Kanadevia INOVA

Re-sourcing solutions

We recover useful materials from bottom and fly ash

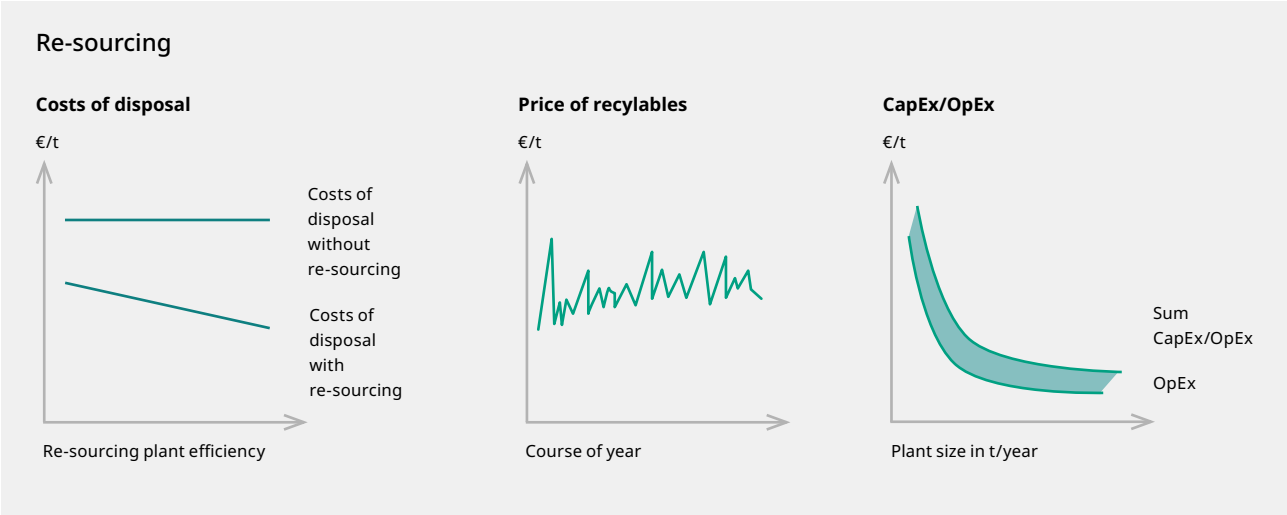
From a waste to a resource economy

The residues from the Waste to Energy incineration process are much more than bottom and fly ash. They contain valuable metals, salts and minerals. We offer our customers innovative processes and technologies to recover these useful materials, enabling our customers to contribute to the circular economy and climate protection through CO_2 savings. The plant can increase profitability by selling recyclables and minimising landfill costs.

Why is urban mining the bottom and fly ash worthwhile?
Recovering recyclable materials from residues is an increasingly relevant part of urban mining for operators of WtE plants. This urban mining has four key benefits:

- Generates additional revenues from the sale of recovered materials such as iron, copper, aluminium, gold, minerals and salts
- Reduces landfill costs by lowering the volume of residue
- Makes a relevant contribution to environmental protection and sustainability. By providing recyclable materials, the operator contributes to the conservation of resources, reductions in CO_2 emissions and the circular economy principle
- Meets the legal requirements governing the recovery of recyclables from waste, which are already mandatory in some countries and regions

