Environment

Recycling of WTE Ash for the Recovery of Ferrous, Non-Ferrous and Precious Metals

- RecuLAB™ NF for matured Ash
- RecuLAB™ Au for fresh Ash
Agenda

- RecuLAB™ NF: Recycling of matured IBA
- RecuLAB™ Au: Recycling of fresh IBA
Characterization of WTE ash

- After waste is incinerated in a municipal solid waste (MSW) incinerator, 20 – 25% of the incinerated waste volume remains as gravel-like incinerator bottom ash (IBA)
- Major oxides (Al, Fe, Si, Ca) found in bottom ash sum up to about 45 – 55%. The glass and ceramic-like ash typically contains about 10% - 15% of ferrous and non-ferrous lumpy metals > 1mm
- The dominant part of the heavy metal and salt contamination can be found in the IBA particles sized < 1/12 "
- Grading of IBA typically shows that 25% of the particles are < 2 mm and 95% < 50 mm
- Particle and bulk density of IBA is typically 50 – 90% of natural gravel aggregates
- After storing and weathering, IBA can be processed in a repeatable manner to standardize the material and remove contaminants and recover valuables
- IBA can be used as an artificial aggregate in various application
State of the art in matured IBA recycling

- Typically, the treatment of matured IBA is performed offside the premises of a WTE plant.
- Traditionally, the recycling processes for matured IBA is based on crushing and fractioning to allow for the usage of magnet and eddy-current systems for the recovery of ferrous and non-ferrous metals.
- Since 2007, sensor-based sorting devices allow the recovery of alloyed steels and encapsulated metals, enabling another value creation.
- Today, applying latest fractioning systems, a modern IBA recycling system can recover metal particles > 1 mm.
- The LAB Geodur RecuLab™ NF process for the treatment of matured IBA comprehends leading edge, best available technologies for the treatment of such IBA materials.
- Sales revenues for non-ferrous metals are in Europe in a range of 25.- - 30.- € / to fresh IBA.
RecuLAB™ NF process focus

Metal recovery focus
- **Quantity**: Increased efficiency on recovery rate (>99%) and recovery bandwidth (> 1 mm)
- **Quality**: Sorting effectiveness and pureness of metals (all metals, even bound in mineral matrix)

Landfill focus
- **Volume reduction**: Sustainability and protection of landfill space (up to 100% re-use)
- **Contamination**: Reduction of chemical load in landfill (by up to 100%)

Construction material focus
- **Chemical**: Reduction of oxidation, carbonization, gas building and leaching
- **Physical**: Creation of visually attractive secondary construction material within defined construction material specifications
RecuLAB™ NF process flow

Removal of contamination, recovery of metals and proper grading

IBA maturing

Screening

Ferrous / non-ferrous scrap metal removal

-> Ferrous scrap metal

-> NF scrap metal

-> Bulky waste material

Ferrous metal removal fine

Oversized / unburnt material removal

Crushing

Sorter

Ferrous metal fine <-

Ferrous metal removal fine

Light waste material <-

Wind shifting / screening

Ferrous minerals removal

Ferrous minerals fine <-

NF metal coarse <-

NF metal mid <-

NF metal fine <-

Non-ferrous metal removal mid-fraction

Minerals fine <-

Minerals mid
Advantages of RecuLAB™ NF process

- Maximum metal recovery > 1 mm (matured ash)
  - Maximum value creation
  - Minimum leachate of residual minerals
  - Direct commercialization by LAB Geodur

- Minimum crushing of minerals
  - Maximum re-use potential as alternative construction material
  - Minimum dust building
  - Minimum wear

- Successful implementation in different ash treatment sites
Impressions of RecuLAB™ NF treatment site
Impressions of RecuLAB™ NF mobile treatment site
Cornerstones of RecuLAB™ NF business model

- Base model: BOO / JV; 10 years +5 years terms
- Minimum ash volume: > 50,000 t / a per site
- Operations
  - Staff: 6-8 FTEs per shift
  - Power: 200 – 250 kW (base: 50 t/h per shift module)
  - IBA disposal cost: unchanged

- WTE plant owner typically manages ash supply to RecuLAB™ NF system; operations and financing cost to be shared – as per business model (open book)

- LAB Geodur takes care of metals and minerals trading; metal revenues to be shared – as per business model (open book)
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<th>Role</th>
<th>WTE plant</th>
<th>LAB Geodur</th>
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<td>Duration</td>
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Agenda

- RecuLAB™ NF: Recycling of matured IBA
- RecuLAB™ Au: Recycling of fresh IBA
RecuLAB™ Au for treatment of fresh IBA

- Fresh, wet discharged IBA can not be treated easily:
  - High moisture content and large mount of adhesive fine particles hinders an effective recovery of metals and produces recovered metals with high mineral contamination
  - Non-continuous infeed (intermitted quenching process) produces complicated, irregular working conditions for metal recovery equipment
  - Space availability on WTE plant premises is typically limited

- BUT, if the precious and non-ferrous metals in the fraction < 2 mm could be recovered, the revenue potential from non-ferrous metals in fresh IBA could be increased by another 25 – 50%

