ANNUAL REPORT
2015-16

Jawaharlal Nehru Aluminium Research Development & Design Centre
Autonomous Body under Ministry of Mines, Govt. of India
Amravati Road, Wadi, Nagpur – 440023
www.jnarddc.gov.in
I have pleasure in presenting the 27th Annual Report of Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur for the year 2015-16. JNARDDC’s support to industry is primarily in Bauxite, Alumina, and Aluminium. With the dedicated efforts of our scientific & administrative work force, we have completed seven projects worth ₹ 199.38 lakhs. The Centre is executing six Science & Technology projects approved by SSAG (Ministry of Mines) with a total value of ₹ 699.56 lakhs spread over 2-3 years. Two industry sponsored projects worth ₹ 49 lakhs are under execution. Furthermore, 23 new projects were proposed to various agencies in this year.

While carrying out the above R&D work, the Centre achieved an internal revenue generation of ₹ 310.86 lakhs. Our scientists have published/presented 10 papers in national & international journals/conferences. Three final patent applications were filed for indigenous R&D process developed by JNARDDC.

The Indian Aluminium industry successfully achieved the energy reduction target set under PAT scheme of Ministry of Power, Government of India. JNARDDC continued to play a pivotal role as the aluminium sector expert of BEE. This year JNARDDC stood up to look for industry-academia connect for development of aluminium metal. Under this effort the institute interacted with academia and industry with common goal of aluminium R&D. Centre also promoted M Tech programs in collaboration with VNIT, Nagpur which were based on the technical issues picked up from Indian aluminium industry. The Centre is in process of setting up additional facilities in areas of downstream with support from Ministry of Mines for providing end to end solution to aluminium process industry. JNARDDC in association and support from NALCO and Ministry of Mines is working to establish “Aluminium Chair Professor” at reputed national academic institution in the country. We are grateful for the support extended by the Ministry of Mines, Government of India, the Honourable Members of the General Body, Governing Body, Research Advisory Committee, Project Monitoring Committee, all the scientists and staff of the Centre, various aluminium industries (especially NALCO), as well as other industries. We are also thankful to other academic organisations and laboratories, MECL in particular for the tremendous encouragement and support given to the Centre to make its achievements possible.

Today we stand at a point, where Indian Aluminium industry, can rely on us, for support guidance and innovation. We are determined to further advance the quality of our services to the Industry.
About JNARDDC

Jawaharlal Nehru Aluminium Research Development and Design Centre, Nagpur is a “Centre of Excellence” set up in 1989 to provide major R & D support system for the emerging modern aluminium industry in India by undertaking basic and applied research in the areas of bauxite, alumina and aluminium. It is a ₹35.00crores rupees joint venture, supported almost equally by the Ministry of Mines, Govt. of India and UNDP. The Centre is located in its own sprawling campus just outside the orange city of Nagpur and became fully functional since 1996. With serene surroundings and housed in a modern technical complex with state of art equipments, provide just the right atmosphere for the scientists of the Centre to make creative contributions to the technological growth of the Indian aluminium industry. JNARDDC, an autonomous body of Ministry of Mines is registered under Societies Registration Act, 1860 (455/87-Nagpur dated 13.8.1987) and Bombay Public Trust Act, 1950 (F-6778-Nagpur dated 8.10.1987) as a Trust.

The Centre is recognized as a Scientific & Industrial Research organization by the Department of Scientific & Industrial Research, Ministry of S&T, Govt. of India. It is the only institute of its kind in India pursuing the cause of R&D from bauxite to finished product under one roof for the growth of aluminium Indian industry. The Centre with its limited and highly qualified manpower has developed a brand image for providing quality technical support services to primary and secondary aluminium industries. JNARDDC has made key contribution in the areas of beneficiation, characterization, technological evaluation, up gradation of bauxites, reduction of energy consumption & environmental pollution, by effective utilisation of aluminium industry residue materials such as red mud, dross & scrap etc and process modelling for the benefit of aluminium industry and the nation as a whole.

The Centre also offers analytical and testing facilities to other non-ferrous industries, steel plants, small-scale industries, R&D organisations and academic institutions particularly in the areas of chemical and mineralogical analysis, powder characterisation, thermal mapping, micro structural studies, mechanical and non destructive testing, failure analysis and technical information.
Objectives of the Centre

- To assimilate and adapt the technologies suitable for raw materials available in India for the production of alumina and aluminium and to develop indigenous know-how and basic engineering packages for future alumina and aluminium plants to be set up in the country.
- To undertake research programs especially in the area of reduction in material and energy consumption and to provide analytical services to the industries.
- To set up and operate data banks in the areas of bauxite, alumina and aluminium production for the benefit of the industries.
- To provide training to the personnel employed in the Indian aluminium industry through organisation of workshops, seminars and group training programs.
- To provide technological assistance to the secondary aluminium industry especially in the areas of downstream processes and wastes recycling.

Vision

"Develop indigenous technologies and provide value addition services to both primary and secondary aluminium industries with a special emphasis on energy reduction and environmental sustenance through scientific research and development for industrial growth and socio-economic development."

Mission

"Provide modern technological inputs to aluminium industries and other sectors for value addition, reduction in energy / material consumption and environmental pollution based on optimum utilisation of existing facilities and further development of technical capabilities."
Bauxite Division

- Geology and evaluation of bauxite deposits
- Beneficiation and up gradation of laterites and bauxites
- Total characterisation of bauxites including trace elements and organic carbon
- Techno-economic evaluation of bauxite deposits for bauxite production and non metallurgical application

XRD
GDS

XRF
ICP

Electrophoresis
Petrological Microscope
Hydro Cyclone

WHIMS

Rotary Furnace

High Temperature Furnace

Bond Work Index Vibrating Screen
Alumina Division

- Technological testing of bauxite including large scale laboratory tests for desilication, digestion, precipitation and settling
- Pre-feasibility and basic engineering package for bauxite mining and alumina plant
- Energy audit of alumina plant, foundry, steam plant, chemical plant etc.
- Mass and heat balance of Bayer's process
Pilot Plant For alumina

Impact Mill
Aluminium Electrolysis Division

- Electrolysis process control
- Cell monitoring
- Energy audit
- Process monitoring of aluminium electrolytic cell
- Mathematical modelling of process including simulation of aluminium smelter process

