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NML NEWS

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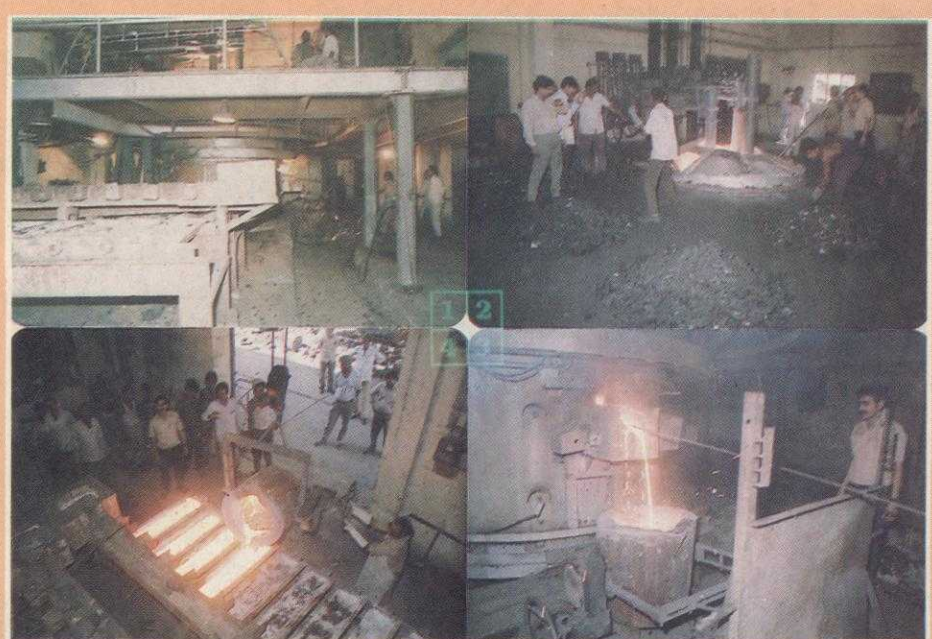
Ferro-silicon Technology

National Metallurgical Laboratory, Jamshedpur has been working on the development of ferro alloys for over three decades. NML has conducted several smelting investigations for the production of varieties of ferro alloys such as Ferro-silicon, Ferro-chrome, Ferro-manganese, Silico-chrome, Silico-manganese, Calcium silicide, Ferro-vanadium etc. The alumino-thermic reduction has been employed for the production of carbon free ferro-alloys like Ferro-vanadium, Ferro-molybdenum, Ferro-titanium, Ferro-boron, Ferro-aluminium etc. High percentage of ferro-silicon in the form of powder is used as a slag deoxidizer in the production of all kinds of steel.Ferro-silicon and Calcium silicide were also produced and technologies were developed for M/s Ispat Alloys Ltd., Balasore, Orissa and M/s Tata Iron & Steel Co.Ltd., Jamshedpur respectively. In both the technologies charcoal was the main reductant.

Looking into the non-availability of standard grade ferro-silicon at internationally competitive price in India, it is noticed that the present crisis of competitiveness is due to the decreased production of charcoal, shortage of power supply and very high power rates to ferro alloy industries. Quantity of raw materials, proper furnace control, laboratory analyses of results and production control parameters are extremely important to produce standard grade ferro-silicon.

Bhutan has abundant reserves of quartzite of good grades and plenty of cheap power at their disposal compared to Indian scenario. Hence, there is an easy possibility that Bhutan quartzite can be economically exploited to produce quality ferro silicon by carbothermic reduction process in a submerged arc furnace at internationally competitive prices. It was therefore, envisaged by Bhutan Ferro Alloys Ltd., Phuntsholing, Bhutan to produce quality ferro-silicon using different grades of quartzite of Bhutan making use of non-coking coal from Meghalaya, low ash imported coke of Chinese origin, wood chips from Bhutan and mill scale from any nearby steel plant, avoiding the use of charcoal in the charge mix to the maximum possible extent. NML was therefore, approached to conduct the trials at the laboratory's 500 KVA Submerged Arc Furnace (SAF) to ascertain the same. In a joint meeting of the representatives of NML, Bhutan Ferro Alloys Ltd., and M.N.Dastur & Co., the project was finalised and taken up for development of the technology for the production of 75% Ferro silicon.



