



Horizon

OCL India Refractory Newsletter



VOL : 5

Issue No. 09/03

JULY 2009

WELCOME 2009 !

After a gloomy second half of 2008 which saw one of the greatest downslide in steel fortunes, the industry has bounced back with our home turf taking an upstart in the new financial year. Backed up by improved demand from auto and construction sector, Indian steel production increased by nearly 4 percent to 4.49 million ton in April 09 compared to that in 2008. Tata Steel registered a double digit growth in output at 5 lacs ton plus while SAIL & RINL posted 2.6 percent decline.

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From Editor's Pen

The air of despondency is over and there is a general consensus that the worst might be over and signs of price stability and pick up in demand are evident in steel sector. Pronounced focus by the new government of India on heavy spending in infrastructure has buoyed up the steel sector. Overall picture of growth in capital goods, cement, and auto has led to an optimistic jump in the stock market. However, the export sector remains dismal and may see a fall as high as 29 percent compared to last year. The refractory industry has started looking good with most of projects in steel by SAIL, RINL, and JSW in revival mode. The ambitious expansion plans of SAIL & RINL inclusive of IISCO modernization and the proposed 4 million steel plant by mining major NMDC at Chhattisgarh, will go a long way in boosting volumes and infrastructure spending will facilitate flow of regular business of refractories for maintenance. All these are expected to keep the refractory industry quite busy in the second half of the year, though there is a lull in the export market. The prices of finished refractory are looking up and the raw material prices are maintaining a steady trend. China – the most dominant producer and consumer of steel in the world is also stabilizing fast and demand there could pick up as early as second half of this year. The stimulus package introduced by governments in South East Asian countries will boost demand in second half of 2009, total value of which was 102.1 billion USD. Once again it is the time to look ahead.

Sk. Bashir Mohammed

BRAVO !

The only region to see a slight increase in April crude steel production was Middle East with 0.2 percent rise led by Iran which saw a 3.2 percent increase. Saudi Arabia also saw a 2.7 percent production increase in April 2009.

Editors : Sk. Bashir Mohammed, Utkal Garg, Ashok Sahu, Anupal Sen

Content Coordinators : B. Prasad

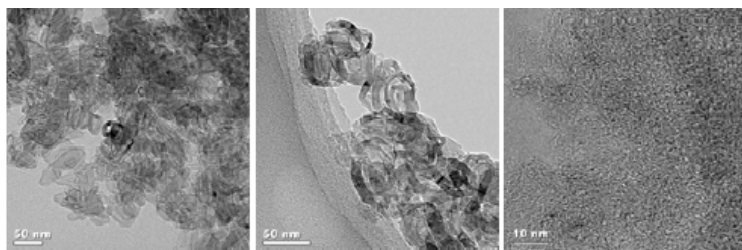
GIVE ME NANO !

Superior properties can be developed in the traditional refractories using nano-size materials, which form nano-structured matrix in the refractory. This results into modification of granulometry, development of desirable phases due to modified reaction kinetics and improvement of physico-mechanical properties.

MgO-C and Al₂O₃-C SN plates are developed by applying nano-structured matrix. Nano-structured matrix can be formed by applying HB (Hybrid Binder) in which nano-carbon particles are dispersed uniformly, HHB (High performance Hybrid Binder) in which the compound graphitized black with B₄C is added and HGB (Hybrid Graphitized Binder) where graphitized black is compounded with B₄C. The corrosion resistance, thermal shock resistance, oxidation resistance, hot strength and fracture resistance of this material are improved.

Special resins are being developed which can form nano-dimensional structure of carbon fibers in the matrix of ZrO₂-C used in the slag line of SEN. This induces the properties like less thermal expansion, excellent mechanical strength and low elasticity. Both the thermal spalling resistance and corrosion resistance are improved due to denser structure.

The improvement of the mechanical properties and the reduction of the firing temperature thus lowering the energy consumption are the main benefits of the use of nano-scaled oxides. The nano materials are very reactive due to their high specific surface area and hence the sintering process starts at very low temperature. The uses of nano-scaled powders in carbon bonded MgO-C refractories are gradually getting momentum. A fully new aspect is the utilization of nano-scaled fumed alumina dispersions as a novel inorganic binder for alumina based cement-free castables. Research is also going on the effective use of nano-zirconia in ZrO₂-C for the slag line of SEN to improve the corrosion resistance.