Pot liquidus apparatus

Mobile lab for Aluminium Smelter

Bath chemistry simulation
- Alloy development
- Melt treatment technology & Primary Casting
- Defect characterisation
- Extrusion Simulation, Friction Stir Welding (FSW)

Universal Testing Machine

Induction Furnaces

Scanning Electron Microscope with EDS EBSD
High Precision Resistance Meter for conductors and Cables

Metallography with Image analysis

Roughness Meter

Extrusion Simulation
Bauxite Division
- Wet Chemical Lab (WCL)
- X-Ray Diffraction (XRD)
- X-Ray Fluorescence Spectrometer (XRF)
- Glow Discharge Spectrometer (GDS)
- Inductively Coupled Plasma Spectrometer (ICP)
- Ion Analyser
- TLC Sample Spot Applicator
- Optical Scanning Densitometer
- Petrological Microscope
- High temperature sintering furnace
- Lab flotation machine
- Hydrocyclone test rig
- Granulating instrument
- Rotary furnace
- Wet High Intensity Magnetic Separator
- Size reduction and sample preparation equipment
- Laboratory Ferrous Wheel Separator
- Rotap Sieve Shaker
- Universal Impact Mill

Alumina Division
- Large Scale Alumina Laboratory
- Laboratory autoclaves, 5 & 10 Litre capacity
- Bomb Digesters
- Total Organic Control (TOC)
- Low Temperature bath equipment
- Equipment for Precipitation Tests
- Angle of repose apparatus
- Brick making unit
- Potentiometric Titrator
- Mathematical Modeling

Aluminium Electrolysis Division
- Laser Particle Size analyser
- Specific Surface Area analyser
- Mercury Intrusion Porosimeter
- Helium Pycnometer
- Thermal Analysis System, (TG & DSC)
- Specific Electrical Resistance (Anode)
  & Mettler Softening Point Equipment
- Infra Red Thermography
- Three Axis Magnetometer, Gauss meter
- Computer controlled Potentiostat / Galvanostat
- Thermal Conductivity Meter
- Photocoupled Spectrometer (PFC measuring Instrument)
- MOBILE VAN for onsite measurement and studies, fitted with
  - Data Acquisition and Processing System
  - Heat Flux Meter
  - Liquidus temperature measuring kit
  - Laboratory Mixing and Kneading Machine

Downstream Division
- 100 kN Universal Testing Machine
- Scanning Electron Microscope with EDS & EBSD
- Vicker’s hardness Tester
- Induction Melting Furnace
- Metallurgical Microscope with image analyzer
- Resistivity / High Precision Micro Ohm Meter
- Digital Rockwell Hardness Tester
- Brinell Hardness Tester
- Ultrasonic flaw detector
- Electro polishing machine
- Heat treatment furnaces
- Conductivity meter
- Roughness meter
- Milling machine
- Hyperextrude software
- Extrusion modeling and simulation
The Centre has offered technological services to outside agencies by utilizing its expertise and analytical facilities. Some of the technological services offered include:

- Beneficiation and up gradation of bauxites / laterites
- Characterization and technological evaluation of bauxites / laterites
- Process monitoring of aluminium electrolysis cell
- Characterization of carbonaceous raw materials CP Coke and CT Pitch
- Chemical, Physical and Physico-chemical analysis
- Energy auditing and PFC measurements
- Alloy development and forming of aluminium alloys
- Microstructural, mechanical, electrical, EBSD characterization
- Melt loss assessment and remedial measures
- Process modelling
Setting up of mini-pilot plant for red mud based light weight foamed bricks for NALCO

Under the seven nations Asia Pacific Partnership on Clean Development and Climate (AP-7) JNARDC, as the nodal agency from India successfully completed the project entitled "Management of bauxite residue / red mud" in Nov. 2009. The Centre developed a bench scale process for Development of Glass Ceramics and lightweight aggregates- Foamed Products by utilizing red mud an industrial waste funded by NALCO. The Centre along with NALCO has already filed joint patent for the above two innovative processes.

With a view to scale up the activity to the next level and attract prospective entrepreneurs, JNARDC set up the Mini pilot/demo plant at NRTC, NALCO.
The Centre developed an in-situ quantitative analytical tool using hand held spectrometer which shall assist in spot determination of decisive inorganic impurity elements such as Fe, Si and Ca in alumina and aluminate liquor.

The real samples tested for quality assessment in the industrial laboratories are generally considered as a pool of elements of higher and lower concentration range varying from micrograms to milligrams. Depending on the nature of sample matrix and components of analytical interests, the analytical procedures and sample preparation steps varies. In general, the analytical emphasis would be in the precise determination of trace elements (impurity elements) which are present among a wide range of major components. The analytical accuracy and reproducibility in the determination of elements in low concentration range is a relentless challenge for applied chemists.
Considering this, the Centre has developed in-situ quantitative analytical tools which use portable visible spectrophotometer for the rapid and cost effective determination of decisive inorganic elements such as Fe, Si and Ca in alumina hydrate (product hydrate), calcined alumina and process liquor samples. These elements are impurities and have detrimental impacts on various stages of alumina production at Bayer plants. The colourimetric procedures developed were calibrated and successfully used for the termination of Fe, Si and Ca in microgram concentrations present in alumina hydrate (product hydrate), calcined alumina and process liquor of plant origin.

During the course of R&D endeavor, a selective dissolution procedure was developed for rapid determination of Fe in alumina hydrate, at room temperature (18-300C). Also, alkali digestion of alumina hydrate also developed for determination of Si. A typical composition of sample and flux ratio is identified for preparation of calcined alumina for pH specific colourimetric determination of Ca.

The complementary analytical procedures developed were demonstrated at NALCO’s refinery laboratory and adequate training was imparted to NALCO personal for analysis of impurity elements in real samples as well as NALCO’s R&D needs. In order to protect the IPR rights, two patents are filed on the determination of iron and calcium.
Under this project, Centre undertook detailed study of various techniques for beneficiation and optimization of different process parameters for reduction of iron, silica content as well as increase alumina in the laterite.

The Centre has undertaken the various lab experiments for separation of silica and iron content on east and west coast laterite. The experiments were carried out under various parameters such as grain size, time, magnetic intensity, reagents, pressure, etc.

