Co-processing waste in the cement industry:

A solution to natural resource preservation and total emission reduction

Anne Dekeukelaere - Cementis
Waste …… an ever lasting problem

- Waste is produced all over the world and increases with the population and the GDP development.

Source: GTZ Holcim guidelines
Waste …… a problem that harm also the health of the population

- Even nowadays, majority of the waste is landfilled, dumped or burned illegally.
- This causes contamination of soil, water resources and the atmosphere.
- The consequences are deterioration of health of population.
The cement industry - its energy & resources needs

- Cement thus concrete plays a vital part in our daily lives. Few people are aware that concrete, with its strength, durability and excellent thermal mass, is a key component in eco-buildings.

  …… but the cement industry consumes a significant amount of natural resources and energy.

- The average needs for 1 ton of clinker =

  - 200 kg coal
  - 1’600 kg of raw material
  - 100 kwh electricity to grind the clinker
  - 1’300 kf of limestone
  - Bauxite, iron oxide, silica, ..

- Worldwide cement production in 2007 was 2.77 billion tonnes, and will rise to 3.40 billion tonnes in 2015.
The cement industry - its CO2 emission

- Cement represents an average 1.6 billion tonnes CO2 or 5% of the global man-made CO2 emissions or a bit less than 1 ton of CO2 for 1 ton of clinker.

Source: wbcsd – June 2005
The cement industry and the preservation of natural resources

Clinker Production

Raw Material → Clinker Kiln → Clinker → Cement Production

AR: Alternative Resources

Examples of AR used primarily as alternative raw material:
- Aluminum hydroxide residues, catalysts, foundry sands, etc.
...

Examples of AR used in the kiln for the production of clinker primarily as alternative energy source:
- Solvents, paint residues, hyrdocarbon residues, wood, paper, sludges from industrial waste water treatment, soils/plastics/textiles contaminated with hydrocarbons, pesticides, etc..
...

Added to the clinker for the production of cement:
- Ground slag (steel), fly ash (power plants), alternative gypsum sources, etc...

AR: Alternative Resources

Sweep-net Beirut Apr 2011
Waste taken as an opportunity

- Did you know that the energy content of one ton of used tires is equal to that of one ton of coal, and that tires also include raw materials such as iron and aluminum that are required for cement production? (coprocem)

**Natural resources**

- Coal = 28 MJ/kg
- Heavy oil = 40 MJ/kg
- Pet coke = 33 MJ/kg

**Alternative resources**

- Animal Fat = 37 MJ/kg
- Waste oil = 30 - 40 MJ/kg
- Waste tires = 30 MJ/kg
- Palm nut shells = 19 MJ/kg
- Car shredded waste = 15 MJ/kg
- Dried sewage sludge = 10 MJ/kg
Alternative raw material for cement is also present in waste

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Waste material</th>
<th>Industrial sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay mineral Al₂O₃</td>
<td>- Coating residues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Aluminium recycling sludge</td>
<td>- Foundries</td>
</tr>
<tr>
<td></td>
<td>- Industrial lime</td>
<td>- Neutralization process</td>
</tr>
<tr>
<td></td>
<td>- Lime sludge</td>
<td>- Water treatment</td>
</tr>
<tr>
<td>Limestone CaCO₃</td>
<td>- Foundry sand</td>
<td>- Foundries</td>
</tr>
<tr>
<td></td>
<td>- Contaminated soil</td>
<td>- Soil remediation</td>
</tr>
<tr>
<td>Silicates SiO₂</td>
<td>- Roasted pyrite</td>
<td>- Metal surface treatment</td>
</tr>
<tr>
<td></td>
<td>- Mechanical sludge</td>
<td>- Metal industry</td>
</tr>
<tr>
<td></td>
<td>- Red sludge</td>
<td>- Industrial wastewater treatment</td>
</tr>
<tr>
<td>Iron-oxide Fe₂O₃</td>
<td>- Fly ash</td>
<td>- Incineration</td>
</tr>
<tr>
<td></td>
<td>- Crushed sand</td>
<td>- Foundries</td>
</tr>
<tr>
<td>Si-Al-Ca-Fe</td>
<td>- Gypsum from gas desulphurization</td>
<td>- Incineration</td>
</tr>
<tr>
<td>Sulfur</td>
<td>- Chemical gypsum</td>
<td>- Neutralization process</td>
</tr>
<tr>
<td>Fluorine</td>
<td>- CaF₂ filter sludge</td>
<td>- Aluminium industry</td>
</tr>
</tbody>
</table>
The cement industry as an ecosystem

