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NML NEWS

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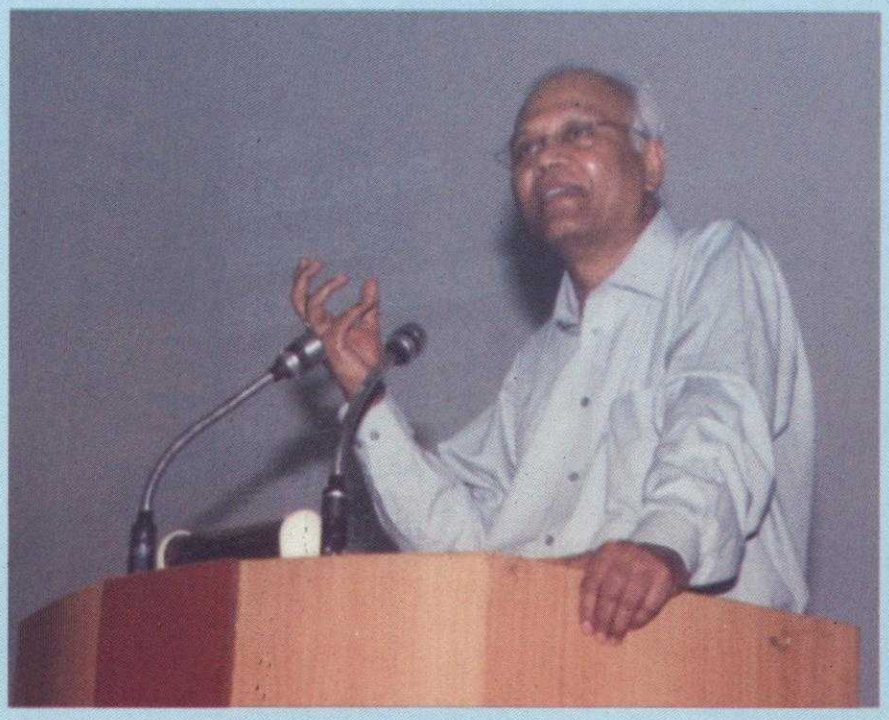
Nickel Recovery from Spent Nickel Catalyst

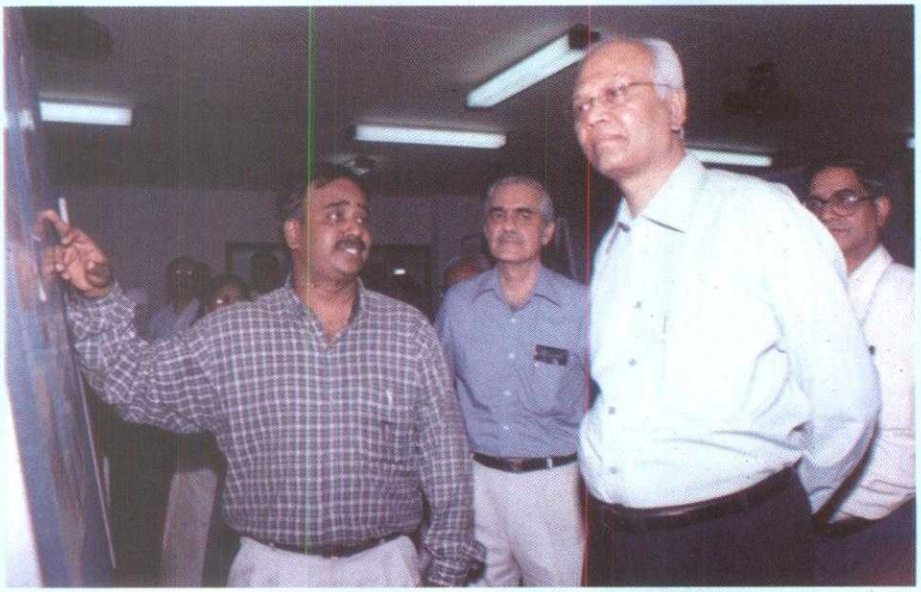
Spent nickel catalyst is one of the rich sources of nickel which is considered as industrial wastes and controlled under strict environmental protection law. Nickel catalysts in particular are catalyst of choice by many industries because of its lower cost as compared to other competitive substitutes and their generation is much more in quantity as compared to other spent catalysts. Metal recovery from such spent catalyst is often not possible due to the complexity of the flow-sheet developed so far. A very simple and interesting process has been developed and patented by NML Scientists. With this almost complete recovery (>99%) of nickel is achieved under moderate leaching condition. Nickel is recovered as pure nickel sulphate. The process tested up to kilogram scale with overall nickel recovery of 96%. Advantages of the process are (i) high nickel recovery (ii) high pulp density leaching resulting in high productivity (iii) generation of leach residue as alumina/silica - a by-product, (iv) no liquid effluent generation (v) less energy requirement. The process gives very high return and is ready for commercialization.

