



COAL REFEREE LAB

JNARDDC



# ANNUAL REPORT

2021-22



# ANNUAL REPORT 2021-22



TC-8254

**JNARDDC - ISO/IEC 17025:2017 NABL Accredited Lab**  
**Jawaharlal Nehru Aluminium Research Development & Design Centre**  
**Autonomous Body under Ministry of Mines, Govt. of India**  
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## From Director's desk



I have pleasure in presenting the 33<sup>rd</sup> Report of Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur for the year 2021-22. With the dedicated efforts of our scientific & administrative work force, we have completed four projects of S&T(Mines) and NALCO worth ₹ 2.57 crores. The Centre is executing seven Science & Technology projects and six industry / other agency sponsored projects. Furthermore, several new projects were proposed to various agencies.

While carrying out the above R&D work, the Centre achieved revenue generation (IEBR) of ₹ 7.20 crores. Our scientists have published / presented 23 papers in national & international journals / conferences. Two patent application was filed for indigenous R&D process developed by JNARDDC and two patents were granted to JNARDDC.

JNARDDC is actively involved in the NITI Aayog initiative of resource efficiency of aluminium. With the inputs of JNARDDC, the National Non-Ferrous Metal Scrap Recycling Framework, 2020 was published by Govt of India in 2021 to promote a formal and well-organized recycling ecosystem by adopting energy efficient processes for recycling leading to lower carbon footprints and to work towards sustainable development and intergenerational equity for shifting towards a circular economy in the coming years for base metals, critical raw materials and other essential materials. Subsequently, JNARDDC has been nominated and authorized for carrying out the non-statutory functions earmarked for Metal Recycling Authority (MRA), as stipulated in National Non-Ferrous Metal Scrap Recycling Framework, 2020.

The Centre was granted upgradation of its accreditation (9T-4561) by National Accreditation Board of Testing and Calibration Laboratories (NABL, New Delhi) for including coal testing, chemical analysis of aluminium and its alloys and mechanical testing of ferrous metals and alloys.

JNARDDC is playing a key role in the Nonferrous Scrap Recycling framework, Zero waste policy for nonferrous primary and secondary sector and NMIMS (Aluminium & Copper import monitoring system)

JNARDDC continued its proactive role in assisting BIS, Bureau of Indian Standards for standards for formulating the guidelines for Al-scrap and Standard for aluminium alloys.

JNARDDC is the sector expert for the aluminium sector under the PAT-2 / 3 (Perform, Achieve & Trade) Scheme in the National Mission for Enhanced Energy Efficiency (NMEEE) under Climate Change Project for Bureau of Energy Efficiency (BEE), Ministry of Power

With diversification in coal characterization facilities, the institute was able to achieve its all-time high internal revenue generation till date. JNARDDC has been nominated by CSIR-CIMFR as the referee lab for third party coal sampling.

We acknowledge the support extended by the Ministry of Mines, 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 others (GSI, MECL, OMECL, CIMFR, QCI etc.).

The immense use of aluminium in transportation, electricity, consumer goods, food & packaging, pharmaceuticals, building & construction industries drives the aluminium market growth. The extrusion segment accounted for the highest market share of about 31.2% in 2021 and is expected to show significant growth shortly. Aluminium extrusion products are increasingly used in automobile radiators & air conditioners, condenser tubes, nuclear reactors, audio/visual systems & electronics, and others. The 14MN extrusion national level press facilities of JNARDDC shall be a boon for extruders. The Asia-Pacific region is projected to be the fastest growing market, owing to factors such as rapid industrialization, rapid urbanization, increased investment and activity in constructing buildings and infrastructure, and expansion in the automotive industry.

JNARDDC will play a vital role in this growth trajectory by providing invaluable R&D inputs in the field of primary metal and downstream segment.

Dr A Agnihotri  
Director

## 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 Rupees 35 crores joint venture, supported almost equally by the Ministry of Mines, Govt. of India and UNDP. The Centre is 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, a Central Government 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.

It's an ISO/IEC 17025:2017 NABL accredited Lab and 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.

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.








- To assimilate and adapt the technologies suitable for raw materials available in India to produce 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 organization 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.

