Recycling of Electronic Equipment and Recovery of Precious metals from E-waste in EU and USA

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EU Current legislation regarding WEEE

- Act No. 165/2001 Coll. on Waste (!!!)
- Directive 2000/53/EC about the Restriction of use of certain hazardous substances in electrical and electronic equipment
- Directive 2012/19/EC about WEEE

WEEE negative impact on environment

- heavy metals
- polybrominated biphenyls
- polybrominated diphenyl ethers

What is inside of the mobile phone?
EU WEEE goal
In 2016
- 45% of collection of end of life equipment
- 5.3 kg WEEE/person/country/CZ

Waste management of WEEE in CZ

Processing:
1. Collecting
2. Transport
3. Storage
4. Sorting
5. Dismantling
6. Recycling

Collecting groups:
1. Large domestic appliance
2. Small domestic appliance
3. IT equipment
4. Consumer equipment and solar panels
5. Lightning
6. Electric tools
7. Free-time and sport equipment
8. Medical equipment
9. Monitoring and control equipment
10. COMs

Waste management of WEEE in CZ

<table>
<thead>
<tr>
<th>Collection companies</th>
<th>Collecting groups, agreed to be treated and financed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASEKOL, Ltd.</td>
<td>1, 2, 3, 4, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>Bren, Ltd.</td>
<td>2, 6</td>
</tr>
<tr>
<td>ECOJAMA, Ltd</td>
<td>2, 6</td>
</tr>
<tr>
<td>Zelotvorny, s.r.o.</td>
<td>1, 2, 3, 4, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>COP - recycling, Ltd.</td>
<td>1, 2, 3, 4, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>REMA System, plc.</td>
<td>1, 2, 3, 4, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>RETELA, Ltd.</td>
<td>1, 2, 3, 4, 5, 6, 7, 8, 9, 10 1, 2, 3, 4, 5, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>ZENEX CZ, Ltd.</td>
<td>1, 3, 9</td>
</tr>
</tbody>
</table>

B2B: 1, 2, 3, 4, 6, 7, 8, 9, 10
B2C: 1, 2, 3, 4, 6, 7, 8, 9, 10

Precious metals in e-waste—what are we talking about?

- What are we able to extract from mobile phone?

Heavy metals and precious metals which we are able to recycle in CZ:
- Pb, Ag, Au, Al, Cu, Hg, Zn, Sb

Two examples of Czech precious metals recycling companies
1. Safina Group
   - DIVISION 1: new Plasma Envi-recycling of low grade materials using BAT technologies melting in plasma reactor
   - more than 90% efficiency, cogeneration and microturbine-heating and el. power
   - environmental friendly, less emissions EoL limits
   - end of life catalysts with Ag, Cu, Ni
   - Ni and Li batteries

Two examples of Czech precious metals recycling companies
1. Safina Group
   - DIVISION 2: WEEE recycling
     1. Primary preparation
     2. Homogenization
     3. Subsequent refining of metals (using tried and trusted)
     4. Analysis
     5. Sales
Two examples of Czech precious metals recycling companies

2. Kovohutě Příbram
   - Integrated recycling of waste containing heavy and precious metals
   - DIVISION 1:
     - division of Pb batteries recycling
     - 1977-installation of new blast furnace

DIVISION 2:
- WEEE recycling
  - Mix of precious metals with organic substances
  - Mix of precious metals without organic substances
  - Toys, cables, connectors
  - Films, photopapers
  - PCB, switches, connectors
  - Wires, batteries

Refinement
- PbAgZn foam
- Destilation
- Aggregation
- Melting AgAu alloys
- SALE

And... what happens with the 55% that we do not recycle???

NO COMMENT...
Recycling of Electronic Equipment and Recovery of Precious Metals from E-Waste
In the USA

2014 APWA International Public Works Congress and Exposition, August 17-20, 2014

Ing. Helena Allison PWLF Engineering Manager MLJ-LLC
Davis, California

Illegal waste dumps in the world

- One of such places is an e-waste dump in Ghana. There are health risks associated with these practices. Young children make a living by scavenging waste to reclaim gold, silver, iron, and copper. The amount of time they spend at dumping grounds is dangerous enough; factor in these poisons and chemicals and these habits can become fatal. Further, the U.S. State Department lists Ghana as one of the top sources of cyber crime in the world. Criminals can purchase salvaged hard drives in an open market, and minutes later they have access to the personal and financial information you left behind in discarded devices.

Did you know?

