Dear Friends,

Indian Union Budget for 2015-16 was presented on 28th Feb, 2015 and widely considered as a balanced budget with focus on growth. Budget forecasts GDP to be 8.0 to 8.5. For the industry it’s encouraging to see Government setting aside Rs. 70,000 crores for infrastructure development and if this is translated to real action, core sector industries like steel and cement should grow rapidly. GST implementation would be another progressive step forward to be effected from FY 2016-17.

We expect that growth will pick up in the next few months putting pressure on refractory industry to offer high performance products that would reduce the down time of furnaces as well as specific consumption of refractories.

Kerneos Team participated in the 4th International Conference on Refractories at Jamshedpur and presented a technical paper on CMA 72 – the unique Calcium-Magnesium-Aluminate binder that offers superior thermo-mechanical properties to castables in addition to increased corrosion resistance and penetration resistance to molten metals and slags. This product has already generated huge interest in the global markets and considering the fast growing demand, we are planning to start producing CMA 72 in our plant in China besides that in France.

Continuing our customer interaction and education programs, we are organising another Regional Workshop at The Gateway Hotel (Taj Group), G.E. Road, Raipur on the “Present and Future of High Performance Refractory Castables” on 22nd April 2015. We are honoured to have Mr. Y. K. Degan, Executive Director (Works) of SAIL - Bhilai Steel Plant to inaugurate the program. Mr. N.K. Pal, General Manager (Refractory) of SAIL – Bhilai Steel Plant and Mr. S.K. Garai, General Manager of SAIL – SRU would be our Guests of Honour. We have received encouraging response from the refractory producers in Central India for the program and are looking forward to having fruitful exchange of ideas during the day’s proceedings. Some of the topics that would be discussed at length during the workshop would include (a) Common issues and problems faced while producing and applying castables (b) Optimising bond system of castables - cement, alumina, silica fume (c) Effective use of additives in low cement castables (d) Testing method and quality assurance of CAC and Castables and (e) Designing castables for precast shapes in ladles.

I would like to take this opportunity to personally invite you for the one day program in Raipur as per details given above. Advance registration is a must and for any additional information on the workshop, my colleagues Mr. Prasanta Dutta (prasanta.dutta@kerneos.com) or Dr. Goutam Bhattacharya (goutam.bhattacharya@kerneos.com) may please be contacted.

This issue of Secar® Gazette covers among other regular columns, a technical article on Improved castable designs for aluminium industry.

Segi P. Idicula, Managing Director Kerneos India & Middle East Operations
**Market Pulse**

**UNION BUDGET PROPOSAL 2015-16 IS MILDLY NEGATIVE FOR THE STEEL SECTOR**

Steel production growth has been declined from 3.46% in 2012-13, 0.56% in 2013-14 to 1.4% in first nine months (April-December) of 2014-15. Finished steel consumption has been grown at a rate of 8.6% between 2001-02 and 2011-12. Declining growth was mainly due to general slowdown of Indian economy coupled with raw material availability issues. Overall industrial growth declined to -0.2% in 2013-14 from 5.3% in 2009-10. Iron ore production declined from 218.6 MT in 2009-10 to 152.4 MT in 2013-14.

GDP growth rate declined from 8.6% in 2009-10 to 4.7% in 2013-14. Exchange rate went up to Rs.61.02 / US$ from Rs.47.40 / US$.

Under such economic scenario, it is a challenge to make projections for future steel demand. However, the new Central Government proposed Union Budget 2015-16, expecting GDP growth between 8 to 8.5%, with a mixed impact on steel industry.

The steel sector is competitive as reflected by ranking of six of Indian steel companies among the top world class steel companies as per the ranking of World Steel Dynamics. This competitiveness is threatened by unrestrained dumping of steel in India. Japan, Korea, China and Russia together constitute over 70% of imports into India.

