Optimizing precious metals recovery from e-waste

EWAM – Kenya
Joris Lauwers
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Agenda

Electronic products and trends
E-waste recycling chain
End-processing @ Umicore: e-scrap & batteries
Conclusions
Electronic products and trends
E-waste: something to ‘deal’ with

COLLECTION & SORTING

DISMANTLING & SORTING

Printed circuit boards
Batteries
Steel scrap
Cable scrap
Plastic scrap
ALU scrap
CRT, LCD
Others
E-waste: not all of it is the focus of precious metal recovery

Western-EU e-waste collected by tonnage (2013)

Priority for precious metals recovery

- **High**
- **Medium or Low**
- **Very Low or None**

*Source: figures from WEEE-Forum*

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These trends and others are already felt in the recycling industry and impact:

- Volumes & tonnages
- Material composition
- Collection & recyclability

Electronic products are constantly changing. The recycling industry must adapt to keep up.
Impact of miniaturization on e-scrap volumes

Increasing efforts required to get 1 ton of PWBs

<table>
<thead>
<tr>
<th>Equipment weight</th>
<th>Desktop</th>
<th>Notebook</th>
<th>Tablet</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWB weight</td>
<td>1/4</td>
<td>1/2</td>
<td>1/10</td>
</tr>
</tbody>
</table>

1,000 units, 2,000 units, 20,000 units

...to get 1 ton PWBs


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Declining precious metal content

The economics of e-scrap processing are dynamic!

Note: metal content for 2014/2015 not available, gross metal value based on metal contents for 2013 with 2014/2015 prices

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E-waste recycling chain
Recycling chain: system approach is key to avoid precious metal losses

- Consider the entire chain & its interdependencies
- Precious metals dominate economic & environmental value ⇒ minimize PM losses
- Mass flows ≠ flows of precious metals
- Success factors: interface optimisation, specialisation, economies of scale

The total recycling efficiency is determined by the weakest step in the chain
The recycling chain is a funnel

**Typical # participants**
- 1,000’s (local)
- 100’s (local)
- 10’s (partly international)
- ≈ 10 (globally)

**Mainly Local**

**Mainly Global**

**Collection**
- Entire EOL-devices

**Sorting/dismantling/components picking**
- Stripped equipment & components

**Mechanical pre-processing**
- Circuit boards & highly complex materials

**Complex fractions refining**

- Large scale metallurgical & chemical technologies
The **Bo2W approach** combines the strengths of recycling systems in developing countries with those of industrialized countries.

- Local treatment is used whenever appropriate, other fractions are exported to state of the art facilities.
- Sound solutions for **all fractions** from E-waste are developed.
- Creation of **jobs** according to international labour standards.
- Fair and transparent pricing of recycling fractions
**Collection & Pre-processing: Where to focus?**

### Collection
- Assure **organized collection** -> proper manual sorting and dismantling
- Active **involvement** existing **unofficial sector** -> Make use of their available strengths
- Create **legislative framework**: promote/facilitate formal collection & recycling
- ‘No collection, no recycling’

### Pre-processing
- **Maximize use of manual dismantling** and minimize mechanical pre-processing
- More complex/interlinked the material -> less selective mechanical separation & higher precious metals losses
- Offer **Reuse & Recycling** as a complete, integrated service (3 R’s)
- Start-ups: have a good understanding of the applicable **legislation**
- Critically **assess added value** of each step of your process
- And: **Ensure materials reach high quality end-processing!**
End-processing @ Umicore: e-scrap & batteries
End-processing of precious metal containing materials at Umicore

- Innovative technology
- Focus on secondary, PM bearing materials
- Over 200 different feed materials
- Recovering 17 metals: Au, Ag, Pd, Pt, Rh, Ir, Ru, Cu, Pb, Ni, Sn, Bi, Se, Te, Sb, As, In
- Global customer base
- High environmental standards
- Service-based business model
Refining @ UPMR
Our process in a nutshell

