HORIZON

OCL India Refractory Newsletter

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OCL CHINA LTD

With a view to tap the raw material and keeping pace with steel demand, OCL refractories started its first overseas venture by setting up a plant at Da Shi Qiao, in Liaoning province of China. The 20,000 mt capacity plant is manufacturing Magnesia-Carbon bricks for use LD Converter, EAF, LF. This is a big feather in our cap, as the plant will address the need for techno-economic supplies to our customer. Bricks from here will be exported to India and other Asian countries in near future.

WHAT'S THAT !!!

India third biggest CO_2 emitter in World

India is the third biggest emitter of CO_2 in the world, with state-own NTPC topping the list of companies belching the deadly gas, according to new data released by a Washington-based think tank, which has advocated an energy revolution in the country based on solar power. The Centre for Global Development (CGD) said India figures at the third position in the list (through power generation) after China and the USA.

From Editor's Pen

The Olympic in China was spectacular as never before. It brought all round glory to China coupled with growth. But the woes of refractory industries are far from ever. The echoes of steep hike in raw materials price especially, BFA, Bauxite, Coke are still lingering and immediate relief is a mirage. In some cases BFA prices have beaten that of Tabular Alumina. Wow! Inspite of the financial crunch, inflation and talks of global economies slow down, the world steel market will remain strong and global steel making capacity will rise from 1560 million ton (Mt) in 2007 to 1849 Mt in 2010 according to OECD (Organization of Economic Corporation & Development). Even Mr.L.N.Mittal sees steel demand growing between 3 to 5 percent. Such growth would require additional steel production between 50 Mt and 70 Mt per year. Because of such forecast, steel producers have started hectic activity to gain direct control over raw materials especially iron ore and coal from Australia to Africa. All these are good news for refractory industry. A spate of big projects and high steel demand is keeping us busy. Scarcities of raw materials have pushed the prices up, but not the margins, as the volumes speak. But the financial melt-down will keep us in tenterhooks for sometime. If it persists, might lead to reversal of projects and that means inventory and capital blockade. Though maintenance requirements may not be immediately affected but delayed shipments will not augur well in volatile markets. OCL products continue to shine. TN-80 slide gate mechanism made a good debut at VSP. Export of special products is on the rise. The launch of Technical Service Centre & e-Newsletter has made our connect with our customers more meaningful. Invited scholars from reputed institutes have joined the momentum of development to keep us ahead. Till the next issue we hope to see the current crisis weakening and economies back to gear. So long.

Sk. Bashir Mohammed

WHATS INSIDE

ON THE INDIAN STEEL FRONT…

SAIL to raise hot metal production capacity

SAIL plans to enhance its hot metal production from the base level of 14.6 Mt to 26.2 Mt per annum by 2011. SAIL is poised to make its mark globally in the years to come with implementation of state-of-the-art clean & green technologies as part of its modernization & expansion plans to increase its hot metal capacity to over 26 Mt by 2011 & 60 Mt by FY 2020, SAIL Chairman Mr.S.K.Roongta said in its annual report.

NMDC to invest 12,000 Cr in Chhattisgarh

National Mineral Development Corporation (NMDC) will invest about Rs.12, 000 Cr to set up an integrated steel plant in Chhattisgarh with an annual capacity of 3 Mt.

Compiled by Dr J K Sahu

ON THE GLOBAL STEEL FRONT…

» ARCELOR MITTAL plan to build two steel plants in Indonesia with a total investment of US$ 6 billion in Parsuran, East Java and Banten Province. Each plant will have capacity of 2 Mt. Land has already been acquired for the purpose

» KRAKATAU STEEL – Indonesian largest steel maker, plans to invest $ 1.2 billion to double capacity to 5 Mt of flats and coils by 2012. It includes a Mt to make thicker sheets used by ship-builders

» ARCELOR MITTAL claimed to have spent $ 522 million towards safety and environmental measures in 2007. It has invested US$ 214 million for R&D related to environment including products for renewable energy market. It has increased use of high strength steel for construc tion and automotive sector, which helps in cutting down CO_2 emission

