IIM Metallurgy Materials Engineering

NEWSLETTER
THE INDIAN INSTITUTE OF METALS
(DELHI CHAPTER)

ANIL GUPTA
Chairman, Delhi Chapter

S. C. SURI
Chairman, Technical & Publication Committee

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INTRODUCTION

This News Letter is containing brief on Annual General Meeting of IIM DC for the year 2010-11 and 1st Executive Committee Meeting for the year 2011-12 held on 25.6.2011.

The News Letter contains the following:

1. Chairman's Message
2. Hindi - Chini Bhai-Bhai (In Corruption) by Shri Raj Tiwari, Immediate Past Chairman, IIM-DC
3. India's Ferro Alloy Industry – A Perspective (Information Extracted from Steel Tech)
4. Revelation of Zn-O dumbbells in facetted nano-particles by Dr. Avanish Kumar Srivastava, Member, IIM
5. Niobium-Bearing Structural Steels for 21st Century by Shri S C Suri, Vice Chairman, IIM DC
6. The News Letter also contains National and International news relating to ferrous & non-ferrous sector

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Chairman's Message

With great humility, I have taken over as Chairman of IIM Delhi Chapter today. Besides me, my colleagues on the new Executive Committee (EC) for the year 2011-12 express sincere thanks to all members of the IIM Delhi Chapter, for reposing confidence in us, to carry out the work forward.

I must mention exemplary performance of last year's Executive Committee. We have been given a very difficult task to outperform them in any manner, with many credits to it for the performance in the year 2010-11. These included many firsts viz. most successful organisation of MMMM 2011 with unmatchable financial surplus and significant participations in the Exhibition cum Conference; a world class Lecture Hall cum Auditorium made ready for organisation of Technical Conferences and meetings, in house. In addition, a dedicated Website for IIM Delhi Chapter was launched this year and technical activities were the highest. The EC also created an Advisory Committee for our Chapter comprising eminent Past Presidents & Chairmen, for guidance.

While applauding the significant performance by previous EC in a number of areas, the new EC would like to take Chapter activities forward by identifying new areas where lot more may be done. In all humility I must mention I see responsibility of Chairman in not having final say in decision making as to what programs and in what manner IIM-DC should operate, but to function as a FACILITATOR to motivate all members to come forward and contribute in terms of ideas, providing services and utilising this platform for contributing to the profession of Metals, Materials, & Metallurgy in innovative manner.

I pray that each one of us put forth at least one idea as well as come forward to pioneer implementation of that idea during this year. On behalf of EC, I assure all considerations, decisions, facilities, services and execution on all positive ideas to make our Chapter a pioneer one.

Delhi and adjoining geographical areas are famous for Small & Medium Enterprises (SMEs), which provide ample opportunity for activities for their benefit. It has been felt during the AGM (held on 04June2011) that lot more needs to be done in developing relations with them to pass on the benefits of knowledge bank available with our Chapter for furthering their interests and growth of this profession. Interaction could be through enrolling them as sponsors, members, participants of various courses, training programmes, skill development or becoming a conduit for technology & serving as knowledge resource bank, consultancy, diversification or even new technology inculcation & adoption. No doubt the existing facilities at `Dhatu Bhawan, Tughlakabad Institutional Area' are excellent. These facilities viz. Conference Room as well as Lecture Hall cum Auditorium shall be available to any individual or Organisation which is engaged in metals, materials & metallurgy profession and is associated with IIM-DC for organising or conducting any of its activities henceforth. IIM-DC shall create requisite back up infrastructure and service set up for its support very soon.

Very many brilliant & innovative ideas have been put forth in the AGM, which deserve serious consideration. The EC meets every last Saturday of the month wherein IIM members are encouraged to bring in their proposals for deliberations. Alternatively Advisory Committee members or EC members can be approached anytime for brain storming on innovative/new ideas or opportunities available to us for giving a boost to our professional activities.

I am committed to develop system support for streamlining the activities so that all new activities can be executed in a manner par excellence.

Please come forward and join us in the rejuvenation endeavour of our Chapter.

4th June 2011

Chapter News

Annual General Meeting

The 59th Annual General Meeting of IM Delhi Chapter for the year 2010-11 was held on Saturday, the 4th June 2011. Election of Executive Committee for the year 2011-12 was held. The list of the EC members for the year 2011-12 is as given below:

The final list of Executive Committee for the year 2011-12

1.	Mr. Anil Gupta	Chairman
2.	Mr. S C Suri	Vice Chairman
3.	Mr. K L Mehrotra	Vice Chairman
4.	Mr. V C Singhal	Hon. Secretary
5.	Mr. G Mishra	Jt. Hon. Secretary
6.	Mr. G I S Chauhan	Jt. Hon. Secretary
7.	Mr. Manoranjan Ram	Jt. Hon. Secretary
8.	Mr. Neeraj Gupta	Hon. Treasurer
9.	Mr. Ram Chandra	Jt. Hon. Treasurer
10.	Mr. P K Chatterjee	Member
11.	Mr. B D Jethra	Member
12.	Mr. V K Tyagi	Member
13.	Mr. R K Gupta	Member
14.	Dr. G N Mohanty	Member
15.	Mr. Raj Tiwari	Member
16.	Mr. M Saravanan	Member
17.	Mr. A C R Das	Member
18.	Mr. M P Sharma	Member
19.	Dr. A K Srivasava	Member

Advisory Committee Members for the year 201-12

1. Mr. L. Pugazhenthy
2. Mr. B R Thukral

Invitees for the year 2011-12

1. Mr. V Atul
2. Mr. K K Khanna
3. Mr. N Vijayan
4. Mr. V N Grover

Executive Committee Meeting

The first Executive Committee meeting of Delhi Chapter for the year 2011-12 was held on 25.6.2011. Different committees for MMMM 2012 were constituted. The details of the remaining activities in the IIM-DC lecture hall were also reviewed during the EC deliberations.

Steel Structures in India – Advancing towards Sustaining Growth

A Technical Conference titled "Steel Structures in India – Advancing towards Sustaining Growth" was held at Pragati Maidan, New Delhi on 23rd & 24th June 2011. Along with the conference, a Technical Exhibition was also organized by Metal Building & Steel Structural Organization.

