SUSTAINABLE PROCESSING OF RAW MATERIALS

Associate Professor D. Panias
Global Iron and Steel Production

Global Copper Production

Global Aluminum Production

Global REOs Production
HUMAN WELFARE VS ECOLOGICAL FOOTPRINT

Meets minimum criteria for sustainability

Threshold for high human development = 0.8

Data sourced from:
Global Footprint Network 2008 report (2005 data)
UN Human Development Index 2007/08
Redesign of Industrial Production through Innovative Raw Materials Processing
The series of unit operations that transforms industrial materials from a raw material state into finished parts or products is called processing.
THESE SECONDARY RAW MATERIALS PROCESSING

Ore → Conc. → Refined Metal → Product

Recycling Processes

Products Manufacturing

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RC = the fraction of metal scrap in the total metal input of fabricated metal

<table>
<thead>
<tr>
<th>RC</th>
<th>&lt; 1%</th>
<th>1-10%</th>
<th>&gt; 10-25%</th>
<th>&gt; 25-50%</th>
<th>&gt; 50%</th>
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<td>11</td>
<td>Na</td>
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<td>K</td>
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<td>Ca</td>
<td>21</td>
<td>Sc</td>
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<tr>
<td>37</td>
<td>Rb</td>
<td>38</td>
<td>Sr</td>
<td>39</td>
<td>Y</td>
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<td>55</td>
<td>Cs</td>
<td>56</td>
<td>Ba</td>
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<td>Fr</td>
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</tbody>
</table>

* Lanthanides

** Actinides

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European Aluminium Association (EAA) & Organization of European Aluminium Refiners and Remelters
COMPOSITION OF MOBILE PHONES

Mobile Phone Composition

MOSTLY CONTAINED IN...
- Circuit Boards
- Case
- Wires
- Screen
- Chips
- Batteries

WEIGHING 100 grams CONTAINS
- 13.7 g. of copper
- 0.028 g. of gold
- 0.189 g. of silver
- 0.014 g. of palladium
Urban Mining is an emerging field for innovations
THE EMERGING FIELD OF LANDFILL MINING

Engineered Systems & Processing Routes

Policy & Legislation

Energy Production

Cardboard

Glass

Materials Recycling

Sustainable Nature

Smaller & Modern Landfills

Market Issues

Business & Organization Models

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THE INDUSTRIAL WASTES PROCESSING

Primary/Secondary Raw Materials

Aqueous wastes
Gaseous wastes

Raw Materials Processing

Valorization
Solid wastes or Residues
Disposal Site
Modern and Smaller Disposal Site

Marketable Products

New Business Models
New Processing Routes
### Red Mud

<table>
<thead>
<tr>
<th>Chemical Species</th>
<th>%wt (dry basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe₂O₃</td>
<td>47.74%</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>16.22%</td>
</tr>
<tr>
<td>CaO</td>
<td>10.73%</td>
</tr>
<tr>
<td>SiO₂</td>
<td>6.09%</td>
</tr>
<tr>
<td>TiO₂</td>
<td>5.93%</td>
</tr>
<tr>
<td>Na₂O</td>
<td>2.51%</td>
</tr>
<tr>
<td>V₂O₅</td>
<td>0.21%</td>
</tr>
<tr>
<td>-SO₃</td>
<td>0.60%</td>
</tr>
<tr>
<td>-CO₂</td>
<td>1.63%</td>
</tr>
<tr>
<td>H₂O(cry)</td>
<td>8.35%</td>
</tr>
</tbody>
</table>
A FUTURE VALORIZATION SCHEME

CO₂ off-gases

Bag Filters

Dust

Coke Fines

Fluxes

Exhausted gases

Red Mud drying

Material Feed Mixing

DUST TREATING EAF

Viscous Slag

Fiberization

Red Mud

Pig Iron

Mineral Wool

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BRAVO: Holistic Approach on Primary Aluminium Production

**EUROPEAN INNOVATION PARTNERSHIP ON RAW MATERIALS**

- **Society**
  - Al-Aware
  - Al-Chain
  - Undertakes all the Innovation & Commercialization activities (IP, New Strategies & Business models, Market Analysis, Policy Issues etc)
- **Environment**
  - Al-Ore
  - Optimising the alumina and aluminium manufacturing process to increase the intrinsic value and recyclability of by-products including red mud
- **Economy**
  - Al-Source
  - Recovers critical metals from RM (Ga, Ti, Se, Ge, Dy, Ce)
  - Al-Build
  - Produces construction materials from RM

More Sustainable Primary Aluminium Production

Public awareness, acceptance and trust regarding aluminium sector activities and generation and management of red mud
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EUROPEAN INNOVATION PARTNERSHIP ON RAW MATERIALS

FineNi: Processing of low grade fine feeds

FeNi Converting

FeNi Alloy to Market

Fe Recovery

Valorization

Residue Valorization in Construction sector
THE FUTURE OF RAW MATERIALS PROCESSING

- The need for sustainable development
- The huge volume of secondary raw materials & wastes
- The strong dependency of European Industry on imported raw materials
- The continuously growing demand for metals & metallic products

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Thank you for your attention