Large-scale Metal Recovery out of Dry Bottom Ash

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Nottwil, Switzerland

04 March 2016 | Dr. René Müller, ZAV Recycling AG
Outline

1. A Strategic Opportunity: Thermo-Recycling
2. Dry Bottom Ash Processing at ZAV Recycling, Hinwil
3. Products and Quality
4. A Paradigm Shift in Waste Management
1. A Strategic Opportunity: Thermo-Recycling
energy generation (incineration process) + material separation

- Electricity
- Process heating
- District heating

recovery of raw materials = „urban mining“

Fly Ash:
- Metals (e.g. Zn)
- Residuals = landfill

Bottom Ash:
- Ferrous metals
- Non-ferrous metals (Al, Cu, …)
- Minerals: today = landfill
- tomorrow = building material?
The new approach in incineration technology

Wet discharge of bottom ash prevents access to small particles (< 5 mm)

Only dry discharge of bottom ash allows efficient access to small particles (< 5 mm)
Dry bottom ash extraction is the key to...

... Higher Energy Yield

... Improved bottom ash quality: low TOC (total organic carbon) content; no cementation / no hardening

... Applicability of efficient separation processes for metals and minerals, with
- increased recovery rate for all metals (>95%)*
- high yields for recovery of non-ferrous metals Al, Cu, Ag, Au, Pd, ... (>95%)*
- recovery of smallest metal particles >0.2 mm
- recovered metals becoming quality products (high purity, low cross contamination of metals and minerals)
- high quality of residual bottom ash (low metal concentrations), opening up new alternatives to landfilling

*) Sum of metals (metallic state) in untreated dry bottom ash = 100%
The difference is obvious

Wet bottom ash

Dry bottom ash
2. Dry Bottom Ash Processing at ZAV Recycling, Hinwil
The new reality in bottom ash processing

Dry Bottom Ash Treatment Plant in Hinwil, Switzerland, located adjacent to «Kehrichtverwertung Zürcher Oberland KEZO»

Operational since Nov 2015

Designed to treat 200'000 t BA / y (approx. 1/3 of Switzerland's production)

Owned by Municipal Waste Incineration Plants of the Canton Zurich
Flowsheet (simplified)

Dry Extracted Bottom Ash

Magnet

Classification

80 mm

30 mm

8 mm

Bottom Ash >80 mm

Crusher

Bottom Ash 30 – 80 mm

Crusher

Bottom Ash 8 – 30 mm

Crusher

Bottom Ash 1.5 – 8 mm

Bottom Ash 0.2 – 1.5 mm

Metals

Minerals
## Technologies applied

<table>
<thead>
<tr>
<th>Technology</th>
<th>Resulting Products</th>
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<tbody>
<tr>
<td>Magnets</td>
<td>Iron scrap (magnetic material)</td>
</tr>
<tr>
<td>Stainless Steel Sorting-machines</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Glass Sorting Machine</td>
<td>Glass (8-30mm)</td>
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<tr>
<td>Eddy Current Separators</td>
<td>Non-Ferrous (NF) Metals</td>
</tr>
<tr>
<td>Separation Tables</td>
<td>NF - light: Aluminium</td>
</tr>
<tr>
<td></td>
<td>NF - heavy: Mixture of Cu, Pb, Sn, Zn, Ag, Au, Pd, ...</td>
</tr>
<tr>
<td>Crusher / Sieves</td>
<td>Disintegration of Bottom Ash Chunks &gt;8mm to separate</td>
</tr>
<tr>
<td></td>
<td>enclosed metal particles</td>
</tr>
<tr>
<td></td>
<td>Classification for optimal metal recovery processing</td>
</tr>
</tbody>
</table>
Dust free Operation!

Transfer of dry bottom ash into special containers (at incineration plant)
Fully automated container storage and handling

Unloading of the containers to start bottom ash processing
Removal and processing of iron scrap

- Magnet
- Followed by mechanical removal of residual minerals
- Sorting out of impurities (e.g. coils)
Classification (sieving)

Transfer of bottom ash by closed conveyor belts to the sieves:

Classification in 3 categories:

- 30 – 80 mm (green)
- 8 – 30 mm (yellow)
- 0.2 – 8 mm (orange)

>80 mm:
manual sorting → crusher → back to start position

<0.2mm:
transfer to residual BA silo
Material recovery equipment (1)

- Glass Separator
- Eddy Current Separator
- Crusher
Material recovery equipment (2)

Separation Tables

Product Silos

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Residual bottom ash

Grain Size <8mm

First humidification of residual bottom ash during truck loading process (to avoid dust emissions)

Today: Landfill of the residual bottom ash in a separate compartment ➔ evaluation of long-term behaviour

Tomorrow: Further processing of residual BA to be used in building materials sector (currently under development)
3. Products and Quality
Quality: e.g. Non-Ferrous Metals

Aluminium > 0.2 mm

NF-heavy > 0.2 mm
Production Quantities (estimation)

Expected Production Quantities (based on 100’000 t dry bottom ash input)

<table>
<thead>
<tr>
<th>Material</th>
<th>[t]</th>
</tr>
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<tbody>
<tr>
<td>Fe &gt; 8mm</td>
<td>9'000</td>
</tr>
<tr>
<td>Fe &lt; 8mm</td>
<td>2'000</td>
</tr>
<tr>
<td>Cu Coils</td>
<td>200</td>
</tr>
<tr>
<td>Stainless Steel &gt; 8mm</td>
<td>250</td>
</tr>
<tr>
<td>Non-Ferrous &gt; 8mm</td>
<td>2'000</td>
</tr>
<tr>
<td>Glass (8-30 mm)</td>
<td>2'000</td>
</tr>
<tr>
<td>Al (1.6 - 8 mm)</td>
<td>1'000</td>
</tr>
<tr>
<td>Al (0.2 - 1.6 mm)</td>
<td>100</td>
</tr>
<tr>
<td>NF heavy (1.6 - 8 mm)</td>
<td>400</td>
</tr>
<tr>
<td>NF heavy (0.2 - 1.6 mm)</td>
<td>50</td>
</tr>
</tbody>
</table>

~50% Sales Volume

~50% Sales Volume
4. A Paradigm Shift in Waste Management
The impact of Thermo-Recycling

Thermo-Recycling opens most effective and efficient ways to keep resources in the loop. This opens new perspectives in waste management:

1) Waste incineration becomes the core element of high-efficient recycling.

2) Using dry bottom ash processing, metals can be recovered with outstanding yields. With its new plant, ZAV Recycling is setting new standards in
   - processing technologies,
   - product quality,
   - environmental protection,
   - occupational health and safety (no dust).

3) Eventually, landfilling shall mostly be avoided by reusing today’s mineralic residues as building materials.
A paradigm shift

New waste management = “urban mining“:

Our civilisation’s residues are the source of energy and materials

Thermo-Recycling goes far beyond energy production –

it’s about preserving our civilisation’s resources!
Thank you for your attention!