Introduction to our Silicon Carbide products

The base of all Silicon Carbide (SiC) refractories is refractory grade alpha silicon carbide, produced in large electrical resistance furnaces at approximately 2400°C from a mixture of silicon, carbide, salt and sawdust. These refractory crystals are then classified, crushed and graded for use as grog or aggregate in bricks or shapes. The alpha silicon carbide crystals impart high thermal conductivity and refractoriness, low thermal expansion and outstanding abrasion/erosion resistance.

In any refractory product in-service performance or failure can usually be attributed to initial failure of the bonding systems and not the refractory grog. Many bonding systems are available that inter-connect the alpha silicon carbide grains and in the case of self bonded refractories, it is mainly in a matrix of silicon and aluminium-silicon glass.

The bonds in self bonded refractories have been carefully formulated to give specific properties and subsequent performance criteria in any specific application.

Self Bonded

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Nitride Bonded

The silicon nitride bond phase in these refractories is the key to their superior performance in demanding applications. The Morsil™ nitride bonding system allows nitride bonded refractories to out-perform other silicon carbide based refractories using silicate, alumina silica, and silicon oxynitride and beta silicon carbide bond systems.

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To manufacture Morsil™ nitride bonded, graded alpha or electric furnace silicon carbide crystals and fine silicon are formed into shape, and fired in a pure nitrogen atmosphere at approximately 1420°C. The result is a refractory consisting of a mixture of alpha silicon carbide grain in a matrix of alpha and beta silicon nitride, with minor amounts of residual silicon and silicon oxynitride. Due to the fact that the bond phase grows within existing porosity, there is little to no dimensional change upon firing and a net weight gain occurs. This bond is mainly responsible for the extremely high modulus of rupture and outstanding oxidation and corrosion resistance of Morsil™ nitride bonded silicon carbide.
## Silicon Carbide: Nitride bonded (cast/pressed), Ramming CFR, Castable CFC

<table>
<thead>
<tr>
<th>Bond Type</th>
<th>Nitrite Bonded Pressed</th>
<th>Nitrite Bonded Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Hot Face Temperature °C</td>
<td>1700</td>
<td>1650</td>
</tr>
<tr>
<td>Modulus of Rupture, ASTM 133</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPa @ 20°C</td>
<td>40</td>
<td>49</td>
</tr>
<tr>
<td>MPa @ 1350°C</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Bulk Density, ASTM 134, gm/cm²</td>
<td>2.62</td>
<td>2.62</td>
</tr>
<tr>
<td>Apparent Porosity (%)</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Thermal expansion coefficient cm/cm/°Cx10⁶</td>
<td>4.7</td>
<td>4.7</td>
</tr>
<tr>
<td>Thermal Conductivity, ASTM C 202, W/m•K @1477°C</td>
<td>16.3</td>
<td>16.4</td>
</tr>
<tr>
<td>Relative Thermal Shock</td>
<td>excellent</td>
<td>excellent</td>
</tr>
<tr>
<td>Specific Heat, 1400°C, cal/gm/°C</td>
<td>0.28</td>
<td>0.28</td>
</tr>
<tr>
<td>Relative Abrasion Resistance, 1400°C</td>
<td>excellent</td>
<td>excellent</td>
</tr>
<tr>
<td>Spall Resistance (%)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Compressive Strength, kg/cm², MPa</td>
<td>&gt;137</td>
<td>&gt;160</td>
</tr>
<tr>
<td>Permeability, ccof air/min/in/m²/in WG press</td>
<td>3.0</td>
<td>Nil</td>
</tr>
<tr>
<td>Electrical Characteristics</td>
<td>Semi-conductor</td>
<td>Semi-conductor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bond Type</th>
<th>Ramming Cements</th>
<th>Castable Cements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Range °C</td>
<td>CFR 0100 (1) 100-1500</td>
<td>CFR 0110 (2) 1100-1750</td>
</tr>
<tr>
<td>Set</td>
<td>heat</td>
<td>heat</td>
</tr>
<tr>
<td>Particle Size, mm</td>
<td>2.8</td>
<td>3.4</td>
</tr>
<tr>
<td>Required Quantity, kg/m³</td>
<td>2240</td>
<td>2240</td>
</tr>
<tr>
<td>Water to be added before use – litre.25kg</td>
<td>1.4-1.5</td>
<td>1.4-1.5</td>
</tr>
<tr>
<td>How shipped</td>
<td>dry</td>
<td>dry</td>
</tr>
<tr>
<td>Pack size, kg</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

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## Silicon Carbide: Nitride bonded (cast/pressed), Ramming CFR, Castable CFC

### Typical Chemical Analysis (%)

<table>
<thead>
<tr>
<th></th>
<th>Nitride Bonded Pressed</th>
<th>Nitride Bonded CFR 0100 (1)</th>
<th>CFR 0110 (2)</th>
<th>CFR 0120 (3)</th>
<th>CFR 0130 (4)</th>
<th>CFC 0100 (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiC</td>
<td>75.0</td>
<td>76</td>
<td>89</td>
<td>89</td>
<td>4</td>
<td>83</td>
</tr>
<tr>
<td>Si₃N₄</td>
<td>23.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SiO₂</td>
<td>0.5</td>
<td>13</td>
<td>7</td>
<td>7</td>
<td>80</td>
<td>2.0</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>0.3</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>10</td>
<td>12.0</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.3</td>
<td>0.7</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>CaO</td>
<td>0.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Trace Elements</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.5</td>
</tr>
</tbody>
</table>

The values given herein are typical average values obtained in accordance with accepted test methods and are subject to normal manufacturing variations. They are supplied as a technical service and are subject to change without notice. Therefore the data contained herein should not be used for specification purposes. Check with your Thermal Ceramics office to obtain current information or a Compliance Data Sheet where guaranteed property specifications are required.

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