To be renowned nationally and globally as primary research hub for all aluminium products and processing



To undertake innovative research projects for providing complete technological solutions to meet the challenges for sustainability of aluminium industry

# Research Areas

Bauxite	Alumina	Smelter	Aluminium	Others
 Characterization Beneficiation Technological Evaluation	 Alumina Technology Special Alumina	 Smelter Process Cell Monitoring	 Metal Forming Casting Alloy development Characterisation	 Modelling Coal Testing Waste Management Energy & Environment

The Centre offers technological services in the following areas:

- Beneficiation and up-gradation of bauxites, laterites and low grade ores
- Characterization and technological evaluation of bauxites / laterites
- Process monitoring of aluminium electrolysis cell
- Characterization of coal, 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

### OUR ASSOCIATES



## Research Facilities

### Bauxite & 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
- Universal Impact Mill
- TLC Sample Spot Applicator
- Optical Scanning Densitometer
- Petrological Microscope
- Rotary & High temperature sintering furnace
- Lab flotation machine & Hydrocyclone test rig
- Granulating instrument
- Wet High Intensity Magnetic Separator
- Laboratory Ferrous Wheel Separator
- Rotap Sieve Shaker
- Bond Mill Index
- Density Instrument
- Halogen Moisture Analyzer

### Analytical Division

- Classical Wet Chemical Laboratory
- X-ray fluorescence (XRF)
- X-ray Diffraction (XRD)
- Inductively Coupled Plasma- Optical Emission Spectrometer (ICP-OES)
- Inductively Coupled Plasma- Mass Spectrometer (ICP-MS)
- Glow Discharge Optical Emission Spectrometer (GD-OES)
- TGA- Moisture, VM, LOI Analyzer
- Bomb Calorimeter
- Humidity Chamber
- Muffle Furnace
- Flame Photometer
- Double beam UV Visible Spectrophotometer
- Microwave Digestion System
- Ultrapure water Purification System
- Fusion Bead making Machine
- Pellet making Machine
- Nano-Milling Machine & Spin Coater
- Bench scale poly aluminium chloride unit

### Downstream Division

- 100 kN Universal Testing Machine
- Scanning Electron Microscope +EDS & EBSD
- Vicker's hardness Tester
- Induction Melting & Heat treatment Furnace
- Metallurgical Microscope + Image analyzer
- Resistivity / High Precision Micro Ohm Meter
- Digital Rockwell & Brinell Hardness Tester
- Ultrasonic flaw detector
- Electro polishing machine
- Conductivity meter & Roughness meter
- Milling machine
- Hyperextrude software
- Extrusion modeling and simulation
- Anodizing lab
- Erichsen cupping test
- 14 MN Extrusion Press
- IR Pyrometer

### Aluminium Electrolysis Division

- Specific Surface Area analyzer
- 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
- Photoacoustic Spectrometer (PFC Instrument)
- Data Acquisition and Processing System
- Heat Flux Meter
- Liquidus temperature measuring kit
- Lab Mixing and Kneading Machine
- Mathematical modeling

## Projects Completed in 2021-22 :: 4 nos.

### S-26 : Fabrication of Advanced Ceramic Nano-coatings for Automotive Applications - S&T Mines and Christ University



#### Objectives:

- Use organic binders to prepare micron sized agglomerates of commercially available non-plasma sprayable nano-sized ceramic compositions feed stock materials such as Stabilized Zirconia, Alumina, Alumina –Titania etc. Raw material synthesis of nano powders also will be carried out.
- Use the micron sized spherical agglomerates consisting of nano-structured feed material into a plasma spray equipment to form nano-structured Plasma Spray Coatings on aluminium / aluminium alloy substrates.
- Deposition of homogenous alumina nanocoatings on aluminium/aluminium alloy substrates using sol-gel technique
- Characterization of the as-synthesized nano-structured coatings for structural phase and microstructure, and very importantly adhesion to the aluminium and its alloy metal substrates. .
- Study the potential of using the above developed fine quality ceramic nano-coatings for certain automotive applications e.g. Zirconia based nano- coatings for engine components (piston crown), wear resistant alumina/alumina-titania coatings for wear resistant bearings etc.
- The project aimed to develop a technology to prepare nano sized plasma spray powder from nano ceramic (commercial) compositions involving alumina and zirconia (in line with Make in India Concept).

### **Background:**

Ceramic coatings are generally applied on metal components to either protect them from the service related environmental (thermal, mechanical or chemical) damage or to enhance performance. Nano grained coatings microstructure offer additional benefits than the conventional micron grained ceramic coatings, because of their superior properties (close thickness tolerance, ability to penetrate microscopic imperfections etc.). Synthesis of the coatings with retention of nano microstructure in the final product is however, challenging. JNARDDC joined hands with Christ University for the development of plasma sprayed nano ceramic coatings for applications in automotive components.