» Export volume pitched up in ASEAN countries since 2003 to reach 12 Mt in 2007 with annual growth rate of 8.7% for 1998 to 2007. Malaysia being the largest exporter of 4.4 Mt in 2007 closely followed by Singapore at 2.8 Mt

» TATA STEEL – World's sixth largest steel maker signed an agreement with VnSteel (Vietnam Steel Corporation) and VICem (Vietnam Cement Corporation) to build 4.5 Mt steel unit valued at $ 5 billion steel complex. The first phase will come up… in 2008-2011 and the third plant will last upto 2015. Tata Steel will hold 65% stake and 35% will be held by VnSteel & VICEM. It will be located at Vung Ang Economic Zone in Central Province of Han Tinh

» CHINA'S steel export rose by 38% to hit a record high of 7.21 Mt in July driven by higher interna tional prices. But it imported 269.6 Mt of iron ore in July, an increase of 21.8% year in year basis

THE RUSH FOR …IRON (M)ORE

With worldwide focus on expansion and capacity building, hectic activity is on for consolidation of iron ore security by all the major players including Arcelor Mittal as they are stepping up takeover of coal and iron ore mines to combat record commodity prices. Contract iron ore prices gained as much as 97% this year. Price of iron ore pellet from Brazil, Chile, and India doubled this year. With high price negotiated by Australia in iron ore,China is likely to trigger a shake up in its iron ore base. More news in this line follows:

» RIO TINTO LTD is on the verge of take over by BHP Billiton for a record US$ 153 billion. The merged company will provide more products, more quickly, claimed BHP Billiton. Among them they have roped in most iron ore contracts with European Steel Makers with increase upto 66% for fines and 96.5% for lumps

» POSCO, largest steelmaker from South Korea is negotiating with North Korea to purchase more coal and iron ore to meet rising demand and costs

» ARCELOR MITTAL–which makes about 9% world's steel is developing iron mines in Senegal and aims to control 80% by 2015 of the ore it uses compared to 45% currently. It has bought stakes in US & Australia. The company will maximize its production in Liberia, Senegal and Mexico. It has signed an MOU for iron ore reserves in these countries

» CHINESE FIRM (CMEC) has signed agreement to develop iron ore at Belinga, in Africa to access 30 Mt annually

» CHINA'S iron ore import reached 350 Mt in 2007, compared to 326 in 2007, inspite of the fact that it remains world largest iron ore producer. Its import is expected to exceed 625 Mt by 2012

» INDIA exported iron ore to the tune of 100 Mt in 2007-08 compared to 93 Mt in 2006-07. There has been a slow down in export as annual growth rate has fallen from 29.1% in 2003-04 to 4.2% in 2006-07. 80% of the exported ores are fines and China receives 80% of total iron ore exports

Facts & Figures

GOLDMINE…

We in India are sitting on a virtual gold mine of huge iron ore deposits. Total reserves of iron ore have been estimated to be over 85 billion ton (bt). This consists of 14.63 bt of hematite ores of which 7 bt is categorized as reserves. Reserves of magnetite ore are only 207 Mt with the rest 10.4 bt classified as remaining resources. These have been mostly estimated upto a depth of 50-60 m or more. At current prices, it will be surely economical to mine deeper. Haematite with 55% Fe are not categorized as reserves and resources. Current technology of beneficiation and iron prices provide sufficient economic value to process ore with much less Fe content. In that case reserves and resources will rise further. Our steel industry can remain comfortable with domestic iron ore supplies even with annual exports of 100 Mt till 2070 at current reserves. As per 11th five year plan, demand is set to rise to 130 Mt by end of theplan and the consumption of scrap to be 18 Mt. To increase domestic availability, government has imposed a 15% duty on export. With the iron ore prices doubling

and global steel producers scurrying to corner as much iron ore for long-term security, it is time to realize the gold mine we are sitting on.