The following members of IIM-DC participated in the conference deliberations:

1 Mr. Anil Gupta
2 Mr. S C Suri
3 Mr. G I S Chauhan

HINDI-CHINI BHAI-BHAI (IN CORRUPTION)

Raj Tiwari
Immediate Past Chairman
IIM Delhi Chapter

I am indebted to Mr. Gilbert Etienne on whose article this note is based. (You have just read first sentence as an example of corruption.)

Corruption is Omni present. Its existence can be realized in all the countries of the world. It is next to GOD or SAITAN (exact choice is difficult to make as it all depends on beneficiary by it). Most of the godmen are involved in creating it, some are involved in fighting the Govt. against corruption. I think corruption was born with Adam and Eve. Both used corruption tools to come near to each other. Let me come back to my title of this write up to compare HINDI – CHINI corruption**.**

HISTORY: In modern historical days, corruption was highly criticized by great philosopher Mr. Confucius in China. (It is my strong belief that the word confusion was taken from his name). In Indian history Kautilya has denounced corruption strongly. (Kautilya is name of Chanakya, this is for information). However, in history of China it is also mentioned that Chinese emperor KANGXI raised the wages of civil servants in order to reduce corruption. (But in India inspite of various pay commissions and its benefits, our Babus remain unsatisfied, so this historical Chinese method of increasing wages is not a remedy towards reducing corruption).

PRESENT: In India in the year 1947, Dr. S. Radhakrishanan has said "Unless we destroy corruption in high places, nepotism and black marketing, we will not be able to raise the efficiency in administration." This means corruption was also during British Raj and subsequently after independence due to licence Raj of 1970 it had spread its wings. The irony of events is that our late P. M. Mr. Rajeev Gandhi had severely condemned corruption during congress centenary in DEC 1985 but some big scandals occurred during this period. This year our president declared on Republic Day that "Corruption is the enemy of development and good governance". (Or those who bring in open the cases are treated as enemy). But common wealth, 2G, Adarsh has done by political party in power and its people. (Opposition do not get chance so they only shout and as soon as they come in power they also get involved in corruption). So our political leader prove without doubt that corruption is game of opportunity.

In China, corruption which was at its peak during the final years of the Kuomintang was severely reduced during Mao Zedong. It literary exploded again with new regime of Xiaoping at the end of 1978. He has said, "When you open the windows, you cannot prevent mosquitoes and the flies entering with the fresh air". (What a practical thinking!!!!!! He was deserving Nobel prize for such nobel thought). Again during episode of Tiananmen Square in 1989 corruption was criticized. However, the corruption was going north in China. It was never controlled in spite of the fact that subsequent President and P. M always denounced it. President Jiang Zemin declared "Corruption is like a virus which threatens to undermine our political stability." Since then, at a every session of Parliament, corruption is denounced by President Hu Jintao and Prime Minister Wen Jiabao. Here, you will notice the similarity between the statements made by our P. M. + Chairperson of UPA and their equivalents in China. So we brothers think alike.

ACTIONS: Compared to India, China being a communist country take fast actions on corrupt officials. On the other hand in India, corrupt leaders or officials become heroes.(There activities in a jail is also remains in news. Our news channel even gives you details about their cell in Tihad Jail including commode). From the year 2002 to 2005, in China, 30,000 civil servants were sentenced for corruption. Some were also executed. In 2003 in China, 792 Judges were prosecuted. In 2008, in China, 41179 officials were under investigation.

However, there is no fall in corruption in China in spite of these strict actions. Compared to this, in our

beloved country, only 163 senior civil servants have been charged with corruption since 1992. Most of them continued in their jobs. Some of them got promotion. As per RTI filed in 2008, even cases from 1997 were not settled. We always give fair chance for improvements to our own Indians. Our positive thinking improves them to collect more money in liquid or asset. This line of action creates better corrupt investors in India who invests in property, in share market, in mutual funds and some of them do business with foreign banks. In some cases, corruption in our country contributed in the enhancement of next young generation who complete their education overseas. Ultimately the black money earned in this country is used again and again and kept in rotation by spending on physical assets or future citizens of India. Even some of them use it for buying the luxury items. In short our corrupt fellows are contributor to Indian economy. So compared to China we are more positive in thinking by prosecuting corrupts through delayed justice technology.

Indian Ferro Alloys Industry – A Perspective

Industry Profile

The Indian Ferro Alloys Industry, a part of the core sector is engaged in supplying crucial intermediates to the steel industry. The Indian Ferro ally industry was established during the Second Five-Year-Plan, as an ancillary industry to cater to the growing needs of the domestic steel industry.

The industry has already invested over Rs. 60,000 million on capital goods, by way of plant and machinery, employing lakhs of people directly and indirectly, with annual capacity of over 4 million tonnes (MT) of bulk and noble ferro alloys, which are vital inputs to produce all types of steel. This industry annually earns more than Rs. 40,000 million worth of foreign exchange for the country, after fulfilling the domestic requirements. The present capacity of the industry, can comfortably cater to the requirement of domestic steel industry to produce 120 MT. of steel per annum.

Ferro alloy units in the country are situated in Andhra Pradesh, Chhattisgarh, Goa, Gujarat, Himachal Pradesh, Maharashtra, Karnataka, Meghalaya, Orissa, Pondicherry and West Bengal; Manganese alloy units are concentrated in Andhra Pradesh, Arunachal Pradesh, Chhattisgarh, Jammu, Jharkhand, Kerala, Maharashtra, Meghalaya, Orissa and West Bengal; Ferro silicon units are present in Andhra Pradesh, Jammu, Kerala, Meghalaya, Orissa, Arunachal Pradesh and Pondicherry; and ferro chrome in Andhra Pradesh, Orissa and West Bengal; Noble Ferro Alloy Units are concentrated in Andhra Pradesh, Gujarat, Orissa and West Bengal.

Ferro alloys are exported to countries like Bangladesh, China, Germany, Pakistan, Japan, Europe, the USA, Korea, Indonesia, Sri Lanka, UAE etc. India is established as a regular exporter of silico-manganese and high carbon ferrochrome.