Among beneficiation techniques employed, hydrocyclone, magnetic separation and flotation techniques were found to be most effective. Reduction of iron content by 25-35 % and silica content by almost 15 % could be achieved. The beneficiation studies indicate that iron content can be reduced substantially from ferruginous laterite which shall lead to increase in alumina percentage.

JNARDDC has suggested the optimized process parameters for up gradation of laterite in the report. This can be blended with good quality bauxite for alumina production. As a result, the life of mines as well as supply position of low grade raw material may appreciable increase thereby leading to optimum utilization of laterite which is lying as a waste at mine site.
A detailed study of scale formation in terms of rate of formation of scales on different precipitation tanks in the series of a stream and to develop a method for estimation of scale thickness in precipitation tanks without using sophisticated instruments was undertaken. Characterization work of precipitation tank scale was also completed. The project recommended the priority basis of maintenance schedule by estimation of scaling thickness in precipitation tanks which will lead to energy savings.

Five set of plant measurements (heat flux, thermograph, air velocity) were done. Equation was developed for estimating the scale thickness in the precipitation on the basis of plant measurement. Chemical, DSC analysis and thermal conductivity measurements were also carried out for scale samples. The findings of the project will assist NALCO in increasing the uptime of the precipitators.
Granulating Machine and high temperature rotary furnace

Raw and sintered granules

Under this project the Centre developed ceramic proppant from PLK and fly ash which can be used in oil and gas industries. In comparison to high grade bauxite partially lateritised khondalite (PLK) and fly ash is cheaper and readily available.

Successful completion of the project has resulted in development of proppant for utilization in oil exploration industry. This is a significant achievement will open new horizons for the disposal and effective usage of reject/waste material (PLK & Fly Ash).
The project developed an economically viable heat treatment process for destruction of toxic cyanide present in SPL and also recovered the mineral values such as carbon, sodium and fluoride for effective use of industrial waste.

This project work achieved destruction of leachable cyanide present in spent pot lining (SPL) materials (carbon portion). Detailed experiments were carried out for destruction of leachable and insoluble cyanides using selective heat treatment methods and the experimental conditions were optimized.

The process steps involved heat treatment of SPL followed by recovery of sodium and fluorine. It was noticed that the cyanide free carbon, obtained from SPL could be used as a fuel in boiler, fuel as well as mineralizer for cement industries, recycling into anode, or recycling into ramming pastes based on the quality of carbon residue obtained after treatment. The recovered sodium is useful in the Bayer alumina refinery. During the recovery process there was no impurity buildup in the carbon residue and they possess higher gross calorific value (GCV) compared to original SPL sample.

The hazardous elements in treated SPL are much below the permissible limits given by CPCB.
The objective of this study is to investigate the sources of melt loss in BALCO cast house and explore possible ways to limit melt losses at various stages of cast house operations.

Shop floor monitoring was undertaken to observe the operating practices like molten metal handing, pouring practices, operating temperatures and various furnace operations. Dross samples were collected to characterize the phases present in the dross to correlate it with the operating practices.

Molten metal tracking for pot line to furnace was also done. Melting and alloying practices observations and furnace operation observations has been done.

Various operating practices like molten metal handing, pouring practices, operating temperatures and various furnace operations etc were studied and monitored. Dross samples were collected and characterized to correlate the phases present with the operating practices. Based on the above, final recommendations for dross reduction and its effective management have been given to BALCO. On implementing these recommendations, BALCO shall achieve the desired reduction in melt losses.
1. Development of Super Thermal Aluminium (STAL) Conductor for Indian Power Sector (Joint project with NFTDC, Hyderabad)
   Zero date: Mar 2014
   Duration: 3 years

The project aims to develop super thermal resistant aluminium conductor (STAL) for energy efficient transmission and distribution of power. As Indian economy is growing and Government’s commitment of “Power to All”, it is imperative to develop indigenous technology to produce such new generation conductors in the country. Since this technology will be indigenous it can be transferred to SMEs at a very affordable cost compared to the imported technology.

2. Development of a real time Instrument/System to measure bath ratio, alumina concentration, bath temperature and superheat of the Aluminium Electrolysis bath
   Zero date: Mar 2014
   Duration: 3 years

The project aims to develop a real time instrument/system to measure the bath ratio, alumina concentration, bath temperature and superheat of the aluminium electrolysis bath which will help the Indian aluminium smelters to increase the process efficiency of the cell by active pot control thereby leading to reduction in AlF₃ consumption and reduce energy consumption.
3. Development of hard and high temperature refractory material /aggregate from Saprolite
   Zero date: Jan 2015
   Duration: 3 yrs

   In general, during the exploration/ mining of bauxite deposits, saprolite is treated as a waste material. There is a huge demand of refractory castable in industry but production/ sources of calcined clay are limited. The project aims to evaluate saprolite resources for developing a product by using saprolite which can be suitable for refractory and other wide range of industrial applications.

   Saprolite-un utilised material

4. Integrated approach for development of process models and pilot production of aluminium alloy extrudates using porthole dies
   Zero date: Jan 2015
   Duration: 3 yrs

   The objective of the project is to simulate hollow aluminium extruded profiles and optimization of die parameters with respect to the quality of the product for enhancing the productivity of extruder. It will provide a scope to reduce the existing shop floor trials and metal rejection. The developed infrastructure facilities (extrusion set up) and expertise will help in providing end to end solutions (optimized die design, fabricated dies with process parameters by product process integration) to small and medium enterprises.

5. Synergistic utilization of aluminium industrial wastes for development of geopolymeric building materials
   Zero date: Jan 2016
   Duration: 3 yrs

   Project jointly sponsored by S&T Mines & Swarnalata Holdings, Raipur. The project aims to study the scope of synergistic utilization of underutilized industrial rejects / waste materials of aluminium industry through geopolymerization process with red mud / fly ash as base materials on preparation of mortar, geopolymeric mortar, cement etc. as well as building products such as bricks and blocks for variety of applications. The final aim is to develop marketable building materials such as bricks, blocks and tiles from geopolymerized raw material combinations comprising industrial wastes. A mini pilot plant trial for selected / marketable product (s) for assessment of cost estimation and scope of commercialization shall be carried out. Under this project the environmental impact of geopolymerized building materials with emphasis on soda leaching and pH, heavy metal contamination, radio activity and physical changes if any shall also be undertaken.
Developing downstream application of strip cast aluminium alloys (AA8011 and AA3004),
Zero date: Feb 2016
Duration: 2yrs

Project jointly sponsored by S & T Mines & NALCO. The main objective of the project is to develop processing parameters for developing texture suitable for increasing the formability by optimizing the cold reduction and annealing temperature and to improve the surface characteristics by anodizing. This will lead to Developing downstream application of the two strip cast aluminium alloys (AA8011 and AA3004).

