CAC for Refractory Applications
Application of CALUCEM – Calcium Aluminate Cements

INTRODUCTION

Resistance to high temperatures is the main reason for using Calcium Aluminate (CA) Cements in refractory products. High heat resistance combined with simple handling and extended workability make mortars and concretes based on CA cements extremely durable refractory products. Monolithic pan linings that are made of compounds that can be pumped, cast and sprayed will result in long lasting reliable linings with a clearly reduced demand for time and labor. Istra CA cement is a major component of castable refractory mixes used in monolithic linings. Mortars and concretes made of Istra CA cements are used in monolithic linings of furnaces, charge chutes and other high temperature areas that may come into contact with molten materials. Monolithic applications are extremely simple, time-saving and cost efficient. By a skillful selection of refractory aggregates and cements, the monolithics can be applied in sections where fired refractory bricks have been traditionally used. Istra CA cements are used in conventional castable (CC) and low cement castable (LCC) products.

PROPERTIES OF ISTRA CALCIUM ALUMINATE CEMENTS FOR THE REFRACTORY INDUSTRY

A carefully controlled chemical and mineralogical composition and a consistent fineness are among the key quality criteria of our cements. The Al₂O₃/CaO ratio is monitored closely for all cements and the Fe₂O₃ content is held at 3 % maximum for Istra 50. This provides for excellent carbon monoxide resistance of Istra 50 with classification A (unaffected) according to ASTM C 288 and overall refractory properties.

The excellent refractoriness of Istra Calcium Aluminate Cements is tested according to EN 993-12 and summarized in figure 1.

PYROMETRIC CONE EQUIVALENT ISTRA CEMENTS ACCORDING EN 993-12

<table>
<thead>
<tr>
<th>Temperature in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1600</td>
</tr>
<tr>
<td>1500</td>
</tr>
<tr>
<td>1400</td>
</tr>
<tr>
<td>1300</td>
</tr>
<tr>
<td>1200</td>
</tr>
</tbody>
</table>

0
1000
1200
1300
1400
1500
1600

/pyrometric cone equivalent istra cements according en 993-12

ISTRA 40 LUMNITE MG
ISTRA 45 LUMNITE
ISTRA 50 RECON MG
ISTRA 55 RECON

Figure 1: Refractoriness of Istra Calcium Aluminate Cements
The combination of the different ISTRA Calcium Aluminate Cements types in combination with different aggregates offer the formulator the optimum freedom for a cost balanced technical solution. The temperature service limit for dense concrete made out of ISTRA Calcium Aluminate Cements and general refractory aggregates are listed in table 1.

The compressive strength development of ISTRA Calcium Aluminate Cements vs. temperature is described in figure 2. ISTRA Calcium Aluminate Cement increases its compressive strength above 800 °C because of ceramic bonding.

### PROPERTIES OF ISTRA CALCIUM ALUMINATE CEMENTS WITH DIFFERENT AGGREGATES

The combination of the different ISTRA Calcium Aluminate Cement types in combination with different aggregates offer the formulator the optimum freedom for a cost balanced technical solution. The temperature service limit for dense concrete made out of ISTRA Calcium Aluminate Cements and general refractory aggregates are listed in table 1.

<table>
<thead>
<tr>
<th>Refractory Aggregates</th>
<th>Istra 40</th>
<th>Istra 45</th>
<th>Istra 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siliceous sand</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basalt, Granite</td>
<td>800 / 1472</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blast Furnace Slag</td>
<td>800 / 1472</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istra Aggregate</td>
<td>1150 / 2102</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chamotte A1S (40-42% Al2O3)</td>
<td>1250 / 2282</td>
<td>1330</td>
<td>1350 / 2482</td>
</tr>
<tr>
<td>Chamotte A0 (≥ 42% Al2O3)</td>
<td>1300 / 2372</td>
<td>1350 / 2462</td>
<td>1400 / 2552</td>
</tr>
<tr>
<td>Sillimanite</td>
<td>1350 / 2462</td>
<td>1400 / 2552</td>
<td>1450 / 2642</td>
</tr>
<tr>
<td>Brown Corundum</td>
<td>1400 / 2552</td>
<td>1475 / 2687</td>
<td>1550 / 2822</td>
</tr>
</tbody>
</table>

Table 1
The data in the tables were developed on specimens made from small size batches under laboratory conditions where temperature, humidity and curing were closely controlled. Actual field conditions may produce different results.

For many years ISTRA CAC has been used with crushed fireclay brick (CFB) to produce refractory concrete suitable for service temperatures up to 1480°C. Alumina-Silica firebrick containing 38 - 45 % alumina is the most commonly used CFB in ISTRA 45 and ISTRA 50 refractory concrete. The abrasion resistance will be fair to good, depending on the type and gradation of the CFB, mix design, consolidation and water/solids ratio. The resistance to thermal shock will be good, and to corrosion only fair.

Table 3 gives the composition of an insulation concrete with Vermiculite and Istra 45 CAC. The properties of the insulation concrete are summarized in figure 3.

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Table 3 gives the composition of a dense refractory concrete made with Istra 45 CAC and Crushed Fire Brick (CFB). The Pyrometric Cone Equivalent is 20. The properties of the insulation concrete are summarized in figure 3.

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ISTRA Calcium Aluminate Cements are a cost efficient solution for insulating and dense refractory products. ISTRA Calcium Aluminate cements are used in precast shapes or in premixed refractory formulations. They can be applied as concretes or gunning mixes and offer the following benefits.

- High Temperature Resistance
- Abrasion and Mechanical Resistance
- Strictly monitored chemical composition for consistent high product quality
- Reliable behavior of ISTRA Calcium Aluminate Cements during installation

Starting formulations are available upon request.

For additional information about ISTRA Calcium Aluminate Cements, please visit the CALUCEM web site at www.calucem.com or contact us worldwide.

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