Capacity

The ferro alloy capacity in India is around 4.04 Mt and the production during 2009-10 was 2.5 Mt with a capacity utilization working out to 62%. Details of the same are shown in Table 1

Table 1

Capacity and Production of Ferro Alloys in India

	Capacity (Mt)	Production in 2009-10 (Mt)	Capacity Utilization, %
Manganese Alloys	2.50	1.49	60
Chromium Alloys	1.30	0.90	69
Ferrosilicon	0.20	0.10	50
Noble Alloys	0.04	0.03	75
Total	4.04	2.52	62

Production and Export Performance

Despite the market slowdown and slow recovery in the developed countries, the ferro alloy industry in

India produced around 2.52 Mt of ferro alloys during 2009-10, an increased growth of 13.51% as compared to the previous year's production of 2.22 Mt.

Manganese Alloys

The industry's manganese alloy production has increased during 2009-10 compared to the previous year. The industry produced 1,489,303 tonnes of manganese alloys, the highest-ever production as compared to 1,276,035 tonnes during 2008-09, registering an increase of 16.71%. Out of the total manganese alloy production, high carbon was 3,74,225 tonnes (3,70,531 tonnes), medium carbon ferromanganese 6,018 tonnes (5,755 tonnes), silico manganese 1,045,226 tonnes (845,432 tonnes), medium carbon silicomanganese 39,233 tonnes (31,521 tonnes), and low carbon silicomanganese 15,379 tonnes (14,505 tonnes). The Eastern region recorded the maximum production of manganese alloys at 64.03% followed by Central region at 17.00%, Western region at 13.31%, Southern region at 5.47%, and a small percentage of 0.19% from Northern region.

Ferro Silicon

The estimated production of ferro silicon of the industry in 2009-10 was 101,917 tonnes (99,595 tonnes), registering a marginal increase of 2.33% during the year. The highest production was from the Eastern region at around 61.11%, followed by Southern region at 35.47% as against 71.63% and 26.34% respectively, during the last year.

Chrome Alloys

The production of HC ferro chrome in 2009-10 was 889,093 tonnes (814,868 tonnes) registering a growth of 9.11%. The highest production of ferro chrome was from the Eastern region at 83.55%, followed by the Southern region at 13.39%, as against 83.39% and 14.45% respectively, in the previous year.

Noble Ferro Alloys

Production of Noble Ferro Alloys in 2009-10 was estimated at 31,308 tonnes as compared to 27,435 tonnes during the previous year, registering an increase of 14.12% during the year.

The production of Noble ferro alloys for 2009-10 is shown in Table 2.

Table 2: Estimated Production of Noble Ferro Alloys for 2009-10

	(Quantity in tonnes)	
Noble Ferro Alloys	2009-10	2008-09
Ferro Molybdenum	2,822	2,162
Ferro Vanadium	1,389	1,501
Ferro Tungsten	150	150
Ferro Silico Magnesium	17,132	13,400
Ferro Aluminium	7,017	8,170
Ferro Silico Zirconium	120	87
Ferro Titanium	2,379	1,661
Ferro Boron	90	83
Ferro Nickel Magnesium	209	221
Total	31,308	27,435

Exports

The industry registered marginal increase in exports of ferro alloys of 864,767 in 2009-10 tonnes as against 849,291 tonnes during the previous year, registering an increase of 1.82% over the previous year (Table 3). The industry's export of ferro alloys during the year ended 31st March 2010, as compared to the previous year is shown in Table 3.

Table 3: Category-wise Export of Ferro Alloys in 2009-10

	(Quantity in tonnes)	
Product	2009-10	2008-09
HC Ferro Manganese	82,530	100,376
Silico Manganese	287,155	208,946
MC Silico Manganese	6,137	5,302
LC Silico Manganese	5,519	4,120
Ferro Silicon	12,934	10,370
HC Ferro Chrome/Charge Chrome	466,977	516,554
Ferro Molybdenum	17	2
Ferro Silico Magnesium	3,028	3,161
Ferro Aluminium	470	459
Ferro Silico Zirconium	0	1
Total	864,767	849,291
Export earnings in Rs. Million	43,478	63,692

However, export earnings have reduced by 31.74% in 2009-10 to Rs. 43,478 million as against Rs. 63,692 million during the previous year. The reduction in export earnings is mainly due to fall in prices of ferro alloys in the international market in 2009-10 as compared to the previous year.

Imports

Imports of ferro alloys are increasing as and when the basic customs duty is reduced. The import of ferro alloys, except ferro nickel, during 2009-10 was 187,956 tonnes valued at Rs. 15,147.36 million as compared to 132,751 tonnes valued at Rs. 15,299.80 million during the previous year. The steel industry and the trading firms have imported the following ferro alloys during the year. Details are shown in Table 4.

Table 4: Category-wise Import of Ferro Alloys in 2009-10

	(Quantity in tonnes)	
Product	2009-10	2008-09
Ferro Manganese	28,605	22,008
Ferro Silicon	125,138	82,751
Ferro Silico Manganese	1,377	239
Ferro Chrome	17,225	12,375
Ferro Silico Chrome	7	0
Ferro Molybdenum	1,111	841
Ferro Tungsten	20	45
Ferro Titanium	1,843	559
Ferro Vanadium	81	242
Ferro Niobium	769	1,779
Ferro Phosphorus	1,138	1,336
Ferro Zirconium	193	125
Ferro Silico Magnesium	1,523	3,833
Ferro Boron	263	198
Charge Chrome	500	0
Others	7,363	6,420
Total	187,956	132,751
Total import value in Rs. Million	15,147	15,300

Foreign Exchange earnings of Ferro Alloy Industry

The details are given in Table 5

Table 5: Foreign Exchange earned by Ferro Alloy Industry (Table 5)

Year	2004-05	2005-6	2006-07	2007-08	2008-09	2009-10
Value in Million US$	266	266	364	1118	1547	880

Contribution of the Indian Ferro Alloy Industry to the Indian Economy

The Indian ferro alloy industry has the potential to make India the hub for ferro alloys to the world.