(B) Sponsored by Industry / other organisations (Ongoing)

<table>
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<tr>
<th>S.N</th>
<th>Sponsoring agency</th>
<th>Title</th>
<th>Zero date Duration</th>
<th>Remarks / Outcomes</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>VEDANTA, Jharsuguda, Odisha Development of a suitable process for conversion of waste aluminium dross into value added product</td>
<td>(Aug 2015) 15months</td>
<td>The project aims to extract alum from waste dross which is generated as an industrial waste during the production of aluminium. Process is also being developed for conversion of the residual dross for refractory applications.</td>
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<td>2.</td>
<td>Larsen &amp; Toubro Ltd. Mumbai Characterization &amp; Technological Testing of Kuturmal and Sijimali bauxite in Odisha,</td>
<td>(Feb 2016) 3 months</td>
<td>L&amp;T, Mumbai is setting up a 30,00,000 MT/annum alumina refinery using Kuturmal and Sijimali Bauxite of East coast. JNARDDC has undertaken the characterization and technological testing of Sijimali and Kuturmal bauxites for L&amp;T which includes pre-desilication studies and optimization of parameters for pre-desilication such as temperature, bauxite solids concentration and residence time. Based on the above studies L&amp;T will be able to fix up the parameters for pre-desilication process in their upcoming plant.</td>
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JNARDDC is collaborating with the following agencies for various R&D projects of mutual interest and for the overall interest of the nation.

**GSI, Nagpur** - JNARDDC has formulated a joint project proposal for “Studies on assessment and extraction of rare earths from industrial waste-red mud (with GSI, Kolkata)”. Centre is also collaborating with GSI, Nagpur for executing various testing and other technical services which are being presently outsourced by GSI.

![GSI Personnel at JNARDDC](image)

**Cement Manufactures’ Association (CMA)** - A Round Table on “Promoting use of Spent Pot Linings in Cement Co-processing” was organised under the Knowledge Exchange Platform (KEP), which is a joint initiative of Bureau of Energy Efficiency (BEE) and Institute for Industrial Productivity (IIP) on 22nd September, 2015 at SCOPE, New Delhi. The Roundtable was attended by more than 50 participants with representation from key opinion leaders of Aluminium and Cement Sectors, Industry Associations (Cement Manufactures’ Association (CMA) and JNARDDC, Technology Supplier (Regain, Australia), Regulators (Central Pollution Control Board), BEE and IIP. Dr. Anupam Agnihotri, Director, JNARDDC, presented the technologies developed by JNARDDC to promote utilization of SPL. He mentioned that technological options are available to support its co-processing in cement plants and JNARDDC has successfully undertaken a pilot bench scale unit and along with NALCO has commercialized the SPL treatment technology. He informed the participants that the test reports of the technology developed by JNARDDC have shown that no Fluoride and Cyanide was found in treated SPL. Many participants showed interest in visiting JNARDDC, Nagpur to gain firsthand knowledge about this technology.
Round Table Meeting with JNARDDC, BEE, Al-Industry & CMA

**MSME Nagpur**

Dr. V Parlewar, Director, MSME Development Institute, Nagpur visited the Centre and provided valuable information and insight into the various schemes/ventures that MSME supports for the benefit of Micro, Small and Medium enterprises. Detailed information could be accessed from the website http://msme.gov.in/Dr. Parlewar took keen interest in the activities of the Centre and suggested ways and means of JNARDDC playing an active role for the betterment of small and medium enterprises in the aluminium sector.

Interaction with MSME on Setting up of Incubation Centre
Air force Maintenance Command, Nagpur

Availability of indigenously produced aviation grade and other high strength aluminium alloys is a major concern for the demanding end users like HAL, IAF and others. Alloys such as AA2024, AA5086, 5056, AM56, AM53, B95PCH, D16CH are routinely required in various forms such as plates, sheets, rods etc. for various maintenance and developmental applications. At present requirement of such alloys is met by import only. Air Marshall P P Khandekar and his team from Maintenance Command visited JNARDDC and were highly impressed by the facilities and services offered. Air Marshall urged to establish National Casting/Processing Facility at JNARDDC to produce high strength aluminium alloys and successfully meet the country’s requirement by minimizing the imports. This will be a major contribution in Make in India Program initiated by Honourable Prime Minister.

Air Marshall P P Khandekar and his team with Director

Demonstration to Air Force Indigenization Officers
MOIL, Nagpur - JNARDDC team visited MOL Head quarters at Nagpur. During the technical discussions Shri G. P. Kundargi, CMD presented the research needs and areas of interests of MOIL. He also stressed upon the need of applied analytical support for MOIL laboratories to carry out rapid and cost effective determination of Mn, Si, Fe and P in manganese ore at mine site. Subsequently, manganese ore samples were received for in-house R&D to develop rapid and cost effective analytical procedures.

Research Designs & Standards Organisation (RDSO), IIT Kanpur, Frontier Alloys and VNIT Nagpur
A team of experts comprising of Dr Anupam Agnihotri, R N Chouhan (JNARDDC) and Dr T VK Gupta (VNIT) visited RDSO Lucknow for the discussions on collaborative R & D proposal submitted to RDSO for the development of aluminium alloys for suitable application in Railway Wagons. Mr. Sanjay Kumar, ED Wagon at RDSO suggested looking into the options of open box type wagon from aluminium alloys. Subsequently team visited IIT Kanpur and had meeting with Prof N S Vyas from Mechanical Engineering Department who is heading the committee for application of new materials in railways. Team also had detailed technical meetings with Frontier Alloys, Kanpur, noted railway wagon bogie manufacturer in the country, for a possible tie up to boost up the envisaged development program.
VINIT, Nagpur

JNARDDC has already signed an MoU with Visvesvaraya National Institute of Technology (VINIT) Nagpur in Dec. 2014 for collaborating in the field of aluminium technology. The Centre has initiated the joint project proposal for developing downstream applications of strip cast aluminium alloys.

