Toward a Waste-to-Resources Community
- Experiences and Solutions -

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February 21, 2012
Taiheiyo Cement Corporation
TCC’s activities span the world

Oversea Cement Sales: 22,649kt (2009)
- U.S.A.: 2,035Kt (9.0%)
- China: 4,766Kt (21.0%)
- Korea: 12,815Kt (56.6%)
- Others: 3,033Kt (13.4%)

Domestic Sales: 14,829kt + Export 5,009kt
Basic cement manufacturing process

Raw material

Limestone
Silica sand
Clay
Iron source

Raw Mill

Sintering

Kiln with SP
Sintered at 1450 °C

Clinker
Ca, Si, Al, Fe oxide composite

Finishing

Gypsum

Cement Mill

Cement
# Annual use of waste and byproducts

## Statistical data in Japan by JCA

<table>
<thead>
<tr>
<th>Type</th>
<th>Used for</th>
<th>FY2000</th>
<th>FY2005</th>
<th>FY2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blast Furnace Slag</td>
<td>Raw, Additive</td>
<td>12,162</td>
<td>9,214</td>
<td>7,647</td>
</tr>
<tr>
<td>Coal Ash</td>
<td>Raw, Additive</td>
<td>5,145</td>
<td>7,185</td>
<td>6,789</td>
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<tr>
<td>Sewage Sludge</td>
<td>Raw (Additive)</td>
<td>1,906</td>
<td>2,526</td>
<td>2,621</td>
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<tr>
<td>Soil from Construction</td>
<td>Raw Material</td>
<td>—</td>
<td>2,097</td>
<td>2,194</td>
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<tr>
<td>By-product gypsum</td>
<td>Raw Material</td>
<td>2,643</td>
<td>2,707</td>
<td>2,090</td>
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<tr>
<td>Ash</td>
<td>Raw, Fuel</td>
<td>734</td>
<td>1,189</td>
<td>1,124</td>
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<tr>
<td>Nonferrous Slug</td>
<td>Raw Material</td>
<td>1,500</td>
<td>1,318</td>
<td>817</td>
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<tr>
<td>Foundry Sand</td>
<td>Raw Material</td>
<td>477</td>
<td>601</td>
<td>505</td>
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<tr>
<td>Steel Slug</td>
<td>Raw Material</td>
<td>795</td>
<td>467</td>
<td>348</td>
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<tr>
<td>Waste Plastic</td>
<td>Fuel</td>
<td>102</td>
<td>302</td>
<td>440</td>
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<tr>
<td>Wood Chips</td>
<td>Raw, Fuel</td>
<td>2</td>
<td>340</td>
<td>505</td>
</tr>
<tr>
<td>Reclaimed Oil</td>
<td>Raw, Fuel</td>
<td>239</td>
<td>228</td>
<td>204</td>
</tr>
<tr>
<td>Waste Oil</td>
<td>Fuel</td>
<td>120</td>
<td>219</td>
<td>192</td>
</tr>
<tr>
<td>Waste White Clay</td>
<td>Fuel</td>
<td>106</td>
<td>173</td>
<td>204</td>
</tr>
<tr>
<td>Coal Mining Waste</td>
<td>Raw, Fuel</td>
<td>675</td>
<td>280</td>
<td>0</td>
</tr>
<tr>
<td>Waste Tire</td>
<td>Raw, Fuel</td>
<td>323</td>
<td>194</td>
<td>103</td>
</tr>
<tr>
<td>Meat and Bone Meal</td>
<td>Raw, Fuel</td>
<td>0</td>
<td>85</td>
<td>65</td>
</tr>
<tr>
<td>Others</td>
<td>—</td>
<td>431</td>
<td>468</td>
<td>518</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>27,359</td>
<td>29,593</td>
<td>26,291</td>
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</tbody>
</table>