Already, the Indian ferro alloy industry is:

- A valuable foreign exchange earner – India is a major ferro alloy exporter and ferro alloy exports are a major foreign export earner.
- Industrialisation of the Eastern and Southern regions – The ferro alloy industry has helped industrialisation of States, particularly Orissa and West Bengal in the Eastern region, and Andhra Pradesh and Kerala in Southern region.
- Employment to people – It is estimated that a 50,000 tonne ferro alloy plant supports around 750 families around the plant (i.e. a total of about 60,000 families by the ferro alloy industry in India), and these plants are located in remote areas where there is no other source of employment.

Issues facing the Industry – Challenges

High Power Tariff

The Indian ferro alloy industry has the potential to be internationally competitive, if certain hindrances like high cost of power are dealt with. Though the raw material availability is insufficient for the industry, but the industry has high qualified man power, latest equipment and technology, which has given them recognition in the international market. Unfortunately, they are being priced out in the global market, primarily due to high cost of electricity. Electricity cost accounts for over 40-70% of the total cost of production, depending on the ferro alloys produced. In India, the power tariff is grossly in excess to that prevailing in other ferro alloy producing countries. While the tariff in other countries is at 1-3 cents/kwh, the tariff in India is as high as between 6-10 cents/kwh.

Inadequate Quality Raw Material: High Grade Manganese Ore and Chrome Ore

Manganese Ore

High grade manganese ore is mainly produced by Manganese Ore India Ltd. (MOIL). The manganese ore produced by other mines in the country is low in manganese and high in iron or high in phosphorus content. Hence, these ores are only suitable for blending with the high Mn:Fe ratio manganese ore being supplied by MOIL, to prepare suitable composition to produce the quality of manganese alloys acceptable to steel industry.

MOIL commands about 50% of the total vital natural resources of manganese ore required by the manganese alloy industry. Supply of manganese ore from Government owned MOIL to ferro alloy producers without captive mines could shrink considerably in the coming years. MOIL is setting up a plant in joint venture with Steel Authority of India Ltd. (SAIL) and Rashtriya Ispat Nigam Ltd. (RINL) for ferro manganese and silico manganese, which will be commissioned in the next 2 years. The two joint ventures between them will have a capacity of 163,500 tonnes per year of ferro manganese and silico manganese.

Chrome Ore

Chrome ore is a key, irreplaceable input for production of chrome alloys. The availability of resources of this metalliferrous ore is limited in the country. It is for this reason, that Government has been reviewing the export policy of chrome ore every year. There is only one major producer of chrome ore in the country namely, Orissa Mining Corporation Ltd. (OMC), Orissa State owned industry. Ferro chrome industry has to depend on their requirement of chrome ore from OMC. The production from OMC is not adequate to meet the domestic requirement.

Some ferro chrome units have captive mines, but are not able to generate the requirement of chrome ore with Chrome/Fe ratio of 2.6:1 for producing chrome alloys. Hence, ferro chrome producers including those having captive mines are importing lumpy chrome ore to blend with the domestic ore for producing Chrome alloys. The availability of lumpy chrome ore is estimated to be 10% of the reserves. The industry started consuming chrome concentrates of around 40%, at almost international price.

Ferro Manganese Slag under restricted items

Ferro manganese slag is generated as a by-product while producing ferro manganese. For every tonne of production of ferro manganese, approximately one tonne of slag is generated. This slag is consumed in the production of silico manganese. The consumption of such slag for producing one tonne of silico manganese varies between 400 Kg. to 700 Kg. per tonne of silico manganese depending on the chemical specification particularly Mn content of the slag. Generally, ferro manganese is produced on high MnO slag practice basis, i.e. above 38% MnO in slag. However, considering the availability of low Mn/Fe ratio of manganese ores in the country, ferro manganese producers are unable to produce ferro manganese with such high MnO slag.

The last four years production of HC Ferro Manganese and silico manganese is given in Table 6.

Table 6: Production of HC Ferro Manganese and Silico Manganese

	2009-10	2008-09	2007-08	2006-07
HC Ferro Manganese	374,225	370,531	377,958	281,013
Silico Manganese	1,045,226	845,432	858,601	738,316
Total	1,419,451	1,215,963	1,236,559	1,019,327
% of FeMn/SiMn	26/74	30/70	31/69	28/72

The details of competitiveness of Indian Ferro Alloy Industry is given in Table 7.

Table 7: India's Competitiveness

	Ore	Power	Reductants	Logistics	Labour	Overall
CIS	2	2	2	3	2	11
China	1	2	3	3	3	12
Europe	1	2	1	3	1	8
India	2	2	2	2	2	11
Japan	1	1	2	3	1	8
South Africa	3	2	2	3	1	11

NB: 1–Low Availability, 2–Moderate Availability, 3–Advantageous Availability

Conclusion

- The India economy is expected to grow at an accelerated growth rate of 8-10%
- Steel production is expected to be around 75 Mt. by 2011-12
- Welcome sign for ferro alloy industry, as domestic consumption of ferro alloys will increase
- Raw materials and logistics will pay a crucial role
- Captive power plants give the option of cheap, uninterrupted power as well as alternate revenue streams

- India has the potential to be a major player in the global ferro alloy industry in the coming years.
- Industry's dominance in Asian market to rise in future
- Industry's capacity is more than sufficient to meet the domestic requirement of steel industry
- If export growth rate is not maintained, domestic market will be plagued with overcapacity
- Need to acknowledge market factors and seize market opportunity in ferro alloys and steel, now!!

Information extracted from Steel tech April 2011
(S C Suri, Life Fellow & Vice Chairman, IIM DC)

Revelation of Zn-O dumbbells in facetted nano-particles

Dr. Avanish Kumar Srivastava
Scientist, National Physical Laboratory

A real space evidence of dumbbell structures of ZnO with an inter-bond length of Zn-O approximately *0.198* nm has been demonstrated by exploiting the technique of high resolution transmission electron microscopy. Such observations are important in realizing the possible manipulation of the bond-length experimentally by introducing different dopants at atomic scale.