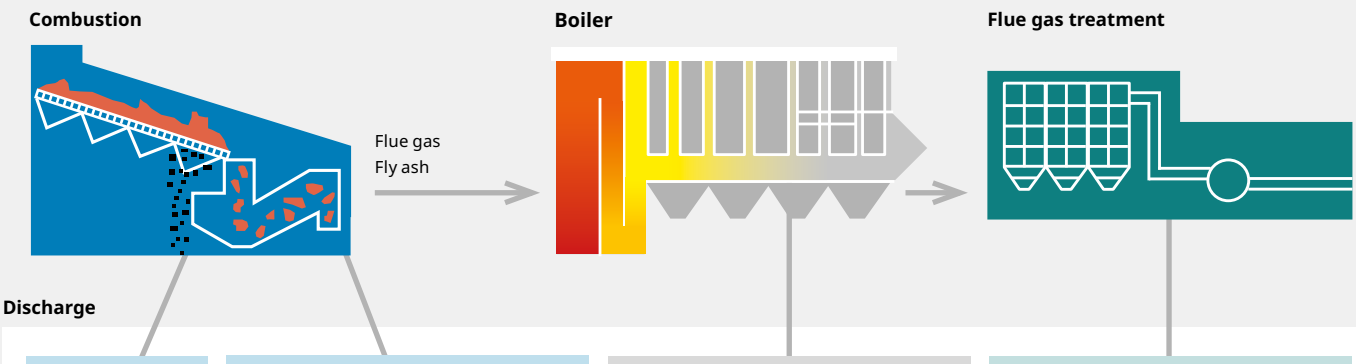
The benefits of urban mining the residues of WtE plants depend on various factors such as the efficiency of the recovery technologies, the cost of



processing the residues and the availability of markets for the recycled materials. Kanadevia Inova offers thorough planning services and technical solutions to maximise the benefits for the plant operator.

If the volumes of residue generated locally are not sufficient for cost-efficient processing, residues from surrounding WtE plants can be processed economically at a centralised processing plant.

Light & precious metal recovery



Discharge

- Bottom ash from grate incineration, part dry discharge
- Bottom ash from grate incineration, can be discharged wet or dry
- Fly ash from empty and convective boiler passes, classified as hazardous waste due to high content of salts (20%) and heavy metals
- Fly ash and contaminated adsorbents from flue gas scrubbing

Treatment

- Grate for Riddlings Fine fraction separation
- Further treatment
- Mechanical treatment of wet bottom ash, with or without maturation
- Mechanical treatment of dry bottom ash
- Acidic fly ash washing [1]
- Neutral fly ash washing
- Evaporation for salt recovery [1, 2]

Output

- Precious metals
- Light nonferrous metals (e.g. aluminium)
- Ferrous metals for recycling
- Aggregates for construction materials

- Heavy metal sludge (zinc, lead, copper, mercury) for further treatment or landfill

- Potassium chloride: fertiliser
- Calcium chloride: dust control/de-icing
- Sodium chloride: industrial processes
- Aqueous ammonia: air pollution control
- Stabilised heavy metals

[1] Acidic fly ash washing can be combined with evaporation for salt recovery
[2] Licence from EasyMining (Ragn-Sells)

Factors in successful urban mining of bottom ash

Basically we offer bottom ash discharge as wet, dry or as a combination. There are pros and cons to each. Combined discharge makes it possible to harness the advantages of both the wet and dry processes. The focus is on ensuring efficient but resource-friendly discharge by first discharging the fine fraction of the bottom ash (particle size of approx. 15 mm) in dry form via the Grate for Riddlings. Around 70% of valuable nonferrous metals, such as copper and aluminium, as well as silver and gold are to be found in the fine fraction. The rest of the bottom ash is discharged using the conventional wet method.

Wet	Dry
+	+
• Widely known technology • No change in existing and known discharge system • Few dust emissions in discharge • Fewer dust emissions during treatment	• Weight reduction reduces landfill, processing and hauling costs • Improved bottom ash quality • High quality of recovered metals • Sorting/separation efficiency • Lower processing costs
–	–
• Poor access to small particles • Difficult bottom ash screening • Low efficiency of treatment • Water consumption/ contamination • More space required	• Enclosed equipment mandatory • Suitable processing technology required

Our dry, wet or combined mechanical treatment system enables the effective recovery of minerals and metals from bottom ash extracted using an aligned treatment solution. These can then be processed further directly and/or recycled as secondary raw materials and materials for use in construction. Compared with purely wet discharge, the combined solution results in less mineral adhesion to fine metal particles. This improves the quality of the fine fraction thanks to greater enrichment of valuable metals, while at the same time reducing operating costs.