Source: wbcsd
Co-processing is the use of waste material (as raw materials, as a source of energy, or both) to replace natural mineral resources (material recycling) and fossil fuels such as coal, petroleum and gas (energy recovery) in industrial processes.

Source: GTZ Holcim guidelines
The position of co-processing in the waste hierarchy

The co-processing of waste has been recognized as a recovery operation under EU legislation.

Source: wbcsd
Co-processing is a triple “win” situation

Source: cembureau
Co-processing and reduction of greenhouse gases

- The industry produces 5% of global man-made CO2 emissions worldwide. Half of this is a result of the chemical process involved in the transformation of limestone into clinker; 40% is a result of burning the fuel. The remaining 10% is split between electricity use and transport.

- There are three main techniques available to the industry in reducing net total and per tonne CO2 emissions:
  - Maximize the efficiency of the manufacturing process and associated equipment to use fuels and materials as efficiently as possible;
  - Reduce the amount of fossil fuel used in the process by replacing it with biomass and wastes that would otherwise have been burned without energy recovery, and other materials having lower carbon content;
  - Replace a proportion of the clinker in cement with alternative materials (which do not require thermal processing), reducing the CO2 emissions per tonne of cement produced.

Source: wbcsd
Co-processing and reduction of greenhouse gases

- Without co-processing, the wastes would have to be incinerated or landfilled with corresponding greenhouse gas emissions.
- In 2006, the percentage of energy gained by the use of waste as a fuel in the EU stood at about 18%, resulting in a reduction of 8Mt of CO2 emissions each year whilst saving about 5Mt of coal. (cembureau)
The use of Alternative Fuel in the world

<table>
<thead>
<tr>
<th>Country or region</th>
<th>% Substitution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>83</td>
</tr>
<tr>
<td>Switzerland</td>
<td>47.8</td>
</tr>
<tr>
<td>Austria</td>
<td>46</td>
</tr>
<tr>
<td>Norway</td>
<td>35</td>
</tr>
<tr>
<td>France</td>
<td>34.1</td>
</tr>
<tr>
<td>Belgium</td>
<td>30</td>
</tr>
<tr>
<td>Germany</td>
<td>42</td>
</tr>
<tr>
<td>Sweden</td>
<td>29</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>25</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>24</td>
</tr>
<tr>
<td>EU (prior to expansion in 2004)</td>
<td>12</td>
</tr>
<tr>
<td>Japan(^{16})</td>
<td>10</td>
</tr>
<tr>
<td>United States(^{16})</td>
<td>8</td>
</tr>
<tr>
<td>Australia(^{17})</td>
<td>6</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>6</td>
</tr>
<tr>
<td>Denmark</td>
<td>4</td>
</tr>
<tr>
<td>Hungary</td>
<td>3</td>
</tr>
<tr>
<td>Finland</td>
<td>3</td>
</tr>
<tr>
<td>Italy</td>
<td>2.1</td>
</tr>
<tr>
<td>Spain</td>
<td>1.3</td>
</tr>
<tr>
<td>Poland</td>
<td>1</td>
</tr>
<tr>
<td>Ireland</td>
<td>0</td>
</tr>
<tr>
<td>Portugal</td>
<td>0</td>
</tr>
<tr>
<td>Greece</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Source: wbcsd

Acid tar deposit
Used tires
Landfilling
Plastic’s mixtures
Industrial wastes
Hydrocarbon sludge’s
Rules of the game for the cement industry