The resolution and quantification of the nature of individual atomic configuration in real space are among the ultimate aim for the characterization of nano-structured materials [JEOL News 2006, Carlier et. al. NanoLett. 2006]. Although there are efforts in the past to demonstrate the structural interpretations of various nano-objects pertaining to nucleation, growth and atomic-scale unit cells, generalization of such analyses is not possible due to various crystallographic constraints which are based on nature of materials under investigation. The sensitivity of various properties depends on atomic configurations of elements incorporated in constituting the material at lattice - scale. Due to increasing interest of ZnO as a promising nano-structured semiconducting material having potential applications in the field of integration in microsystems such as electrochemical and electromechanical coupled sensors and transducers, a fine tuning in the basic structure of ZnO has always stimulated scientific and technological usage. The immense applications of ZnO originate due to its unique combination of being piezoelectric, pyroelectric and a wide band gap (~ *3.4* eV) with large exciton binding energy (*60* meV). ZnO is a wurtzite hexagonal crystal structure (space group: C6mc, lattice parameters: c = *0.52* nm, a = *0.32* nm), with the alternating planes of tetrahedrally coordinated O^{2-} and Zn^{2+} stacked along the c-axis. Under such structure and properties, a detailed identification at atomic-scale revealing the configurations of Zn and O atoms becomes very important for the fabrication of ZnO-based nano-devices in future. In the previous calculations, the bond length between Zn-O has been reported approximately 0.198 nm [Erhart et. al. Phys. Rev. B. 2005, Brehm et. al. J. Appl. Phys. 2006] which might vary depending on the dopants incorporated in pure ZnO lattice. Here we elucidate the high resolution electron micrographs of Zn-O within a unit cell of basic hexagonal crystal structure. To the best of our knowledge, this was first experimental observation in real space [Srivastava et. al. 2010] to reveal dumbbell-structure of ZnO resolving between two different species (Zn,O).

A nanoparticle with facetted morphology (size about 40 nm) of hexagonal-shaped has been displayed as inset A in Fig. 1(a). We noted the hexagonal morphology with the orientation of the particle along [*0001*] zone axis of hexagonal crystal structure. (inset B in Fig. 1(a)). The three important planes: $\bar{1}\,100$, $01\bar{1}\,0$ and $10\bar{1}\,0$ are marked as 1, 2, 3, respectively on the corresponding selected area electron diffraction pattern (inset B in Fig. 1(a)). A corresponding high resolution – TEM image clearly exhibits the atomic columns of different planes along the orientation of [*0001*] of hexagonal-lattice structure of ZnO. An interplanar separation of 0.28 nm related to the set of $10\bar{1}\,0$ planes has been marked on the micrograph (Fig. 1(b)). It is important to mention that at the periphery of such

nanoparticle (inset A in Fig. 1(a)), a very thin region (thickness less than *10* nm) exhibits the interatomic networking of Zn and O atoms within the basic ZnO structure (region C in Fig. 1(b)). The regions D and E are further magnified and displayed in Figs. 2 (a) and (b), respectively. These results (Figs. 2 (a) and (b)) are discussed to understand the crystallographic structure of ZnO-unit cell.

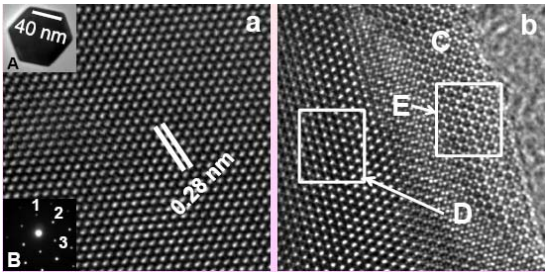

Figure 1.
Facetted topographical feature of ZnO nanoparticles (inset A of (a)), selected area electron diffraction pattern (inset B of (a)) and high resolution electron micrographs (a,b).

A unit cell of ZnO along [*0001*] orientation has clearly been marked by a set of six bold-circles in Figs. 2(a) and (b). Fig. 2(b) reveals the Zn and O atoms within the unit cell. The size of the bright circular images and the grey-level contrast distinguishes the Zn^{+2} (atomic no.: *30*) and O^{-2} (atomic no.: *8*) in the microstructure. Few atoms of Zn and O are marked on the atomic-scale, which in principle demonstrates the dumbbell-structure of Zn-O in the unit cell of hexagonal-ZnO. The tetrahedron bonding of Zn^{+2} and O^{-2} has been indicated within the unit cell by drawing three white lines from the central O^{-2} to three Zn^{+2} ions in the centre of one unit cell (Fig. 2(b)). Moreover a separation of approximately *0.198* nm between two Zn^{+2} and O^{-2} ions are indicated in the micrograph (Fig. 2(b)). To understand in a better way, a schematic of ZnO-unit cell has been drawn in Fig. 2(c). Regular wurtzite hexagonal-structure of ZnO consisting exposed crystal planes of ($10\bar{1}\,0$), ($01\bar{1}\,0$), ($\bar{1}\,100$) and (*0001*) along hexagonal-orientation are elucidated (Fig. 2(c)). A facetted-hexagonal growth of ZnO (inset A in Fig. 1(a)) is a resultant of preferred growth along [*0001*] orientation of wurtzite-ZnO, which has also been confirmed by selected area electron diffraction pattern (inset B in Fig. 1(a)) and high resolution electron micrographs (Figs. 1(a) and 2(a,b)). A skeleton within the unit cell depicts the tetrahedron co-ordination of Zn and O atoms which contributes the unit cell (Fig. 2(d)), resolving the bond length of 0.198 nm between Zn and O atoms. Figure 2(e) elucidates a corresponding real space simulated image of ZnO along [0001] direction of hexagonal crystal structure.

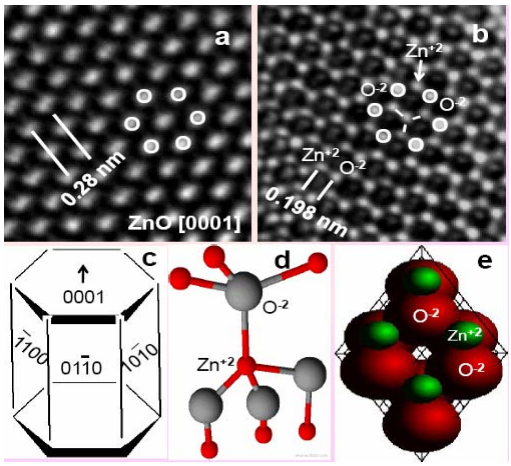

Figure 2.
Magnified regions (a and b) correspond to D and E rectangles, respectively, as marked on Fig. 1(b). Unit cell of hexagonal ZnO (c), skeleton within unit cell with tetrahedron coordination of Zn^{+2} and O^{-2} (d) and real space simulated image of ZnO along [0001] direction (e).