(1) 500 KVA Submerged Arc Furnace at NML under operation (2) Top view of the Furnace (3) Tapping of Ferro-silicon (4) Casting of Ferro-silicon in pig moulds

As desired, the trials were conducted under this project. The results demonstrated the suitability of Bhutan quartzite and other reductants for the production of 75% Ferro-silicon. Initially the smelting was carried out with charcoal as reductant, then charcoal was partially replaced by Meghalaya coal and wood chips in the second instance. Finally the mixed reductants consisting of charcoal, imported coke, Meghalaya coal and wood chips were used to test the suitability of quartzite. A number of compositions of charge mix were tried, decreasing the percentage of charcoal in the mixed reductants upto about 5% and process parameters were optimized. The result of the present investigations will be the basis for further smelting trials to the coming up industrial plant of M/s Bhutan Ferro Alloys Ltd., Bhutan. ❑

R & D Highlights

Failure of work roll of cold rolling mill

Work roll failure in multistand cold rolling mills have been reported and investigated frequently, but, more often than not, no unequivocal conclusions appear to have been arrived at as to the exact cause of such failures. It is believed that complex factors, both mechanical and metallurgical, play a combined role in the premature failure of work rolls. While the mechanical view has concentrated on misalignment, uneven roll surface, localised overload, and contact fatigue, metallurgists have considered the failures as arising out of hydrogen pickup from coolant, localised overloading, temperature gradients, the presence of non-metallic inclusions, and phase transformations. Work roll failure is characterised to a great extent by the distinguishing features of failed surfaces. Various mechanical, thermal and microstructural factors leading to roll failure in general have been studied in detail. It has been observed that cracks initiate at the subsurface region of the roll, propagate obliquely into the hardened shell, and branch out in a river pattern during cold rolling.

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Inhibition of steel corrosion by Thiourea derivatives

The Thiourea and its derivatives have been studied for more than three decades because they inhibit the corrosion of steels and are superior to amine-based inhibitors in acidic media. However, their inhibition mechanism is not fully understood. The effect of thiourea; allylthiourea. N,N-diethylthiourea; N,N.-di-isopropylthiourea; phenylthiourea; thiocarbanilide and symdiotolythiourea on the corrosion reaction and on the amount of H_2 absorbed by cold-rolled mild steel in 1N H_2SO_4 at 40°C was studied. Inhibitor efficency increased with increase in molecular weight and inhibitor concentration. Higher inhibitor concentrations decreased H_2pickup. Thiourea accelerated corrosion reactions and H_2 pickup at higher concentrations. Potential studies showed cathodic reactions were inhibited at lower concentrations and anodic reactions were inhibited at higher concentrations. Results were based on the adsorption theory and all inhibitors studied follow the Langmuir isotherm.

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Megascopic view of Pan-Heavy fraction from Purulia region shows the presence of gold in the sample

Purulia Gold Ore

Characterisation and beneficiation of low grade Purulia gold ore has been sponsored by Directorate of Mines and Minerals, West Bengal. Characterisation studies on various Gold ore samples are in progress.

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Beneficiation and Assessment of Magnesite ore

At the instance of Tata Refractories Ltd., Jamshedpur NML undertook studies and visited the magnesite mines of Karnataka for evaluation of the available ore reserves. Detailed studies carried out on the reject dump sample from Talur Mines revealed that a concentrate analysing 1.02% silica with an yield of 58.8% could be obtained. While preliminary study on the exposed vein sample resulted in product. Assaying 2% silica and 37% yield. Pellets were made using the concentrate and fired at 1750°C. The fired pellets showed good properties. The studies resulted in the effective utilisation of waste and subgrade dump samples of magnesite lying utilised into a useful product .