The following announcements have been proposed in the Union Budget 2015-16 which directly gives impact on steel industry:

- The tariff rate of basic customs duty on iron & steel and articles of iron & steel, to be increased from 10% to 15%.
- SAD on melting scrap of iron & steel including stainless steel scrap for melting is to be reduced from 4% to 2%.
- Basic customs duty on metallurgical coke is to be increased from 2.5% to 5%.
- Import duty on coking coal to be exempted from 2.5% & 2% CVD.
- Import duty of Iron ore may be brought down to zero from 2.5%.
- Customs duty on steel grade limestone and dolomite are to be reduced from 2.5% to nil.
- Customs duty on all key raw materials like Ferro Nickel, Ferro Niobium, Ferro Vanadium, Ferro Titanium and Ferro Moly (used in the production of stainless steel) are to be reduced to zero.
- Import duty on electrodes and refractory materials may be reduced to nil from 7.5% and 5% respectively.
- Steel should not be a part of free trade agreement.

Union Budget proposal 2015-16 is mildly negative for the steel sector. However, the promise to spend Rs.1.25 lakh crore on infrastructure will improve the domestic demand scenario for the steel sector. Further the proposed completion of 1 lakh km road and to build another 1 lakh km in coming years, target of 20 million houses in urban areas and 40 million in rural India by 2022 will provide impetus to steel industry.

**Tech Edge**

**Technical News:**

Kerneos participated in the 4th International Conference on Refractories (ICRF) on 3rd & 4th February 2015 at Jamshedpur, India which was organised by the Indian Ceramic Society, Jamshedpur Chapter and Tata Steel Ltd. Dr. Goutham Bhattacharya presented the following paper in the conference.

“Novel Calcium Magnesium Aluminate Bonded Castables for Steel and Foundry Ladies.” By G. Bhattacharya*, C. Wohrmeyer; J.M. Auvray; B. Li; H. Fryda; M. Szeplizdyn

*Kerneos, Kolkata, India.

**Kerneos Corner**

“Fellows” by Indian Institute of Ceramics on 2nd February, 2015. Both of them are associated with Kerneos since inception of the Indian subsidiary at Kolkata in 2008. Prasanta Dutta's graduate Ceramic Engineer with 30 years of experience in the field of refractories & metallurgy, while Dr. Goutham Bhattacharya is Ph.D from University of Sheffield in Material Science and Engineering with 17 years experience in the field of refractories, Calcium Aluminate cement and building chemistry.

Congratulations!

We are happy to inform you that our team members, Prasanta Dutta & Dr. Goutham Bhattacharya have been elected as "Fellows" by Indian Institute of Ceramics.
Introduction:

Aluminosilicate castables, which are widely used in aluminium transformation furnaces, are prone to chemical reactions between molten aluminium and the refractory lining. In order to overcome these problems, additives such as BaSO_4, CaF_2, AlF_3, ZrSiO_4 and some glass frits are normally added in castables [1,2]. The effect of these additives varies with firing temperature. It has been shown e.g. barium sulphate is effective for firing temperatures up to 1000°C, while the performance of CaF_2 appears after firing at higher temperatures [2]. The level of additive additions to the refractories usually varies from 0.5 to 6 wt.-% [3]. The detailed action mechanisms of the additives are still under debate [4]. Many authors believe that the root cause is due to a non-wetting effect of e.g. BaSO_4, and thereby a reduction of aluminium penetration into the monolithic refractory product [5]. However, this explanation is challenged with contact angle results in presence and absence of BaSO_4 [6]. Hence, it might be possible that the non-wetting may not be the correct explanation for the improvement of refractories by barium sulphate additions. One alternative root cause is the formation of BaO•6Al_2O_3 or BaO•Al_2O_3 that fill the refractory pores and channels, thereby reducing the penetration of molten aluminium. Since large-scale production of aluminium is done world wide by electrolytic reduction of aluminium oxide in molten cryolite (Na_3AlF_6) at a temperature of 950°C to 980°C, many corrosion studies focus also on cryolite attack. It has been shown that the cryolite resistance depends on the permeability rather than on the chemical composition of the refractory microstructure [7]. The present study aims to elucidate the impact of different castables.

Experimental:

The compositions of the hydraulic castables are given in Table 1. All castables are based on bauxite. For the castables M2 and M4 the cement content is threefold the cement content of M1 and M3 to achieve the same total CaO content in the castables as CMA 72 (CMA) contains only 10 wt.-% compared with 30 wt.-% in SECAR®71 (CAC). Besides reactive alumina all test recipes contain polycarboxylate ether (PCE) based Peramin® AL 200 & AL 300 in order to deflocculate efficiently. Polypropylene fibres are added to all castables to facilitate the dry-out. M3 and M4 castables contain barium sulphate (5 wt.-%) which has a d 50 of 15.6 μm. The necessary water addition for the barium sulphate containing castables to reach a certain consistency is slightly higher when compared to the others. From the M1 – M4 concretes, crucibles and covers were prepared after prefiring for 5h at 1000°C.