High resolution transmission electron microscopy work was carried out at POSTECH, Pohang, South Korea under INSA (Indian National Science Academy) – KRF (Korean Research Foundation) international bilateral exchange program. Reference: Book; Microscopy: Science, Technology, Applications and Education, Authors: A.K. Srivastava, R. Gakhar, P. Dua, K. Senthil, J.S.Tawale, K.N. Sood and K. Yong, Eds. A. Méndez-Vilas and J. Diaz, FORMATEX Press, Spain.

Niobium-Bearing Structural Steels for the 21st Century

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Structural Steels represent well over half of the total global steel production and consumption. Structural steels include beams, plates, rods, bars, shapes and long products for a variety of applications. Niobium bearing steels provide designers and engineers with opportunities to improve structural steel properties at a value-added cost for wide-ranging properties needed for diverse applications.

Value-added application of niobium (Nb) micro-alloyed steels have been developed for commercial implementation to meet increased material demand and improved properties for 21st century structural applications. These applications demand Nb-bearing steels.

These steels deliver improved toughness, fracture and fire resistance and weldability. Such applications include medium and jumbo beam, boiler, bridge, container, heavy equipment, long product, pressure vessel, ship, storage tank and wind tower applications.

Steel producers have developed micro-alloyed steel grades that cost effectively meet end user demands for higher strength at thinner cross sections, better low temperature toughness to resist brittle fracture in building, pressure vessel and ship structures. Niobium is a key element to achieve these results.

Niobium process metallurgy has become important to leverage the ability of niobium to obtain ultra-fine grain, homogeneous structural steel microstructures with superior mechanical properties. In addition, with the ever-growing concern regarding the environment and resource sustainability, the application of advanced high strength Nb-bearing steels for both long product and structural applications have been shown to reduce resource usage and improve the carbon footprint. Recent Nb-microalloyed steel applications provide more efficient product design, reduce steelmaking emissions and reduce energy consumption.

The global steel industry has accepted the challenge of cost effective design and produce value added niobium bearing structural steels with superior toughness, weldability, seismic and fire resistance, corrosion resistance, controlled yield to strength ratios and higher strengths to meet demanding end user requirements. The need for higher quality steels in structures is compelling to help mitigate the effects of catastrophic earthquakes and other manmade and natural disasters. Niobium bearing structural steel development and commercialization also contributes to industry sustainability and a cleaner environment. Many of these high strength niobium bearing steels help designers to build more with less, saving scarce resources and producing less greenhouse gas emissions per structure.

National & International News

India's Steelmaking capacity to rise 10-15 mtpa in 2011-12

India's steel making capacity is expected to increase by 10 to 15 million tonnes per annum (mtpa) in 2011-12, according to the Union Steel Secretary, Mr. P K Misra. This is expected to take the total steel making capacity in the country to around 93 mtpa by March 31, 2012, he said. Mr. Misra was speaking at in interactive session organized by the Merchants' Chamber of Commerce (MCC) in Kolkata. The total installed capacity as on 2010-11 stood at 78 mtpa, he said. According to Mr. Misra, the country's steel consumption is expected to grow by 12 percent during the current fiscal. This is a tad lower than the World Steel Association projection of 13.3 percent rise in consumption level in the current year. In 2010-11, the country's real consumption of finished steel rose by 10.6 percent at 65.61 million tonnes (mt) from 59.33 mt. During the same period, production grew by 8.9 percent at 66.01 mt from 60.62 mt.

Mr. Misra agreed that there is a definite gap in demand-supply scenario in the country. While the steel production was growing at a compounded annual growth rate (CAGR) of 8.5 percent, consumption was growing at a CAGR of 9.2 percent. This has resulted in the country being a net importer in 2010-11 with imports to the tune of 6.79 mt. The elasticity of demand has increased to 1.1 in 2010 from 0.8 percent as on 2005. At the current growth rate, steel demand is expected to touch 193 mt in 2020 and 265 mt in 2025, he said.

This, according to Mr. Misra, needs careful evaluation of the policies followed till date. As a first step, the ministry has favoured stoppage of unabated export of iron ore from the country by raising the export duty on both fines and lumps to a steep 20 percent. This is part of a graduated approach to conserve iron ore in the country, as the industry is a major employment generator and sudden stoppage of exports would harm the economy. Raising the export duty has already had its effects on exports of the steel making raw material, which according to Mr. Misra, has witnessed a sharp decline to 90 mt in the year 2010-11, thereby registering a drop of over 23 percent from the previous year's comparable level of 117 mt.

He, however, laid stress on the need for beneficiation technology so that iron ore fines can be utilized in a better manner. It may be noted that iron ore exports are expected to drop more this fiscal due to rise in export duty, he opined. The Steel Secretary said that efforts are also on to secure coking coal from mines abroad. The steel ministry is also emphasizing on development of sophisticated technology for better usage of raw material of inferior grades through beneficiation process. He also added that in its bid to increase capacity in the midst of slower implementation of new projects of Posco and Arcelor Mittal and to meet the rising demand in the country, the ministry is mulling setting up of ultra mega steel projects (UMSPs) in states with iron ore reserves. The projects are planned to have a minimum capacity of 10 mtpa each. However, it is being evaluated at present as to whether these projects are feasible. As special projects, the government is also evaluating as to what fiscal concessions can be given to these projects. The ministry is thinking that perhaps providing the scarce resource of land in proximity to water in a region which meets environmental concerns would be the best concession that could be provided to these projects.

Thereafter, the projects could be handed over to the highest bidder who can source iron ore and coking coal to set up the project. The factors such as compensatory afforestation in forest areas which could be allowed are still being looked into. However, Mr. Misra said that the concept is still at an evaluation stage. It will take another six months to evolve a concrete project structure for the same. The amended Mines and Minerals (Development and Regulation) Act looks at the fact that the natural resources get their desired value and encourages auction to determine the highest value. The Act also lays stress on handing over the mineral resource to the group that invests in prospecting and discovering the resource. Mr. Misra feels that the National Steel Policy of 2005 is outdated. There is a need to seriously re-evaluate the National Steel Policy to find out how much capacity is required and by what time, after taking into consideration the current elasticity of demand vis-à-vis supply, Mr. Misra feels.

