LIFE CYCLE INVENTORY FOR CEMENT AND CONCRETE IN INDIA

About Indian Cement Industry

- 2nd largest producer & consumer of cement in the world
- 210 Large cement plants with installed capacity of ~ 400 million tonne
- One of the highly energy intensive industry
- Most energy efficient in the world
  - Specific energy consumption of few units are lowest in the world
    - Thermal Energy – 677 kcal/kg clinker
    - Electrical Energy – 64 kWh/MT Cement
    - Electrical Energy – 44 kWh/Tonne of Clinker
About Indian Cement Industry

- Cement sector plays vital role in economic growth of country
  - Construction sector alone contributes 7% of the country’s GDP
  - Per capita consumption <200 kg, while world average 500 kg
- Cement industry likely to grow by 8.0%
  - Development of Cement Concrete National Highway
  - 100 Smart Cities
  - Urban & Rural Housing & Road Connectivity
  - Dedicate Freight Corridors etc.

Life Cycle Inventory (LCI)

- LCA – Sustainable tool that helps to assess, evaluate & reduce
  - Environment impacts throughout the product’s lifecycle
    - Energy & material consumption,
    - Emissions
    - Waste generation
- LCI dataset required for carrying out LCA study
- For Cement & Concrete - Global dataset available
Why - India Specific Data Set?

- Global dataset may not provide accurate results for Indian companies
  - Variation in operating parameter

- More than 30% power from Captive Power Plant
- Low utilization of AFR as compared to European country
- Product specification
Why - India Specific Data Set?

- India specific dataset help industries
  - To estimate precise overall environmental performance of their activity / product
- CII-GBC in partnership with ecoinvent developing India specific LCI dataset

Methodology

- Defining system boundary & functional unit
- Preparation of questionnaire for different product
- Identification of organization to be contacted
- Circulation of questionnaire to identified organization
- Collection & Analysis of data
- Review of the data with key personal of the industry
**Case Study – Clinker {IN} | Production**

**System boundary**
- Activity starts with reception of different types of raw material & fuels at the factory gate
- Activity ends with cooling of the produced clinker

**Functional unit**
- Provides reference to which inputs & outputs can be related
- 1 kg of clinker production

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**Questionnaire**

**Material Consumption**
- Limestone, Laterite, Iron Ore, Bauxite, Clay etc.

**Fuel Consumption**
- Solid fuel – Imported Coal, Indian Coal, Petcoke
- Liquid fuel – Furnace oil, HSD etc.
- Biomass, Solid waste

**Resource Consumption**
- Water

**Electricity**
Questionnaire

- **Air emission**
  - CO₂, CO, NOₓ, SO₂, SPM

- **Water emission**
  - BOD, COD, Temp, PH

- **Waste Generation**
  - Oil, Grease, Steel scrap, Refractory

Data Collection & Analysis

- More than 60% of India’s cement production
- Includes all cement clusters
Analysis

Variance in Raw Material Mix

Includes alternative raw material

Raw Material Mix

<table>
<thead>
<tr>
<th>Raw material to Clinker Ratio</th>
<th>T Raw Material/T Clinker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limestone Consumption</td>
<td>1.447 T Limestone/T Clinker</td>
</tr>
<tr>
<td>Laterite Consumption</td>
<td>0.0339 T Laterite/T Clinker</td>
</tr>
<tr>
<td>Bauxite Consumption</td>
<td>0.0084 T Bauxite/T Clinker</td>
</tr>
<tr>
<td>Iron ore Consumption</td>
<td>0.0025 T Iron Ore/T Clinker</td>
</tr>
<tr>
<td>Alternative Raw Material</td>
<td>0.0169 T Alternate Raw Material/T Clinker</td>
</tr>
</tbody>
</table>
Fuel Consumption

- Variance in Fuel Quality
  - Includes solid & liquid waste and biomass consumption

Energy Consumption

- Thermal Energy Consumption
  - 736 kcal/kg clinker
- Electrical Energy Consumption
  - 52.6 kWh/Tonne of Clinker
Water & Inventory Consumption

<table>
<thead>
<tr>
<th>Inventory Consumption</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lubricating Oils</td>
<td>0.019 Kg/Tone of clinker</td>
</tr>
<tr>
<td>Lubricating Grease</td>
<td>0.0072 Kg/Tone of clinker</td>
</tr>
<tr>
<td>Grinding Media</td>
<td>0.065 Kg/Tone of clinker</td>
</tr>
<tr>
<td>Refractory bricks</td>
<td>0.36 Kg/Tone of clinker</td>
</tr>
</tbody>
</table>

Data Analysis

- It also considers different technology
  - Different stages of Preheater
  - ILC/SLC and combination of both
  - WHRS
    - Installed capacity 237 MW
  - AFR Utilisation
    - 3.7% Thermal Substitution Rate
Data Entry in Ecoeditor

Impacts due to AFR utilization in cement industry

- CO₂: CO₂ generated reduces by 5% per tonne of clinker
- Reduces the ozone layer depletion potential by 8%
- Reduces land required for landfill by 20%
- Co-processing ranks higher in the hierarchy in comparison to disposal activities namely landfilling or incineration
- Waste generated becomes a resource for other and due to its environmentally effective waste management system
- Co-processing will support the country in moving towards "Zero waste to Environment"
Conclusion & Next Steps

- To estimate precisely the overall environmental performance of the product/activity throughout their life cycle
- Similarly, developing dataset for Concrete
  - Concrete, 25-30 Mpa
  - Concrete block
  - Concrete slab
  - Aggregates etc...

Thank you!

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