SUITABILITY OF RAW MATERIALS IN GUJARAT FOR PRODUCTION OF LOW CARBON CEMENT

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Objective

• To select and validate the quality of china clay available in the state of Gujarat, India

• To test the suitability of the selected china clay in the pilot production of low carbon cement
Rationale for Gujarat

- Abundant raw material availability for possible use in blended cements
- Availability of various types and ranges of cement production units
- Easy logistics facilities
- Supporting research partner i.e. Ultratech Cements Ltd.

- 54% of total China clay production in India
- 10% of total limestone production in India

*(Indian minerals yearbook 2013)*
Raw material mapping in Gujarat
Methodology

• Mapping of china clay

• Sampling

• Characterization of raw clays

• Calcination of selected clays

• Evaluation of calcined clays

• Selection of calcined clay for pilot calcination
Reasons for selecting Kutch

• Wide ranges of china clay
• Maximum reserve of china clay
• Availability of rotary calciner and clay processing units

• 68% of total reserve of china clay in Gujarat

<table>
<thead>
<tr>
<th>Major Minerals</th>
<th>Minor minerals</th>
</tr>
</thead>
<tbody>
<tr>
<td>China clay</td>
<td>Gypsum</td>
</tr>
<tr>
<td>Limestone</td>
<td>Ball clay</td>
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<tr>
<td>Bauxite</td>
<td>Fire clay</td>
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</tbody>
</table>

*(Indian minerals yearbook 2013)*
Mapping of china clay in Bhuj (Kutch)

**Sampling**

- Clay1
- Clay2
- Clay3
- Clay4
- Clay5
Characterization of raw clays

XRF analysis

- Clay5 contains highest alumina
- Comparable alumina content for clay1-clay4
- Clay2 contains highest iron oxide.
Thermal analysis

TGA plots of raw clays

% kaolinite contents of raw clays

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Clay1</th>
<th>Clay2</th>
<th>Clay3</th>
<th>Clay4</th>
<th>Clay5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight loss (%)</td>
<td>5.2</td>
<td>7.9</td>
<td>6.3</td>
<td>6.9</td>
<td>9.9</td>
</tr>
<tr>
<td>Al₂O₃ content (%)</td>
<td>20.52</td>
<td>24.95</td>
<td>21.45</td>
<td>22.89</td>
<td>37.13</td>
</tr>
<tr>
<td>Kaolinite content (%)</td>
<td>38</td>
<td>57</td>
<td>45</td>
<td>50</td>
<td>71</td>
</tr>
</tbody>
</table>
XRD analysis of raw clays

M - Muscovite
K - Kaolinite
G - Gibbsite
Q - Quartz
A - Anatase
H - Hematite
Calcination parameters

- Programmable controller Muffle furnace (capacity 15 kg)
- Temperature of calcination: 700°C, 800°C & 900°C
- Soaking time: 4 hrs.
- Sample: in the form of hydraulically pressed rectangular brick of dimension 230mm x 110mm x 35mm
TGA of clays calcined at 800°C

- Complete dehydroxylation at 800°C
- Optimum calcination at 800°C
XRD pattern of clays calcined at 800°C

- No peaks of kaolinite
- No peaks of mullite
Evaluation of calcined clay

Reactivity of calcined clays

- Clay5 shows highest pozzolanic reactivity
Compressive strength of mortars

![Compressive strength graph]

- **OPC**
- **Clay5**
- **Clay4**
- **Clay2**

**Pilot calcination**

- 3 days
- 7 days
- 14 days
- 28 days

Compressive strength (MPa)
Conclusions

- Pozzolanic reactivity of calcined clay linearly depends on kaolinite content of respective raw clay and calcination parameters.

- Quality of blended cement depends on various factors (apart from pozzolanic reactivity) like specific surface area, particle size, hardness of individual ingredients, matrix homogeneity, chemical composition of clay etc.

Incorporation of calcined clay also shows an effort towards effective resource management and waste utilization.
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  - Technical & research guidance

THANK YOU