



**CSIR-National Metallurgical Laboratory
Jamshedpur, India**



From the Director's Desk



Chairman, Members of the Research Council, Invitees and Dear Colleagues,

It is indeed a great pleasure to welcome all the members of the Research Appraisal Groups and the Research Council of CSIR-NML. We have conducted the second meeting of Research Appraisal Groups (RAG) on May 31, 2018. The activities of the R&D Division have been presented in the RAG meetings and the respective Project Leaders presented the outcome of their projects completed during October, 2017 to March 2018. I will briefly present to you our salient achievements and performance

since the last Research Council meeting.

Deliveries : Output and Outcome

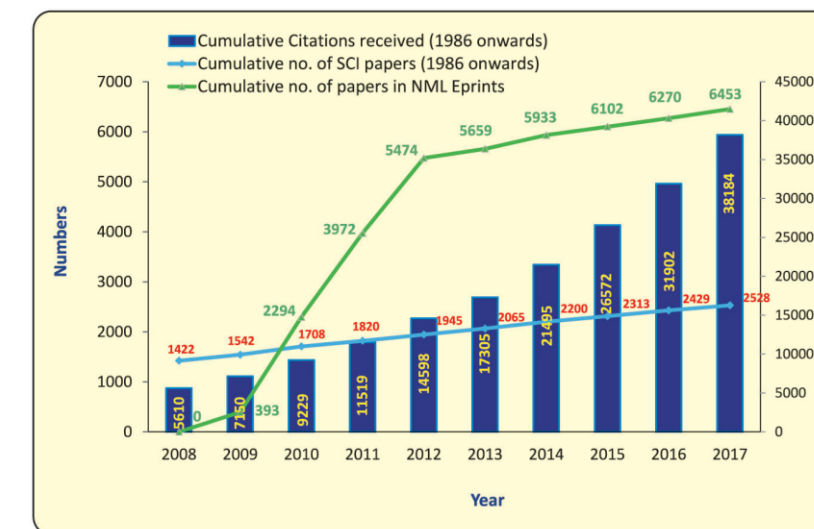
As was indicated in the previous Director's Desk, we will categorize our outputs and outcome with regards to the Four "Goods" identified by the Kelkar Committee namely, i. Public Goods; ii. Private Goods; iii. Strategic Goods and iv. Societal Goods. In the interregnum since we last met, CSIR-NML has delivered the following outcome and output which are classified as per the "goods" nomenclature:

Public Goods

Knowledge Generation and Dissemination

Publications

During the last year, CSIR-NML Scientists and staff published 130 papers in SCI/Non-SCI Journals. The citation, the cumulative SCI publications (1986 onwards) from CSIR-NML has increased from 31902 (December 31, 2016)



Growth of Research Publications, Citation and NML IR (Eprints)



CSIR-National Metallurgical Laboratory

Jamshedpur-831007, India

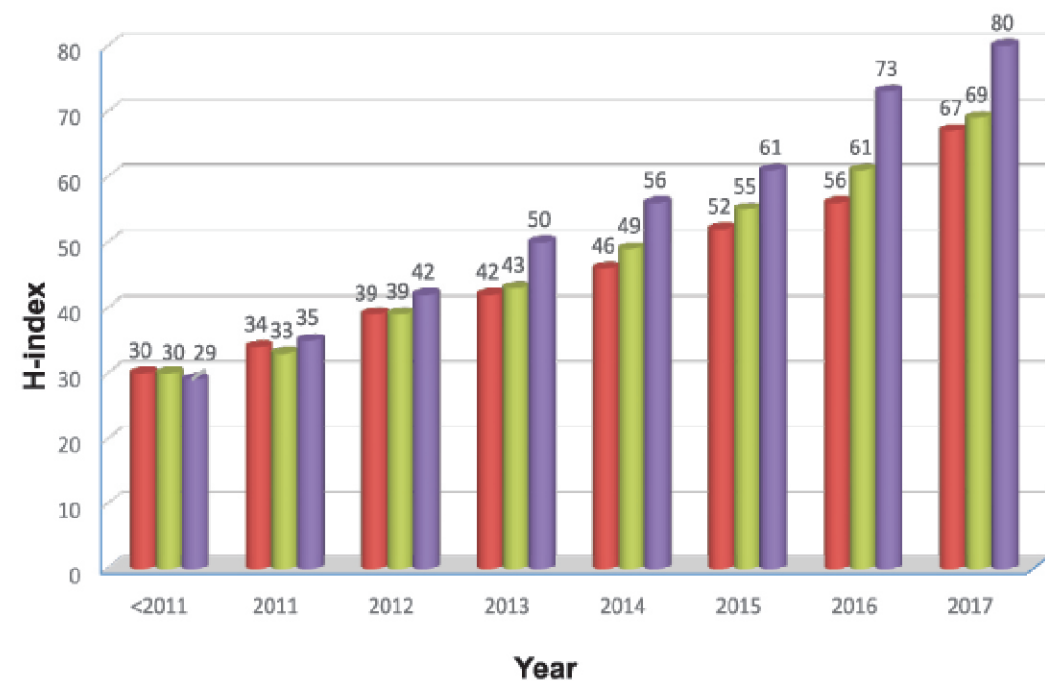
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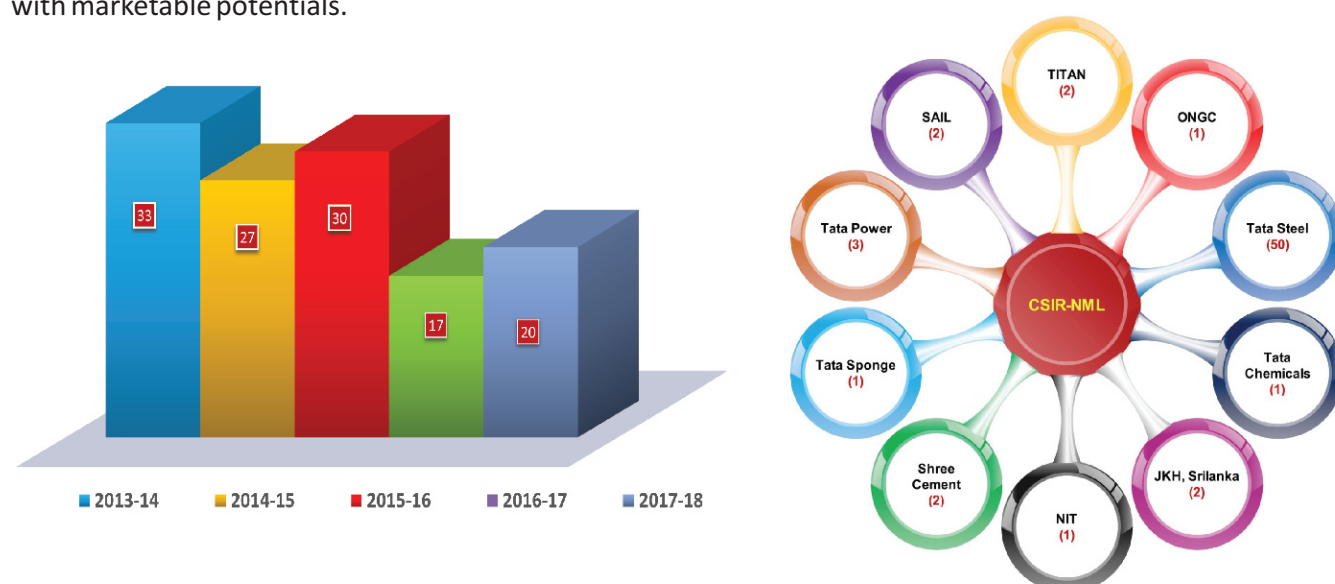
to 38184 (December 31, 2017) registering an increase of about 20%. During Jan-May, 2018 more than 43 papers were published in SCI journals. The average citation per paper is 15.10 against 13.20 in the last year. The institutional H-index has increased to more than 75