Nano-size carbon fibers developed from special resin

Fixed carbon of normal phenolic resin

SIGNS OF REVIVAL: GLOBAL STEEL SCENARIO

- » **Essar International Steel** is planning to build an upstream plant in central Kalimantan, Indonesia for HBI which will be integrated with its plant at Cilegan with an investment of US\$ 1 billion.
- » **Indonesia's** state owned PT Krakatau Steel plan expansion for hot rolled coil plant of 2 million ton/year at its work in Cilegan, West Java, in association with POSCO. Currently they are expanding the existing hot strip mill to 2.4 million ton/year from 2 million ton/year and boosting sponge iron production by 250,000 ton/year.
- » **World** crude steel production fell 23.6 percent to 89 million ton in April 09 compared to April 08. Biggest decrease seen in North America, Australia & New Zealand. For the first four months world crude steel production declined by 22.7 percent to 354 million ton. In EU April crude steel declined 48.6 percent, in South America 36.1 percent and CIS by 30.1 percent. In rest of Europe it decreased by 20.4 percent. In Africa by 19.8 percent and in Asia it dropped by 10.8 percent.
- » **Taiwan's Dragon Steel Corp** has started hot commissioning of a Primus recycling plant supplied by Paulwirth which recovers tin and zinc from process waste. The plant treats fine material like dust and sludge from its existing EAF shops and in future will treat wastes from BF, BOF processes.
- » **Japan's Sumitomo Metal Industries** may build a BF based steel plant with Bhushan Steel by investing as much as \$ 3 billion. Sumitomo will hold 30-40 percent stake. The plant would produce semi finished steel products as well as steel sheet starting around 2015. Bhushan is already tied up with Sumitomo Metal as it converts semi-finished products from Sumitomo to steel sheet and sells it to Indian units of Japanese automakers and others.
- » **Australian steelmakers' Vietnam unit Bluescope Vietnam** launched clean COLORBOND steel products for manufacturing facilities as well as curved roofs and walls of structure to tap the local market.
- » **POSCO Vietnam Company's** steel mill project with a capacity of 1.4 million tons a year would be put into total operation in Sept 09. The port for receiving ships is being finalized.
- » **For the first** four months in 2009 crude steel production in Asia declined by 9.5 percent to 231 million ton while EU saw a 44.2 percent decline to 44 million ton. North America came down by 48.5 percent producing 23.5 million ton upto April 09

STEEL INDIA: HARDLUCK

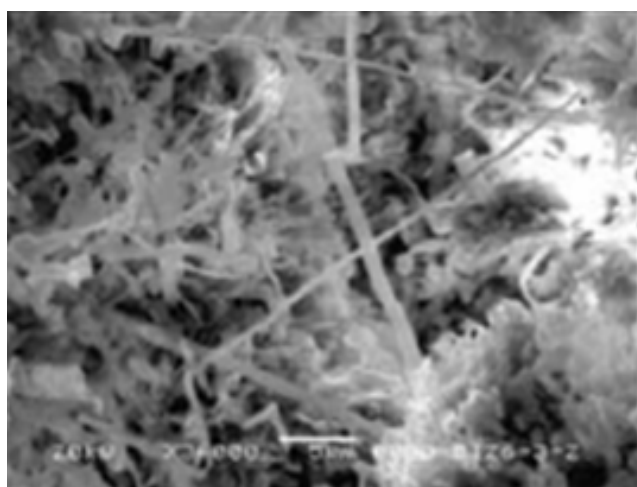
- » **Import of steel** items in April 09 increased by 5.6 percent to 3.8 lac tonne. Export however took a beating and fell by 16 percent to 3.10 lac tonnes