Compiled by S B Mohammed

LAUNCHING CEREMONY OF TECHNICAL SERVICES CENTRE & E-NEWSLETTER

5th August 2008 was an event-making day for refractory division of OCL INDIA LTD, as the division launched the first ever-electronic newsletter and technical service centre, in presence of President Syt. R H Dalmia, a senior official from MECON, Shri D D Atal-ED (Cement Works), Shri J N Tiwari ED (Refractory Works), and a host of officials. The concept of e-newsletter and Technical Service Center has been evolved to enhance technical interactions with customers as refractory technology is making noteworthy strides along with metal processing industry esp. in iron and steel. The technical service center will take care of all issues and problems in a novel format and a rush team has been formed to reach out to customers on top priority. In this process OCL Refractory division has gone ahead with a new-connect with global refractory and steel industry. With a click of the mouse by the President and ED (Cement Works) the information about Technical Service Center and e-Newsletter was transmitted to customers all over..

TECHNO-FRIENDLY

Effect of bauxite based ß-SIALON on properties of Al_2O_3 Castables

Non-oxide ß-SIALON has higher conductivity, lower expansion coefficient, higher hot strength, good thermal shock resistance. Thus composites of SiALON and oxides possess much better strength, corrosion against metallurgical slags and oxidation resistance than that of carbon bonded materials.

The effects of bauxite-based ß-SIALON have been studied on bauxite-based ultra low cement castables. On addition in matrix the following developments are observed:

- HMOR is increased at 1300°C from 1.2 MPa to 5.2 MPa
- Thermal shock resistance is remarkably improved as noticed in Residual strength ratio at 1200°C difference, which improves from 52% to 91%
- Critical temperature difference (ΔTc) is higher, 800°C compared to 600°C of oxides, as mea sured from changes in MOR after thermal shock at temperature difference from 400°C to 1300°C. These properties are attributed to the following:

1. In glassy effect, ß-SIALON fines instead of partial bauxite fines would lead to decrease the amount of glass, which may lead to increase in high temperature strength
2. In crystal effect, the mineral phases of baux ite castables after firing are corundum and some mullite with many micro-crevices needle-like or fibrous ß-SIALON crystals that fill in the corundum skeleton structure thus enhancing the strengthening and toughening effect

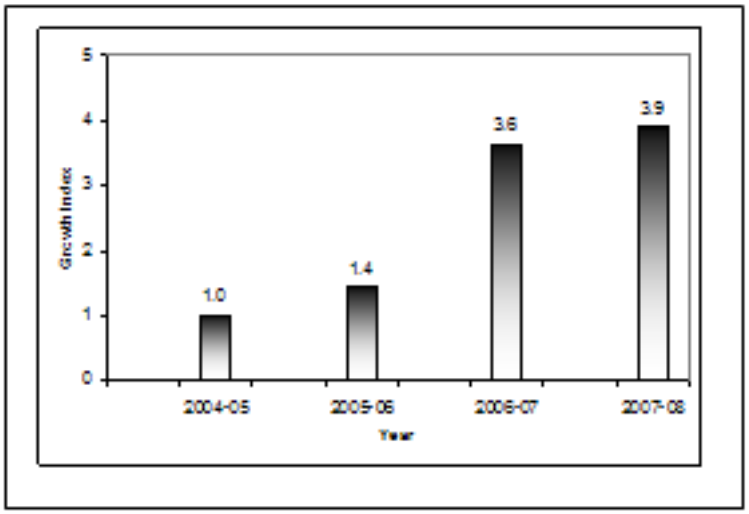
With above properties ß–SIALON will prove quite effective in enhancing performance of BF runners for iron-making and reformers in petrochemical industries.

Compiled by S B Mohammed

SPEAKING FOR ITSELF...

Export of Castable & Precast product

All of our special products continue to display an uptrend in growth in export market. Along with Concast refractories & Slideplates, Castable & Precast products have also joined the party.



TN-80 Slide Gate Mechanism

The TN80 Slide gate mechanism, the details of which were covered in our July issue, has come out successfully in 150-ton ladle at Visakhapatnam Steel Plant. The mechanism not only performed satisfactorily, but the plates also gave maximum 4 heats so far. The system has an inherent advantage of high degree of safety over the existing one.

