JAPANESE CLEAN TECHNOLOGIES FOR SOUTH AFRICAN CEMENT INDUSTRY
6, September 2012
### List of clean technologies applicable to South African cement plants and their benefits

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<th>Clean Technology</th>
<th>Benefits</th>
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<tr>
<td><strong>Waste Heat Recovery</strong></td>
<td>Reducing purchased power (= Reducing indirect emissions)</td>
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<td>Generating power using waste heat from kiln and supplying it to cement production</td>
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<td><strong>Co-processing (of wastes)</strong></td>
<td>Contributing to establishment of recycling based society</td>
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<td>Burning effectively combustible waste in cement kiln or waste incinerator.</td>
<td>Reducing total fossil fuels consumption</td>
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<td>Reducing total GHG emissions reduction</td>
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<td><strong>Co-processing (of biomass)</strong></td>
<td>Life extension of landfill site due to reduction of volume of wastes disposed</td>
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<td>Burning effectively biomass in cement kiln or waste incinerator.</td>
<td>Reduction of fossil fuels consumption required for decomposing CFC and PFC</td>
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<td><strong>Decomposing of CFC and PFC</strong></td>
<td>Reducing GHG emissions from CFC and PFC in local</td>
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<tr>
<td>Decomposing CFC and PFC in cement kiln without any damage of product</td>
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1. Waste Heat Recovery

Generating power using waste heat from kiln and supplying it to cement production.
CO2 emission reduction by introducing Waste Heat Recovery

About one-third of electricity required for cement manufacturing process Can be substituted by WHR generated electricity.
Waste Heat Recovery power generation system
2. Co-processing of waste

- **Rotary Kiln**
  - Flame: 1800 - 2000 °C
  - Material: 1450 °C > 15 min

- **Precalceriner**
  - Gas: > 900 °C - 3 sec
  - Raw meal: 700 °C

- **Preheater cyclones** =
  - dry scrubber for acid gases and metals

- **Raw meal**
  - CaO/CaCO₃
  - SiO₂
  - Fe₂O₃
  - Al₂O₃

- **Energy**

- **Clinker cooler** = dry scrubber for acid gases and metals

- **Clinker**
Cement Rotary Kilns’ Unique Characteristics

1. High temperature in a Kiln can decompose almost all of toxic organic substances.
2. Primary raw material, limestone, is the most widely used neutralizing agent for hazardous materials.
3. Ash component of waste is effectively used as raw material, thereby no secondary waste is generated from the cement plant.
4. Trace elements such as heavy metals are safely captured in the cement clinker.
5. Production capacity of Kiln is very large compared to waste material usage.
Co-processing of Waste in burning process

Alternative Raw Materials

Mineral Wastes (Inorganic)
Coal ash
Sludge
Slag
Molding sand etc.

Calciner
Liquid / Solid
Waste oil, Waste plastics etc.

Kiln inlet
Bulky wastes
Used tire, Waste wood
Sludge, RDF etc.

Kiln burner
Readily combustible
Waste oil, Waste plastics,
Unburned soot etc.

Alternative Fuels
Important points in Co-processing of wastes and countermeasures

- To keep stable operation
  (Automatic control program)
- Uniformity in quality and quantity
  (Mixing, Feeder, processing .....)
- Reduction of ‘hazardous’ element (Cl, S...) 
  (Coating prevention)
Examples of Co-processing of waste in Japan
Used tires transported for burning in kiln
Feeding point: Kiln Inlet
used tire, Waste wood
Sludge, RDF etc.
Flow diagram for waste plastics pre-treatment at Kumagaya Plant, Japan

Type of Waste Plastics

<table>
<thead>
<tr>
<th>Material</th>
<th>Type</th>
<th>Note</th>
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<tbody>
<tr>
<td>Formed PE</td>
<td>sheet</td>
<td>Capacity</td>
</tr>
<tr>
<td>Bridged PE</td>
<td>sheet • rolled</td>
<td>8,500 t/y</td>
</tr>
<tr>
<td>PET, PE, phenol</td>
<td>solid</td>
<td></td>
</tr>
<tr>
<td>PET, PE</td>
<td>rolled</td>
<td></td>
</tr>
</tbody>
</table>

Capacity

2.5 t/h
Shredder for waste plastics
Feeding point: Calciner

Liquid / Solid waste
Waste oil, waste plastics etc.