CSIR-NML H-index

Patents

We have been very rigorous and selective with regards to patent applications, restricting ourselves to patents with marketable potentials.



During the FY 2017-18, 20 patent applications have been filed; 10 patents have been filed since the last RC meeting. Many of these patent applications have been filed jointly with industries. As shown, during the last 5 years a significant number of patents have been filed jointly with our clients.

- Professional Training Programme on Coal for Metallurgical and Thermal Applications: An Appraisal of its Characterization & Utility (CMTA 2018)
- MAF 2018 Professional Training Programme on Metallurgical Analysis of Failure (MAF 2018)
- E-waste Deconstruction (EWD 2018)
- Metrology and Calibration for Quality Assurance (MCQA-2018)
- Skill Training on Energy efficient Brass melting furnace for Production of Brass artifacts
- Corporate Training Program on Inspection and evaluation of flash butt welded rails for RITES Officials.
- CSIR-Integrated Skill Training on Technopreneurship (How to start a tech business?)

Hello and goodbyes

Retirees :

Mr. K.N. Mishra, Mr. I.B. Mishra, Shri Hanesh Prasad, Shri Shaikh Mahidul Islam, Shri Bholanath Mandal, Shri Prem Narayan Thakur

We express our sincere thanks for their services and wish them very happy retired life.

New Arrivals :

- | | |
|--------------------------------------|---|
| 1. Mr. Saurabh Shekhar, Scientist | 4. Mr. Shivendra Sinha, Scientist |
| 2. Ms. Y. USha, Scientist | 5. Mr. Avanish Kr. Chandan, Scientist |
| 3. Mr. Chandra Veer Singh, Scientist | 6. Ms. Priya M Toppo, Jr. Secretariat Assistant |

Our warm welcome to the new entrants.

Looking Forward.....

CSIR has developed a horizontal structure of project planning and implementation which incorporates laboratories with similar interests to propose and collaborate in impact making projects. This horizontal scheme is formalized through 8 theme areas with each theme co-ordinated by a theme director. CSIR-NML has its major activities covered by the 4M (Mining, Minerals, Metals and Materials) theme. As indicated in "Public Goods" NML has already proposed a number of technology development projects as well as niche-creating and focused basic research projects in this theme. We have also developed certain mission mode programmes under this theme. The acceptance and implementation of our proposals will be known shortly and will be reported to the next RC meeting.

The final go-ahead for the prestigious Twinning programme with MIDI, Ethiopia has been received and the first tranche of funding obtained. The programme will start in full swing from July. In addition to the nationally important missions in which NML is participating and other on-going projects, indicated earlier, NML is expecting significant collaborations with Tata Steel, MOIL, GSI and several other organizations. We look forward to a challenging and satisfying research activities in the days to come.

You can never cross the ocean until you have the courage to lose sight of the shore

-Christopher Columbus

(I. Chattoraj)
DIRECTOR



Distinguished Visitors

- o Dr. Sourav Pal, Director, Indian Institute of Science Education and Research (IISER) Kolkata, delivered the Dr. B.R. Nijhawan Memorial lecture on CSIR-NML Foundation Day.
- o Prof Walter Arnold, Dept. of Materials Science & Materials Technology, Saarland University, Saarbrücken, Germany and I. Physikalisches Institut, Georg-August Universität, Fritz-Hund-Platz 1, Göttingen, delivered a talk on Contact Mechanics Applied to Measure the Mechanical Surface Properties of Comet 67P, on 31st January, 2018.
- o Dr. DH Van Der Weijde, Program Manager, Tata steel Europe Research and Development, Netherlands, delivered a talk on "Recent advances in electroplating and Formable polymer coating". On 12th February, 2018.
- o Prof. NN Viswanathan, Dept. of Metallurgical and Materials Science, IIT, Mumbai, delivered a talk on "A methodology to quantify the physicochemical phenomena during induration of single magnetite pellet". On 28th February, 2018.
- o Mr. Ashok Kumar, CTO, Tata Steel, delivered a talk on "With an iron hand" organised by IIM Jamshedpur chapter in association with CSIR-NML on 21st March, 2018.

