Kemi mine – 50 million tons chromite ore, 50 years of production

Jyrki Salmi
Head of DeepMine Program
Kemi Mine
Accident frequencies

TRI – Total recorded incidents
LTI – Lost Time Incidents

TRI- and LTI-frequencies are calculated per 1,000,000 working hours that include all own (200) and external workers (350).
Tornio operations

• Integrated ferrochrome and stainless steel production chain in Kemi-Tornio area.

• Competitive advantages
  ✓ Integrated operations
  ✓ Only chrome deposit in the EU
  ✓ Stable, cost efficient electricity
  ✓ Excellent cost curve position

• Target capacity of ferrochrome production 530,000 tons annually.
• Target capacity of stainless steel production 1,400,000 tons annually.

2018
Kemi Mine – 50 million tons chromite ore, 50 years of production
Kemi Mine – The only chromium mine in the EU

- The biggest underground mine in Finland. Annual ore handling capacity is 2.7 million tonnes.
- Chromite ore mined from the underground mine and processed in the mills above ground. Producing annually:
  - 0.85 Mt fine concentrate and
  - 0.40 Mt lumpy ore.
- Products delivered to close by Tornio FeCr-plant and stainless steel mill
- 200 own employees. In addition, 300+ contractors and service suppliers
Kemi Mine area

Total area of 9.16 km²
- Mill area
- Open pits (4)
- Tailings pond (1), water treatment ponds (2), landscaped tailings ponds (4) = 2.8 km²
- Waste rock heaps (3) and X-ore heap (1) = 1.5 km²

Tailings sand 16 Mt. Waste rock 115 Mt.
Kemi Mine mill area

- Entrance into the underground mine
- Hoisting tower
- Lumpy concentrator
- Product storages
- Crusher
- Milling
- Fine concentrating
- Homogenization of fine concentrate mill feed
- Warehouses
- Office
- Canteen
- Dressing rooms
The products of Kemi Mine

Upgraded lumpy ore
- 36.5% - Cr₂O₃
- Average grain size 10-120 mm.

Fine concentrate
- 44.5% - Cr₂O₃
- Average grain size 0.2 mm.
Environmental impacts of the Kemi Mine are very small:

1) Oxidic ore mineral (Cr₂O₃) => No dilution of harmful substances from the oxidic rock material to the nature.

2) Gravity separation process => Only mechanical rock handling and gravity based separation of valuable minerals and therefore no chemicals used in the concentrating process.

3) Internal water circulation => All waters used within the mine area are handled in the internal and almost fully closed water circulation, where drainage waters from the mine and process waters from the concentrating plant are recycled through the water treatment ponds back to concentrating process to re-use.
Chromite reserves of the world
9,106 Million tonnes in 2016

Reserve base by country

<table>
<thead>
<tr>
<th>Country</th>
<th>Million tonnes</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Africa</td>
<td>6,751</td>
<td>74.1</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>930</td>
<td>10.2</td>
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<tr>
<td>Kazakhstan</td>
<td>387</td>
<td>4.2</td>
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<tr>
<td>Turkey</td>
<td>220</td>
<td>2.4</td>
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<tr>
<td>Finland</td>
<td>120</td>
<td>1.3</td>
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<tr>
<td>India</td>
<td>54</td>
<td>0.6</td>
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<td>Brazil</td>
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<tr>
<td>China</td>
<td>5</td>
<td>0.1</td>
</tr>
<tr>
<td>Others</td>
<td>621</td>
<td>6.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9,106</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Including UG2
Sources: DMR, IBM, DNPM, NBSC, Company Information and Heinz H. Pariser
Others countries: Afghanistan, Alcania, Australia, Canada, Cuba, Indonesia, Iran, Madagascar, Pakistan, Philippines, Sudan, Vietnam
Mineral reserves and resources

Classification according to Fennoscandian Review Board standard (FRB). January 1st, 2018.
Strategic targets for 2018; 3% productivity gain
Manufacturing excellence

Projects for the productivity walk
- Increasing ore recovery from stoping
- Optimizing rock enforcement and production drilling
- Synchronization of the waste rock logistics and mining
- Internal waste rock shaft development
- Mine ventilation optimization
- Higher recovery rate of the fine concentration process
DeepMine
Kemi Mine
EUR 250 million investment 2018-2021 in deepening Kemi Mine

- Outokumpu invests EUR 250 million during 2018–2021 to Kemi Mine’s vertical expansion.
- The investment secures continuous chrome ore and concentrate supply for the coming decades.
- The DeepMine program extends the mine to 1,000-level (1 km)
- New infrastructure and facilities of the DeepMine will be in use in 2021.
The new infrastructure of the whole new deeper mine

- During the DeepMine program a whole new infrastructure will be built.
- During 2014–2017 Outokumpu has excavated the ramp from the 500-level to more than 1 km depth.
- From the ramp and from the exploration tunnel at 900-level, it has been possible to explore the deeper continuities of the ore.
- The ramp is the main route to the underground mine, as well as access to the future ore production areas around the 1,000-level.
Thank you!