DG, CSIR visits NML



Director General, CSIR, Dr. R.A.Mashelkar visited NML on 10th April. Infact, Dr. Mashelkar came to Jamshedpur to deliver the convocation address of XLRI, Jamshedpur and as a Head of the CSIR family, he extended his trip to NML. Prof. Mehrotra, Director NML extended a warm and hearty welcome to Dr.Mashelkar. During his visit, Dr.Mashelkar inaugurated the newly installed Atomic Force Microscope in the laboratory. An exhibition depicting the ongoing R&D was also organised. While going through the exhibits and interacting with the Scientists, DG, CSIR expressed his happiness over the exciting works that are being planned at NML under the leadership of Prof. S. P. Mehrotra, Director, NML.

Later, DG, CSIR, Dr. Mashelkar, addressed the staff members gathered at the Laboratory's Auditorium. He spoke of the great strides made by Science and Technology in India in



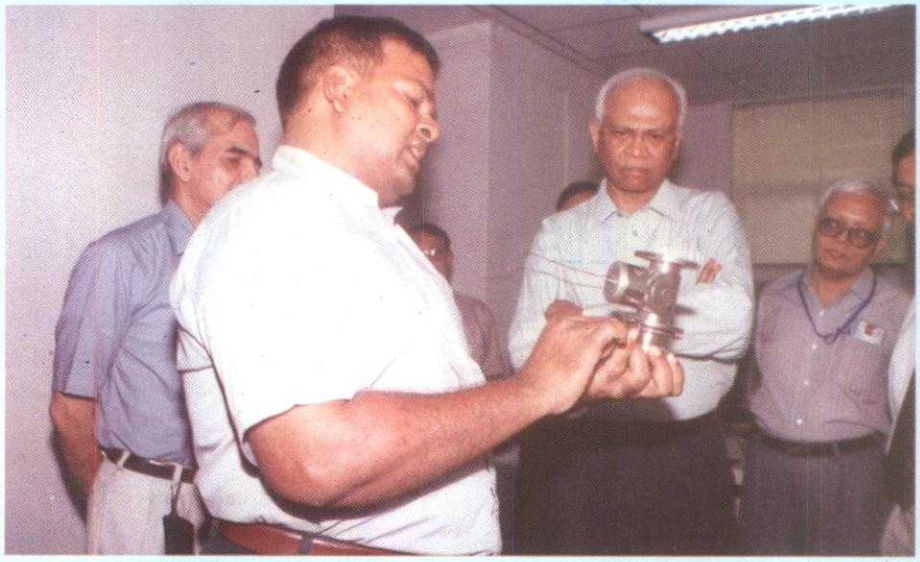
DG CSIR expressed happiness over the R&D progress.

the recent past and the contributions of CSIR in these advancements. The excerpts of his lecture is given below:

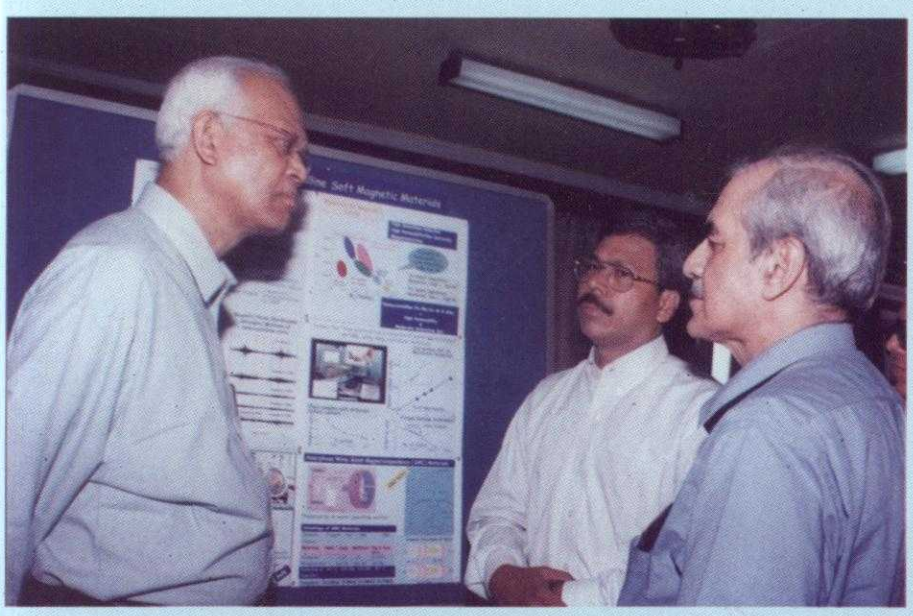
Prof. Mehrotra and dear members of my family. Its always a pleasure to be at NML. Each time I have come, I enjoyed being with you all and this time it's no exception. But this time the joy is really special I must say. Because I am seeing a new vibrancy in the air. I am getting a good smell of vision, an achievement of pride in what one is doing which is rather unique. I must thank you Prof. Mehrotra and congratulate you for the tremendous leadership that you have provided. What I saw today was very special for a number of reasons.

