Recycling of Incinerator Bottom Ash

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
Recycling of IBA

Key issues

• Identifying metal and mineral value in IBA
• Innovative technologies for recovery
• Applications for products from IBA
Non-ferrous metal value
Non-ferrous metals in IBA in kg/dry ton after Fe-separation

Aluminium

Heavy non-ferrous

Not recovered Recovered by standard technology (NL 2011)
Fine non-ferrous metals
Fraction -6 mm from ECS
Fine non-ferrous metals

Analysis

- Fine aluminium has low smelt recovery (50%)
  - Mainly low-alloyed (wrought Al)
- Complex but valuable heavy non-ferrous:
  - 60-70% copper
  - 20-25% zinc
  - 5-10% lead
  - Traces of dozens of other metals
Environmental gain fine metal recovery
Depletion and CO$_2$-emission

<table>
<thead>
<tr>
<th>Non-ferrous scrap</th>
<th>kg/ ton of ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>6</td>
</tr>
<tr>
<td>Copper</td>
<td>1.5</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.3</td>
</tr>
<tr>
<td>Lead</td>
<td>0.2</td>
</tr>
<tr>
<td>Silver</td>
<td>0.006</td>
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</tbody>
</table>

Recovered fine non-ferrous metals from 1 ton of IBA saves 40 kg of CO$_2$-emission (EU emission pro capita: 7.5 t/y)

Fraunhofer Institute
Use of minerals in concrete/cement
Use of minerals in concrete/cement
30% replacement by IBA minerals increases FTS

Concrete tiles

Min. Flexural tensile strength (KIWA)
Use of minerals in concrete/cement

Environmental gain: LCA
Innovative technologies for IBA

Overview

- Deep metal recovery (ADR, Wet, Martin process)
- Steel scrap upgrading
- Cement from IBA minerals
- Concrete from IBA minerals
Aging
Reducing free moisture content

- Increased heavy non-ferrous metal recovery (+6 mm)
- Low cost treatment if space is available
- Storage needed for 6-12 weeks of production
- Ca 6 kg Al/ton of IBA is consumed
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Wet process

Socio-environmental versus industrial-economic

AEB, NL

- Clean mineral > 80%
- High NF recovery
- No dust
- Process costs > 16 €/t
- Water treatment
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Earnings, jobs and innovation (EEA)

EU Recycled materials value: 12% of total use

Plastic, Concrete and Glass are underperforming in terms of recycling

ADR Technology
ADR
Dry removal of fines from the IBA in a jet stream

- Low cost compared to washing (2.5 €/ton of IBA)
- No aging required: no storage/no degradation of Al
- High recovery of non-ferrous metals in downstream ECS operation (down to 1-2 mm particle size)
- Simple/robust process (max. input 120 ton/h)
Why remove fines?
Moist materials cannot be processed at mm-size

- Moist fines act as a glue on entire 0-16 mm fraction
- Classification of 0-16 mm is problematic at typical free moisture levels (5-10%)
- Removal of 0-0.5 mm and associated moisture greatly improves workability

<table>
<thead>
<tr>
<th>Opening size [mm]</th>
<th>Limiting free moisture</th>
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<tbody>
<tr>
<td>1.0</td>
<td>0%</td>
</tr>
<tr>
<td>2.5</td>
<td>1%</td>
</tr>
<tr>
<td>5.0</td>
<td>2%</td>
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<tr>
<td>10</td>
<td>4%</td>
</tr>
<tr>
<td>20</td>
<td>6%</td>
</tr>
<tr>
<td>&gt;25</td>
<td>No limit</td>
</tr>
</tbody>
</table>

SME Mineral processing Handbook
ADR
Principle of ADR technology

0-16 mm

ADR

1-16 mm

0-1 mm
ADR
Cumulative size distribution of feed and products
ADR

Economics: example

Extra non-ferrous product per ton IBA: 11.0 €

6 kg Aluminium 1-12 mm 0.5 €/kg 3.0 €
2 kg Heavy non-ferrous 1-12 mm 4 €/kg 8.0 €

ADR cost per ton IBA -2.5 €

Net profit per ton IBA 8.5 €
Thank You