Ecocement

New recycling resources reborn for an affluent future

What is Ecocement?
Ecocement, a coinage associated with Ecology and Cement, is a new type of cement produced from municipal incineration ash, sewage sludge and additional limestone and clay.

There are two types of Ecocement, Ordinary type and Rapid hardening type.

Ordinary type Ecocement
Ordinary type Ecocement, having virtually the same performance as Ordinary Portland cement, can be applied to reinforced concrete structures or a variety of other uses including as soil stabilizer or solidifying agent for sewage sludge.

Rapid hardening type Ecocement
Rapid hardening type Ecocement can be used in the non reinforcing concrete market, taking advantage of its rapid hardening property, which strengthens quicker than high early strength Portland cement.

Municipal incineration ash contains minerals that are all essential for producing Portland cement. (See Table 1) However, its high chlorine content makes it an obstacle to use it as a raw material in Portland cement. We have found an effective way of removing the chlorine together with accompanying heavy metals, thereby developing Ordinary type Ecocement whose chemical composition is similar to that of Ordinary Portland cement.

Rapid hardening type Ecocement, on the other hand, turns the chlorine into a useful component of a special cement clinker mineral(C11A7CaCl2) which has a very fast hardening property being a match for Jet Cement.

History of Ecocement
The research project on Ecocement started in 1994, the Ecocement manufacturing technology was established in 1997. The first and second Ecocement plants started operation in 2001 and 2004, respectively.
Ecocement process:

- produces cement appropriate for a variety of uses due to its stable quality,
- makes contaminants in municipal waste harmless,
- is an excellent Zero-Emission production process.
- is equipped with a perfect environmental protection system including heavy metal recovery and flue gas purification.
- prolongs the life of precious landfill sites and greatly contributes to the Resources Recycling Society.
• Typical raw material combination
  Municipal incineration ash: 0.6ton (generated from 6.0 tons of garbage and trash)
  Supplemental natural resources (Limestone, etc ) : 0.8 tons
  These raw materials are used to produce Ecocement by grinding and subsequent burning and finish grinding with additional gypsum.
• Ecocement substitutes calcium oxide in incineration ash for a part of limestone (calcium carbonate) which is required for producing cement, thus reducing de-carbonation energy and CO$_2$ emission.
To prevent cement clinker from heavy metal contamination, heavy metals contained in municipal incineration ash are maximally separated from the flue gas stream in the form of metal chloride. Separated metal chlorides are concentrated and purified to the extent that they can be reprocessed as useful metals in refineries. In this way, the Ecocement process saves precious metal resources and at the same time, realizes enhanced environmental protection. Traces of residual heavy metals are melted into clinker, but are harmless because they are all fixed in clinker crystals.
**Property of Ecocement**

Table 1, Figure 1 and 2 comparatively show the physical properties and the setting/hardening properties of Ecocement (Ordinary type and Rapid hardening type) and Ordinary Portland cement.

Ordinary type showed the setting time and strength development to be similar to Ordinary Portland cement. Rapid hardening type develops strength very fast. (3-hour compressive strength of 12N/mm²)

<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 Ecocement</td>
<td>3.16</td>
<td>4,300</td>
<td>2:20</td>
<td>3:30</td>
</tr>
<tr>
<td>Rapid hardening type Ecocement</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>

**The setting and hardening of Ecocement**

Physical test results according to JIS R 5201

![Comparison of setting time](Figure1)

![Mortar compressive strength](Figure2)
Examples of applications

Interlocking blocks at Hitachi Seaside National Park

Tetrapods set by Mikawa Harbor Office, Aichi prefecture

Soil stabilization using Geoset Eco, cooperatively developed by the Ministry of agriculture, Forestry and Fishery of Japan and Taiheiyo.

from the pamphlet of Taiheiyo Cement Corporation