The purpose of CSIR is not only to do scientific research but to make sure that we make a difference to the lives of the people who support us. So, we have this dual purpose of being innovative, cutting edge scientific research and also being ahead of others. At the same time be useful to the Nation. And what I saw during the last two hours was a beautiful blend of both of these aspects. We on one hand have a cutting edge science, cutting edge technology. I have heard for the first time something that is unique, something which will have global potential. As a Scientist after all we get our pay etc but that is fine, that is physical income but what really keeps us in the laboratory and working in the way we do is psychic income and being ahead of the others, having a global need is something which gives us psychic income. There are plenty of psychic income in evidence. On the other hand, the Laboratory has not forgotten its purpose, whether its cokeless cupola, whether it is set of innovative processes. Each one of them has an impact on the lives of the people. What I also found was that the laboratory is willing to take up new challenges and that is extremely important. It has chartered out into new territories in new directions, so I must say I go from here after a few hours as an extremely satisfied, as a very very happy individual, indeed.

I thought I'll make use of this opportunity to speak to you for around 10 odd minutes, to convey something that I see from my vanity's point in Delhi as I move in Delhi as I move around not only in India but around the world, because, it is the context that the contents is constantly changing. You are seeing the emergence of a new India but not because of the advertisements we see by the way, I am not talking about that but things are really beginning to happen. If you really see the change that is taking place, it is absolutely true. I mean if you look at India in 1991, you know we were left with only one week of foreign exchange for imports and today we talk of 110 billion dollars, right? We used to depend upon what is called as Air India Club from Paris and in the evening we used to wait for the news about how much aid we are going to get. Now, you see a new India, which says: no aid, trade that's it. We are beginning to return our loan even before the due date. This is a quick shift. You also do find that we are able to do things, which we did not do in a time that is much shorter. You build something like 11 kms a day whereas you build 11 kms per year the first 50 years. That's a difference. Why? We have started thinking big and that is what I like very much. Like the linking of river project for example, so you see an emergence of India, which is emerging as a confident nation. And therefore what NML has to do, what CSIR has to do is to raise its level of ambition, so that we fulfil the aspirations of the new emerging period and that is where I talk about leadership being ahead, I mean rising to an occasion.



Scientist explaining about the recoverable space capsule programmes in collaboration with ISRO



DG CSIR taking stock of the R&D progress made at NML

Infact I am seeing a vast difference. We had the first project presentation when we talked of NML project. We talk about Team India Project and I remember when I took over, each laboratory had 50 projects, now the entire CSIR is having 55network project. In each project, you know, you have task force of 5 laboratories, 10 laboratories, 15 laboratories, all working together so as to see laboratories like NML is sharing its part of responsibility. I see it as a big change that we are having. I find the Government is supporting us. This year the rise in our plan was close to 30% which is the highest that is given to a scientific department. No other scientific department has got it. CSIR has got it. Similar emphasis was there last year and year before last. There is a huge expectation from CSIR all over that you can quite really see that. Infact, I was trying to basically sort out things in recent times. The role of public institutions and one more thing I mentioned was that the real test of public institution is who recognizes it, who appreciates it. You find that if you look at CSIR, there is a wide range of appreciation that has come from everywhere. You see the business community, you talk to anyone, you talk of CSIR's story as a major transformation story. You talk to management gurus. Unfortunately, Sumanto Ghoshal died about a month ago. He has written 'World Class in India'. As you know he has actually done case studies on those organisations which has done, let us say, has shown greater propensity to radical change. There was a full chapter on CSIR. So, that is an applause. Further, interestingly, the applause was from a scientist. The ten best things that happened in the 21st century in India. He starts with Ramanujam's work in 1920 goes onto Meghnad Saha's work, goes to S.N. Bose's work on particle physics, goes onto C.V. Raman's work who brought the Nobel Prize, goes on to Ramachandra's work on molecular biophysics and then comes to the origin of space and the 10th one that he has picked up as a scientist is the CSIR transformation in the mid 90's. He says, these are among the 10 best things that has happened to India. Whether it is a scientist, whether it is a businessman, whether it is an institution, Acknowledgement whether it is by a management guru, you look at the list of all Govt's achievements during the last five years, on Science & Technology, there was a full page on CSIR. Do you know 60% of that page was based on CSIR's achievements. So, there is an appreciation from the government. The Prime Minister, who is the President of CSIR mentioned that he is proud to be CSIR president. I believe this particular pride, this particular accolade that we are getting from across the nation is not because of anyone but it is all because of you. It is because , you have been able to do and is getting reflected in terms of this accolade. So I like to make use of this opportunity to thank you from the bottom of my heart for rising to this great occasion.