Recyclables

Industrial by-products

Collector metals

17 different metals
Umicore can treat most types of precious metal containing components & fractions

**High grade materials** (1-2 t min. lot size)
- printed circuit boards
- cell phone handsets (battery removed)
- IT components (chips, CPU, processors)
- metallic pins
- IT connectors

**Low grade materials** (10 t min. lot size)
- printed circuit boards (after removal of excess Al/steel)
- shredded mixed PWBs / metals / plastics

- High copper materials – coils, wires, electromotors
- Laptops (with screens)
- PWBs with large metallic pieces
- Hard disk drives
- Devices with many cables
- Power cords

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Packaging materials for shipment

- 200 L drums
- Big bags
- Bales
- Gayford boxes

Documentation
- Packing list
- Loose (bulk) shipment
- Different lot compositions
  - 1 lot per truck/container
  - 2 or more lots
  - 1 lot, more shipments
Why work on **assay-based settlement**?

- Sustainable business model
- Feedback on process operation & evolution of materials
- Correct financial settlement with supplier
- Enables selection of optimum processing route for material >> Optimum metals recovery
- Monitoring of operations

*Determinazione of exact composition is key*

*Choosing a reliable end-processor is critical!*
How to conduct a **representative sampling**?

- State-of-the-art facilities and procedures processing ~ 8000 lots (350 000 t) per year
- In-house developed expertise
- ~300 people employed in S&A at UPMR
Recycling batteries
Umicore also treats all types of Li-ion and NiMH batteries

- Capacity: **7000 ton/y**
- Specially designed furnace, **Umicore IP**
- No cell dismantling
- Products
  - Co-Ni-Cu Alloy
  - Slags
Recycling batteries
Feeding equipment / batteries handling

For any size of batteries
- Small electronic appliances
- Industrial batteries
- HEV/EV batteries

For Li-ion and Ni-MH chemistries

No crushing…
- Safe for workers
- Safe for environment
- Cost effective

Specially designed gas treatment
- A unique Umicore design
- No VOC formation
- All dust removal
Packaging end-of-life portable Li-ion batteries

Example of UN approved 200l barrel

Filled up to the lid with sand

Weight%:
Sand ±25%
Batteries ±75%

Volume%:
Sand ±16%
Batteries ±84%

• UN approved barrels (plastic drums or steel drums with plastic bag inside). UN packaging group II

• Use of sand as cushion material to protect from shortcuts and to avoid propagation of fire
“How do I find a good end-processor?”
Refining @ UPMR
Sustainable business

London Good Delivery
(Au, Ag)

LME brand
(Pb)

CE & BENOR certified
(Betozand & Betogrind)

Conflict-free smelter

ISO 9001
ISO 14001

OHSAS 18001
Quality & performance standards
Working to create a level playing field across the chain

EERA/Eurometaux end-processing standard for Cu/PM-bearing materials

- **2010** the four major metal smelters in the EU & N-Am joined with their associations to define requirements
- **2014** finalized and signed
- **2015** Umicore audited and approved

- Offers possibility to be incorporated or used by existing certification schemes focusing on collection, logistics, pre-processing

- **Not** restricted to:
  - Limited group of smelters
  - A particular technology
  - A geographical region
Conclusions
Optimizing precious metal recovery: How to get there

What must be avoided in end-of-life treatment

- Landfill, disposal
- Incineration
- Backyard recycling
- Smelters *without* the appropriate offgas purification.
- “Fake” recycling
  - look further than a nice building, ISO & OHSAS certificates, or a nice website
  - check material streams to the final destination.

Collection and pre-processing

- Avoid precious metal losses in shredding processes
- Assess added value of each process step and leverage complementarity with end-processors
- Standards and certificates are important to ensure sustainable development.
Thank you!

Joris Lauwers

Adolf Greinerstraat 14
2660 Hoboken
Belgium

joris.lauwers@umicore.com
www.preciousmetals.umicore.com

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https://www.youtube.com/watch?v=IPd95D6zsHI