Foreign Deputations :

- Mr. Sanjay Agarwal, Senior Scientist was deputed to KIGAM, Korea on Raman Research Fellowship.
- Dr. Rakesh Kumar, Chief Scientist was deputed to Kosice, Slovakia for Income-2017.
- Mr. Krishna Guguloth was deputed to Dusseldorf, Germany for a Conference.
- Dr. Amitava Mitra, Chief Scientist was deputed to Warwick University, UK for attending a Project Meeting.
- Dr. S. Siva Prasad, Principal Scientist was deputed to Ulm, Germany for an International Forum.

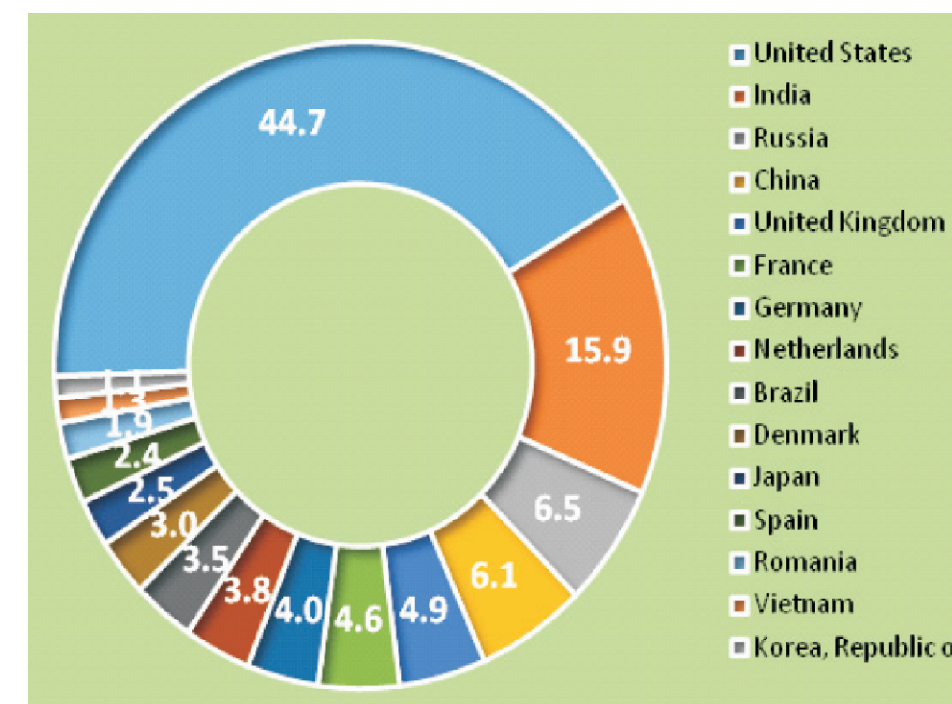
Major Events organized

The Laboratory was a host to a number of technical as well as social activities. During the last 6 months the following major events were organised:

- Monitoring and Prevention of Industrial Corrosion (MPIC 2017)
- Corporate Training Programme (CTP) on Metallurgical Analysis for Quality Assessment (MAQA 2017)
- Professional Training Programme on Experimental Techniques in Iron and Steel making (ETIS 2017)
- Professional training programme on Metallurgy for Engineering (M4E-2017)

Dissemination

The CSIR-NML Institutional repository (<http://eprints.nmlindia.org>) has maintained its global visibility and achieved a 26 fold increase in popularity with average hits of over 0.238 million per month and a cumulative of over 19.84 million hits since inception (2009). The researchers from 197 countries have accessed NML repository database. Among the global users, the top fifteen countries in decreasing order are United States, India, Russia, China, UK, France, Germany, Netherlands, Brazil, Denmark, Japan and Spain.



NML Eprints in terms of No. of Countries & hits / downloads

Public Funded Projects

The Laboratory has submitted proposals for 7 Fast Track Translation (FTT) and 1 Fast Track FTC project to the CSIR 4M Theme Directorate. Out of these, four FTC/FTT projects have been short-listed- (i) Scale up studies and commercialization of indigenously developed hydrogen standard in steel (FTC), (ii) Smart sensing system for cold drawn high end wires (FTT), (iii) Development of biodegradable eco-friendly flotation reagents for sillimanite, limestone and coal and (iv) Piloting of the process for Production of Premium Grade Iron Oxide from Waste Ferrous Chloride Solution Generated from Steel Pickling and Ilmenite Processing Units. The following four FTT proposals are under review - (i) Annealing simulator integrated with online process control sensors for run out table process simulation, (ii) Pilot Scale processes for recycling of metals/ materials from E-waste, (iii) Scale-up, Technological, Engineering and Market prospect evaluation of Spent Electric Vehicle Lithium Ion Battery Recycling Technology and (iv) Technology for Reclamation of Spent Refinery Catalyst. The Laboratory has recommended three Niche Creating Project (NCP) proposals - (i) Self-healing Coatings for Corrosion Protection of Steel and Aluminium alloys, (ii) On the slag-metal refining of future generation steels and (iii) Synthesis of new 2D materials other than graphene for energy application and one Focused Basic Research (FBR) proposal - Developing criteria for design of high entropy alloys for structural applications.