Flow Modifier-Turbo Stop

With the ongoing thrust on flow control, OCL has launched a new flow modifier at Visakhapatnam Steel Plant. The high Al_2O_3 precast fitted in the 27 ton Tundish performed full sequence of 6 hts, with required dynamics of flow control. The very less skull formation was appreciated by the customer.

MgO-C bricks for LD-Converter

OCL MgO-C bricks gave a record life of 1523 heats at SMS-I of Bokaro Steel Limited. This is by far the highest life here, for any supplier.

Direct-bonded Mag-Chrome bricks

OCL Direct-bonded Mag-Chrome bricks gave a life of 164 heats in Platinum furnace in one of the UK based-plant. This being double the life achieved with the bricks of our competitor.

Lance for Gas-Stirring at VSP

OCL GS Lance gave the highest life of 437 minutes of stirring in the IRUT treatment , that happens to the highest in 2008.

Desulphurisation lance at TATA STEEL LD1

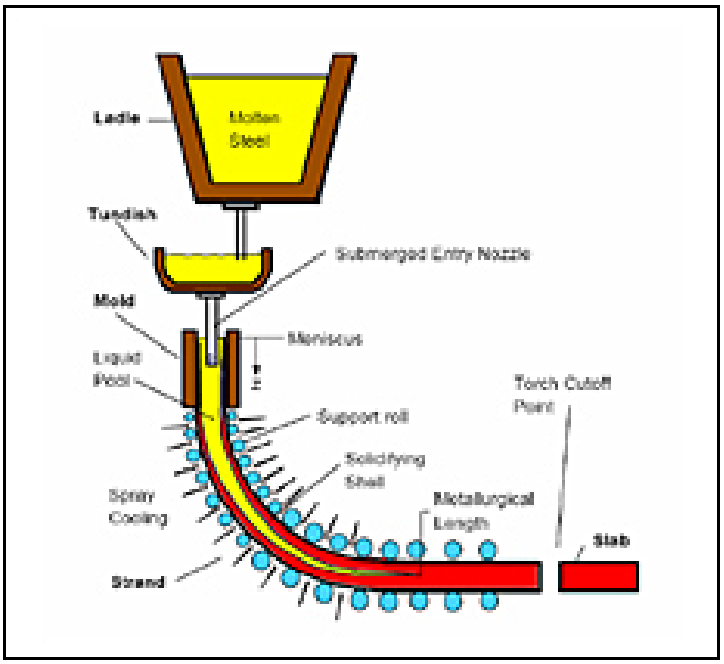
OCL Desulphurisation lances gave an average of 1294 minutes of treatment in September '08 - the highest so far in 2008.

FLOW-VISUALISATION THROUGH SEN BY MATHEMATICAL MODELING

INTRODUCTION

The flow pattern of steel within the submerged entry nozzle (SEN) and at the ports exit mostly depends upon its design. This affects the cast steel quality to a great extent. Mathematical simulation of steady turbulent (K-Є) flow is one way to understand & investigate the influences of the nozzle geometry on flow inside the SEN and the mold.

The design parameters mostly include the shape, angle, height, width, and thickness of the ports and the bottom geometry of the nozzle.



COMPUTATIONAL MODEL

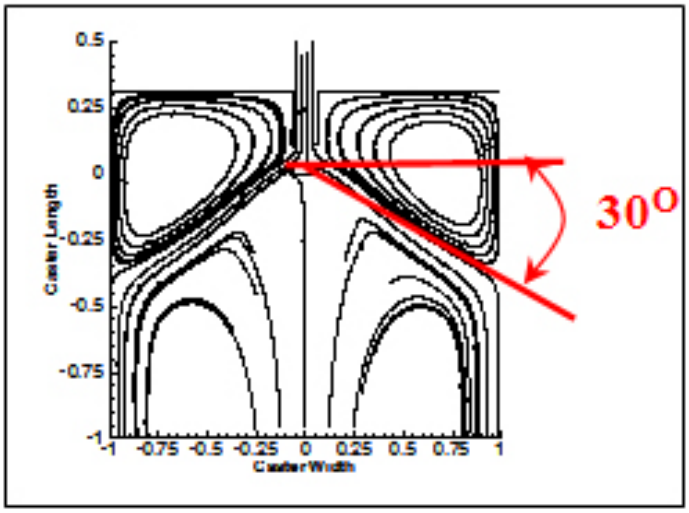
Various computational models are available. A finite volume based model can be used to compute the steady-state turbulent flow through SEN. 2D simulations can be performed with various commercial CFD, standard K-Є turbulence model.