A inter-ministerial group is being formed to look into the matter and the country can expect to get a new National Steel Policy in the next six months, he said. The group would look into issues like raw material supply, infrastructure, steel making technology and capacity issues, among others. Industry associations and experts on the industry would also be roped in to formulate the new policy, he added.

(Extracted from a write-up by Mr. Tamajit & Arusha Das)

Optimising Recovery of Iron and Steel Wastes

Steadfast members of the iron and steel industry gathered to resolve the on-going issue of wastes under the flapping banner of Roosevelt's Mantra: To waste, to destroy our natural resources, to skin and exhaust the land instead of using it so as to increase its usefulness, will result in undermining in the

days of our children. The two-day Conference on Waste Recovery in Iron making and Steelmaking Processes, held in London, UK, from 13-14 December 2010, presented a mixture of challenges and tangible solutions. However, it was universally agreed that the iron and steel industry was in need of both a change in mind-set and further education on how to tackle and use wastes, as both a sustainable resource and a commodity.

Waste or Asset?

Kevin Linsley of RD&T, Tata Steel, Europe gave the attendees some food for thought, stating, 'In the 1850s ore mined from the Cleveland Hills contained 30% Fe total, was considered prime raw material. Now, some gas cleaning slurries contain 60% Fe total but, in some instances are considered as a waste and are disposed off as such, is it really a waste or simply an example of a wasted opportunity? He asked. To highlight the incentives for the proper disposal and of iron and steel wastes, Brooks revealed an estimation of hazardous waste landfill costs for Tata Steel for 2010-2011.

Methods of exploiting wastes that were discussed included briquetting. An example given was at the US Steel Kosice Slovakia site, which processes over 55,0001of dusts, ores and scales each year for use as a basic oxygen steel making coolant. Sludges, dusts and scales can all be briquetted and returned to iron and steelmaking furnaces. Sludges can also be processes to reduce the moisture content. Dusts and scales are then introduced to produce a base mix to which various binders are finally added to ensure product strength. The resulting product can be charged to a blast furnace (BF), blast oxygen furnace (BOF) or electric arc furnace (EAF), thereby increasing the internal recycling rate. Another technique or optimising iron and steelmaking processes is micro-pelletizing the by-products, to produce a single homogeneous blend to improve the sinter bed permeability. The use of EAF dust in the cement industry and in ceramic mixtures for building applications was also explored and presented by researchers from Isfahan University in Iran.

Pellet Production

A recovery process from Japan that uses a high temperature rotary hearth (RHF) to reduce steel dust into direct reduced iron (DRI) created interest at the event. The furnace, combined with a hot briquette machine, is said to have an estimated treatment capacity of 220 ktpa. The DRI pellets can be used as a supplement to steel scrap and iron ore as the main raw material. The zinc that is removed can also be used as a part substitute for pure zinc ore. A combination process for recycling EAF and steelmaking residues into nickel-chromium alloys and zinc was introduced by Paul Wurth, Luxembourg. The EAF, called i-Meltor, has been designed for reducing melting, setting and fuming of slag and residues. It operates with bottom gas stirring and central charging between three electrodes. The technology, added Ingo, can be used as part of a complete unit or as a stand alone system. The main components include: a central duct, graphite electrodes and water coolers in the form of spray coolers that increase the lifetime of the refractory lining in the slag zone. The unit is also equipped with an off gas cleaning system.

Source: Steel Tech. April 2011

Pig Iron Granulation at Essar Steel

Essar Steel granulated the first three heats in November 2010 using UHT's GRANSHOT for the first time in India. In their 10 Mtpa Hazira production complex, the GRANSHOT plant is an important buffering possibility between the pig iron sources-one blast furnace and two Corex 2000 modules and the downstream refining and casting processes in the brand new steelmaking plant. The plant has a capacity to granulate 140 tonnes pig iron heats in less than one hour. The Granulated Pig Iron (GPI) is mainly used in the Conarc EAFs to deoxidise the hot heel steel. Surplus GPI is used as an alternative to HBI or scrap within Essar's production, or is sold as an easily used and highly reactive merchant pig iron.

Source: Steel Tech: April 2011

Kobe Steel Invests Malleable Metal 80% Lighter than Steel

Kobe Steel in Japan has developed a lightweight type of aluminium, which is hard as regular steel, but can be easily moulded into unconventional shapes. The idea is to use porous aluminium in automobiles. Because it is so comparably light, the developers believe it could drastically reduce the carbon footprint of new cars. It costs less than aluminium sheets or composite carbon fibre. Production could begin as early as in 2011. Despite all the fancy green tech gizmos a vehicle packs, the weight of the vehicle is critical in terms of its ability to how well a car can curb its emissions. Foam resin is placed bertween two 0.15 mm aluminium sheets and then heated at over 200 deg. C. The result is a material as hard as steel, but only 3mm thick. It is highly malleable and can be rolled and bent but its material strength means it's tough to bend out of shape. Kobe Steel sys porous aluminium is up to 80% lighter than steel and 60% lighter than regular aluminium. The problem is the material cannot be welded and it has to be riveted. Kobe hopes to market it to manufactures to roll-out on vehicle interiors. At least for this purpose, Kobe may reduce competition in the market. In Japan, the average selling price for regular aluminium per square metre is over JPY 2,000 or roughly USD 25. Kobe will sell its porous aluminium at JPY 1,500 or USD 18 per square metre far cheaper than the useful but expensive composite carbon fibre.