The Laboratory undertook an ambitious programme to enhance and improve the efficiency of power capacity of India through the introduction of Advanced Ultrasupercritical (AUSC) Power Plants. The programme has two fold objectives: (a) to undertake all R&D aspects, especially, that of materials to be employed in AUSC power plants and (b) setting up a 800MWe AUSC demonstration power plant. The plant would employ a steam cycle of 300kg/cm² pressure at 710-720°C temperature. A National Mission Directorate comprising representatives from BHEL, NTPC and IGCAR will oversee this project. One of the challenges in developing technologies for such enhanced steam cycle, is the selection of materials and understanding their behaviour. In the Indian version of AUSC, it has been decided that for some of the components the materials would be similar to those in the supercritical units already in operation. For certain components (eg., top end of superheater/re-heater tubing, HP/IP control valves, HP/IP turbine blades, turbine integral piping) new materials have been identified/developed. The proposed materials likely to be indigenously developed for different components are: Grade 23 Steel for Water wall tubes; 304HCu, IP/HP for Final stage Superheater; Alloy 617M / 625 for turbine parts; Grade 91 Steel for Superheater/Re-heater tubes; Alloy 617M for Hot zone of SH/RH tube; and 10Cr/Alloy 617M for Turbine rotors. All these materials will be evaluated for their mechanical and high temperature corrosion/oxidation behaviour to meet the design requirements and a round robin test programme has been initiated by AUSC Mission for this purpose. Apart from this, there is also a need to develop NDE based technologies (sensors, techniques and procedures) for damage detection, monitoring and life prediction. CSIR-National Metallurgical Laboratory has been identified as one of the key participants in this round robin programme and for the development of advanced NDE tools.

The Ministry of Steel, Government of India, has granted a project with an outlay of thirty six crores for the pilot scale development of amorphous electrical steel for energy applications. The project will span over four years which would include activities pertaining to processing of amorphous electrical steel at a pilot scale level, so that it could reach a technology readiness level acceptable by Indian industrial units for indigenous production of amorphous electrical steel. The proposed pilot plant will be established in one of the pilot plant premises of the Laboratory with two fold objectives (i) establish a 100kg pilot scale melt spinning facility and establish process parameters for the production of FeSiB based continuous amorphous electrical steel having dimension 100mm wide & 25-30mm thick and (ii) a prototype transformer development using the manufactured amorphous electrical steel.

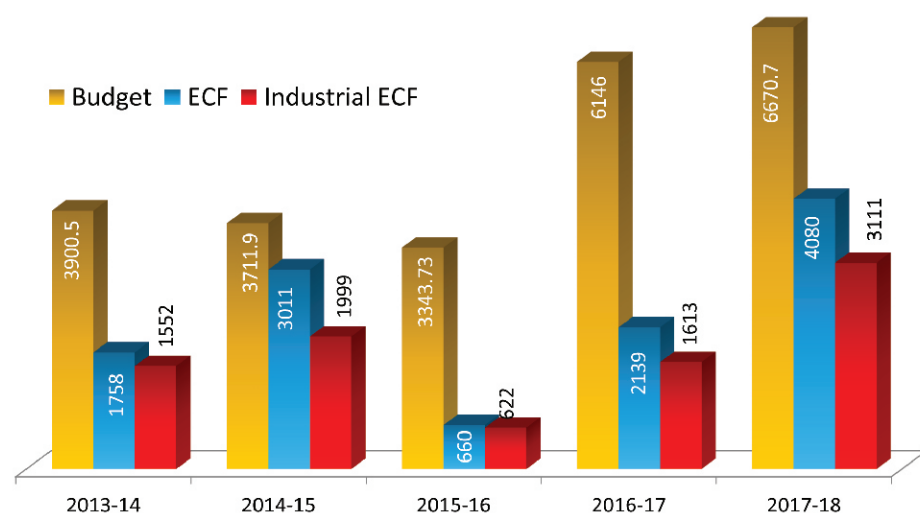
The Laboratory has developed a novel flux for the development of low Phosphorus Steel in Induction Furnace. The lab scale studies were carried out using neutral lining with CSIR-NML developed flux. These experiments revealed that the Phosphorus of steel could be reduced to a level varying between 0.014%-0.035% from an initial Phosphorus ranging between 0.08%-0.1%. Slight slag-metal line erosion was observed under highly oxidizing condition which can be solved by patching from time to time. Subsequently, industrial trial was taken in a 12 ton induction furnace lined with neutral refractory material. Phosphorus level was brought down from 0.07 % to 0.035% which is well within the prescribed limit of BIS. Lining erosion tendency has been reduced. Boiling tendency of bath have been observed due to high oxygen potential of the bath. The technology has evinced interest from a couple of potential clients. The progress of the FTT project, Technology for Extraction of Tungsten (W) from a Variety of Scraps is encouraging. The process has been optimized at a Bench scale for recycling of W-heavy alloy scraps. A process for recovery of Co from WC scrap leach solutions through solvent extraction route has also been established. Consultancy service has been provided to M/s Wolfram MetChem Pvt. Ltd., Chindwara for setting up of 150MT/y W-powder plant based on CSIR-NML technology. Besides CSIR, some of these activities are also sponsored by Ministry of Defense through DMRL, Hyderabad.

Awards / Distinctions/ Fellowships/ Received

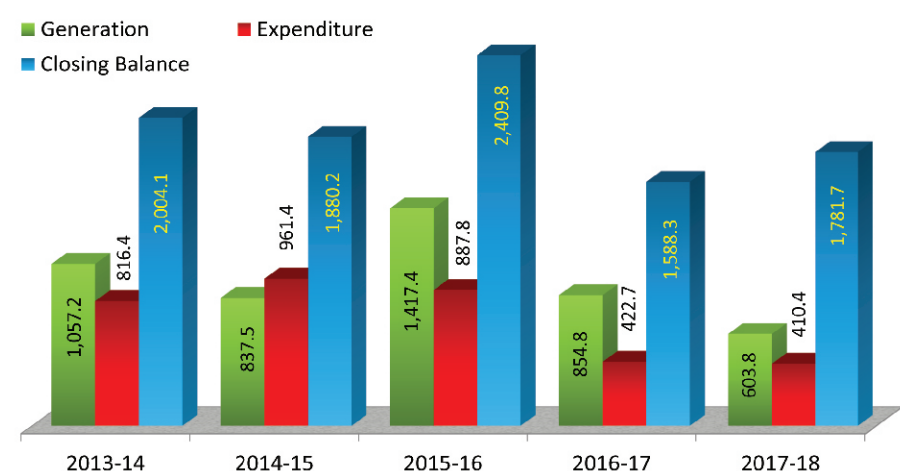
During the reporting period, several recognitions came our way:

- SCIENTIFIC INSTITUTION AWARD 2017: CSIR-NML received the "Scientific Institutional Award 2017" for its exemplary commitment towards achieving technological innovations in the field of non ferrous minerals, metals and materials, in the 21st International Conference on Non ferrous Minerals and Metals-2017, held at New Delhi.
- SKOCH Order-of-Merit Award 2017: was awarded for the project "Institutional Repository: Prospect and its Global Impact", with Dr. A.K. Sahu as the leader.
- SKOCH Order-of-Merit Award 2017: was awarded for the project "Technology Dissemination for MSME Brassware Artisans: Energy Efficient, Less Polluting Brass Melting Furnace and New Anti-tarnishing Lacquer", with Dr. A.K. Mohanty as the leader.
- FELLOW OF INDIAN NATIONAL ACADEMY OF ENGINEERS (INAE) was conferred on Dr. I. Chattoraj with effect from November 2017.
- NON- DESTRUCTIVE TESTING NATIONAL NDT AWARD: Dr. Sarmishtha Palit Sagar, received the Non-Destructive Testing National NDT Award for International Recognition (ISNT) jointly sponsored by ISNT & Ferro flux Products, Pune for the year 2017.
- OUTSTANDING REVIEWER AWARD by "Hydrometallurgy" journal was conferred on Dr. Thomas Alex.
- YOUNG ENGINEER AWARD of the Mineral Engineering Science Association, Vishakapatnam, India (2017) was awarded to Dr. Abhilash.
- CSIR-NML received Runner-up in Cricket in the inter CSIR 49th SSBMT Outdoor Tournament held at CSIR-CSIO, Chandigarh.
- HORTICULTURE AWARD: Mr. Sanatan Naiya and his team won 22 awards in different categories in the Horticulture competition held at Gopal Maidan, Jamshedpur on 31st December 2017.
- BEST POSTER AWARD: Ms. Charu Singh received this during the 'International Conference on Advances in Material Processing; Challenges and Opportunities (AMPCO)-2017" at Indian Institute of Technology, Roorkee.
- SECOND BEST PAPER AWARD: Dr. TC Alex, Mr. DP Sahoo and Dr. Sanjay Kumar received the second best paper award, Tata Search, 2016 for their research paper "Cold bonded briquetting of iron ore slime".

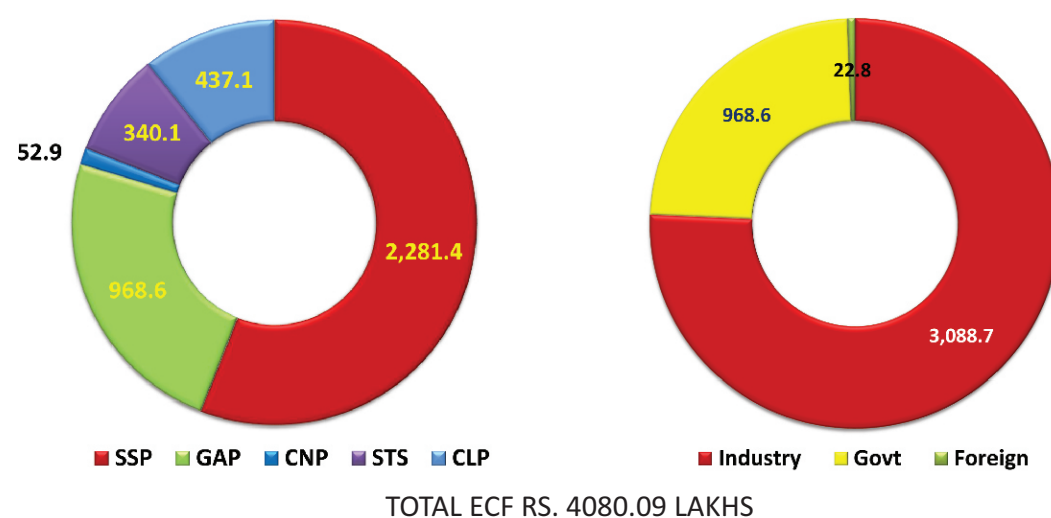




The Laboratory is making conscious efforts to concentrate on industrial collaborations and to reduce government grants. As a result of this, our Laboratory reserve is healthy.



For the FY 2017-18, the distribution of external cash-flow [ECF] among the various categories of projects is depicted below :



DMRL, Hyderabad, has sponsored a major project on development of process flow-sheet for extraction of tungsten metal from Hutti gold mine tailings & recycling of tungsten based heavy alloy scraps. Bench scale process flow-sheet has been developed for production of W metal powder (purity >99.9%) from tungsten heavy alloy scraps of all sizes & shapes, generated by various defense establishments. The developed flow-sheet is unique, in providing the shortest route for efficient recycling of such scraps with much lower processing cost compared to contemporary technologies. The process for recovering W metal from Hutti gold mine tailings is under development. Initial bench scale experimentation for enrichment of W from 0.02% level to a suitable extractable level (~ 5%) showed promising results. In India, this is the first ever endeavor for economic extraction of tungsten from such low grade material. The Hutti tailing was observed to contain 73% passing 12 m with scheelite as the tungsten bearing mineral. The mines waste was subjected to gravity separation followed by magnetic separation and a scheelite pre-concentrate with about hundred times enrichment was obtained. The tungsten pre-concentrate was further processed by hydrometallurgical routes for production of high pure APT. The pre-concentrate was subjected to alkali leaching followed by solvent extraction of tungsten from the leach solution. The tungsten loaded organic was stripped by NH₄OH followed by evaporation of ammonium tungstate to crystallize high pure ammonium para-tungstate crystals (purity >99.6%). The tungsten recovery for pre-concentrate achieved was higher than 90%. The pilot scale study is under progress. The scope of the second project is to develop process flow-sheet at a pilot scale (100 kg/day W-powder production) for production of high pure tungsten metal powder from W-heavy alloy turnings generated by various ordnance factories of our country. The heavy alloy turnings contain about 90% W along with Ni (~5%), Fe (~4%), Co (~0.2%), Mo (~0.2%) and traces of various other impurities. Accordingly, CSIR-NML has developed a process flow-sheet and validated this at a bench scale (few kg/batch) for production of high pure tungsten metal powder conforming to/better than the specified grade (As specified by Defense Ministry grade CQAM 58 with product purity >99.94%; Particle Size 3 - 5 μ and lose density 3 - 5 g/cc). The produced metal powder has been tested by DMRL and was found suitable for various defense applications. The main features of the developed process know-how include: (i) shortest and cheapest route for production of W-powder from such scraps, (ii) process yield highest tungsten recovery (>98%) in comparison to other contemporary recycling technologies (80 -85%), and (iii) effluent generation is minimum in comparison to other processes (only NaCl effluent is generated), and (iv) process recovers other valuable metals such as Ni, Co and Mo as saleable by-product(s) with high recovery efficiency (>95%). CSIR-NML has already completed the installation and commissioning of the 100 kg/day scale W-powder production pilot plant, which has been operational recently