I remember that there was a time in 1995 where people were wondering as what to do in CSIR. Whether CSIR will exist as an organisation, whether in post liberalised India, CSIR will be relevant at all? From that point of time, I think we have vision to absolutely reach heights. The real challenges will be ahead of us. The challenges are because of globalisation, because of opening up, because of competition. Only yesterday I was in Aligarh at the convocation of Aligarh Muslim University. As you know in Aligarh, rock industry was one of the best in India. I found it has wide demand. But the Chinese competition is going to be the key and therefore what we deliver for our industry, for our society has to be unique. In order to meet the demands of the industry we have to work harder than before, you have to run faster than before, you have to think smarter than you did before and deliver. That is why I was extremely pleased to see the portfolios that you have been able to display. Before ending I would extend my best wishes to you for a great great future of NML. It is a great laboratory and it has been given possible support. I know by supporting NML you will be supporting a great cause not only on technology but for providing products and services to the nation which will make it competitive and give its rightful place in the commitment to our nation. □

Current Sponsored Projects

- Improving the quality of red oxide pigments
- Performance of coatings on HSLA steels in tropical environments
- Development of chromium free passivators for galvanized coatings
- Development of rust preventive oils to achieve defect free coatings for cold rolled products
- Studies on steels exposed to acidic water in hydro electric project of MSEB
- Advise on adequacy of material specifications and protective devices under the conditions specified by the MSEB
- Advise on production and implementation of corrosion inhibitors

National Technology Day Celebrated

Chief Guest Shri Suresh Thawani lighting the lamp. On his left Prof. S. P. Mehrotra, Director NML

Like earlier years, the staff and members of National Metallurgical Laboratory observed National Technology Day on 11 May, 2004 at a function organised at the auditorium. NML Director, Prof. S.P. Mehrotra welcomed the gathering and gave an overview and significance of the Technology Day in the Indian context. Dr. R.N. Ghosh, Head, Materials Science & Technology Division introduced the Chief Guest, Mr. Suresh Thawani, Managing Director, JAMIPOL, Jamshedpur.

Delivering his Technology Day lecture, Shri Suresh Thawani mentioned that India had been technologically advanced since the ancient times. He said that other than science and technology, the country is in a developing stage. He said 'India has advanced in atomic power, satellite technology, however, the illiteracy, population and poverty is to be tackled with an iron hand'. He also said '25% people live below the poverty line. Thereby, in order to bring reality to 'Vision 2020' of our Hon'ble President of India, support of scientists is needed. 8% GDP is not enough and more 2% is required. He lamented that per capita income of the Nation was Rs.3687 in 1950s, Rs. 9007 in 1997 and Rs.10,754 in 2001 while the population growth was of 359 million, 946 and 1037 in 1950, 1997 and 2001 respectively'. Discussing over the growth rate between India and China he said that it must be enhanced. He added that at present birth rate of China is more than 10% and export is of 50 vs 326 million dollar. He said that with the help of science and technology this poor condition of the nation could be ended. He said that India has implemented concentrate policy on agricultural and food fronts to become self-reliant. Education and health care must be provided attention. Wider information and communication skill is needed. Infrastructure and electric power is to be enhanced. Strategic industry and critical technology in space and defence related industry is needed to be prioritized.

Dr.S.Tarafder, Sr. Scientist, NML delivered an amazing talk on 'Engineering Critical Assessment' which happened to be the subject matter of a networked multi-laboratory research initiative of CSIR in its Tenth Five-Year Plan, undertaken under the nodal leadership of NML, Jamshedpur. Dr. Tarafder's talk was elaborated on the concept of Engineering Critical Assessment. He discussed the fundamental approach towards its application. The R&D that have taken place over the past few decades were outlined in order to provide the background that had led to the modern procedure of Engineering Critical Assessment. The scope of work that required to be carried out in order to develop the technology still further was summarised. Dr. Tarafder presented how the current research strategy of CSIR targeted to fill this gap and the role played by NML was also highlighted.

While delivering a thought provoking talk on 'Intellectual property Rights (IPR) - Inventing the Invention, Dr. S. Prakash, who heads the Business Development & Monitoring wing of NML raised several questions. 'If technology was central to competition, why were R&D institutions undergoing such struggle? Dr. Prakash added, "While the impact of science and technology on business was perhaps greater than ever, the nature of challenges faced by the science-based enterprise had deeply changed. Gone are the days of clear objectives, frozen specifications and proven technologies. If we wait until all uncertainties are resolved, the market opportunity will disappear. The leading firms have acknowledged the need for building flexibility into product development and have developed in objective and specification- all founded on a solid base of experience and skill and its protection."

