Circular economy in steel industry

Marko Mäkikyrö

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Circular economy in steel industry

1. SSAB Merox
2. Briquettes
3. Scrap
Sustainable operations - Reducing CO$_2$ emissions

At the end of 2019 SSAB will have achieved a lasting reduction of 200,000 tonnes in CO$_2$ emissions

- Equal to 2.1% of SSAB total CO$_2$ emissions
- Corresponds roughly to 100,000 cars driving 15,000 km each
- Reduction efforts focused on production
  - 90% of total is generated from the ore-based iron and steel making (coke and coal)
- Today, SSAB uses nearly the minimum amount of carbon raw materials possible with current technology

SSAB is one of the best in the world in iron making CO$_2$ efficiency - 7% better than the European average

Blast furnace efficiency

Sustainable operations - Reducing amount of purchased energy

At the end of 2019 SSAB will have achieved a lasting reduction of 300 GWh (both electricity and fuel) in purchased energy

► Equals to approx. 3.5% of SSAB`s total amount of purchased energy

► Target level corresponds roughly to the energy used by 15,000 households for electricity, hot water and heat during one year
Sustainable operations - Utilization of residuals

At the end of 2019 SSAB will have achieved lasting improvements in residual utilization by 30,000-45,000 tonnes

- Achieved through improved internal recirculation and external sales of by-products

- This reduction corresponds to:
  - 12% of the total amount of material currently sent to landfill
  - Roughly to a normal football field filled with 3 meter of material

CASE 1

- **Merox** – optimizing the value of SSAB’s by-products and reducing waste in the Nordics

- 4 million ton of residuals handled annually
Merox in short

- Merox is a business within SSAB, with a mission to optimize the value of SSAB’s by-products and reduce waste.

- Prioritized areas:
  - Recirculation of material to SSAB production
  - Processing and selling products externally
  - Managing waste which cannot be re-circulated or processed into new products

- Production in six locations in Sweden and Finland

- The number of employees in Merox about 70 and about 200 people work through various contractors within Merox business

- Sales in Merox responsibility area 1 500 MSEK

Merox handle yearly about 4 million ton of residuals: In average 52% recirculated (mostly as raw material to SSAB steel production), 33% sold externally, 9% storage and 6% landfill.
4 000 000 t/a

Route
Oxelösund-Borlänge-Luleå-
Raahe-Hämeenlinna ≈ 1 900 km

100 000 × 1 truck ≈ 1 900 km
Value In Use (VIU)

- VIU > market price → USE
- VIU < market price → SELL
Market segments - internal

► Raw material for SSAB steel production
  - Slag recirculation (LD and ladle slag for BFs)
  - Scrap (scrap from slag and recycled steel)
  - Internal raw materials (briquettes, tundish covering powder)

► Steel works services
  - Landfill services (management and long term planning)
  - Waste management services (non-process waste such as paper, oils, etc.)
  - Used equipment services (taking care of discarded equipment)
  - Utilizing materials (develop the best usage for by-products and waste)

► SSAB sustainability support
  - REACH management and coordination
  - Environmental expertise consulting
Market segments – external

- **Earthworks & road construction**
  - Granulated and air cooled blast furnace slag
  - Ground Granulated Blast furnace Slag (GGBS)
  - Mixture of converter slag and granulated blast furnace slag

- **Agriculture**
  - Granulated blast furnace slag
  - Ladle slag
  - Mixture of calcite and granulated blast furnace slag
  - Mixture of calcite and desulphurization slag
  - Air cooled blast furnace slag

- **Industrial sales - raw materials**
  - Scrap
  - Coke products
  - Coking plant by-products
  - Blast furnace slag
  - Iron oxide
  - Zink dross
  - Copper
Recycling in SSAB/Merox level

Steel recycling

SSAB

All internal recycling

Merox
Recycling in overall level

Outside → Inside

Internally

Inside → Outside
Recycling (Raahe)

- Coking plant
- Lime kilns
- BFs
- Desulphurisation
- Converters
- Rolling mills
- Component factory
- Power plant
- Other sites in Finland
- Other materials
- Recycled steel
- LD slag, steel scrap
- Steel works earth works

CASE 2
- Briquetting

- Coal tar, benzene, sulphur, coke products
- Coke breeze, coke dust
- Mill scale
- Mill dust
- BF slag
- BF gas
- BF dusts
- Des. slag
- LD slag

Iron oxide, Zn dross, Demolition scrap, scrapped rolls

MEROX
Shutdown of Sintering plant in Dec 2011
Startup Briquetting plant in March 2012
Quality Factors of Briquettes

- Raw materials
  - grain size distribution
  - properties
  - composition

- Mixer & Machine
  - Mixing times
  - Press force and vibration frequency etc.