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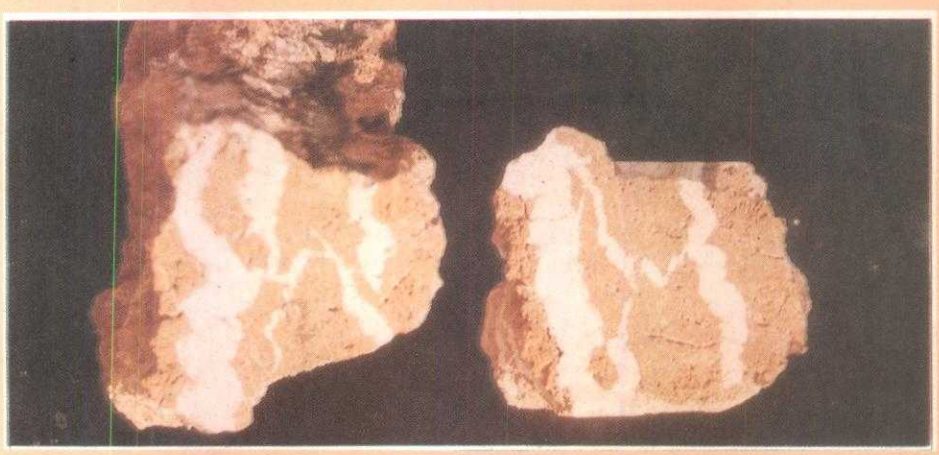
Coal Beneficiation and Slurry Combustion

CSIR approved a project on 'Coal Beneficiation and Slurry Combustion" for non-coking coal with CFRI, Dhanbad as nodal agency and NML Jamshedpur, RRL Bhubaneswar, RRL-Trivandrum as participating laboratories. Accordingly a series of meetings were held to formulate the work plan and distribution of work load. NML



Magnesite (white) in altered dunite (brown)

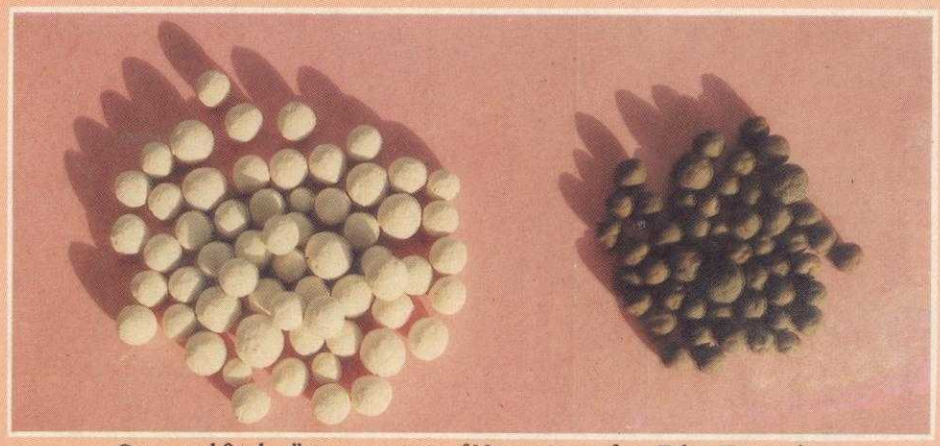
scientists alongwith CFRI and RRL (Bhubaneswar) visited Talcher Thermal Power Station (TTPS) and worked out a sampling device to collect samples from feeder coal conveyor over a prolonged period. The samples were sent to different laboratories by TTPS. Large scale jigging was performed at RRL-Bhubaneswar by a team comprising scientists from participating laboratories. Jigged clean coal of 25% ash (approx.) was taken to individual laboratories for further studies. Detailed investigations were carried out adopting different beneficiating schemes. ❑