Shri Thawani delivering the National Technology Day Lecture

Dr. Prakash mentioned, "Traditional R&D models are completed by mechanism for technology transfer. Several mechanisms have been proposed to provide a bridge between Research and Development. The transferring knowledge from research to development (or from development to manufacturing) is facilitated by a variety of factors including the transfer of individuals from research to the development that are broadly familiar with research and the protection of its IPRs".

At the end, a vote of thanks was proposed by Shri Rameshwar Dass, Controller of Administration.

Enhancement of Process-Efficiency in the Production of Ferro-Chromium

Production of ferro-chromium using the submerged-arc furnace is an energy-intensive process. Optimisation of specific energy consumption is a major aim of development in this field. Reduction of coke rate in the process is fast becoming a major concern due to the high demand for this material due to very short supply in the international market. However, the process usually consumes about 5-20% more than the amount of carbon required for the reduction reactions and for the amount dissolved in the hot metal. There is good scope for improving the recovery of chromium, which is usually estimated at 85%. The industry is keen to increase productivity at optimum specific energy consumption and coke rate.

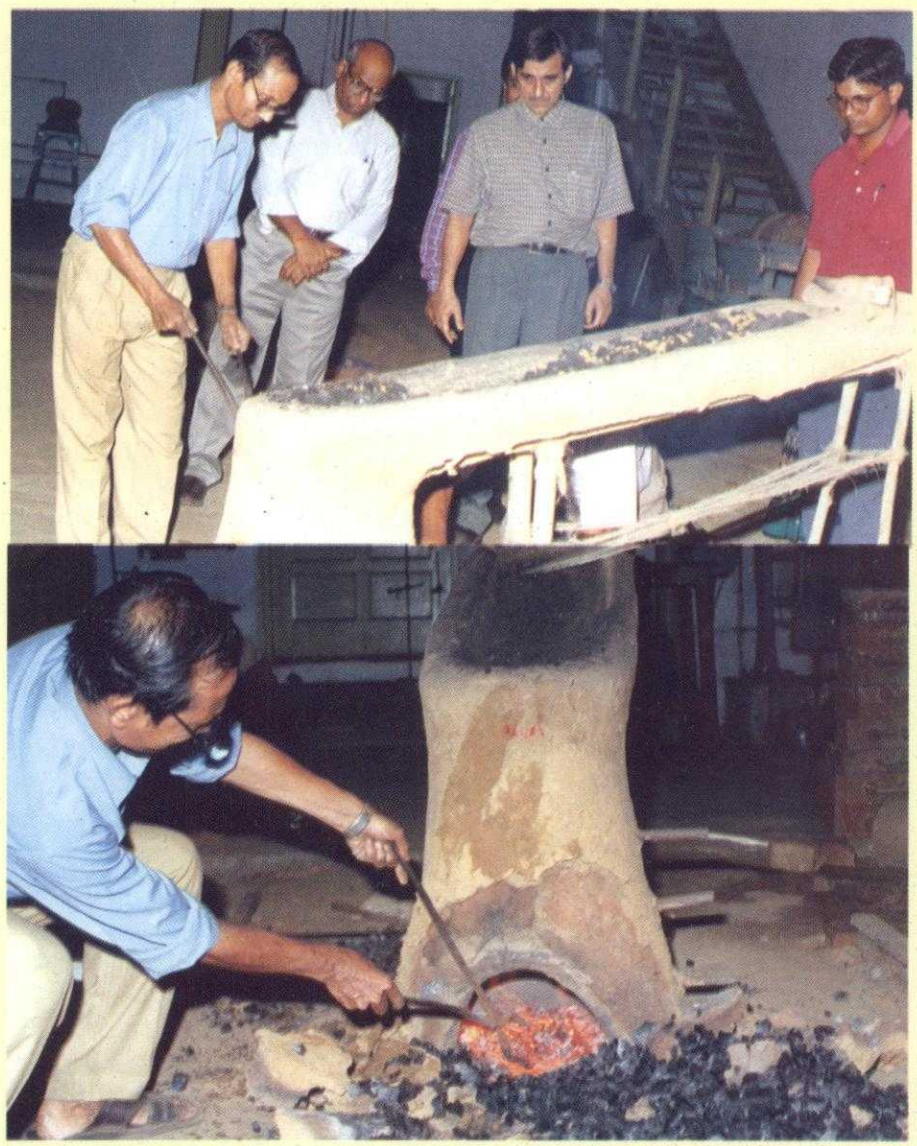
The specific energy consumption can be significantly reduced by rationalising operation practice. For example, a considerable amount of heat is lost from the furnace as sensible heat of the lag and hot metal. Analysis of plant data shows that the temperature of the slag varies from tap to tap by as mush as 200°C. This leads to large heat loss with no proportional benefit accrued in improved production or recovery. The temperature of the slag is controlled by the nature and quantities of the various charge materials charged to the furnace. Rationalising the furnace burden can significantly help in reducing the specific energy consumption. This can lead to a saving of as much Rs.50 lakhs per annum for an industry producing 50,000 tonnes of the metal per annum.