HULMIN of Aluminium Business Initiative (A joint venture of HULMIN & BHP Billiton)

Mr. Reginald Nyandeni and team visited JNARDDC to explore possibilities of future interactions as Aluminium Business Initiative is planning to develop entrepreneurs to set up aluminium industries in Pietermaritzburg in South Africa and they are exploring for technical tie ups.
The following final patent applications were filed under the Patents Act, 1970 for various indigenous R&D process developed by JNARDDC under various research projects.

<table>
<thead>
<tr>
<th>SN</th>
<th>Application Number</th>
<th>Date of filling</th>
<th>Title of Patent</th>
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<tbody>
<tr>
<td>1</td>
<td>3582/MUM/2014</td>
<td>12.11.2015</td>
<td>Development of process for selective in-situ dissolution of alumina &amp; silica bearing mineral phases in bauxite at room temperature for geo- analytical application</td>
</tr>
<tr>
<td>2</td>
<td>3585/MUM/2014</td>
<td>12.11.2015</td>
<td>'Development of process for conversion of Saprolite into refractory aggregate'</td>
</tr>
<tr>
<td>3</td>
<td>201621005485</td>
<td>17.02.2016</td>
<td>A process for preparation of aluminium hydroxide with low soda content.</td>
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</table>

N.B. – All the above three projects were funded by the Ministry of Mines
Training on “Alumina technology” at JNARDDC, Nagpur

The 2nd phase of training program on “Alumina Technology” for NALCO alumina refinery executives was organized at JNARDDC in July, 2015. Participants were exposed to various analytical facilities and procedures for characterization and technological testing of bauxite, alumina making process such as digestion, settling etc. The manufacturing process of hard and light weight bricks from red mud was performed and use of thermography tools were explained to the trainees. NALCO was impressed with the training modules and has expressed satisfaction in the theory and practical sessions conducted at JNARDDC. The management expressed willingness to train fresh batches of NALCO trainees.
With a view to promote the exchange of knowledge the Centre has taken the initiative to regularly organize workshops on various topics. Both external and internal personnel are encouraged to give lectures on various knowledge based areas.

**Dr. (Mrs.) Mangala Hirwade, delivering lecture on Plagiarism and Copyrights**

a) Dr. Mangala Hirwade, HOD, Library, RTM, Nagpur University conducted a workshop on 30th Nov. 2015 (Monday) on "Plagiarism".

b) Dr. Anupam Agnihotri, Director, JNARDDC delivered a lecture on "SWOC analysis of JNARDDC" on 14th Oct. 2015 (Wednesday)

c) Dr. Mangala Hirwade, HOD, Library, RTM, Nagpur University conducted a workshop on 9th Oct. 2015 (Friday) on "Research quality measurement tools and e-resources for research"

**JNARDDC scientists visit “Make in India Centre”, Mumbai**

Senior Scientists of JNARDDC attended Make in India Week in Mumbai, on 15-16th February 2016. The team had intense interactions with representatives from various organizations including, ISRO, HAL, DRDO to explore the opportunities for indigenization of Aluminium alloys in the country.

**Principal Scientist R N Chouhan interacting with ISRO officials**
World standards day

'World Standards Day' or "International standards day" is celebrated internationally each year on 14 October. The aim of World Standards Day is to raise awareness among regulators, industry and consumers as to the importance of standardization to the global economy. The celebrations organized by world Standards Bureau, Nagpur was inaugurated by Dr. Anupam Agnihotri, Director, JNARDDC on October 15, 2015.

Visit of students to JNARDDC

JNARDDC has been regularly providing summer internships training for students from various educations institutions as a part of their B.Tech & M.Tech programs. The world class R&D facilities of the centre provide the ideal location for education tours for several Universities and Educational Centres.
JNARDDC is making key contributions in the areas of energy, environment and waste utilization of aluminium Industry. JNARDDC has been nominated as an aluminium sector expert by Bureau of Energy Efficiency (BEE) under the PAT (Perform, Achieve & Trade) Scheme in the National Mission for Enhanced Energy Efficiency (NMEEE) under Climate Change Project launched by the Honourable Prime Minister of India.

ENERGY IS LIFE

B E E

CONSERVE IT

2. Downstream activities at JNARDDC, R N Chouhan; Workshop on “Microscopic techniques in Aluminium Industry” on April 16-18, 2015 at JNARDDC, Nagpur (CD Vol. PN-11)

3. Indian Bauxite Deposits, Morphology and Petrographic Characteristics, P G Bhukte; Workshop on “Microscopic Techniques in Aluminium Industry” on April 16-18, 2015 at JNARDDC, Nagpur (CD Vol PN-5.)


9. Development of cube recrystallisation texture in strip cast AA3004 aluminium alloy; Rohit Singh, Rajesh K Khatirkar, R N Chouhan, Sanjay G Sapate; Trans Indian Inst Met., Published Online, Feb 2016


4. Factors influencing the non-ferrous market; A Agnihotri, Sustainable Growth Exploration, 2nd Non Ferro India Summit, New Delhi, January 5, 2016


6. DC casting of Al Alloys; R N Chouhan, at Department of Metallurgy, Govt. Polytechnic, Nagpur, January 7, 2016

7. Downstream activities at JNARDDC; R N Chouhan, at Head Quarter, Maintenance Command, Indian Air Force Nagpur, Indigenization conference “INDICOon-2016” on January 20, 2016


9. Special Alumina Products and Nano-Alumina; Suchita B Rai, at Department of Chemical Engineering, Visvesvaraya National Institute of Technology, Nagpur, February 27, 2016

10. Disruptive innovation-New paradigm for sustainability and growth; A Agnihotri, 2nd Prof Anand Oke Memorial Oration, Yashwant Rao Chavan College of Engineering (MECHNOVA-16), Nagpur University, March 31, 2016
Dr. Anupam Agnihotri, Director