Factors in successful urban mining of fly ash

In addition to bottom ash, a modern waste treatment facility produces fly ash and residues from flue gas treatment. These account for 2–3% of the incinerated material. Given the high proportion of salts (more than 20%) and heavy metals it contains, fly ash is classified as hazardous waste and must be disposed of as such. We have been offering fly ash washing systems for several decades. While processes used to focus purely on “stabilising” the hazardous substances, they have been optimised to the extent that metals and salts can now be recycled. The remaining treated residue can then be landfilled as so-called inert material.

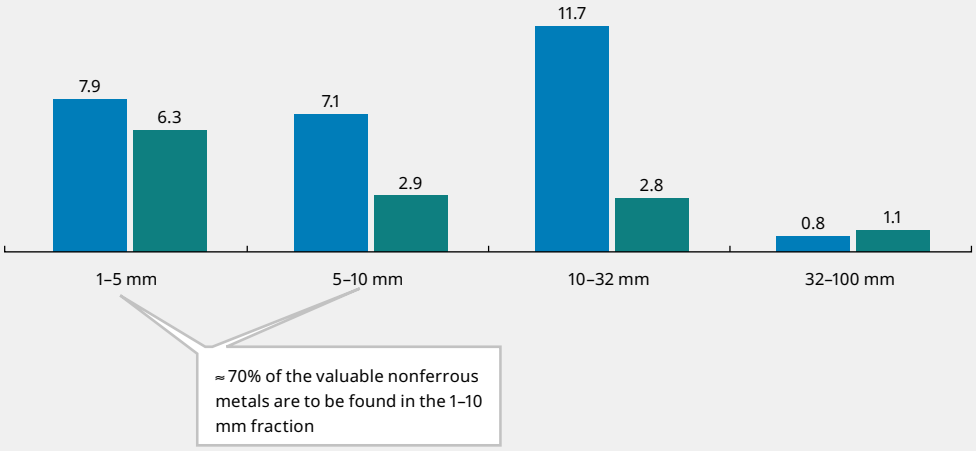
In neutral fly ash washing, the dusts or ashes are washed with water. In the process all soluble salts (mainly chlorides) are washed out and the residual material can be landfilled or reused. This process makes sense, especially if the residues contain only a few heavy metals.

In acidic fly ash washing, the dusts or ashes are washed with a dilute acid. This dissolves all soluble salts and a relevant part of the heavy metals. The heavy metals are precipitated as hydroxide sludge, which can then be fed into the metal recovery process. The Ash2Salt process is the most recent technology for this. It was developed by EasyMining, the innovation arm of Ragn-Sells, and is distributed exclusively by Kanadevia Inova in Europe. This process enables both neutral and acidic fly ash washing to be expanded to a decisive extent.

In both processes, a liquid residue with a high chloride content is produced in addition to the

washed ash. The Ash2Salt process recovers sodium, potassium and calcium chloride from this liquid residue. The process works without generating wastewater needing to be discharged. The salts recovered are of high quality to be used commercially (road deicing in winter, fertiliser industry, etc.).

Distribution of metals in waste treatment plant bottom ash



2.75 wt% LNF (light nonferrous = aluminium)