### **Outcome:**

#### **Highlights of the findings achieved in the Project**

- Micron sized free flowing plasma sprayable powders of (a)  $\alpha$ -Alumina and (b) 8YSZ grains, suitable for injection into the high temperature plasma stream of an APS system was developed by spray drying the starting nano powders. Complete optimization of spray drying parameters and publication of an Indian patent are the major outcomes.
- The powders when fed through the high temperature plasma resulted in highly adherent plasma sprayed coatings with nano grained microstructure.
- Nano crystalline powders of 8YSZ and nano alumina powders were synthesized in the laboratory by employing sol-gel method.
- The influence of nano  $\alpha$ -Al<sub>2</sub>O<sub>3</sub> (<100nm particle size) as sintering aid to obtain the desired microstructure in sintered micron sized (1 to 5  $\mu$ m)  $\alpha$ -Al<sub>2</sub>O<sub>3</sub> was studied by spray drying various composites and sintered at 1450°C/3 hrs. Significant improvement in densification at the lower than normal sintering temperatures (1600°C) was obtained.
- Nano alumina coatings coating on Gudgeon Pin in the CI Engine run for 100 hours did not adversely influence the engine performance and the coating quality was intact even after 100 hours of endurance test at maximum load. The suitability of the coating for engine application and the good coating quality was reconfirmed via this test.

- 8YSZ coated piston was mounted in the engine and the performance was evaluated for 100 hours. 22% increase in performance (reduced BSFC) and correspondingly other beneficial outcomes (higher thermal efficiency etc.) was a major achievement and a highly significant outcome of the project.



***Nano ceramic coated Piston (NiCrAlY/YSZ) mounted on diesel engine***

Micron sized alpha alumina powder (99.0 and 98.5 weight %) were spray dried with 1.0 and 1.5% Nano alpha alumina powders respectively. The spray dried powders removed from the chamber and cyclone of the spray dryer were subjected to identical processing conditions (compaction, sintering etc.). In addition to sintered density, fracture surface analysis of the sintered ceramics exhibited the significant influence nano alumina addition has on the microstructural characteristics of sintered micron alumina. Furthermore, spray dried powder removed from the cyclone of spray dryer exhibited a near ideal microstructure involving well sintered dense crystals with a hint of liquid phase sintering to suggest high densification. However, from the limited scope of experiments conducted here, it is inferred that small addition of nano alumina to micron alumina significantly reduces the sintering temperature. 99.0MA+1.0NA from chamber offered high densification. Further optimization of spray drying parameters to control the agglomerated particle size in the chamber is expected to provide a higher yield of the desired composite as well.

In addition to the development of two technologies (nano plasma sprayable powder synthesis & nano coatings synthesis via APS) 3 Indian patents were filed under this project. Based on successful lab scale findings the pilot scale work can be taken up.

## S-29 :Techno-economic Survey of Aluminium Scrap Recycling in India - (S&T Mines)



### **Objectives:**

- To “Establish techno-economic scenario of aluminium scrap recycling industry in the country” for which field survey, online survey and secondary research were carried out.

### **Background:**

Recycling is not just a single activity but involves chain of activities such as collection, dismantling, shredding, trading, melting, transport etc. and it is not policy neutral. Government policies, including environmental regulations and taxes, fiscal support also affect the dimension, shape, and form of industry value chains. Therefore, to establish

the techno-economic status of aluminium recycling industry in the country, sources of scrap, production volumes, application & market



Baled UBC Scrap



Al Wheel Scrap



Sorted Auto Scrap



Misc attachments in Scrap

share of recycled aluminium, infrastructure of recycling industry, governing rules & regulations, issues of recycling industry and global practices were surveyed

**Outcome:**

Based on various interactions with recycling value chain, national & global policies/acts, white papers, published articles etc the following recommendations were submitted in the project report.

- Digitalization of aluminium recycling eco-system to improve data collection
- Traceability of secondary aluminium to ensure source of scrap and end applications
- Setting up of recycling zones/clusters with central laboratories and testing centres to help small (micro) entrepreneurs who find it difficult to maintain laboratory set-up.
- Introduction of Extended Producer Responsibility (EPR) for aluminium containing products so that scrap can be channeled in organized way.
- Awareness programs about resource efficiency and circular economy for OEMs to promote usage of recycled aluminium in end products
- Standardization of recycling practices and products
- Certification of recycled products to ensure quality and maintain recyclability of the aluminium products for long
- R&D on aluminium and health to find whether aluminium utensils specifically from recycled aluminium can cause any health problems
- R&D system for aluminium recycling sector to improve the efficiency of aluminium value chain and quality of the recycled products
- Quality control orders for recycling industry to ensure product quality specifically for the retail consumers who can not ensure the product quality easily
- Capacity building for informal value chain like ragpickers, kabadiwalas, local aggregators or traders
- SOP for obtaining clearances for setting up and operations of recycling units.
- Measures for prevention of metal theft specifically from public infrastructures.
- Fiscal incentives/support to recycling industry/recycled product users for technology upgradation
- Uniformity in rules & regulations for the aluminium recycling eco-system
- Minimum recycled content for the aluminium end products to promote the recycling industry

While domestic recycling of aluminium provides employment apart from its energy and emission advantages, it has to overcome several challenges. These challenges include lack of system for domestic scrap collection and processing, high capital infrastructure for scrap pre-treatment and QA, logistics, lack of dedicated recycled zones, quality concerns regarding quality, lack of R&D, etc.