Scientists : 15

Dr. S.P. Puttewar, Sr. Principal Scientist
Mr. M.T. Nimje, Sr. Principal Scientist
Mr. M.J. Chaddha, Sr. Principal Scientist
Mr. R.S. Mishra, Principal Scientist
Mr. R.J. Sharma, Principal Scientist
Mr. P. Dungore, Principal Scientist
Dr. Md. Najar, Principal Scientist
Dr. (Ms) S. Rai, Principal Scientist
Dr. P.G. Bhukte, Principal Scientist
Mr. R.N. Chouhan, Senior Scientist
Mr. S.B. Wadodkar, Senior Scientist
Dr. U. Singh, Senior Scientist
Mr. V. Ammu, Senior Scientist
Mr. V.K. Jha, Senior Scientist
Mr. P. Mahendiran, Scientist

Scientific & Technical Supporting Staff : 15

Mr. K.R. Rao, Sr. Sci. Off. Gr-II
Mr. S.K. Thokal, Sr. Sci. Off. Gr-I
Mr. N. Warhadpande, Sci. Off. Gr-I
Mr. K.J. Kulkarni, Scientific Officer
Ms. M. Panchal, Sci. Asst. III
Mr. D.R. Meshram, Sci. Asst. III
Mr. A.S. Gijare, Sci. Asst. II
Ms. V. Meshram, Tech. Asst. III
Mr. P. Manthena, Tech. Asst. II
Mr. V. B. Wankhede, Tech. Asst. II
Mr. K. B. Gour, Tech. Asst. II
Mr. V. Kshirsaut, Tech. Asst. II
Mr. S. Yadav, Tech. Asst. II
Mr. V.P. Naik, Tech. Asst. I

Administrative Staff : 9

Mr. R. Srinivasan, Secy.cum. Admin. Officer
Ms. R. Vishakha, Asst. Admin. Officer
Mr. S.R. Barhanpurkar, Personnel Officer
Mr. G. Bhaskar, AAO (Accounts)
Mr. R.K. Meshram, Personal Secretary
Ms. R. Tembhurne, Personal Secretary
Mr. N. D. Pethe, Personal Asst.
Ms. D. Sheshukumari, Sr. Asst.
Mr. K. Kishore, Asst

Supporting Staff : 3

Mr. A.J. Hatwar, Driver-cum-Lab. Attdnt. Sr. Gr
Mr. R.C. Patley, Driver-cum-Lab. Attdnt. Sr. Gr
Mr. R. Khobrgade, Driver-cum-Lab. Attdnt. Gr-I

Total Staff Strength: 43
Review of JNARDDC by Mr Balvinder Kumar, Secretary, Ministry of Mines

Mr Balvinder Kumar, Secretary (Mines) visited the Centre on 13th July 2015 to review the activities of the Centre. The completed and ongoing R&D projects were reviewed by Secretary (Mines) which was followed by lab visit and inauguration of the new XRF lab.

Mr Balvinder Kumar, Secretary (Mines) inaugurating new XRF Lab
Visit of Shri Subhash Chandra, Joint Secretary, Ministry of Mines

Shri Subhash Chandra, IFS, Joint Secretary (Mines) visited JNARDDC on 28th January 2016. This was his first visit to JNARDDC on assuming charge in Ministry of Mines. During his visit, he had a quick look at the state of the art facilities of the Centre and had an intense interaction with the Scientists. Shri Subhash Chandra also reviewed the progress of the Centre and expressed his satisfaction over it. He advised the employees to work in the direction of commercializing the technologies developed by JNARDDC.

Shri Subhash Chandra, JS(Mines) looks at STAL conductor

Tree plantation by Shri Subhash Chandra, JS(Mines)
Workshop on “Microscopic Techniques in Aluminium Industry”

As a culmination of Silver Jubilee Celebrations in April 2015, the Centre organised a workshop on “Microscopic Techniques in Aluminium Industry” from 16th to 18th April, 2015. The objective of this workshop was to impart in depth knowledge in the areas of optical/electron microscopy, sample preparation techniques, microstructural evaluation & identification of phases & image analysis techniques. Participants included personnel from aluminium & aluminium related industries along with young scientists, engineers/technologists and technicians.

Workshop was a huge success with participants from primary/secondary aluminium industries, R & D institutions, educational institutions and equipment suppliers. Faculty which included some renowned names (Dr. T R Ramachandran, Emeritus Scientist, NFTDC Hyderabad, Prof Indradev Samajdar, IITB, Prof. Sandeep Sangal, IITK) delivered lectures on microscopic techniques for bauxite and alumina characterisation, quantitative metallography using Image analysis software for wrought and cast aluminium alloys. Participants were thoroughly exposed to laboratory demonstration on state-of-the-art petrological/metallurgical microscopes and electron microscopy.
Aluminium Extruder’s Meet

JNARDDC successfully organized one day National Extruder’s Meet on “Aluminium extrusions in the strategic applications and challenges ahead” on 29th April 2015. The meet was inaugurated by the Chief Guest Shri Saurabh Kumar GM OFAJ and Guest of honour, Shri Ranjit Kapoor, (M.D. White Metals Limited). The meet appreciated the lead taken by JNARDDC for formulating the new standards for acceptance of extruded product. It was also suggested that JNARDDC should play a lead role in helping small & medium enterprises in the area of extrusion and develop a data bank of the extrusion industry.

Aluminium Extruder’s Meet

The meet was focused to discuss the technology requirements and developments in the aluminium extrusion process by all sub systems in the extrusion industry such as billet manufacturers, extruders, die designers, equipment/technology suppliers under a common platform. Role of simulations in product design challenges was also explored. The Meet received the widespread and active participation from primary producers, secondary aluminium industries, press manufacturers, die designers, Defence organizations including OFAJ Nagpur who shared their rich experience in extruding high strength aluminium alloys. Meet concluded appreciating the efforts initiated by JNARDDC in aluminium extrusion area and promised to extend all possible help and support to JNARDDC in their future endeavours.
Aluminium India 2015: JNARDDC was a key partner for Aluminium India-2015 organized by Reed SI Exhibitions Pvt Ltd which focused on the entire aluminium industry. This international exhibition and conference was be held at Bombay Exhibition Centre, in Mumbai (India) during September 7-9, 2015.