It is usually found that much of the reduction of the ore occurs in the slag or the partly melted charge. Chromium and iron get reduced at different temperatures. The utilisation of coke can be improved by a good understanding of the thermo-dynamics of reduction of the solid ore and other parameters that influence the reduction process. This thermodynamic analysis combined with a rationalisation of the utilisation of coke can considerably reduce the coke rate of the process. The recovery of chromium also can be improved by application of the knowledge gained from the thermodynamic analysis of the process and optimisation of process parameters and process control.

The present project at NML aims at developing suitable process parameters to reduce the specific energy consumption, decrease the coke rate and increase the recovery of chromium based on the analysis of the process using thermodynamics and phase relations in the process.

Revival of Traditional Iron Making Technology

Iron age was heralded in India long before the industrial revolution in Europe. It is the tribal of India who made the iron centuries before the advent of modern iron and steel industries. They produced pure form of iron having very log carbon content (approx. 0.10 - 0.15%) which was corrosion resistant. However the yield and the production capacity were very low (yield 20-25% and production 3-4 Kg per heat in 3-4 hours duration). So the Ministry of Steel, Govt. of India, came forward to finance R&D Organisations with a view to increase the productivity and capacity of



Experimental studies on the traditional iron making in the laboratory set-up

production. With their financial assistance, NML has undertaken a project on "Documentation and development of tribal iron making process of India". An attempt is being made to increase the rate of heat input and reduce wastage of heat energy. It is expected that with this exercise, it may be possible to increase the productivity by 1.5 to 2 times. A programme has been drawn with the involvement of NGOs to popularise this improved technology among the tribals who are already engaged in this traditional iron making process.

Bio-mimetic synthesis

A technology on Bio-mimetic synthesis of biomaterial for implants to synthesise biocompatible mesoporous hydroxyapatite-polymer composites of high toughness and biomimetic coating of hydroxyapatite on metal implants, has been transferred to a Pharmaceutical Co., in India. In extension to its activities in the area of Biomimetic synthesis of inorganic nano-particles under micro gravity, NML has been offered a platform on the first flight of recoverable space capsule by Indian Space Research Organization (ISRO) to develop a biomimetic pay-load so that one can study the effect of micro gravity on pre-organisation of supramolecular matrix that ultimately controls the nucleation and growth of the inorganic nano-particle.

R&D for minimising flight accidents

In addition to the Investigation and Characterisation of the rotary slide valves of centrifugal governor of main fuel pump of R-25 aeroengine of MIG-21 aircrafts, which was failing and causing the national loss of both men and materials, NML has now undertaken several studies in this sector. In the recent visit of Air Marshal A.K.Singh, he encouraged the NML performance that has effectively contributed through its R&D activities towards saving the life of several pilots. He further informed that the implementations of the recommendations of NML on improving RSV material and its design are under way progress which would help decrease the number of flight accidents occurring mainly due to rotary slide valve.

Production of silico-manganese from waste

The technology on Production of silico-manganese from leach residue of polymetallic sea nodules to utilize the waste products containing about 20% manganese and 10% iron, with the support from the Department of Ocean Development exhibiting a great potential for its commercialisation.

Squeeze casting process for automotive industry

The project on Developing Capabilities in Advanced Manufacturing Technologies has been progressing well. It comprises of Development of near net shape components of Al-alloy by squeeze casting process to develop technology for manufacturing Aluminium alloy automotive components by squeeze casting including brake drum, steering wheel, piston etc.

Production of wide ferro-magnetic glass ribbons

Development of manufacturing technology for production of wide ferromagnetic metallic glass ribbons to develop the technology for the production of wide amorphous ribbon having excellent soft magnetic properties was in progress.

Treatment of industrial effluents

NML at its Madras R&D Centre, Chennai is engaged Treatment of industrial effluents by electro flotation for the removal of suspended solids, COD, BOD, sulfides, sulfates, tannins, metals etc. from various chemical and metallurgical industries including textile, printing, paper and pulp, hotel/restaurant, meat and food processing, dairy tanneries etc. The system can be designed, installed and commissioned for specific applications on turnkey. The proposed system for industrial effluents help overcome the problems encountered by the conventional settling ponds etc.