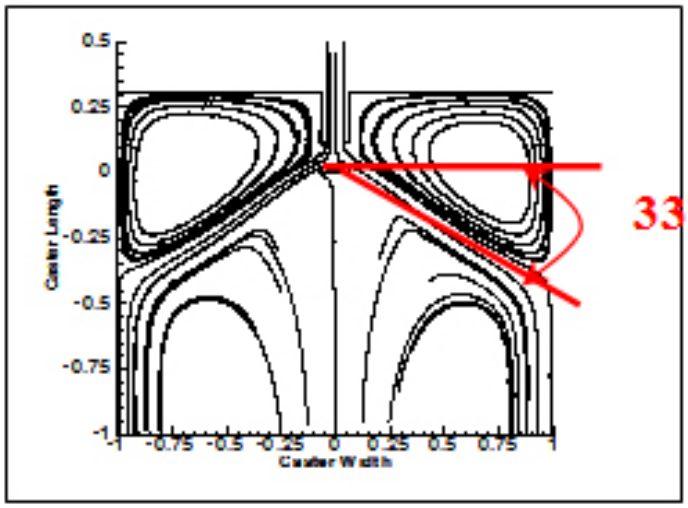
FLUID FLOW

3.1 Jet Angle

When steel flows through a two-port nozzle into the mould, it forms two-recirculation zone called as upper roll & lower roll ("double roll") pattern. The jet characteristics influence the flow dynamics inside the caster. The jet angle is controlled mainly by the port angle, but is steeper with larger port area and thinner walls. Turbulence levels in the jets are higher in smaller ports with higher casting speed. Lower jet speed leads to longer residence time for the inclusions to float up to the meniscus.

Jets at a deeper angle tend to transport more inclusions into the lower roll, encouraging the formation of internal defects such as slivers and blisters. The angle also influences the velocity and the profile of the top surface liquid level. Jets at smaller downward angles are likely to increase the velocity and the liquid level-fluctuations along the top surface, by carrying more fluid and momentum into the upper roll.





3.2 Meniscus Velocity

Excessive fluctuation of the liquid level at the top surface interrupt the steady supply of the molten mold powder into the interfacial gap and cause heat-transfer variations, resulting in longitudinal cracks, transverse depressions and other defects. High local surface velocity across the top surface can shear off the liquid slag into the liquid pool to form harmful mold-slag inclusions, causing skin de-laminations, slivers and other

defects in rolled sheet product. To avoid this problem, the top surface velocity should be kept below the critical maximum velocity of 0.4m/s. On the other hand, if the steel jet is directed too deep, then the liquid surface will have very little motion and will become too cold. This can lead to meniscus freezing. Thus it appears that a good design should have the average top velocity lying in the region between 0.2 and 0.4m/s.

3.3 Port Velocity

Jet emanating from the port decides its momentum. Lower momentum leads to a longer residence time for inclusions to travel to surface. A lower jet momentum also reflects lesser impact of the jet on the narrow face leading to lesser amount of shell thinning and subsequently lesser chances of strand breakout.

3.4 **Effect of mold width**

The jet impinges at successively lower points on the narrow face shell wall as the mold width increases and the jet travels further. With increasing mould width, the jet impinges successively closer to the mould exit & there is a danger of breakout for the wider slabs under these conditions