- The recycling of electronics waste is regulated on a state by state basis.
- Currently only 26 states in the USA have regulations in place to increase recycling and divert discarded items from ending up in a landfill or from being incinerated.
Federal rules and regulations

Pending or Proposed U.S. Federal Legislation

- H.R. 2791: Responsible Electronics Recycling Act (RERA) of 2013
  This bill was introduced in the House of Representatives in the 113th Congress on 7/23/13. From the press release announcing the bill’s introduction by Reps. Mike Thompson (CA) and Gene Green (TX), RERA “creates a new section in the Resource Conservation and Recovery Act (RCRA) that prohibits the export of restricted electronic waste from the U.S. to countries that are not members of the Organization of Economic Cooperation and Development (OECD) or the European Union (EU). Restricted electronic equipment refers to any equipment that contains specific toxic materials at levels greater than those deemed non-hazardous by the EPA. In 2008, the Government Accountability Office (GAO) reported that many of the developing nations that receive e-waste from the United States do not have the capacity or facilities to safely recycle and dispose of these used electronics.

- There have been many bills introduced in Congress but many did not make it. H.R. 2284, introduced on 6/22/11 in the 112th Congress, which was also known as the Responsible Electronics Recycling Act. That bill died (i.e. was referred to committee but was not enacted).

- Bill 2791 created a research program at the Department of Energy to help assess the recycling and recovery of Rare Earth Metals from electronics. This provision helps to ensure the proper collection and recycling of precious and strategic metals.

Bills that ensure proper collection and recycling of precious and strategic metals.

- In order to increase the e-waste recycling rate in the U.S., Federal regulation is needed to develop the necessary infrastructure, by setting mandatory recycling targets and establishing financing and enforcement mechanisms for e-waste collection and recycling.

- Currently the smelting and refining industry dominates e-waste recycling. Hydrometallurgical processing is just emerging as a potential domestic solution for treating e-waste. A "green chemistry" technology with selective chemical process is used to recover valuable materials like silver and gold from obsolete wiring boards (Printed Wiring Boards PWB). Non-toxic hydrometallurgical processing recycling method for e-waste may be a safe domestic solution for the U.S.
Cellphone Cycle

- Online Purchasing: 68% from Smart Phones, 32% from Computers
- US population vs. active cellphones: 317.8 M vs. 327.6 M
- Average relationship with a cellphone: 730 days
- Hoarding vs. Recycling: 2 out of 3 Americans hold on to their old device
- $60 M worth of precious metals sent to landfill each year

User Habits
- 80% text messaging
- 50% e-mails
- 31% Health and medical
- 29% Mobile Banking

List of countries by number of mobile phones in use

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Number of Mobile Phones</th>
<th>Population</th>
<th>Evaluation Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>1,227,360,000</td>
<td>1,349,585,838</td>
<td>Dec 2013</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>904,510,000</td>
<td>1,220,800,359</td>
<td>March 2014</td>
</tr>
<tr>
<td>3</td>
<td>United States</td>
<td>327,577,529</td>
<td>317,874,628</td>
<td>April 2014</td>
</tr>
</tbody>
</table>

Russia ranked number 5 and Lithuania ranked number 61 but both have close to double number of phones as population.

So what is in our cell phones?

- It is estimated that one metric ton (1,000 kg) or (2,240 pounds), of used mobile phones (~6,000 handsets) contains:
  - 340 g=0.7496 lbs. of gold
  - 3.5 kg = 7.2 lbs. of silver
  - 140 g = 0.3086 lbs. of palladium
  - 130 kg=0.2866 lbs. of copper

- With the current price of gold, this leads to a combined value of over $29,000 per ton of mobile phone boards. The total market is huge! Globally in 2013 over 1.7 billion cellular handsets were purchased! Of course there are many other categories of e-waste as well.
Additional facts about electronic waste in the United States:

Electronic waste is the fastest growing municipal waste stream. 20 to 50 million metric tons of electronic waste are disposed of worldwide each year. Recycling metals from electronic waste uses a fraction of the energy needed to mine new metals.

Hard drives and memory storage systems need to be completely erased to prevent unauthorized access to proprietary and protected information.

USA Refinery offers the most advanced equipment for recovering gold, silver, platinum, palladium and copper from solids, liquids, sludge and powders.

Sims Recycling Solutions is permitted by the U.S. EPA to receive and process precious metal bearing hazardous waste including F001-F009, D001-D004, and D006-D011 listed wastes.

Thank you

George and Helena