Mechanical activation in improved blended cement processing

India with its cement production of over 120 million tonnes and more than 126 cement plants ranks second only next to China which produces 5-6 times more cement. The world production of cement is of the order of 1.7 billion tonnes and given a continuing annual growth rate of 3%, global cement consumption is expected to reach ~ 2 billion tonnes by 2008 Cement industry is material intensive, energy intensive and is responsible for huge emission of carbon di oxide. One tonne of cement consumes 1.2 - 1.5 tonnes limestone, 4000 MJ of energy and produces 1-1.2 tonne of carbon dioxide. Based on these figures the environmental impact of cement manufacturing is easy to gauge. Thus, resource conservation, energy efficiency and reduction in CO2 emissions are some of the critical issues along with increasing demand on quality and performance. Sustainable growth of cement industry calls for utilisation of Industrial wastes, such as BF slag and fly ash in cement manufacturing. Inspite of significant utilisation of these wastes in cement industry, only 40-50% BF slag and 5-8% of fly ash generated in the country is used in the blended cements, namely, Portland Slag Cement (PSC) and Portland Pozzolana Cement (PPC) manufacturing. The ratio of clinker produced and total cement production in India, that is indicative of waste utilisation in cement industry, is lower than China. Thus, there is a need to maximise utilisation of industrial waste in the cement industry. Chemical and mechanical activation of blended cement constituents, in conjunction with suitable admixtures, offers immense potential to increase utilisation of industrial wastes in cement industry, besides preparation of clinkerless cements purely based on slag and other wastes. The research module, 'Mechanical Activation in Improved Blended Cement Processing' under the NMITLI project on improved granular processing aims to develop processes for improved blended cements containing higher proportions of

slag and fly ash, high performance cement and clinkerless cement. The deliverables under the project are defined based on the benchmarking study of Indian blended cements. It is proposed to develop alternative strategies to increase the utilisation of the slag and fly ash from the current level of about 25 and 45% to 80 and 50%, respectively. Development of high performance cements (strength > 90 MPa) and clinkerless cements also falls under the preview of the project. The novelty of the project is to exploit the concepts of mechanical activation in conjunction with chemical activation. It has been established that the current level of utilisation of slag and fly ash, ~ 45 and 25%, respectively, can be increased to 80% and 50% through the judicious application mechanical activation. Application of high-energy mills, e.g. attrition mill, vibratory mill, separately or in combination with traditional ball mill, is explored and differences in mill type/milling scheme are elucidated. Significant results of fundamental importance are obtained on the hydration of mechanically activated slag. It has been established for the first time that granulated blast furnace slag, which shows latent hydraulic activity, can hydrates due to mechanochemical activation in few days even in the absence of a chemical activator. The slag hydration product has a crystalline character, unlike amorphous gel that is normally observed, and the crystallinity of the product increases with increase in the milling time. Since reactivity of the slag has been a major concern, these results offer possibilities of developing novel cements based on the mechanically activated slag. Clinkerless cements having 80-90 MPa strength are developed under the project. Studies are in progress to study the replacement of slag by fly ash in the clinkerless cements.

Development of technology for beneficiation of low grade barite

Barite is an important industrial mineral. Most of barite produced is consumed by oil industries. Its other important uses are in the manufacture of paper, glass, pigment and rubber. It is also used for diagnosis of digestive system by x-ray radiography. India's reserve of barite mineral is approximately 75 million tonne. Out of this, 74 million tonne is deposited in Mangampet alone in Cuddapah district of Andhra Pradesh. Mangampet mines is open cast and being worked by M/s Andhra Pradesh Mineral Development Corporation (APMDC). The mining is mechanised and the mineral extracted from the mines is manually segregated on estimate basis into marketable grade lumps and fines with +4.12 specific gravity and the rest is dumped as rejects along with other mined wastes like tuff and black shell. Nearly 700,000 tonne of mined wastes is accumulated at mines site as waste dumps and approximately 150,000-200,000 tonne of such waste is added to these dumps every year. At times stocks from the waste dump is sold at Rs.150-175/- per tonne. Earlier a project for bench scale studies was sponsored by DMRTUF (Development of Mineral Resources and Technology Upgradation Fund, A Trust of the Govt. of Andhra Pradesh) with an objective of determining feasibility of recovering marketable grade barite from waste dump. Result of the studies indicated that barite concentrate product with over 4.20 specific gravity value could be recovered with 75% yield from the waste by flotation separation route. Encouraged by the findings, DMRTUF sponsored the project on pilot scale trial to see technical feasibility of the process developed at bench scale. Pilot scale beneficiation studies were conducted on a sample of 30 tonne drawn from barite waste dumps with the objective to developing a technological scheme, which would upgrade barite waste to recover product for use in oil industries. Results of the pilot scale trial indicated that the sample could be upgraded to produce barite concentrate with ~4.20 specific gravity with 74% yield. It was concluded that 74% of the waste dump could be recovered as premium barite, which may be sold at Rs.1300/-. Deliverables from NML included results of mineralogical studies, basic engineering data consisting of physical characteristics like size spectrum of as received ore, angle of repose, bulk density, crushing strength, grindability index and ball mill work index etc. and technological flow sheet with all parameters. The report submitted by NML to the sponsor also contained ballpark work on techno-economics of the process based on 200,000 t/y throughput beneficiation plant on aspects of manpower, electrical energy, equipment etc. The findings were presented by NML scientists before the board members of the Trust at Hyderabad. On elementary analysis the project looked profitable. However, the sponsor DMRTUF and the APMDC were advised to get the assistance of consultants to prepare TFR (Techno Economic Feasibility Report). M/s AAPMDC is analysing the report with a view to utilising the results from this study for Greenfield installation of a barite beneficiation plant. The Cabinet Sub-Committee of the Govt. of Andhra Pradesh has reportedly approved the decision for installation of a beneficiation plant to recover barite values from waste. Commissioning of beneficiation plant will be helpful in utilisation of off grade barite dump sample leading to conservation of barite resources. In addition to generating employment, the activity will have significant economic impact.