3.5 Level Fluctuation

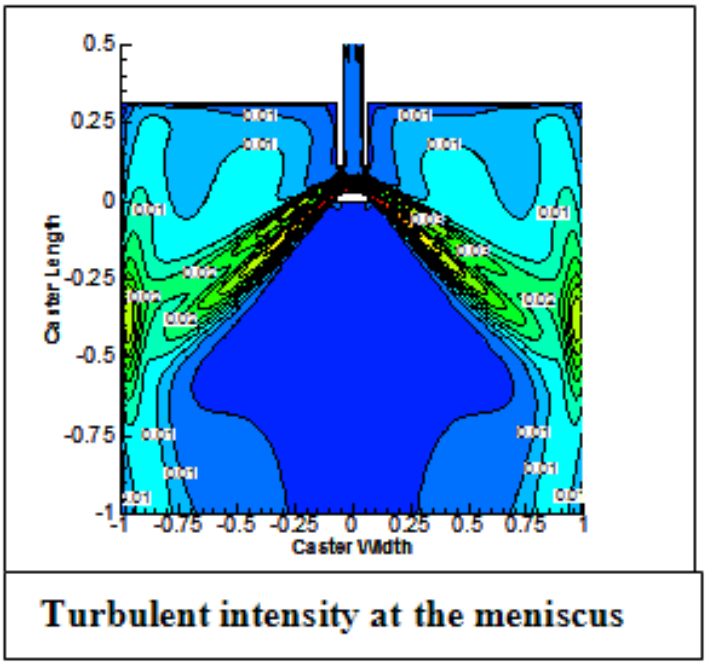
The condition of the meniscus during solidification has a tremendous impact on the final quality of the steel product. Meniscus behavior is greatly affected by the shape of the top “free” surface of the liquid steel, and in particular, the fluctuations in its level with time. This surface actually represents the interface between the steel and the lowest powder layer, which is molten. If the surface waves remain stable, then the interface shape can be estimated from the pressure distribution along the interface calculated from the simulation with a fixed boundary as:

$$h = \frac{P_{surface} - 1_{atm}}{(\rho_{steel} - \rho_{flux})g}$$

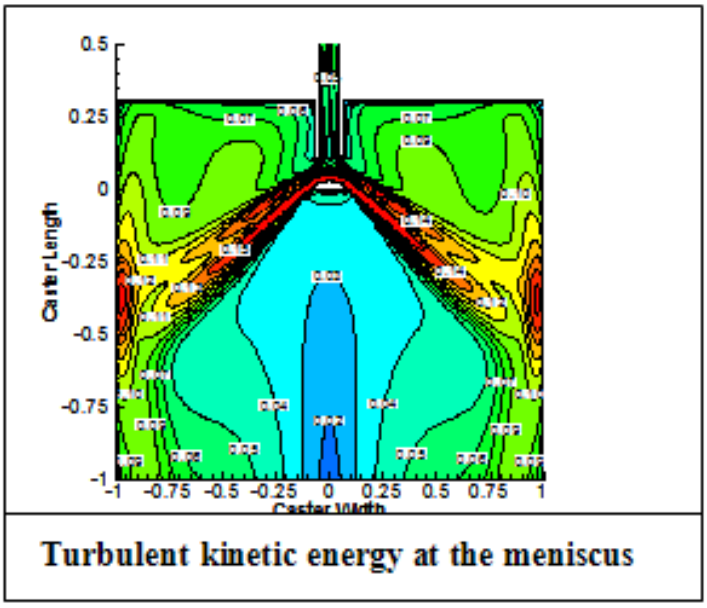
Where, h is the standing wave height

3.6 Turbulent Intensity and Turbulent Kinetic Energy

Turbulent kinetic energy and turbulent intensity gives an idea of the extent of turbulence inside the port and mold region. While a higher turbulent energy and intensity is beneficial for heat dissipation, too high of turbulent intensity near the meniscus may result in slag entrapment.



Turbulent intensity at the meniscus



Turbulent kinetic energy at the meniscus

CONCLUSION

SEN should be designed to deliver steel with the optimum level of superheat to the meniscus while preventing both detrimental surface turbulence and shell erosion or thinning due to excessive impingement of the hot molten steel jets. Accordingly bore size, port angle & its opening size to be designed. Immersion depth is to be considered to get a optimum flow so that the top surface velocity remains in the range between 0.1 to 0.4 m/s.

Compiled by Dr. J.K.Sahu & B Prasad

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