- Cement
  - quality
  - amount

- Moisture
  - setting of concrete
  - compaction

- Strength of Briquette
  - after 28 hours
  - after a month
  - Strength in BF shaft
The raw materials of cold bonded briquettes

- Coke dusts: 4%
- BF dust from cast and bunker houses: 4%
- Pellet fines: 16%
- Steel scrap: 7%
- Mill scale: 20%
- Pre-mix (BF flue dust and steel scrap): 21%
- Briquette fines: 11%
- Binder: 11%
- Iron scrap: 7%
- Slag cement: 4%
- Portland cement: 7%
The main component of briquettes

Iron

Lime

Coal

Wt. %

Fe  CaO  C  SiO2  Al2O3  MgO  Mn  S

Iron  Lime  Coal
### VIU: Briquettes to BF

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Unit</th>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fe</strong></td>
<td>Fe in Briquette</td>
<td>% Fe</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>C content</td>
<td>%</td>
<td></td>
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<tr>
<td></td>
<td>Metallic Fe of total Fe</td>
<td>%</td>
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<tr>
<td></td>
<td>Value Fe</td>
<td></td>
<td>SEK/tn</td>
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<tr>
<td></td>
<td>Saved coa/coke due to Metallic Fe</td>
<td>t Ctl Fe</td>
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<td></td>
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<tr>
<td></td>
<td>Saved coa/coke</td>
<td>kg/t Briquette</td>
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</tr>
<tr>
<td></td>
<td>Saved coa/coke</td>
<td></td>
<td>SEK/t Briquette</td>
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<tr>
<td><strong>Intrinsic value Fe ttn briquette</strong></td>
<td></td>
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<td>SEK/tn</td>
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<tr>
<td><strong>CaO</strong></td>
<td>CaO in Briquette</td>
<td>% CaO</td>
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<td></td>
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<td></td>
<td>Value CaO/t Briquette</td>
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<td>SEK/t</td>
<td></td>
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<td></td>
<td>Saved coa/coke due to CaO instead of CaCO₃</td>
<td>kg/t Briquette</td>
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<td>Saved coa/coke</td>
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<td>SEK/t Briquette</td>
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<tr>
<td><strong>Intrinsic value CaO ttn briquette</strong></td>
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<td>SEK/tn</td>
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<tr>
<td><strong>Manganese</strong></td>
<td>Analysis</td>
<td>% Mn</td>
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<td></td>
<td>Value Mn</td>
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<td>SEK/t</td>
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<td><strong>CO₂</strong></td>
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<td>kg/t Briquettes</td>
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<tr>
<td><strong>Saved cost for less CO₂ emission</strong></td>
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<td>SEK/t</td>
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<tr>
<td><strong>Landfill</strong></td>
<td>Cost for landfill</td>
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<td>SEK/t</td>
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<td>Cost avoidance for cost of landfill</td>
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<td>SEK/t</td>
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Ways of recycling

CASE 3
• Scrap

Outside → Inside

Internally

Inside → Outside
Scrap terminal

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<tr>
<th>L14</th>
<th>L13</th>
<th>L12</th>
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<td>df-roostu</td>
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<td>skalli</td>
<td>ostokuvi</td>
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![Image of scrap terminal](image1.jpg)

![Image of scrap terminal](image2.jpg)

![Image of scrap terminal](image3.jpg)
Slag derived scrap

- Steel scrap 30-150 mm for converters
- Pig iron scrap for BF
- Pig iron scrap for sales
Edge cuttings ➔ cooling scrap
Home scrap
External scrap
VIU: Slag scrap to converters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
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<td>Market value purchased scrap</td>
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<tr>
<td>Market value purchased scrap</td>
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</tr>
<tr>
<td>Replacement purchased scrap</td>
<td>EUR/tn</td>
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<tr>
<td>Value loss due to internal handling (slag scrap)</td>
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<tr>
<td>Quality</td>
<td>EUR/tn</td>
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<tr>
<td>Yield</td>
<td>EUR/tn</td>
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<tr>
<td>Production cost</td>
<td>EUR/tn</td>
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<tr>
<td>Transportation</td>
<td>EUR/tn</td>
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<tr>
<td>Total value</td>
<td></td>
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<tr>
<td>Total value of own slag scrap EUR/tn</td>
<td>EUR/tn</td>
</tr>
<tr>
<td>Used amounts</td>
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</tr>
<tr>
<td>Used amount of own scrap</td>
<td>tnn/month</td>
</tr>
<tr>
<td>Total value</td>
<td></td>
</tr>
<tr>
<td>Total value EUR/month</td>
<td>EUR/ month</td>
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</tbody>
</table>
Something to think...

SHOULD WE FOCUS MORE ON DECREASING CIRCULAR ECONOMY?
Slag volume in SSAB Raahe BFs, 1964 – 2014

kg/t hm

140 160 180 200 220 240 260 280 300 320 340 360 380


800 000 t/a

460 000 t/a
Thank You!

marko.makikyro@ssab.com