S WONDERKOP SMELTER OPERATIONS

Figure 2: Overview of the Wonderkop Plant

Plant History

2004 — Second pelletising plant commissioned
2003 — Second alloy recovery plant commissioned
          Wonderkop plant full six furnace production
2002 — Furnace 5 and 6 commissioned
2001 — ISO 14 001 listing
          Conclusion of JV agreement with Samancor
2000 — Block plant commissioned
          ISO 9 002 listing
1999 — Pelletising plant commissioned
1998 — Furnace 3 and 4 commissioned
1997 — Alloy recovery plant commissioned
1996 — Furnace 1 and 2 commissioned
1995 — Wonderkop project started – Greenfield project

Plant Capacity

460 000 ton of Ferrochrome per Annum
- Normal Grade Product and Alternative Grade Product
- Recovery Product (Typical < 3% slag)
6 Furnaces with 270MVA Installed Capacity
- 35% to 40% low temperature sintered pellets
Agglomeration Capacity 780 000 ton p.a.
- Blocks 240 000 ton p.a. Pellets 540 000 ton p.a.
- In-house developed low temperature (700 deg. C) process
- Fluidized bed driven baking grate
Recovery Plant 30 000 ton Ferrochrome p.a.
- Magnetic upgrade and gravity separation
Product Specification (Ferrochrome): 48-52% Cr, 7-8% C, 3-5% Si, 35-37% Fe
XSTRATA’S BOSHOEK SMELTER OPERATIONS

Figure 3: Overview of the Boshoek Smelter Operations

**Plant Capacity**

240 000 ton of Ferrochrome per Annum
- Normal Grade Product (>50%Cr)
- Alternative Grade Product (<50%Cr)
- Recovery Product (Typical < 3% slag)

2 Furnaces with 110 MVA Installed Furnace Capacity
- Fully integrated Outukumpu pelletising, pre-heating and smelting plant.

Agglomeration Capacity 540 000 ton p.a.
- Pellets 540 000 ton p.a.
- Outukumpu Technology
- High temperature (1200 deg. C) sintering process.
- High flexibility in fine ore input selection

Recovery Plant 8 000 ton p.a. ferrochrome

**Product Specification**
- 48-52% Cr, 6-8% C, 3-5% Si, 35-37% Fe, <0.030% P, <0.05% S
XSTRATA’S LYDENBURG SMELTER OPERATIONS

Figure 4: Overview of the Lydenburg Plant

Plant History

- 402 000 ton of Ferrochrome per Annum.
  - Normal Grade Product
  - Recovery Product (Typical < 3% slag)

- 4 Furnaces with 171 MVA Installed Capacity
  - Pre-reduced pellets

- Agglomeration Capacity 550 000 ton p.a.
  - Pellets 550 000 ton p.a.
  - Premus pre-reduction process

- Recovery Plant: 24 000 tons Ferrochrome p.a.

- Product Specification: +50% Cr, 6 - 8% C, 1.5-4% Si, <0.020% P, <0.05% S
  - Approximately 65% of Product is Granulated (40mm down)
  - Approximately 35% is Crushed to Customer Specification (80*10mm)
CONVENTIONAL PROCESS WITH AGGLOMERATION

Figure 5: Conventional Route Production Flowsheet

Figure 6: Furnace Process Inputs and Outputs

Figure 7: Post Taphole Operations
THE PREMUS PROCESS

It is the most sophisticated and competitive process used today in the production of ferrochrome. Designed to reduce electrical energy consumption and provide high recoveries of metallic oxides, utilizing low cost reductants and energy sources such as anthracite and O₂. As electrical energy and chrome ore cost increase (50% of current variable cost structures) the plant’s competitiveness improves.

Premus Process Versus Conventional Process

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Premus Process</th>
<th>Conventional Process</th>
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</thead>
<tbody>
<tr>
<td>Electrical Energy:</td>
<td>2400 kWh/ton</td>
<td>3900 kWh/ton</td>
</tr>
<tr>
<td>Chrome Ore:</td>
<td>90% Recovery</td>
<td>70% Recovery</td>
</tr>
<tr>
<td>Other:</td>
<td>100% Fine Ore</td>
<td>Lump/Fine Mix</td>
</tr>
<tr>
<td></td>
<td>60% Fine Reductant</td>
<td>All Lump Reductant</td>
</tr>
<tr>
<td></td>
<td>Waste Gas Heat Utilized</td>
<td>Off Gas Burnt</td>
</tr>
<tr>
<td></td>
<td>High Capital Cost</td>
<td>Low Capital Cost</td>
</tr>
<tr>
<td></td>
<td>Low Si Product (&lt;3%)</td>
<td>High Si Product (&gt;4%)</td>
</tr>
</tbody>
</table>

Premus Process Flowsheet

Figure 8: Pelletising and Pre-reduction

Figure 9: Premus Smelting Process
Process Characteristics and Benefits in the Boshoek Operation

- Designed to accept a large proportion of material as fine ore feed (65 – 85%)
- Agglomerated ore feeds allow increased chromium recovery efficiencies and flexibility in ore sourcing strategies.
- Closed furnace configuration reduces pollution and enables CO product utilization.
- Use is made of the CO rich furnace off-gas to pre-heat the feed- reducing electrical energy consumption, reducing the overall environmental footprint of the process
- The large capacity of the Boshoek pelletising plant offers specific flexibility in the process
What is Vanadium?
- Silver grey metal
- Melting Point = 1710 deg. C
- Atomic Number = 23
- Atomic Weight 50.942

Main Sources of Vanadium
Vanadium is often a co-product or by-product.

Most production comes from vanadium-containing magnetite ores
- Pig iron may be a co-product; vanadium is then recovered as a slag for further processing
- There is also some co-product production from iron sands

Other sources include uranium ore, phosphorus ore, crude oil, power plant ash, spent catalysts, other residues

Vanadium materials are converted into ammonium vanadates and subsequently into vanadium oxides, most commonly pentoxide (V$_2$O$_5$)

Vanadium oxides are further processed into commercial products
- Slags can be processed directly into 40% ferrovanadium
- 80% ferrovanadium is a more common grade, produced from V$_2$O$_5$