Ferrochromium Smelting In Zimbabwe

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by
D. Miso-Mbele/B. Chitambira/M.Gumbie
Zimbabwe’s ferrochrome production is mainly from four established smelters;  
- ZIMASCO in Kwekwe,  
- Zimbabwe Alloys in Gweru,  
- Maranatha in Kadoma, and  
- Oliken in Kwekwe.

Small-scale ferrochrome smelters on the central Great Dyke;  
- MonaChrome in Chegutu,  
- CINA in Gweru,  
- Jin An Corp & Xinyu in Gweru,  
- Well Mining in Gweru,
Zimbabwe traditionally produces three ferrochrome products;

- High Carbon Ferrochrome,
- Ferrosilicon Chrome, and
- Low Carbon Ferrochrome

ZIMASCO and Zimbabwe Alloys represent more than 90% of Zimbabwe’s FeCr smelting capacity [490K tonnes of FeCr product - approximately 6% of 2008 world production],

Chromium is used principally as an alloying element in cast irons and steels.
### World Chromite ore reserves

<table>
<thead>
<tr>
<th>Million mt</th>
<th>Chromite ore reserve</th>
<th>Chromite ore output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mt</td>
<td>%</td>
</tr>
<tr>
<td>South Africa</td>
<td>5,500</td>
<td>72.4</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>930</td>
<td>12.2</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>320</td>
<td>4.2</td>
</tr>
<tr>
<td>Finland</td>
<td>120</td>
<td>1.6</td>
</tr>
<tr>
<td>India</td>
<td>67</td>
<td>0.9</td>
</tr>
<tr>
<td>Turkey</td>
<td>20</td>
<td>0.3</td>
</tr>
<tr>
<td>Brazil</td>
<td>17</td>
<td>0.2</td>
</tr>
<tr>
<td>Others</td>
<td>626</td>
<td>8.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,600</strong></td>
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</table>
In Zimbabwe chrome occurs in two distinct geological features;
1. Great Dyke, and
2. Greenstone belts.
- Zimbabwe hosts over 80% (est.) of the world’s resources of metallurgical grade chromite, mainly on the Great Dyke (11 narrow seams - stratiform)
- Great Dyke - approx. 550 km long and 11 km wide.
- Seams are narrow, averaging 10cm in thickness, extending both sides of the entire length of the Dyke.
Zimbabwe Chromite ore reserves

- Greenstone belt (pods and pipes)- Shurugwi, Mashava & Limpopo Mobile Belt (Mberengwa).
- Shurugwi deposit - most important sources of metallurgical chromite in the world (high grade & hard lumpy).
- Refractory - perfect FeCr refiners,
- Reserve estimated at approx. 1 million MT.
- Zimbabwe has total proven reserves of about 140 million MT (Total resource +/-1 billion MT).
Zimbabwe Chromite ore reserves

Monachrome
Maranatha
ZIMASCO Oliken
Zimbabwe Alloys
The chrome industry in general consists of three value system:

1. Ore producers
   - Industry is segmented by ore characteristics:
     - Refractory grade ore (>60% Cr),
     - Metallurgical grade ore (>46% Cr),
     - Chemical grade ore (40% < Cr < 46%)
2. Ferrochrome producers
   - Integrated alloy smelters,
   - Independent alloy smelters

3. End-use customers
   - Primary stainless producers,
   - Refractories and foundries,
   - Chemicals.
Challenges:

- High CAPEX and OPEX,
- Cost reduction
- Waste Reduction, and
- Improving SHE.

Global trend of ferroalloy prices is downwards, thus producers have to decrease overall production costs in order to maintain profitability of the industry.
Ferrochrome Smelting
in Zimbabwe

Ferrochrome Technology

- Efficiency of the ferrochrome process
  - type and pre-conditioning of the feed materials,
  - pre-heating and pre-reduction.

- Agglomeration plants (Sinter, pelletisers, briquetting etc) enable the consumption of chromite ore fines and concentrates

- Sintering;
  - chromite pellets heated to silicates fusion point, binding the chromite grains,
  - Fe in chromite oxidises from Fe$^{2+}$ to Fe$^{3+}$, releasing energy - & the transformed grain structure facilitates reduction,
  - Electrical energy consumption typically 2.0 - 2.5 MWh/MT alloy
Alternative Technology

Outokumpu Ferrochrome Process

- Grinding
- Filtering
- Mixing
- Pelletizing
- Sintering
- Scrubbing
- Preheating
- Gas cleaning
- Smelting
Ferrochrome Market Analysis
1994 - 2008

- Chromium alloys demand has been expanding by approx. 5% annually over the past decade - and chromite ore followed closely (average growth rate 4.6% p.a),
- Between 1994 and 1999, chrome ore production stagnated,
- 2000 and onwards, market volumes increased from 15 million MT to 24 million MT in 2008 - due to the-then rapidly rising global stainless steel demand and production in China.
Ferrochrome Market Analysis
1994 - 2008

Spot price
2.45 – 3.25 USD/lb

Contract price
Q2/08: 1.92 – 2.05 USD/lb

Source: Metal Bulletin, including Q2/08
At the onset of the economic downturn from mid-2008, demand for chromium plummeted,

- Year-on-year ferrochrome consumption fell by 3.5%,
- Major Asian and European consumers significantly reduced orders to a minimum to run down inventories.
FeCr export prices fell by 68% for the ten months to May 2009,

Zimbabwe’s major producers of ferrochrome cut back on production (approx. 70% of world FeCr production capacity was suspended in the first quarter of 2009),

During Q2 of 2009 staggered returns to full production were initiated by producers driven by declining inventories of stainless steel mills.
Current and Future capacity of Chrome industry in Zimbabwe

- Major limiting factor in the growth of the FeCr industry is inadequate regional power supply. (investment into power generation is required).
- Little investment into Ferrochrome smelting technology in recent years,
- Marked increase in small-scale smelters installations over the central part of the Great Dyke.
- Investment in smelting capacities to consider the pre-treatment processes of chromite ore fines
The production of HCFeCr in SAF using sintered pellets in place of briquettes or ore blocks is comparatively better in all respects w.r.t specific power and furnace operation leading to higher production,

Global trend is construction of larger, closed or semi-closed furnaces, for better efficiencies in production
Current and Future capacity of Chrome industry in Zimbabwe

- Primary challenges influencing growth in the local FeCr industry;

1. Inadequate Power supply & high energy costs

2. A large portion of the chromite currently being mined requires agglomeration,

3. The growth in the base metals and steel industry has precipitated worldwide volatility in the price of metallurgical reductants,

4. Logistical infrastructure (road/rail) is increasingly being strained by stronger demand,
Conclusion

- Zimbabwe’s large chromite reserves forecast to alleviate an anticipated FeCr supply shortage on the world market,

- Zimbabwe’s FeCr industry has high investment capacity. Industry has lagged behind other minerals in investment volumes,

- Implementation of major projects, including pelletisation and sinter of friable ores within 3 -4 years will allow Zimbabwe to supply between 10% to 20% of global FeCr demand.