Post-consumer steel scrap
Technical developments and economic feasibility
Resources & Recycling
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Resources & Recycling at Delft

Mission

Create innovations in recycling that add value from all perspectives: social, environmental and industrial-economic
Steel scrap from IBA
High contamination levels > low/variable price

Double gain from cleaning: sales of Cu and increased value of steel
Environmental gain recycle steel

CO$_2$-emission

Recovering fine & midsized steel from 1 ton of IBA saves 30-50 kg of CO$_2$-emission
Steel scrap upgrading

CSM technology

*Installation at Sluiskil, the Netherlands (Resteel, 50 t/h)
# Steel scrap upgrading

## Flows and contaminants

<table>
<thead>
<tr>
<th>Type of steel scrap</th>
<th>EU production [Mt/y]</th>
<th>Typical capacities* [t/h]</th>
<th>Typical contaminants/levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEEE</td>
<td>2</td>
<td>1-5</td>
<td>2.3% Cu</td>
</tr>
<tr>
<td>IBA</td>
<td>1</td>
<td>2-20</td>
<td>0.7% Cu, 1% batteries, Phosphor, 0.1% S, 10% sand/rust, 0.2% coarse stone, 0.1% cloth/plastic</td>
</tr>
<tr>
<td>ELV</td>
<td>8-11</td>
<td>30-200</td>
<td>0,7% Cu, rubber, stainless, cast Al</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11-14</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Input steel scrap for hand sorting operations
Steel scrap upgrading
Hand picking of Cu-parts: statistics & costs

At 18 t/h of IBA scrap, six hand-pickers recover max. 50 mass% of the copper contaminants, at a (hand-picking) cost of about 6 €/t of IBA scrap
Steel scrap upgrading

Principle of CSM technology

\[ F_{\text{magnet}} = \frac{V}{D_z} H_z \left| \frac{\partial B_z}{\partial x} \right| \]

\( D_z \): Demagnetizing factor

Shape & orientation-sensitive field
Principle of CSM
Relation shape & orientation and D-factor

Demagnetizing factor

- bar
- sheet
- granular
- critical D

Upgrading post-consumer steel scrap
Principle of CSM
Distribution of D-factor for IBA steel scrap

Cumulative mass
Demagnetizing factor

Clean steel
Copper containing parts
Steel scrap upgrading
Example parts ending up in two products of CSM

Near product
Flat & bar-shaped steel

Far product
Ball-shaped steel, Cu-parts, batteries, rock, cloth
Beverwijk, the Netherlands

Upgrading post-consumer steel scrap
Flowchart IBA scrap plant
IBA Steel scrap upgrading
Beverwijk, the Netherlands

- Handpicking: 3.5 t/h
- 2 t/h Cu-parts
- 6 t/h sand/dirt
- 42 t/h clean steel

50 t/h input

CSM plant
IBA Steel scrap upgrading
Economics 50 t/h (investment CSM plant 1.6 M€);

Extra product revenue per ton IBA: 3.1 €

60 kg Ferrous 15-300 mm 0.035 €/kg 2.1 €
2 kg copper-containing parts 0.7 €/kg 1.4 €
8 kg sand/dirt -0.05 €/kg -0.4 €

CSM plant processing cost per ton IBA* -0.5 €

Net profit per ton IBA 2.6 €

*based on 80 kton/a of IBA scrap
Thank You