Dr. Anupam Agnihotri delivering speech during Aluminium India 2015

"IBAAS-CHALIECO 2015" symposium IBAAS 2015 in CHINA:

JNARDDC associated with IBAAS for organizing the "CHALIECO 2015" International symposium. "The Development and Future of Aluminium Industry in China - Reality and Dream" was held in Suzhou (Near Shanghai), Jiang Su, China from November 25-27, 2015 in cooperation with China Aluminum International Engineering Corporation Limited (CHALIECO) and Suzhou Research Institute for Nonferrous Metals (SINR). JNARDDC delegation actively participated in the symposium and presented various technical papers in the event.

JNARDDC delegates at IBAAS-2016
Rashtriya Ekta-Diwas

India celebrated the birth anniversary of the first Deputy Prime Minister of India, Shri Sardar Vallabhbhai Patel as Rashtriya Ekta Diwas or the National Unity Day on October 31, 2015. The decision was taken by the Union Government to reiterate India’s strength and buoyancy against adversaries. On this occasion the Directors of JNARDDC and NIMH jointly addressed the assembled gathering and the pledge of National Unity was administered.

Vigilance Awareness Week

JNARDDC observed Vigilance awareness week during October 26-31, 2015 in association with NIMH. Shri Manish Bhimte, CVO, MECL, Nagpur was Chief Guest in inaugural function held on October 27, 2015. As part of the awareness week, a pledge was undertaken and JNARDDC participated in the awareness rally organized by MECL and IBM.
Progressive use of Hindi

JNARDDC continued its efforts to promote the progressive use of Hindi. The Centre celebrated Hindi Pakhwada during 16-28 September 2015 which included several competitions. Shri G.P. Kundargi, CMD, MOIL inaugurated the pakhwada and the concluding ceremony was presided by Shri Gopal Dhawan, CMD, MECL as the Chief Guest. Director, JNARDDC emphasized the need for further use of hindi in day to day official use of the Centre’s activities.

Felicitation of Dr. B.K. Satpathy Executive Director (BD), NALCO

The Centre facilitated Dr. B.K. Satpathy, Executive Director (BD), NALCO and member PMC & RAC of JNARDDC. Dr. Satpathy was applauded for his invaluable contribution in the field of aluminium R&D.
Welfare for Persons with Disabilities, SC, ST and OBC.

The Centre is following the various government guidelines w.r.t. PWD, SC & ST reservation. The Centre used the services of visually handicapped persons for canning of office chairs and provided indirect employment to handicapped persons. Persons with disabilities actively participated in various programs such as Hindi week etc.

Annual Sports Event

The Centre organized an Annual Sports event in JNARDDC during January 2016 annual to further strengthen the interpersonal bond, develop the sportsman spirit in facing the challenges ahead and rejuvenate the tired minds. All most all the Employees of the Centre actively participated in various indoor and outdoor games which included Cricket, Table tennis, Badminton, walkathon and Carom etc. Event was a huge success and the winners were honoured and awarded at the hands of Mr Vishal Naik, Special Olympic Coach, Nagpur.

Implementation of Right to Information Act, 2005

The Centre received 7 applications and one 1st appeal under the RTI Act in the financial year 2015-16. All of them were disposed off within the schedule time frame. The Centre is regularly updating the website with regards to RTI data.
Shri Balvinder Kumar, IAS, Secretary to the Government of India, Ministry of Mines is the Ex-officio chairman of the General Body and Governing Body of JNARDDC. The other committees include the Research Advisory Committee (RAC) and Project Monitoring Committee (PMC) constituted by the Governing Body for monitoring R&D programs &projects of the Centre. The Centre is headed by the Director who is the principal executive officer.

The organization chart is as below:

- General Body
- Governing Body
- Research Advisory Committee
- Project Monitoring Committee
- Director
- Admin
  - Accounts
  - Stores
- Downstream
  - Beneficiation & processing
    - Alumina
    - Special Alumina
    - LSAL
- Al. Electrolysis
  - Electrolysis
  - Mobile van
- Bauxite
  - Wet Chemical
  - XRF & XRD
- Alumina
- Business development
  - Carbon
  - Waste Utilisation
  - Physical testing

Chairman, Research Advisory Council
Prof. S.P. Mehrotra
IIT, Gandhinagar

Chairman, Project Monitoring Committee
Prof. S. Subramanian
IISc, Bangalore
### List of General Body Members: 2015-16

**Chairman**

**Shri Balvinder Kumar, IAS**
Secretary to the Government of India
Ministry of Mines, 3rd Floor, Shastri Bhavan
Dr. Rajendra Prasad Road, New Delhi - 110115

**Members**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Position/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Prof. Ashutosh Sharma</td>
<td>Secretary to the Govt. of India, Department of Science &amp; Technology, Technology Bhavan, New Delhi - 110 016</td>
</tr>
<tr>
<td>2.</td>
<td>Dr. Girish Sahni</td>
<td>Director General, CSIR, Council of Scientific &amp; Industrial Research, Anusanandhan Bhavan 2, Rafi Marg, New Delhi - 110 001</td>
</tr>
<tr>
<td>3.</td>
<td>Shri R. Sridharan, IAS</td>
<td>Additional Secretary to the Govt. of India, Ministry of Mines, 3rd Floor Shastri Bhavan, New Delhi - 110 115</td>
</tr>
<tr>
<td>5.</td>
<td>Shri Subhash Chandra, IFS</td>
<td>Joint Secretary to the Govt. of India, Ministry of Mines, 3rd Floor Shastri Bhavan, New Delhi - 110 115</td>
</tr>
<tr>
<td>6.</td>
<td>Shri Satish Pai</td>
<td>Managing Director, HINDALCO Industries Limited, Aditya Birla Centre B-Wing, 3rd Floor, S.K. Ahire Marg, Worli, Mumbai - 400030</td>
</tr>
<tr>
<td>7.</td>
<td>Shri A.K. Tyagi</td>
<td>Chairman-Managing Director, Metallurgical &amp; Engineering Consultants (India) Limited, Doranda, Ranchi - 834 002 (Jharkhand)</td>
</tr>
<tr>
<td>8.</td>
<td>Shri T.K. Chand</td>
<td>Chairman-cum-Managing Director, National Aluminium Company Limited, NALCO Bhawan, P/1, Nayapalli, Bhubaneswar - 751 013</td>
</tr>
<tr>
<td>9.</td>
<td>Shri Ramesh Nair</td>
<td>Chief Executive Officer, Bharat Aluminium Company Limited, PO: BALCO Nagar KORBA - 495684 Chhattisgarh</td>
</tr>
<tr>
<td>10.</td>
<td>Shri Abhijit Pati</td>
<td>President &amp; COO, Sesa Sterlite Limited, VEDANTA Aluminium &amp; Power, Vill. : Bhurkmunnda, Jharsuguda - 768 202, Odisha</td>
</tr>
<tr>
<td>12.</td>
<td>Dr. Anupam Agnihotri</td>
<td>Director, Jawaharlal Nehru Aluminium Research Development and Design Centre, Amravati Road, Wadi, Nagpur - 440 023</td>
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</table>
# List of Governing Body Members: 2015-16