Foreign Deputation

Dr. Vikas Chandra Srivastava, Scientist visited Germany to carry out research under CSIR-DAAD Exchange Programme. The purpose of the visit was to have hands on experience on advanced and sophisticated spray forming set-up, to produce different kinds of metal matrix composites by this process and to characterise them, to meet experts in different research areas of his interest, to assess the scientific advancements that have been made in the area of his work and to learn new techniques of materials processing. The visit has resulted in a joint collaborative research programme.

Task Force Meeting on TECA

The third Task Force meeting of the TFYP project on Technology for Engineering Critical Assessment was held on 18-19 May, 2004 in the Lecture Hall. Representatives from various CSIR Laboratories participated in TECA, as well as invitees from IIT-Kharagpur and IGCAR, Kalpakkam attended the meeting. NML, being the nodal co-ordinating laboratory for the project, all scientists involved in the implementation of the project attended and participated in the proceedings.

The welcome and opening remarks were delivered by Prof. S.P. Mehrotra, Director, NML. It was followed by discussions on the structure of TECA, monitoring the implementation of TECA and the purpose of the third task force meeting. Presentations from participants from various laboratories were made on the following: (i) the various Task sub-elements (projects) being implemented in the laboratory; (ii) the milestones and deliverables of each Task sub-element (project) and (iii) the status of preparedness for capital expenditure in 2004-2005 by the laboratory. CGCRI, Kolkata; CMERI, Durgapur; NAL, Bangalore; SERC, Chennai; RRL, Bhopal; CBRI, Roorkee and CRRI, New Delhi were the participating laboratories.

The programme will form a major activity in one of the niche areas of NML to develop technologies for Engineering Critical Assessment (ECA) for the generic class of structures and components viz. pressure vessels and pipelines of the thermal and nuclear power plants, petrochemical and process industries, airframes and aeroengine components, infrastructural assets of the transportation industry: e.g. concrete and steel bridges, railway wheels and railway tracks, offshore structural components. The programme will also involve Engineering Critical Assessment for sub-structural and surface processes, signal and image processing techniques for damage assessment, sensor devices for surveillance.

- PARAM-supercomputers to enhance the design and analysis capabilities in the areas of computational fluid dynamics, computational transport and rate phenomena, computational mechanics, 3D visualisation graphics, computational metallurgy and associated disciplines.
- State-of-the-art facilities for offering scientific services include Analysis pro- keen view and SIS workstation extended to transmit the TEM image on a video screen, which helps in various types of analysis.
- 3D particle image velocimetry (PIV) system for flow visualisation and the study of whole field characteristics of the fluid flow. It is capable of making 3D measurements of the flow under study.
- Non-Destructive Evaluation Centre which is equipped with some of the most advanced state-of-art equipment, will provide new capabilities in predicting the failure and assessing the residual life of components in strategic sectors like power plants, petrochemical industries and railways. The Centre has already set up facilities like Real-time X-ray Radioscopy 225kV system; Ultrasonic flaw detectors and other accessories.

Recognition

Dr. R. P. Bhagat, Scientist, NML has been elected a Fellow of Institution of Engineers (India).

Talk organised

Group Capt. P. B. Patel, Indian Air Force, Samana Station, Jamnagar delivered a talk on Cosmic and other alternate healing at NML Lecture Hall on April 21, 2004

Wishing a Happy Retired Life

Shri Hardev Singh (Tech. Gr.I/4); Shri Vijay Pal Singh (T.A.Gr.II/4); Shri Rajendranath (T.A.Gr.II/4); Smt. Padmavati (Safaiwala); Shri D.M. Chakrabarti (Scientist E-II); Shri T.J.Rao (T.A.Gr.II/4); Shri Pishwari Lal (T.A.Gr.II/4).

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