- Co-processing respects the waste hierarchy
- The use of suitable alternative materials does not have any negative impact on emissions
- No negative impact on the environmental and technical quality of the final product
- Co-processing in the cement industry does not have a negative impact on the health & safety of the workers in the plant and the people living in the neighborhood
- The cement plant must comply with the relevant regulations, monitor and control the inputs, process, products and emissions and finally must communicate transparently
- Promote dialogue with local authorities
Rules of the game for the authorities

- Creation and interpretation of waste statistics
- Develop a national waste management strategy
- Create an appropriate legal framework for waste
- Enforcement of the national regulations and permissions
- The “polluter-pays” principle must be the basis
- Keep in mind the waste hierarchy but sometime LCA (life cycle analysis) can invert the latter because it can judge the advantages of different waste management solutions.
- Authorities need to be qualified to authorize, control, and monitor co-processing?
- National emissions standards must be applied by the concerned authorities
Co-processing: Example India

Guidelines on Co-processing in Cement/Power/Steel Industry

February 2010

Central Pollution Control Board
(Ministry of Environment & Forests, Govt. of India)
Parivesh Bhawan
East Arjun Nagar, Delhi - 110 032
EU recognizes co-processing as a resource efficient solution

- The co-processing of waste has been officially recognized by the European Commission as a resource efficient best practice under its flagship initiative for a resource-efficient Europe under the Europe 2020 strategy.

- Published on 26 January, the Commission Communication on a resource-efficient Europe is one of seven flagship initiatives under the Europe 2020 strategy.

- The cement industry co-processes waste as a substitute for primary raw materials and fossil fuels. It offers a safe and sound solution for society, the environment and the cement industry, by substituting non renewable resources with societal waste under strictly controlled conditions. The use of alternative raw materials also has numerous benefits, including reducing the environmental footprint of extraction activities.

- This ensures that both, natural raw materials and fuels are preserved and CO2 emissions are globally reduced
Co-processing: moving to an **UN legal frame**

- **June 2008**: Co-processing is presented in Basel Convention COP 9 Decision: To review incineration guidelines portfolio, including co-processing
- **Nov 2008**: Chile volunteer to draft Technical Guidelines for Co-processing of Hazardous Waste in Cement Kilns
- **Nov 2009**: Chile send 1° TGs Draft to SBC, and first round of comments is open
- **March 2010**: Chile issued a 2° Draft
- **May 2010**: 2° Draft is presented and discussed in the OEWG (Geneva)
- **Oct 2010**: Comments received (Canada – Cembureau – European Union – IPEN)
- **Nov 2010**: 3° Draft issued by Chile
Co-processing: moving to an **UN** legal frame

**OEWG-VII/9: Draft technical guidelines on the co-processing of hazardous waste in cement kilns**

*The Open-ended Working Group,*

Noting with appreciation the contributions made by Chile as lead country and by other stakeholders in the development of the technical guidelines on the co-processing of hazardous waste in cement kilns.

1. *Invites* Parties and all stakeholders to provide comments to Chile with copies to the Secretariat on the draft technical guidelines by 31 August 2010 for publication on the website of the Basel Convention;

2. *Requests* Chile, on the basis of the comments received pursuant to paragraph 1 above, to prepare a revised version of the technical guidelines, to be made available on the website of the Basel Convention by 31 October 2010;

3. *Invites* Parties and all stakeholders to provide further comments on the draft referred to in paragraph 2 above by 31 January 2011 for publication on the website of the Basel Convention;

4. *Requests* Chile, on the basis of the comments received pursuant to paragraph 3 above, to prepare another revised version of the technical guidelines for publication on the website of the Basel Convention by 31 March 2011;

5. *Requests* the Secretariat to submit the revised draft technical guidelines referred to in paragraph 4 above for consideration and possible adoption by the Conference of the Parties at its tenth meeting.
The sustainability of the cement industry is not a dream!