TECHNOLOGY FOR FUTURE

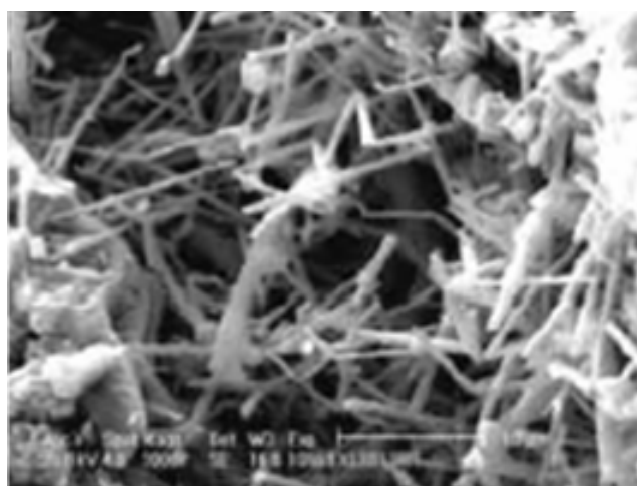
Happy Union : Oxide-nonoxide composites



Microstructure of SiAlON



SEM photograph of fiber-shaped β -SiAlON



Prismatic AlN in Al/Si bearing alumina-graphite materials

The oxide-nonoxide composite materials would develop to be a new family of high performance refractory ceramics for applications at high temperature and severe conditions. These composites possess better hot strength and oxidation resistance than the carbon-bonded refractories and better thermal shock resistance than pure oxide materials. They also have good corrosion resistance against metallurgical slags and alkalis. However, the limitation in their applications lies in their high production cost because of high purity oxides and nitrides used as starting materials. Some recent developments have been done aiming at the reduction of production cost.

SiAlON bonded corundum composites for blast furnace have been produced by reduction-nitridation sintering at high temperature, using bauxite instead of alumina in the matrix. Si metal is nitrided by heat-treating at 1300°C in N₂ atmosphere to form β -Si₃N₄, which combines with alumina to generate SiAlON.

Low carbon Alumina-SiAlON slide plate materials successfully used in the continuous casting of high quality steel have been developed in which most of the graphite in Alumina-C brick is replaced by bauxite based β -SiAlON.

The hot strength and thermal shock resistance of alumina-based castables have been significantly improved by adding β -SiAlON. Needle like and fibrous β -SiAlON crystals interlace in the corundum skeleton structure inducing strengthening and toughening effects.

MOR of Alumina-graphite refractories can be substantially improved by adding composite metal additives of Al and Si and heat-treating at 1300°C in N₂ atmosphere. This will result into in-situ formation of AlN and SiAlON, which will be distributed at the grain boundary and the fracture toughness of the refractory will be improved. Formation of Al₄C₃ leading to hydration and subsequent volume expansion will be totally prevented in this process. This has been successfully applied in slide plates for ladles and tundish.

MgO-SiC-C composites can replace traditional MgO-C refractories in ladles for low carbon steel where carbon pick up can be significantly reduced.

In situ β -Si₃N₄ can be formed in low carbon MgO-C refractories for BOF applications, by addition of Si metal and subsequent nitridation at 1200-1300°C. This will impart improved hot strength and abrasion resistance to the refractory.

Compiled by Anupal Sen

We invite our customers to share their achievements and information regarding their expansion and innovations. We will be proud to publish these in our subsequent editions of newsletters.

DEVELOPMENT OF NANO MATERIALS

A research initiative by

OCL India Ltd & Dalmia Institute of Scientific & Industrial Research Rajgangpur -770017, Orissa

What is Nano material?

Nano materials are those materials, which have particle size in the range of 10 to 100 nano meter (10^{-9} m) with very high specific surface area. These materials include refractory oxides, Non-oxides and metallic composites.

Background

Though research on nano materials has started long back in UK, USA and other part of the world, application of nano materials in refractories has been started in the year 2003 in Japan. Since 2005, OCL & DISIR (Dalmia Institute of Scientific & Industrial Research) have jointly started research work on preparation of nano materials, their characterization and their application in refractories.