**Consumption (kg/ton-cement):**

<table>
<thead>
<tr>
<th></th>
<th>FY2000</th>
<th>FY2005</th>
<th>FY2009</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>332</td>
<td>400</td>
<td>451</td>
</tr>
</tbody>
</table>
Conventional recycling cement plant

Typical recycling loops

Cement Plant

Limestone

Coal ash

Gypsum

Blast-furnace slug

Limestone

Power Plant

Steel Plant
Trend of waste recycling in cement production

Recycling area expands to Urban waste

In Japan FY2009 (JCA)
Advantages of urban waste recycling

- **To elongate the life of land-fill site**
  
  After starting the recycling in cement production, the concern for the life of land-fill sites will be relieved.

- **To decompose dioxin**
  
  Even if a small amount of dioxin is contained in the wastes, dioxin will be decomposed safely in cement kilns.

- **To stabilize heavy metals**
  
  Urban wastes practically contains some heavy metals, however, hardened cement and concrete will prevent those heavy metals from leaching out for long term.
Flow of sewage treatment

Sewage

Sedimentation

Aerobe/Aeration

Clean water

14Billion m³/y

Sludge

Condensation

Digestion

Dewater 8Mt/y

Incineration ash 220kt/y

In Japan FY2009 (JCA)

Cement plants 32%

Agriculture Fields 36%

Building Material 10%

Landfills 20%
Flow of MSW treatment

MSW 48Mt/year

- Incineration (81%)
  - Land fill 80%
  - Recycling (19%)
    - Recycled after separation
    - RDF (Refuse Derived Fuel)
    - Fertilizer/meal for livestock
  - Cement Plant ~6%

In Japan FY2009 (JCA)
Waste-to-resources on MSW management

- Incinerators
  - Incinerated ash
  - Ash processing
    - AK (Applied Kiln)
  - Eco-cement
    - Existing Cement Plants
    - Landfill sites (extension of life)

- Development of Community
  - Cement & Concrete
AK (Applied Kiln) System

Hidaka City: Population 50,000
MSW 15,000 ton/y

Crushing, Sieving & Separation

Aerobic Bio-digester

Cement production line making use of digested MSW

Saitama Plant, TCC

CLOSED
Ash processing systems

Fly Ash Washing System (15,000 tons/y)

Bottom Ash Processing System (50,000 tons/y)

Kumagaya Plant, TCC
Chloride bypass system

Enable stable operation with no clogging
One third of MSW in Tokyo has been recycled as Eco-cement since 2006. Tokyo Metropolitan Government has constructed the plant in their landfill site and operation has been commissioned to Taiheiyo’s subsidiary.

- Input MSW (as incinerated ash) 300t/d
- Output Eco-cement 430t/d
Research and development of the Eco-cement process technology were supported by NEDO
Comparison of Eco-cement and OPC

Raw materials of Eco-cement and OPC

Physical properties of Eco cement

<table>
<thead>
<tr>
<th>type of cement</th>
<th>density (g/cm³)</th>
<th>specific surface area (cm²/g)</th>
<th>setting (hr:min)</th>
<th>compressive strength (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>initial</td>
<td>final</td>
</tr>
<tr>
<td>Ordinary type Eco cement</td>
<td>3.16</td>
<td>4,300</td>
<td>2:20</td>
<td>3:30</td>
</tr>
<tr>
<td>Rapid hardening type Eco cement</td>
<td>3.13</td>
<td>5,300</td>
<td>0:09</td>
<td>0:13</td>
</tr>
<tr>
<td>High early strength Portland Cement</td>
<td>3.13</td>
<td>4,340</td>
<td>2:03</td>
<td>2:50</td>
</tr>
<tr>
<td>Ordinary Portland cement</td>
<td>3.15</td>
<td>3,220</td>
<td>2:22</td>
<td>3:20</td>
</tr>
</tbody>
</table>
Development of communities

Waste-to-resource community

TCC can introduce such technologies and experiences on waste management
Thank you for your attention

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