Feeding point: Kiln burner

Readily combustible waste
Waste oil, waste plastics, soot etc.

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Blended fuel from wastes

Recyclable wastes (liquid / sludge)

- Waste oils (lubricant, cutting, hydraulic, animal/vegetable, ship/vessel etc.)
- Waste solvent (alcohol, organic acid etc.)
- Sludge (tank sludge, paint, water treatment sludge etc.)
- Waste alkali
- Others

Blending treatment by waste oil company

Specification of “Blended fuel”

LHV: 4,500 – 5500 kcal/kg
Chlorine, viscosity, moisture, flushing point

Cement plants
Feeding point: Calciner
Liquid / Solid waste
Waste oil, Waste plastics etc.

Feeding Point: Kiln burner
readily combustible
Waste oil, Waste plastics, Soot etc.
Use of waste “Pachinko” Machine (RDF)

Waste Pachinko machine will be processed into RDF after crushing and kneading.
TSDS: Drying /Crushing of Sewage Sludge
(TSDS: Taiheiyo Sludge Drying System)
Basic Process Flow of TSDS

- Sludge tank
- Preheater
- Collecting Cyclone
- Pre duster
- Dried sludge
- Hot gas
- Blower
- Pump
- Fed to Preheater
- Inlet moisture 80%
- Outlet moisture 20%
- Return to preheater

Inlet moisture 80%
Outlet moisture 20%

Taiheiyo Engineering
Burnable Wastes:
used tire, Waste wood
Sludge, RDF etc.
3. Co-Processing of Biomass

• Biomass co-processed in Japan
  – Wood chip
  – Scrap wood from demolished house
  – Waste straw mat

• Treatment for biomass co-processing is similar to solid waste.
Operation difficulties from Co-Processing

Some of the wastes contain high chlorine and sulfur components. ⇒ coating trouble at preheater and Kiln inlet may occur.

Taiheiyo Chlorine By-Pass System
Taiheiyo Coating Solution System

are the solutions.
Countermeasures for more Co-Processing

1. Taiheiyo Chlorine Bypass System
   \(\rightarrow\) To prevent coating trouble by removing chloride contained in kiln exhaust gas

2. TCS: Taiheiyo Coating Solution System
   \(\rightarrow\) To prevent coating by absorbing \(\text{SO}_2\) gas and sulfur compound with dispersed raw meal at Kiln end.

3. Kiln Control Programs
   \(\rightarrow\) Raw Mix Control, Preheater Control
   \(\rightarrow\) Auto adjustment for stable Kiln operation by Model Predictive Control
Taiheiyo Chlorine By-Pass System
To prevent coating at Kiln inlet caused by low melting point chloride substance
Actual Installation of Taiheiyo Chlorine bypass system
TCS (Taiheiyo Coating Solution) System

Raw meal feeding from upper stage cyclone to avoid coating formation
Automatic Control (adjustment) Programs for maximum Co-Processing
Raw Mix Control Program

Process Model

Model Predictive Control
4. Decomposing of CFC and PFC

• Advantages of decomposing CFC and PFCs in Cement kiln
  – Stable decomposition (CFCs decompose at 900°C)
  – No additional equipment required
  – No additional energy required
  – No big investment required
CFC and PFC Decomposition system

1. Collected CFC
2. Gas Cylinder Manifold
3. Pressure Reducing Valve
4. Flow Control Device
5. Flow Control Device
6. Compressed Air
7. Ejector

- **Gaseous CFC Feed Line**: e.g. CFC12
- **Liquid CFC Feed Line**: e.g. CFC11,13

Taiheiyo Engineering
Thank you for your attention