## Chairman
**Shri Balvinder Kumar, IAS**
Secretary to the Government of India
Ministry of Mines, 3rd Floor, Shastri Bhavan
Dr. Rajendra Prasad Road, New Delhi - 110115

## Members

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| 1.  | Shri R. Sridharan, IAS| Additional Secretary to the Govt. of India
Ministry of Mines,
3rd Floor, Shastri Bhavan
New Delhi - 110 115 |
| 2.  | Ms. Sujata Prasad, IAS| Financial Advisor to Government of India
Ministry of Mines, 3rd Floor
Shastri Bhavan
New Delhi - 110 115 |
| 3.  | Shri Subhash Chandra, IFS| Joint Secretary to the Govt. of India
Ministry of Mines,
3rd Floor, Shastri Bhavan,
New Delhi - 110 115 |
| 4.  | Shri T.K. Chand        | Chairman-cum-Managing Director
National Aluminium Company Limited, NALCO
Bhawan, P/1, Nayapalli,
Bhubaneswar - 751 013 |
| 5.  | Shri Ramesh Nair       | Chief Executive Officer
Bharat Aluminium Company Limited
PO : BALCO Nagar
KORBA - 495684, Chhattisgarh |
| 6.  | Director General       | Bureau of Energy Efficiency
Ministry of Power
New Delhi. |
| 7.  | Shri Abhijit Pati      | President & COO, Sesa Sterlite Limited
VEDANTA Aluminium & Power
Vill : Bhurkamunda,
Jharsuguda - 768 202, Odisha |
| 8.  | Shri Satish Pai        | Managing Director
HINDALCO Industries Limited
Aditya Birla Centre B-Wing
3rd Floor, S.K. Ahire Marg, Worli
Mumbai – 400030 |
| 9.  | Dr. S.V. Kamat         | Outstanding Scientist & Director
Defence Metallurgical Research Laboratory,
P.O. Kanchanbagh
Hyderabad - 500 058 |
| 10. | Prof. S.P. Mehrotra    | Indian Institute of Technology Gandhinagar,
Vishwakarma Govt. Engineering College
Complex, Chandkheda, Visat-Gandhinagar
Highway, Ahmedabad – 382 424 |
| 11. | Prof. S. Subramanian   | Department of Materials Engineering
Indian Institute of Science
Bangalore – 560 012 |
| 12. | Shri G.P. Kundargi     | Chairman-cum-Managing Director
MOIL Limited
MOIL Bhawan, 1-A, Katol Road
Nagpur - 440 013 |
| 13. | Dr. Anupam Agnihotri, Director, Jawaharlal Nehru Aluminium Research Development and Design Centre, Amravati Road, Wadi, Nagpur - 440 023 |
### List of Research Advisory Committee: 2015-16

**Chairman**  
Prof. S.P. Mehrotra  
Indian Institute of Technology, IIT Gandhinagar  
Vishwakarma Government Engineering College Complex  
Chandkheda, Visat-Gandhinagar Highway  
Ahmedabad – 382 424 (Gujarat)

#### Members

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<tr>
<td>1.</td>
<td>Shri Ravinder Gaur</td>
<td>Scientist-D / Advisor, Department of Science &amp; Technology, Technology Bhavan, New Mehrauli Road, New Delhi - 110 016</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Prof. S. Subramanian</td>
<td>Department of Materials Engineering, Indian Institute of Science, Bangalore - 560 012</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Shri K.S. Raju</td>
<td>Ex-CG, IBM, Plot No. 19, Pragati Layout, 14th Cross, Bhuvaneshwari Nagar, Kempapura, Hebbal Post, Bangalore - 560 024</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Shri N.R. Mohanty</td>
<td>Director (P&amp;T), National Aluminium Company Limited, NALCO Bhawan, P/1, Nayapalli, Bhubaneswar - 751 013</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Dr. A.K. Mukhopadhyay</td>
<td>Outstanding Scientist, DRDO, Defence Metallurgical Research Lab, PO: Kanchanbagh, Hyderabad - 500 058</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Shri M Rathakrishnan</td>
<td>General Manager (R&amp;D), Bharat Aluminium Company Limited, PO: BALCO Nagar, KORBA - 495684, Chhattisgarh</td>
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<td>Director, Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Amravati Road, Wadi, Nagpur - 440 023</td>
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<td>Dr. B.K. Satpathy</td>
<td>General Manager (R&amp;D), National Aluminium Company Limited, NALCO Bhawan, P/1, Nayapalli, Bhubaneswar - 751 061</td>
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</tbody>
</table>
### List of Project Monitoring Committee: 2015-16

**Chairman**  
Prof. S. Subramanian  
Department of Materials Engineering  
Indian Institute of Science (IISc), Bangalore – 560 012

**Members**

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<td>2</td>
<td>Prof. D.R. Peshwe</td>
<td>Head, Department of Metallurgical &amp; Materials Engg., VNIT, Nagpur – 440 010</td>
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<td>Shri N.R. Mohanty</td>
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<td>7</td>
<td>Dr. T.R. Ramachandran</td>
<td>Emeritus Scientist, Nonferrous Materials Technology Development Centre (NFTDC) P.O. Kanchanbagh, Hyderabad - 500 058 (AP)</td>
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