Fly Ash-based Wear-resistant Ceramics

The fly ash-based wear-resistant ceramics are harder than tool steel and close to diamond in hardness. These extremely dense, hard and impenetrable ceramics have superior resistance to both sliding and impact abrasion and erosion, and can be extensively used as lining material in material handling equipment of thermal power plants, steel plants, cement and other related industries. Application of such ceramic material substantially decreases maintenance cost and increases life of components to almost 8-10 times than that of a metal. The process has been developed on a laboratory/semi-pilot plant scale for production of various shapes of wear-resistant ceramics. Fly ash based wear resistance ceramic technology was transferred to M/s Tatanagar Bricks Ltd., Adityapur, Jamshedpur to manufacture 600 MT of ceramic tiles/annum. The project cost envisaged Rs.121.00 lakhs with Return on Investment 69.85% at a break even point of 36.0%. The plant is being commissioned and is expected to start production by December 1994.

Evolution of microstructure in rapidly solidified alloys

The evolution of microstructure in rapidly solidfied alloys is an extremely complicated process and is a function of many variables. The microstructural evolution can be viewed from many different angles. For example, one may consider the nature and stability of interface leading to homogeneous, cellular or dendritic morphologies. The problem can be understood and correlated with the conventional solidification modes by determining the extent of solute partitioning that occurs at the interface. The microstructure can also be correlated to the degree of undercooling attained in the process. All these apparently different aspects can also be synthesised to yield a unified picture of microstrctural evolution. Further work is in progress.



Green and fired pellets concentrate of Magnesite ore from Talur, Karnataka

Papers published

- Bhattacharjee S., Dasgupta P., Jha S.N., Rao A.S., Gupta K.K. and Pandey L.P., (1993), Computational elimination of interelemental interference in the analysis of copper, cobalt and nickel in polymetallic sea bed nodules by flame atomic absorption spectrometry, *Talanta* **40**(5) : 675-680.
- Chattopadhyay S. and Srikant S., (1994) The CdSe-MnSe Pseudobinary System (Cadmium Selenium-Manganese Selenium), *J. Phase Equilibria* **15**(1) : 96.
- Jana R.K., Singh D.D.N., Roy S.K. and Sircar S.C., (1993), Electrochlorination of sea nodules to recover copper, nickel and cobalt, *Hydrometallurgy*, **32** : 21-38.
- Jana R.K., Singh D.D.N., amd Roy S.K., (1994), Hydrochloric acid leaching of sea nodules with methanol and ethanol addition., *Mater. Trans. Jap. Inst. Met.*. **32:** 593-598.
- Jana R.K. (1993), Leaching of sea nodules in acidic chloride - sulphide media., *Trans. Inst. Min. Met.* **102**C : 191-194.
- Kavipurapu C.S., Gupta K.K., Dasgupta P., Chatterjee N.N., Pandey L.P., (1993), Determination of boron in steels by inductively coupled plasma optical emission spectrometry, *Analysis* **21**:21-25.
- Kumar Rakesh, (1994) Leaching characteristics of disordered birnessite and goethite doped with Ni, Co and Cu in sorption mode, *Mater. Trans. Jap. Inst. Metal* **35**(1) : 27-34.
- Prasad S., Pandey B.D., and Palit S.K., (1994), Direct sulphation of chalcopyrite with steam and oxygen, *Trans. Inst. Min. Met. Sectopm* **103** C : C69-C75.
- Saha A.K., Khan Z.H. and Akerkar D.D (1993) Reduction of maganese sea nodules with non-coking coal,*Trans. IIM*, **46**(2) : 63-69.