Another important project sponsored by Ministry of Steel and Tata Steel under SDF is the Study on the interface layer formation during hot dip galvanizing of advanced high strength steels for automotive applications. The project was carried out with the objectives to develop process window for Galvanized and Galvannealed Zn-Al, Al-Si and Zn-Al-Mg (ZAM) coatings on IFHS, C-Mn steel with strength upto 440 MPa and AHSS such as DP (600-1000MPa), MA, TRIP/multiphase steels. GI & GA coatings on AHSS (980 MPa) grade was obtained and Zn-Al-Mg coatings on AHS grades of steels is under progress. In future, GI & GA coatings, Al-Si and ZAM on AHSS (~1000 MPa) grades will be studied.

Production of Highly Metallised Directly Reduced Iron (DRI) from Mill Scale and Lean Grade Coal in Tunnel Kiln, was sponsored by the Ministry of Steel with two fold objectives - (i) Laboratory Investigation (500 gms to 5 kg scale) on Feasibility study for production of highly metalized DRI using mill scale and lean grade coal, development of alternate saggars/crucibles and optimization of process parameters and (ii) Pilot Scale Trials

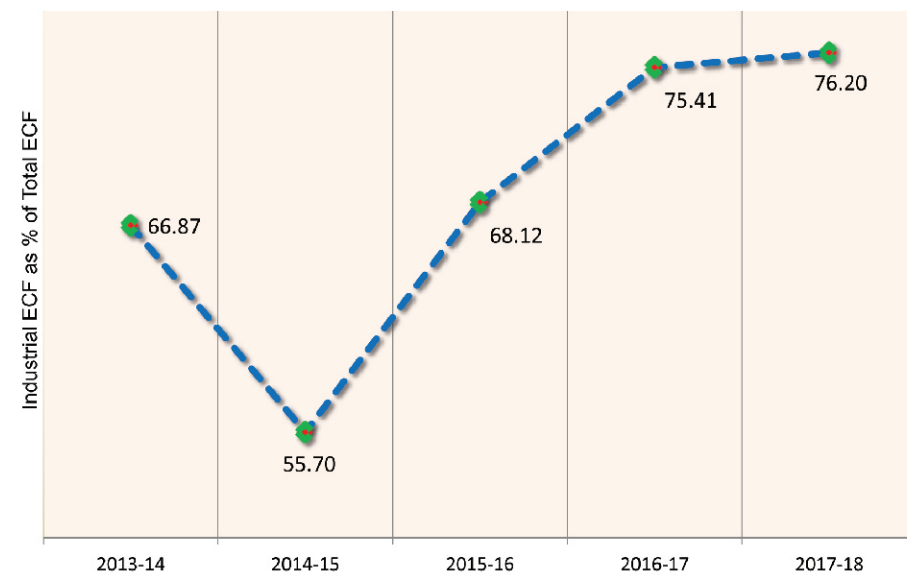
(100 tons) in tunnel kiln. Based on the laboratory scale investigation and initial pilot plant trials more than 120 tons of mill scale pellets were prepared with 20% waste iron ore fines and 0.5% bentonite. Pilot plant trials were carried out in a batch of 3 to 5 ton scale to fine tune the process parameters in a commercial tunnel kiln. After fine tuning, more than 100 ton of quality DRI has been produced successfully in a continuous manner @18tons/day at M/s. SMRW, Ranchi. Detailed presentation has been made during review of the project on 30th November 2017. The Project review committee has appreciated the work done and recommended patenting the technology and to make it available for adoption by the DRI producers. The Committee also advised to organize a workshop in association with SIMA and SIDBI to help the MSME sector to adopt the technology.

Private Goods

Projects and Programmes

CSIR entered into an agreement with the Metal Industries Development Institute (MIDI), Ethiopia to implement a "Twinning Programme on Capacity Building to Transform Metal Industry Development Institute (MIDI)". The agreement was signed by me, as the Director of NML, Jamshedpur on behalf of CSIR, and the Director General of MIDI on 7th June 2017. This multimillion dollar (~7million USD) international project was clinched by CSIR through an internationally competitive process and it is one of the largest programs between CSIR and a foreign entity. Five CSIR laboratories (i.e. NML, CMERI, CEERI, CSIO and CLRI) will jointly implement the program and NML is the Coordinating Nodal Lab for the program. These five laboratories, complementing each other and together, provide the ideal knowledge and expertise fountainhead for MIDI to embark on its capacity and capability building. They will share their domain expertise in the matters of organization, structure, functional efficiencies, metals processing, manufacturing and post-processing, through twinning with MIDI. The principal objective of this transformation program is to enhance the competitiveness of the metal and engineering industry through speeding up the transformation and development of the sector, through a transformation of MIDI into a globally competitive center of excellence in the field of metals and metals manufacturing. The benefit will have a great impact on Ethiopian metals industries. The first installment of the payment has been received and coordinators of the partnering Laboratories visited MIDI during March, 2018.