Source: Steel tech April 2011

Danieli Corus update on BF order from NMDC

Danieli Corus in consortium with TATA Projects has signed a turnkey contract with NMDC Limited for setting up a blast furnace at Nagamar in Jagdlapur District of Chhattisgarh. The state of the art blast furnace with 4506 cubic meter inner volume will be the largest in India and among top 10 in the world. It would produce around 3.3 million tonne of hot metal annually to meet the entire requirement of hot metal for phase 1 on NMDC's forward integration plans. Commissioning is scheduled in 33 months with the help of TATA Projects and Danieli Corus' Indian subsidiary. The blast furnace would be equipped with Danieli Corus advanced technology in the areas of refractory lining & cooling, hot blast system, hydraulic charging unit, PCI injection system, gas cleaning system, cast house and slag granulation system etc.

Source: Steelguru

Steel industry health remains stable - BIR World Recycling Congress

Recycling Today reported that delegates attending the Ferrous Division Meeting at the 2011 Bureau of International World Recycling Congress heard mostly positive things about the health of the steel and ferrous scrap industries. Reporting from the European perspective at the late May event was Mr Thomas Bird of Van Dalen UK Limited, Stratford Upon Avon in England. He remarked that the ferrous market in Europe has enjoyed bullish sentiment at times in the first half of 2011, but also has stuttered somewhat on occasion in reaction to world events. He continued that most recently, a view of a weaker market in May did not materialize, Mr Bird commented. Considerable volumes of tonnage were bought at the end of April and early May

2011. Prices for heavy melting steel increased to the high USD 460s and rebar levels for Turkish finished product were USD 710 at time of writing this presentation.

Mr Bird said that "May saw healthy demand across the European Union, with inventories at mills running at relatively low levels. The

Request for Contributions to the News Letter

We are trying to give a technical orientation to IIM DC activities. The News Letter can become an effective dissemination source of technical contributions. We also wish to circulate the News Letter to different academic institutions, research organizations, regional IIM Chapters and small and medium industrial enterprises. We want that these institutions become aware of the services that IIM DC can provide to these units. Technical write-ups and other important personal news, family events such as marriage, birth, scholarships, victory, higher education, acquiring additional qualification etc. etc. are earnestly solicited from our esteemed members for the monthly News Letter. Your inputs and contributions for inclusion in the news letter are earnestly requested.

S C Suri
Chairman
Technical & Publication Committee

market has taken a little bit of a breather in the last few days, but I do not believe this is anything but just that. Finished product demand remains healthy, and we are expecting demand for scrap to remain strong for the immediate future." Mr. Ikbal Nathani of the Nathani Group of Companies of Mumbai reported that India's crude steel production has been growing from 60 million tonnes in 2009 to 67 million in 2010 to an estimated 75 million tonnes produced in 2011. However, Indian mill companies are producing or buying greater amounts of direct reduced iron to feed their furnaces, opting not to bid up scrap prices in a competitive global market.

Mr. Nathani said that "India is blessed with natural raw materials, and thus is not dependent on scrap. Also, India's growing ship breaking activity at facilities in Alang is providing Indian consumers with superior quality HMS and re rolling scrap. There are around 100 vessels currently beached and being broken in Alang." Mr Andrey Moiseenko of Ukrmet Limited told delegates that Russia collected some 21 million tonnes of ferrous scrap in 2010 while Ukraine collected more than 6 million tonnes. Both government regulations and market conditions kept most of this scrap from being exported. New investments in electric arc furnace steel mills in both nations have strained supplies. Mr Moiseenko said that "Even one billet producer in Ukraine was stopped for a couple of weeks because of supply constraints,that has never happened before. Ukraine became a net scrap importer for one month, in February of 2011."

DMRC earns Rs. 2.4 Cr through carbon credits

We Delhi Metro Rail Corporation (DMRC) was the first project in the world to be registered by the United Nations under the clean development mechanism (CDM) which enabled it to claim carbon credits. "This was the first time in the world that the United Nations Framework Convention on Climate Change (UNFCCC) had registered a project based on regenerative braking". Under the regenerative braking process, whenever trains on the Metro network apply brakes, three – phase traction motors installed on these trains act as generators to produce electrical energy which goes back into the overhead electricity (OHE) lines. The regenerated electrical energy supplied back to the OHE is used by other accelerating trains on the same services line, thus saving overall energy in the system as about 30 per cent of electricity requirement is reduced.

DMRC has earned Rs. 2.4 crore in the year of 2008-09 by selling certified emission reductions (CER) under carbon credit scheme by the Japan Finance Carbon Ltd. DMRC hopes to channel the funds generated by the sale back into its carbon credit programme, as well as into research and development of technology for reducing greenhouse emissions. Starting from chassis upwards, DMRC coaches are built in stainless steel. The stainless steel coaches are lighter in weight and use environmentally friendly process as stainless steel is 100% recyclable material. In stainless steel production, 60% of the charge is recyclable material which includes stainless steel scrap. At the end of life 100% of stainless steel gets recycled.

High tech approach of DMRC to use latest technology which includes the choice of coach material and regenerative braking process has minimized the effect of greenhouse gases and thereby earning carbon credits.

Mr Blake Kelley of Sims Group Global Trade Corporation noted that scrap prices in North America declined in early May but were rebounding as the month ended. He said that "There are significant transportation problems, both on the inland river system due to severe flooding and high water conditions, while the railroad system is struggling to perform as a result of a fully utilized railcar fleet. Difficulty with both transportation modes is frustrating dealer efforts to complete delivery commitments." On the demand side, Mr Kelley noted that steel mills in the United States are running at about 73% of capacity, with flat rolled steel in greater demand than long products. Scrap export flows are also healthy. He said that "China and Korea have been aggressively buying and consuming raw materials. China reportedly purchased many bulk cargoes with shredded pricing around USD 480 CIF, South Korea has also purchased many cargoes with heavy melting steel prices flat in the mid USD 470s CIF." That information was confirmed by Mr Hisatoshi Kojo of Metz Corporation, who said that "In the end of April and early May, South Korea bought about 21 deep sea cargoes for May or June shipment, and China bought about 10 deep sea cargoes for June or July shipment."

Mr Kelley noted that the world's steelmakers are on pace to produce 1.54 billion tonnes of steel in 2011, a figure that is some 111 million tonnes greater than the 2010 output. Mr Kelley said that "An increase of this magnitude in steel production, and its corresponding increase in raw materials consumption, has made for an interesting beginning to the year. Seemingly, there is enough supply to cover that amount of demand."

Source: Steelguru