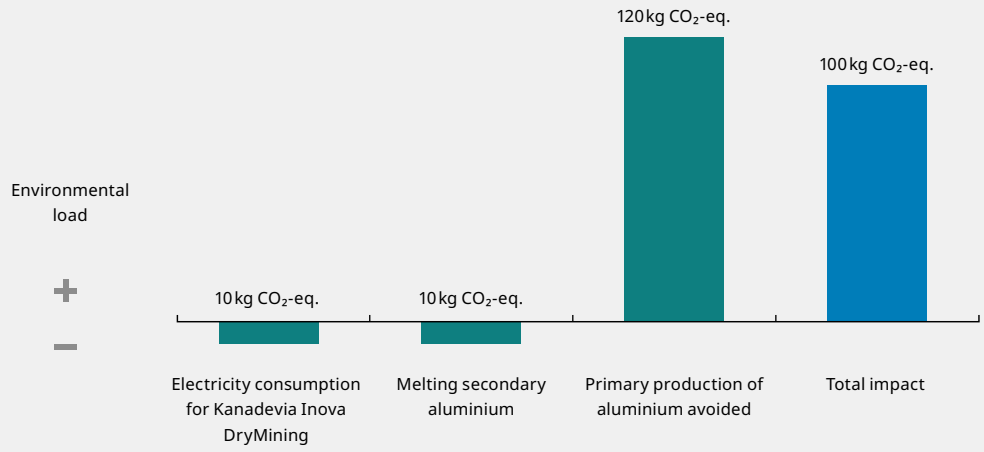
1.00 wt% HNF (heavy nonferrous = Cu, Zn, Pb, Ag, Au, etc.)

Particulate metal content [kg/$t_{bottom\ ash}$]

Quelle: Kanadevia Inova proprietary measurements

Sustainability and lca: focus on aluminium recycling

Simplified carbon footprint in kg of CO_2 equivalents per tonne of dry bottom ash



Base value = 12.8 kg aluminium per tonne of dry bottom ash

Source: proprietary study by Kanadevia Inova Research & Development

Referenzen

Emmenspitz/Zuchwil: grate for riddlings
At the Emmenspitz Waste to Energy (WtE) plant in Zuchwil (line 4), our patented Grate for Riddlings is used in the final grate zone. 30% of the total bottom ash is separated as dry fine fractions before the wet bottom ash extractor. This amounts to almost 4,400 tonnes per year out of a waste throughput of 70,400 tonnes containing a high percentage of precious metals and valuable nonferrous metals. The dry discharge allows a high recovery rate for these metals. The larger grate ash fraction is discharged via the existing wet discharge system.

Högbytorp: dry bottom ash discharge
The plant in southern Sweden processes 246,400 tonnes of municipal waste and biomass per year. When it was commissioned in 2020, Europe's largest dry bottom ash discharge system also went into operation. An airtight conveyor system removes almost 48,000 tonnes of slag from the incineration process each year. The dry discharge process preserves fine fractions in particular, which contain valuable metals.

Poznań: wet bottom ash discharge
The first Waste to Energy (WtE) plant built by Kanadevia Inova in Poland as a turnkey facility converts 210,000 tonnes of waste per year into electricity and heat. The plant produces 57,750 tonnes of bottom ash per year and has bottom ash treatment and fly ash stablisation on site. The wet bottom ash is processed at a treatment capacity of up to 40 tonnes per hour. Various fractions of aggregates as well as most of the ferrous and nonferrous materials in the bottom ash are separated for re-use.

Liberec: fly ash washing

The plant, located in a mixed residential and commercial area, processes 96,000 tonnes of muncipal waste per year from the Liberec region. A unique feature of the plant is an acid fly ash scrubber with a capacity of 2,500 tonnes per year, which removes heavy metals from the boiler and fly ash and allows it to be blended with the bottom ash. The mixture of treated fly ash with bottom ash is used as a bedding layer for roadways, embankments or backfill. The residue remaining after the final wastewater treatment is disposed of in landfills

Högbytorp: Ash2Salt

At the Ash2Salt processing plant in Högbytorp, the air pollutant control residues (APCRs) separated from the flue gas are washed in neutral water. This process produces purified ash and leachate containing mainly chloride salts and heavy metals, whiCh are sent to a second treatment stage. In the second stage, heavy metals are precipitated from the leachate. Calcium chloride, potassium chloride and sodium chloride are then separated by evaporation from the resulting chloride-saturated liquid. The treatment capacity of the plant is 130,000 tonnes per year. In addition to fly ash from Högbytorp WtE plant, fly ash from other waste and biomass incineration plants is also treated.

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