Table 1: Castable composition

<table>
<thead>
<tr>
<th>Raw Material</th>
<th>M1 without BaSO_4</th>
<th>M2 without BaSO_4</th>
<th>M3 with BaSO_4</th>
<th>M4 with BaSO_4</th>
</tr>
</thead>
<tbody>
<tr>
<td>RK – Bauxite</td>
<td>63</td>
<td>63</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Reactive Alumina</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>BaSO_4</td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Spinel AR 78</td>
<td>23</td>
<td>11</td>
<td>23</td>
<td>11</td>
</tr>
<tr>
<td>Secar® 71</td>
<td>6</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>CMA 72</td>
<td></td>
<td></td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Peramin® AL 200 &amp; AL 300</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>PP Fibres</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Water</td>
<td>5.7</td>
<td>5.7</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 2: Chemistry of Al7075 alloy in wt.-% (Δ = Al+0.15others).

<table>
<thead>
<tr>
<th></th>
<th>Si</th>
<th>Fe</th>
<th>Cu</th>
<th>Mn</th>
<th>Mg</th>
<th>Cr</th>
<th>Zn</th>
<th>Ti</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secar®71 + BS</td>
<td>0.4</td>
<td>0.5</td>
<td>1.2 - 2.0</td>
<td>0.3</td>
<td>2.1 - 2.9</td>
<td>0.18 - 0.28</td>
<td>5.1 - 6.1</td>
<td>0.2</td>
</tr>
<tr>
<td>CMA 72</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

The inner diameter of the crucibles was adjusted to 25 mm. The crucibles were loaded with an 80:20 wt.-% mixture of cryolite/Al7075 alloy (Table 2). The loaded crucibles were heated in an electro oven with 5K /min. to a temperature of 950°C. This temperature was held for 72h before cooling to room temperature.

Results:

The crucibles loaded with a 80:20 wt.-% mixture of cryolite and Al7075 alloy after 72h of corrosion test at 950°C (Figure 1) showed significantly higher infiltration and corrosion for castables without BaSO_4 (M1 & M2) than those with BaSO_4 (M3 & M4).
M4), which showed almost no infiltration. Also, the corrosive mix of cryolite and Al7075 alloy did not stick to surface of the BaSO₄-containing castables. Castables without BaSO₄ (M1 & M2) develop higher compressive strength up to 1000°C (Figure 2), which may be related to higher water addition for the castables with BaSO₄ (M3 & M4). Castables with BaSO₄ (M3 & M4) after drying 24h at 110°C show higher open porosity due to higher water addition compared to corresponding castables without BaSO₄ (M1 & M2). After heat treatment, however, open porosity values show hardly any difference among different castables (Figure 3). However, permeability values differ significantly. Castables without BaSO₄ (M1 & M2) develop lower permeability than those with BaSO₄ (M3 & M4) and also CMA 72 based compositions develop lower permeability (M1>M2 after 6h at 900°C and 1000°C and M3>M4 from 800 to 1000°C) (Figure 4). Similar open porosity with different permeability indicates difference in pore size distribution, which is confirmed by Hg intrusion porosimetry (Figure 5 & 6) after 5h at 1000°C. CMA 72 based compositions develop microstructure with smaller pores with lower permeability, which supports less penetration and corrosion.

**Conclusion:**
Castables without BaSO₄ (M1 & M2) show significantly higher penetration and corrosion compared to the castables with BaSO₄ (M3 & M4) against 80:20 wt.-% mixtures of cryolite and Al7075 alloy after testing for 72h at 950°C, although the open porosity values of all castables after firing are almost similar. The permeability of castables with BaSO₄ (M3 & M4) is higher than those without it. CMA 72 based compositions develop lower permeability (900°C and 1000°C) and pore size in both types of castables with BaSO₄ and without (M1>M2, M3>M4). Small pore diameter together with presence of BaSO₄ makes composition M4 probably the contender for the best application performance.

**References**