=> RecuLAB™ Au: LAB Geodur fine ash recycling module for wet discharge systems
RecuLAB™ Au for wet discharged IBA

Out of 100,000 to of fresh IBA, the following volumes of non-ferrous and precious metals can be recovered in the fraction < 2 mm

- Au: 25 – 40 kg
- Ag: 550 – 650 kg
- Cu: 140 – 180 to
- Zn: 120 – 200 to
- Other precious metals (Pt, Pd, Cr, Ni, Mo, …)

RecuLAB™ Au cornerstones

- ONLINE, ONSITE, WET pre-treatment of wet discharged, fresh IBA, special processing technologies for the fraction < 2 mm;
- Modular concept, e.g. easy integration into existing IBA recycling site, unchanged use of installed IBA recycling technologies for treatment of fraction > 2 mm (optionally updating);
- Small footprint for infeed / outfeed storage through timely processing of IBA;
- Massively reduced dust emissions, also for subsequent conventional treatment of fraction < 2 mm;
- No additional residues expected, closed-loop process water management;
- Improved metal quality in all fractions resulting in higher sales revenues;
- Increase metal recovery rates in fraction > 2 mm as better working conditions for eddy-current systems;
- Further re-use of treated mineral fractions as secondary construction materials if possible
RecuLAB™ Au main modules

- Infeed
- Concentration
- Fractioning
- Water treatment
RecuLAB™ Au integrated into RecuLAB™ NF

WTE plant as is

- Wet discharger

Pre-treatment module (onsite, near quencher)

- Fines separator and NF / precious metals agglomerator

RecuLAB™ NF

IBA treatment module > 2 mm (onsite or offsite)

- Hand picking
- Ferrous scrap
- NF scrap
- Stainless scrap
- NF metals fine
- NF metals medium
- NF metals coarse
- Stainless medium
- Ferrous medium

Concentrator module (centralized, onsite or offsite)

- Metal concentrator
- NF and precious metals very fine
Contamination per ash particle size (I/II)
Contamination per ash particle size (II/II)

- Cr [ppm]
  - Coarse Mineralic 8-100mm
  - Fine Nonmagnetic Mineralic <2mm
  - Fine Magnetic Mineralic 4-8mm
  - Fine Magnetic Mineralic 2-4mm

- Zn [ppm]
  - Coarse Mineralic 8-100mm
  - Fine Nonmagnetic Mineralic <2mm
  - Fine Magnetic Mineralic 4-8mm
  - Fine Magnetic Mineralic 2-4mm

- Sb [ppm]
  - Coarse Mineralic 8-100mm
  - Fine Nonmagnetic Mineralic <2mm
  - Fine Magnetic Mineralic 4-8mm
  - Fine Magnetic Mineralic 2-4mm

- Pb [ppm]
  - Coarse Mineralic 8-100mm
  - Fine Nonmagnetic Mineralic <2mm
  - Fine Magnetic Mineralic 4-8mm
  - Fine Magnetic Mineralic 2-4mm

17/04/2015 LAB Geodur Re-use of ash minerals
Major oxides per ash particle size

![Graphs showing major oxides per ash particle size for different particle sizes and mineral classes.](image-url)
Contamination of washed ash (I/II)
Contamination of washed ash (II/II)
Contamination of washing water

- Pure IBA
- Combined ash
RecuLAB™ Au synergy effects for WTE plant

- **Operations:**
  - Regular operation of WTE plant not disturbed
  - Operation with existing operations team
  - Improved working conditions through dust reduction and simplified processing
  - Omission of ash storage for maturation, with this reduced footprint requirements for IBA treatment

- **Investments:**
  - Abandonment for retrofitting in aspiration and dedusting systems
  - E.g. Leasing or JV model for RecuLAB™ Au treatment module
  - Updating of modern metal recovery systems for ash fraction > 2 mm

- **Revenues:**
  - Increased recovery volumes and qualities of existing ash treatment facility
  - Higher metals sales revenues for NF fractions
Cornerstones of business model

- Leasing model  
  First down payment e.g. 50%, constant monthly leasing rates, 10 years term
- IBA to be processed > 50,000 t/a
- Recoverable metal concentrate < 2 mm ca. 0.4%
- Sales revenues for metal concentrate ca. 3’000.- €/t
- Operations cost: 
  - Staff: existing
  - Power: 56 kW (50 t/h module)
  - Water: closed loop + 0.5 m³/h
  - Repair and wear: 1% of first down payment
  - IBA disposal cost: unchanged

- WTE plant owner operates fine IBA treatment system with existing staff, coverage of operations, financing cost etc.

- 85% of metal concentrate sales revenues for WTE plant owner, 15% for LAB Geodur as handling fee for commercialization of metal concentrates (open book)

- Operation of fine IBA treatment system remotely supervised by LAB Geodur
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## Timing for RecuLAB™ Au and NF modules

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- Decision of WTE plant
- Contract signing / ordering
- Permitting
- Preparation, adaptation
- Installation, training
- Commissioning, operation
Contact information

LAB Geodur Zug
Riedstrasse 13
CH-6330 Cham / Switzerland

Telephone: +41 41 766 88 16

E-Mail: r.weippert@geodur.ch