Papers presented

- *"High alumina refractories from sillimanite beach sand"* by S.K.Malaviya, N.N.Mathur, K.K.Singh and K.N.Gupta, presented at the 57th Annual Session of Indian Ceramic Society held at New Delhi during January 20-22, 1994.
- *"Sintering and densification behaviour of raw magnesite in air and argon atmosphere"* by B.Chatterjee, K. K. Singh and N.N.Mathur and K. N. Gupta, presented at the 57th Annual Session of Indian Ceramic Society held at New Delhi during January 20-22, 1994.
- *"High temperature strength retaining capacity of mixed calcium aluminates in relation to refractory aggregate"* by S.K.Das, oroganised by Indian Ceramic Society at New Delhi during January 20-22, 1994.
- *"Bonding characteristics of alumina"* by A.K.Bose presented at the 57th Annual Session of Indian Ceramic Society held at New Delhi during January 20-22, 1994.
- *"Development of high strength zircon-zirconia refractory composites"* by K. K. Singh, B. Chatterjee, N .N. Mathur, S. K. Malaviya and K. N. Gupta presented at the Indian Refractory Congress held at NML Jamshedpur during February 14-16, 1994.
- *"On the condition for faceting of primary phase"* by P.Ramachandra Rao at the International Conference on Physical Metallurgy, held at Bhabha Atomic Research Centre, Bombay during March 9-11, 1994.
- *"Creep behaviour of Zr-2.5% Nb pressure tube material"* by S.Chaudhury, R.K.Sinha, R.Singh, R.N.Ghosh, T.K.Sinha and S.Banerjee presented at the International

Conference on Physical Metallurgy, held at Bhabha Atomic Research Centre, Bombay during March 9-11, 1994.

o *"Viscosity of Undercooled Liquids"* by P.Ramachandra Rao at the Indo-US Workshop on "Nucleation and growth in Solids" held at Indian Institute of Science, Bangalore during March 14-16, 1994. ❑

Visits abroad

Dr. B. D. Pandey

Dr. B. D. Pandey, Scientist, Non-ferrous Processing Division, has been deputed to France under bilateral exchange programme CNRS(France) - CSIR(India) for a period of three months. Dr.Pandey worked on a project "Solvent extraction of Cr(III) from spent tanning bath". ❑

Dr.(Ms) J.L. Pandey

Dr (Ms). J.L. Pandey, Scientist, Corrosion Protection Division, has been deputed to Poland under CSIR-PAS S&T Exchange Programme for a period of three months. The purpose of the visit was to acquire up-to-date knowledge on sulfidation/oxidation kinetics of metals and alloys with special reference to rare earth additions on oxidation of Ni, Fe, Co-based binary/ternary alloys and refractory metals and to work in a fully established organisation at Krakow. ❑

Shri D.Jha, Scientist, Non-ferrous Processing Division, has been deputed to U.K. for one week under the Equipment Training Programme for On-line particle size. ❑

Dr. R.P. Bhagat

Dr. R. P. Bhagat, Scientist, Mineral Processing Division, has been deputed to Germany under the CSIR-DAAD Exchange Programme of Scientists. for three months starting from mid January, 1994. Dr. Bhagat carried out research on *'Adsorption of Anionic Surfactant on the oxidic Minerals'* in the Institute for Macromolecular and physical chemistry, University of Regunsburg. He also visited the Institute for Mechanical Process Engineering and Mechanics, University of Karlsruhe. There he delivered lecture on his research at NML. ❑

Patent filed

o *"An improved device useful for creep rupture testing of thin-walled tube specimen at room/elevated temperature"* by Gurudev Jaura. ❑

Talk organised

- *Material science activities at NAL, Bangalore* by Dr. A. K. Singh, Dy.Director, NAL, Bangalore (21.03.94). ❑

Lecture delivered

- Dr. S. C. Srivastava, Scientist delivered a lecture on *X-ray fluorescence spectrometry and materials researach* at the Department of Applied Chemistry, Indian School of Mines, Dhanbad on March 16, 1994.

STAFF NEWS

Welcome at NML.....

Dr. S. Ranganathan, Scientist (on transfer from CSIR, Madras Complex), Shri Tusher K. Minz, Pharmacist, Shri Satnam Naiya, Pump Operator, Shri G. Jeevanandam, Machinist, Shri M.Varghese, Fitter, Shri H.S. Tirkey, Plumber and Shri T.Mukhi, Safaiwala. ❑

Wishing a happy retired life...

Shri P. Basak, Scientist E1, Shri R.Pandey, Shri D.Prasad, Technical Assistants, Shri R.N.Das, Fine Mechanic and Shri T.Singh, Driver. ❑

Forging of NML standard sample ingot

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