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

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

- RecuLAB™ NF: Recycling of landfilled ash
- RecuLAB™ Au: Recycling of fresh ash
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 bottom ash.
- 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.
- In USA, air pollution control (APC) residues are jointly discharged with the bottom ash (combined ash).
- The dominant part of the heavy metal and salt contamination can be found in the combined ash particles sized < 1/12”.
- Grading of combined ash typically shows that 25% of the ash is < 1/12”, 95% < 2”.
- Particle and bulk density of ash is typically 50 – 90% of natural gravel aggregates.
- After storing and weathering, the ash can be processed in a repeatable manner to standardize the material and remove contaminants.
- Ash can be used as an artificial aggregate in various applications.
State of the art in matured / landfilled ash recycling

- Typically, the treatment of matured / landfilled ash is performed offside the premises of a WTE plant
- Traditionally, the recycling processes for matured / landfilled ash is based on crushing and fractioning a suitable infeed 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 ash recycling systems can recover metal particles > 1 mm
- The LAB Geodur RecuLab™ NF process for the treatment of matured / landfilled ash comprehends leading edge, best available technologies for the treatment of such ash material
- Sales revenues for non-ferrous metals are in USA in a range of 25.- - 30.- USD / to fresh ash
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

- Ash maturing
  - Screen
    - Ferrous / non-ferrous scrap metal removal
      - Oversized / unburnt material removal
      - Crushing
        - Sorter
          - Minerals mid

- Ferrous metal fine <-
  - Ferrous metal removal fine

- Light waste material <-
  - Wind shifting / screening
    - Ferrous minerals removal
      - Non-ferrous metal removal mid-fraction
      - Oversized / unburnt material removal
        - Crushing
          - Sorter
            - Minerals mid

- Ferrous minerals fine <-
  - Non-ferrous metal removal mid-fraction
    - Oversized / unburnt material removal
      - Crushing
        - Sorter
          - Minerals mid

- NF metal coarse <-
  - NF metal mid <-
  - NF metal fine <-

- Minerals fine <-
  - Ferrous scrap metal
    - NF scrap metal
      - Bulky waste material
Advantages of RecuLAB™ NF process

- Maximum metal recovery > 1 mm (matured or landfilled 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
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 and ash dispatch after treatment; operations and financing cost to be shared – as per business model (open book)

- LAB Geodur takes care of metals trading; metal revenues to be shared – as per business model (open book)
## RecuLAB™ NF roles and responsibilities

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<th>WTE plant</th>
<th>LAB Geodur</th>
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Agenda

- RecuLAB™ NF: Recycling of landfilled ash
- RecuLAB™ Au: Recycling of fresh ash
RecuLAB™ Au for treatment of fresh ash

- Fresh, wet discharged ash 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 < 1/12 "could be recovered, the revenue potential from non-ferrous metals in fresh ash could be increased by another 25 – 50%"

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

- Out of 100,000 tons of fresh ash, the following volumes of non-ferrous and precious metals can be recovered in the fraction < 1/12 "
  - 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 ash, special processing technologies for the fraction < 1/12 “;
- Modular concept, e.g. easy integration into existing ash recycling site, unchanged use of installed ash recycling technologies for treatment of fraction > 1/12 “ (optionally updating);
- Small footprint for infeed / outfeed storage through timely processing of ash;
- Massively reduced dust emissions, also for subsequent conventional treatment of fraction < 1/12 “;
- 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 > 1/12 “ 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
- Water treatment
- Fractioning
RecuLAB™ Au integrated into RecuLAB™ NF

**WTE plant as is**
- Wet discharger

**Pre-treatment module (onsite, near quencher)**
- 0 – 500 mm
- 0 – 2 mm
- 2 – 100 mm

**Ash treatment module > 2 mm (onsite or offsite)**
- Hand picking
- 100 mm
- Metals:
  - Ferrous scrap
  - NF scrap
  - Stainless scrap
- NF metals:
  - NF metals fine
  - NF metals medium
  - NF metals coarse

**RecuLAB™ NF**
- Concentrator module (centralized, onsite or offsite)
- 100 mm
- NF and precious metals very fine

**RecuLAB™ Au**
- Metal concentrator
- NF and precious metals fine
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 ash 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 > 1/12

- **Revenues:**
  - Increased recovery volumes and qualities of existing ash treatment facility
  - Higher metals sales revenues for NF fractions
# RecuLAB™ Au roles and responsibilities

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Timing for RecuLAB™ Au and NF modules

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