Advantages of nano materials

Due to very small particle size and high specific surface area, the nano materials are very reactive and they induce the following properties in the products:

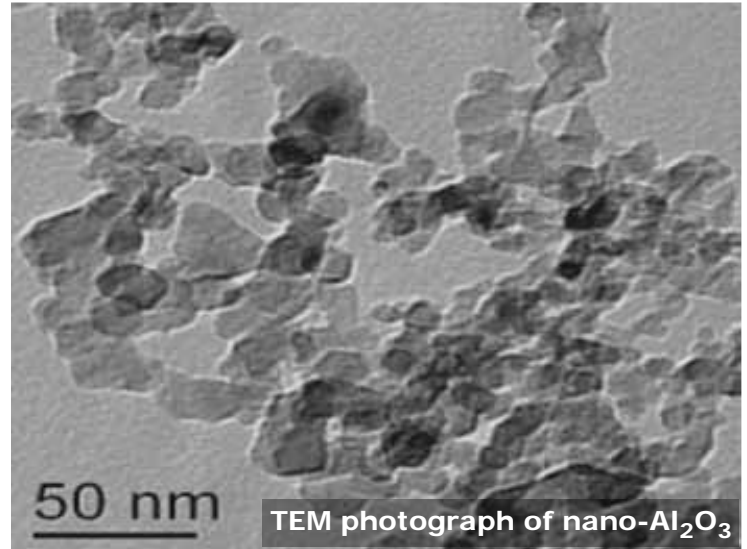
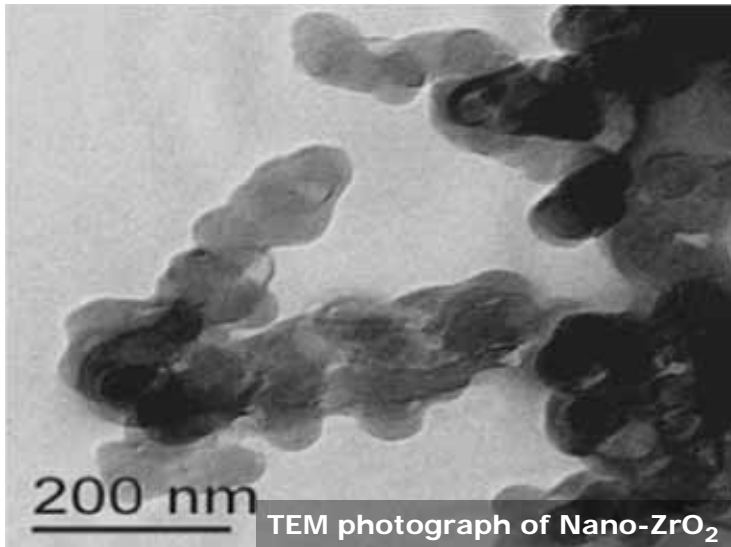
- » It reduces the sintering temperature.
- » It reduces the porosity and increases the bulk density of the material, which improves the different properties like CCS, MOR, HMOR, Thermal shock resistance, erosion and corrosion resistance of the materials.

Development of Nano oxides

OCL & DISIR have prepared each of the following nano materials:

- » TiO_2 (Titanium Dioxide)
- » ZrO_2 (Zirconia)
- » Al_2O_3 (Alumina)

TEM photographs of these synthesized nano-oxides are given below:



Application of nano oxides in various refractory products

Application of the synthesized nano-oxides has been made in following areas.

1. Nano TiO_2 in silica and basic bricks :

Thermal expansion co-efficient has substantially decreased leading to volume stability by incorporating nano TiO_2 in silica bricks.

In Mag-Chrome refractories, high densification is achieved with decrease in AP and increase in BD by incorporation of optimal amount of nano TiO_2

Nano TiO_2 has reduced the sintering temperature of magnesite bricks and comparable physico-mechanical properties have been achieved at lower firing temperature.

2. Nano ZrO_2 in Sub Entry Nozzle.

Nano ZrO_2 has been effectively used at the slag band of SEN, which has reduced the pore size and number of pores to create a uniform pore size distribution in the matrix. This has resulted in high densification which in turn has improved the Corrosion resistance leading to higher life of SEN.

3. Nano Al_2O_3 in high alumina materials, castables and slide gate refractory.

Use of nano Al_2O_3 in Al-C Slide Gate Plates has resulted into high densification, increased hot strength and improved corrosion resistance.

In high alumina castables, CCS has increased considerably with increase in density and decrease in porosity by the application of nano Al_2O_3 in the matrix.

Your comments and suggestions may please be sent to bmohammed@ocl.in

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