A period of good deliveries and good understanding of industrial problems has resulted in an increase in our industrial earnings from ~55.70% of our total earnings in 2014-15 to ~76% during 2017-18.



The School-NML Interaction programme (SNIP) has been designed to give the students, teachers and professionals an exposure to modern laboratory environment and to develop a scientific temperament in them for their career development. This programme has been carried out at CSIR-NML since June 2011 and till date, a total 16,700 students from 191 School along with teachers have participated in this programme and derived the benefits. During 2017-18, a total of 699 students and 38 teachers from 13 schools had visited the laboratory.

A school interaction programme designed specifically for Kendriya Vidyalayas named "JIGYASA", in collaboration with the Ministry of human Resources Development, is a CSIR programme for connecting school students and scientists to extend the classroom learning of students with experimental education in research laboratory environment. CSIR-NML has selected the Kendriya Vidyalayas in the Ranchi zone and had invited students and teachers of such schools. Around 180 students and 10 teachers of Kendriya Vidyalaya, Chakradharpur, and Atomic Energy Central School, Turamdih have already visited CSIR-NML and further interactions with other schools are planned.



Financial Health : Earnings and Expenditure

FY 2017-18

The earnings and expenditure over the last five fiscals are shown below. We are glad to report that our total external cash flow increased by about 91% while our industrial earnings increased by 93% during FY: 2017-18. During the FY: 2018-19 we have a target of 40.0 Crs total ECF and out of that ~32.5% has already been realized during the last 2 months.

Strategic Goods

During July to December, 2017, we completed or are carrying out 16 projects for the strategic sectors. Our sponsors for these are organizations like DRDO, BARC, IGCAR, Indian Air Force, HAL, ISRO, etc. Some of the important projects (completed or ongoing in the reporting period) are as follows:

- Development of process flowsheet for extraction of tungsten metal from Hutti tailings
- Extraction of tungsten metal powder from recycling of tungsten base heavy alloy scraps
- Technology development for commercial production of sodium metal
- High temperature mechanical deformation and fracture behavior of nickel based super alloys
- Development of a process for production of gadolinium metal by fused salt electrolysis
- Microstructural characterization & Fractographic analysis of nuclear grade graphite
- Stress Rupture Behaviour of SS304l material
- Creep behavior of nickel base super alloy SU-720
- Failure analysis of aero engine damaged blades of SU-30MKI
- Optimisation of al-based metallic foam production method and development of metal foam for BARC applications

In the strategic sectors our activities should result in at least the following technologies

- Technology development for production of high pure tungsten powder from lean grade indigenous ore/gold ore tailings and tungsten heavy alloy (WHA) scraps of HAPP
- Technology for the beneficiation of low grade tungsten ores
- Technology for production of Sodium metal
- Technology for production of gadolinium metal

Implementation of NABL accreditation replacing existing ISO System in CSIR-NML

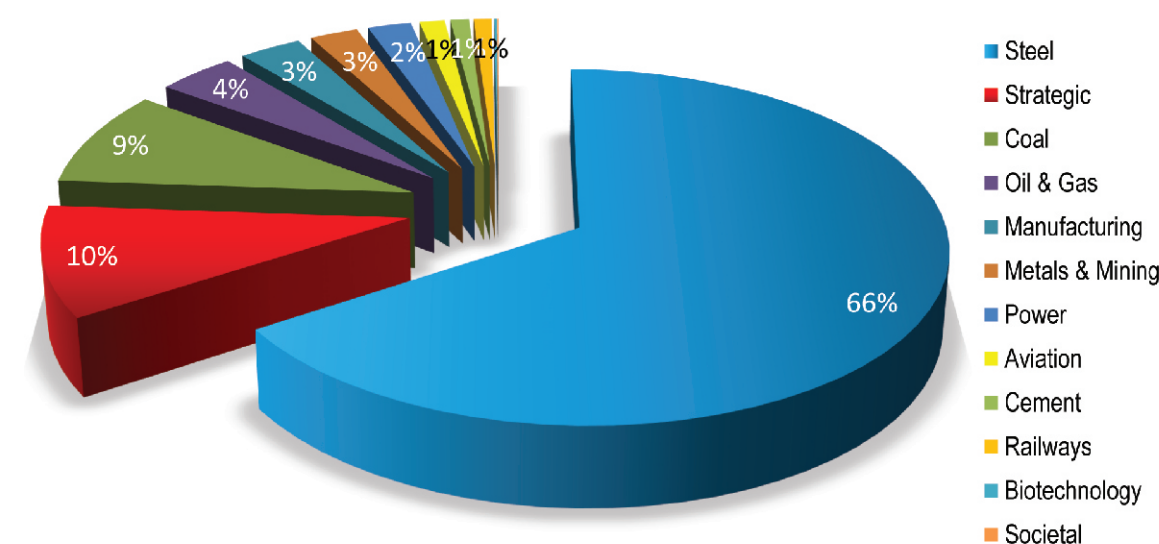
A new robust internal auditing system is under process and will comprise of three independent audit groups; (a) Safety and Environment Audit, (b) Process Audit, and (c) Equipment and Facilities audit. The mission of CSIR-NML Internal Robust System should be to provide independent, objective assurance and consulting services designed to add value and improve the operations. It should help the organization accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of project management, equipment management and the governance processes.

CSIR-NML, Jamshedpur is all set for NABL Accreditation of Creep laboratory of MTE Division in compliance with ISO/IEC 17025 Standard.

Societal Goods

CSIR-NML has dedicated itself to a three tiered system of enlightenment and facilitation of scientific and technological knowledge to the pertinent target groups in Jharkhand, namely, i. The school students; ii. The teachers; iii. The technical students

The sector-wise break up of our involvement is shown below, which underscores Steel, Metals & Mining, Coal, and Strategic sectors as our major client bases. We also conducted projects for Aviation, Power, Oil & Gas, Cement, and Manufacturing sectors.



