ALTERNATIVE FUELS FROM WASTE – SPECIAL RECIPE FOR CEMENT KILNS
- CASE STUDY -

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Introduction

- Waste recipe in cement production is one of the most closely guarded secrets.
- The list of wastes accepted for co-incineration included almost 200 type of waste.
- The clinkerization process uses a mixture of conventional and alternative fuels.
- The conducted researches hereof, has the main purpose to constitute the base for further ecological solutions for conversion waste to energy, including:
  - the optimization of the mixture of waste, from calorific point of view, and
  - calibration of existing plants in order to allow the use of solid wastes as alternative fuel.
- The recipe can be used at large scale, in cement kilns, all over the world.
Criteria of Waste Selection

### Environmental Protection
- Not lead to increasing pollutant emissions
- Have a low impact on the environment
- Low quantities of pollutants contained in waste

### Economic / Profitability
- Waste has to be cheap
- Subtle process changes needed
- Minimal technological installation adjustments
- The investments has to be sustainable

### Technological Point of View
- Waste supplied rhythmic
- Delivered in sufficient quantities
- Present as small variations in quality
- Implementation of the quality assurance systems

### Most important parameters
- Calorific value
- Burner adequacy

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Waste Combustion in Cement Plants
Preparing the Fuel from Waste - Large solid waste

- Using scrap tires as alternative fuel is recommended
  - high calorific value similar to that of brown coal,
  - availability in significant quantities.
- An additional advantage of using scrap tires is steel insertion.
  - The steel can substitute, in part, or all, for the iron requirement in the raw meal recipe thereby reducing the raw meal cost.

Tires – Storage and Automated conveyor transports of the scrap tires to the injection point in the kiln system
Preparing the Fuel from Waste - Small solid waste

System for processing of plastics, paper and cardboard to be used as alternative fuels

System for processing of wood, to be used as alternative fuels in cement kilns

Paper, cardboard, plastic, textiles, solid fraction of waste from catch pits
Composition of Waste Recipe Fuel Mixture

75% traditional fuels
25% alternative fuels from waste

- Liquid waste: 61%
- Small solid waste and wood waste: 26%
- Tires and large solid waste: 13%

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Calorific value MJ/kg</th>
<th>Share in the mixture %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid waste</td>
<td>25</td>
<td>61</td>
</tr>
<tr>
<td>Small solid waste and wood waste</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td>Tires and large solid waste</td>
<td>26</td>
<td>13</td>
</tr>
<tr>
<td>Mixture</td>
<td>25,65</td>
<td>100</td>
</tr>
</tbody>
</table>
## Calorific Value of the Fuel Mixture

<table>
<thead>
<tr>
<th>Type of fuel</th>
<th>Fuel</th>
<th>Calorific value MJ/kg</th>
<th>Percentage in the mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>Natural gas</td>
<td>50</td>
<td>75 %</td>
</tr>
<tr>
<td></td>
<td>Coal</td>
<td>26-30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy oil</td>
<td>40-42</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Mixture - recipe</strong></td>
<td><strong>33,5</strong></td>
<td></td>
</tr>
<tr>
<td>Alternative</td>
<td>Liquid wastes</td>
<td>30</td>
<td>25 %</td>
</tr>
<tr>
<td></td>
<td>Wood waste and other solid waste small</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>dimensions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tires and large solid wastes</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Mixture - weighted</strong></td>
<td><strong>25.65</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Calorific value of the mixture</strong></td>
<td></td>
<td><strong>31.54</strong></td>
<td><strong>100 %</strong></td>
</tr>
</tbody>
</table>
Greenhouse gas simulation – NOx
Greenhouse gas simulation – CO2
Results

Increasing the quantities of waste used as alternative fuels +
Increasing oxygen amount by supplementing excess air =>
Optimal conditions required for a high-quality clinker product
The use of waste as alternative fuels, involve some special quality requirements, control and preparation but, following a special recipe, the cement producers can successfully replace the traditional fossil fuels with alternative secondary fuels having multiple benefits.

The research results can be used by the managers of the cement industry in order to extend the quantity and the variety of waste prepared as alternative fuels and, also to optimize waste burning in rotary kilns. The other interest on the research results may be from the part of the environmental authorities in order to include the new approach into the national waste management plan.

For further research we can vary the percent of wastes in the mixture and analyze what’s happen with calorific value of the mixed fuel and the greenhouse gas emissions of the plant.
Thank you for your kind attention!

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