Some of the other important activities, project and programmes that led to "Private Goods" are as follows :

- Dry Beneficiation of High Ash Indian Thermal coal
- Benefits of Cr micro-alloying/ modification of microstructure for enhancing corrosion resistance of carbon steel for water injection pipeline
- Evaluation and characterization of band by band coal analysis
- Creep damage assessment of high temperature headers and pipeline using multi parameter non-destructive examinations.
- Development of advanced electromagnetic sensors for assessing property scatter in high value steel
- Effect of inclusions on pitting corrosion on line pipe steel
- Development of quenched & partitioned steel through hot strip mill route
- Development of Non-linear Ultrasonic based technique for multi-axial fatigue damage evaluation in SA333Gr6 and SS304LN
- Development of stationary bed pellet induration
- Development of Al-Mn coatings by electrodeposition process using ionic liquid
- Production of DELF in bulk for recycling
- Development & fabrication of cannon liners for explosive testing
- Development of process technology for third generation advanced high strength steel
- Development of methodology for identification of secondary (used) CRGO strips using electromagnetic sensor.
- Assistance in design, erection & commissioning of 1000TPD column flotation plant for barite beneficiation

- Development to improve corrosion performance and service life of aluminium alloy bracket
- Development and evaluation of flotation reagents (collector) for coal tailings
- Production of DRI from Steel Plant wastes such as Mill Scale, LD sludge and BF sludge.
- Reduction of energy consumption in iron ore sintering by modified coke breeze distribution.
- Development of alternative of cyanide for chemical cleaning of plain carbon steel and stripping of gold
- Development of Zn-Al-Mg coating with better resistance to surface backening and powdering
- Development of suitable grinding aid for improving productivity of cement mill and development of performance improver to reduce water/cement ration and consequently to improve compressive strength
- Production of pigment grade iron oxide from ferrous chloride solution
- Collagen-graphene composites for energy devices.
- Development of Fe flash coat to eliminate uncoated surface during galvanizing of advanced high strength steel.
- Development of Fibre Bragg Grating (FBG) sensor based applications at Tata Steel
- Development of process for real time temperature mapping of 4 faces of the billet mould using densely multiplexed Fiber Bragg Grating (FBG) sensor
- Environment friendly coatings: to replace hexavalent chrome conversion coating with chrome free coatings.
- Recovery of vanadium from spent sulfuric acid catalysts
- Synthesis and characterization of bio-compatible Mg alloys
- Technology demonstration for geopolymers cement
- Development of metal oxide nano material based anti corrosive chemical

Technology Development & Transfer

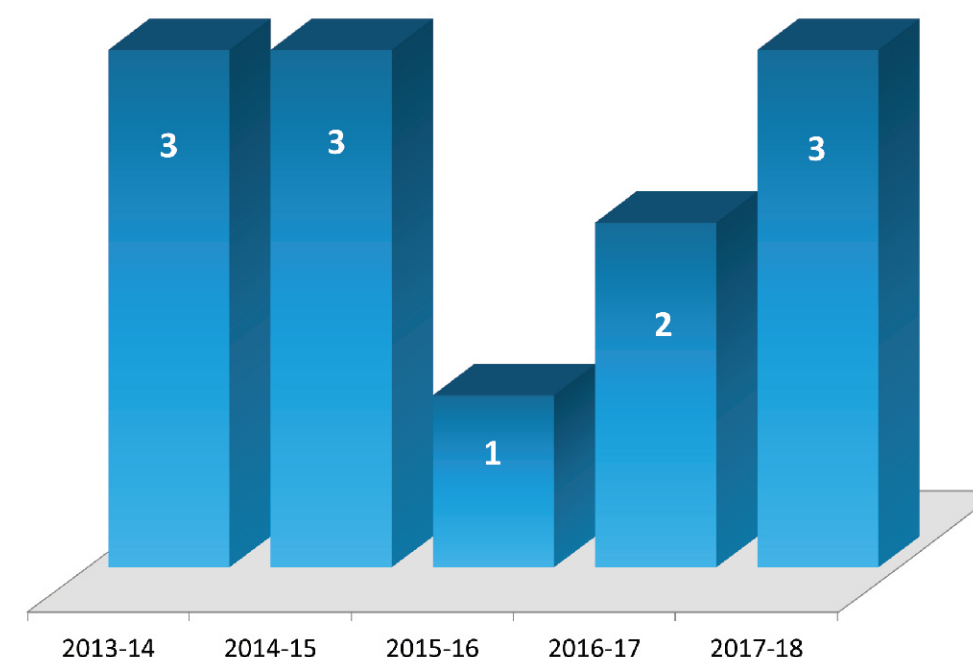
The Laboratory has more than 69 technologies of Technology Readiness Level (TRL) greater than 5 and ready for commercialization.



During the last six months the Laboratory has developed the following technologies.

- Modified synthetic flux and a process for de-phosphorization of steel in induction furnace
- Cyanide free process for leaching and recovery of gold
- Cyanide free alkaline electrolyte and electrochemical process for rust removal from plain carbon steel components
- Improved version of metal oxides nanomaterial based anti-corrosive chemical
- Ultrasound Pulser-Receiver for Onboard Propellant Gauging of spacecraft

During the above period, the laboratory has transferred 3 technologies - (1) Production of pigment grade iron oxide from iron chloride solution (M/s Rang Sarjan chemical, Bhuruch), (2) Know How of quick repairing material by geopolymerisation of fly ash and GGBFS (M/s Venspra lab. Ltd, Vijayawada) and (3) Production of electrolytic zinc powder from zinc dross (M/s Kanpur metals processors Pvt Ltd.)



Agreements Reached

Since the last Research Council meeting, around 7 Agreements and MoUs were signed with various clients including international organizations. These were with

- Shree Mahabir Refractories Work
- Hindalco Industries Ltd., Mumbai
- Vedanta Limited, Mumbai
- Venspra lab. Ltd, Vijayawada
- Kanpur metals processors pvt
- IIT, Kanpur
- Tata Steel Limited, Jamshedpur