Government initiatives like National Non-Ferrous Metal Scrap Recycling Policy (MoM), National Resource Efficiency Policy (MoEF&CC), Circular Economy in Scrap Metal (NITI Aayog & MoS), Vehicle Scrapage Policy (MoRTH), Resource Efficiency in Aluminium (MoM), Non-Ferrous Metal Import Monitoring system (MoM), Motor Vehicles (Registration and Functions of Vehicle Scrapping Facility) Rules (MoRTH), etc. are expected to address majority of these problems and prepare the domestic aluminium recycling industry to increase its share in total aluminium production in near future.

***N-45 : Development of ceramic proppant from low grade materials (Partially Lateritized Khondalite -PLK, Fly ash, etc.) - Phase-II-Scale up studies, NALCO, Bhubaneswar***



**Objectives:**

- Setting up of scale-up facility to produce proppants from low grade materials (PLK, etc), additives, and optimization at bench scale (10-15 kg /day processing)
- Characterization and validation of product
- Flow sheet development

**Background:**

Based on the successful lab scale process developed by JNARDDC, the scale-up project for developing ceramic proppant from low grade materials (Partially Lateritised Khondalite -PLK, Fly ash, etc.) under Phase-II was undertaken.

In general, the characteristics of PLK comprise low alumina ( $Al_2O_3$ -32-36%), high silica ( $SiO_2$ -25-30%), high iron oxide ( $Fe_2O_3$ -16-18%) and low titania ( $TiO_2$ -1-3 %). Due to moderate alumina, high silica and iron content, this material could not be used for alumina production. Usually, ceramic proppant is manufactured from high grade bauxite. An attempt has been made for converting unutilized materials into value added product (proppants). It's an effort towards 'Make in India' and 'Swatch Bharat' zeal

**Outcome:**

The representative samples of PLK and fly ash were collected from Panchpatmali (NALCO) mine and alumina refinery, Damanjodi respectively. After detailed characterization studies, beneficiation tests were carried out on PLK for the removal of iron oxide. The samples of PLK were prepared in the required size for the preparation of granules. The granules (12/20, 20/40 & 40/70 mesh, etc.) were prepared from low-grade materials (PLK, fly ash) by using various additives i.e. binding agents such as bentonite and gaur gum. Calcination tests were carried out on granules with varying temperature, size of granules, feed rate, the quantity of granules and time in rotary kiln. Following calcination of granules, characterization and various related properties have been studied. Chemical, mineralogy and morphological characterization of granules was studied in detail. The chemical analysis indicated an increase in iron and alumina content in granules after calcination. The calcination studies indicate that granules feed rate, quantity, temperature and time plays important role in the calcination process.



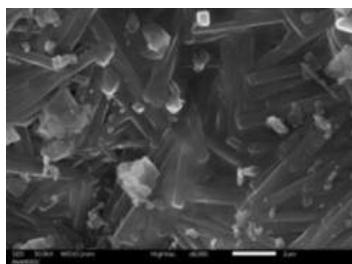
**Granules generated from PLK& additive**



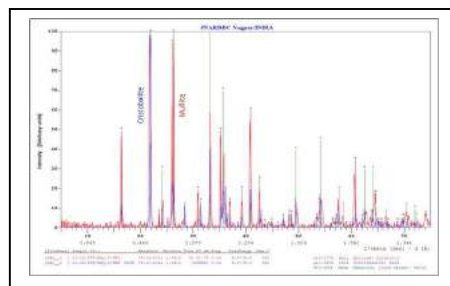
**Calcined Granules (Proppant)**



**Sphericity & Roundness of Proppant**



**SEM Micrograph of calcined granules (Proppant)**



**X Ray Diffractogram of proppant**

The proppant properties such as crush resistance, sphericity, roundness, bulk density, acid solubility and turbidity were determined in calcined granules. The result shows that the sphericity and roundness of granules are in the range of 0.6-0.8 and 0.6-0.8 respectively. The acid solubility of calcined granules is in the range of 2-7 %. The analysis of various calcined granules shows turbidity values in the range of 20-60 FTU/NTU which are within the limit value of  $\leq 250$ . The validation tests on proppant sample were carried out from an external NABL accredited laboratory. Ceramic proppants are highly useful in extraction of oil and gas as they can withstand a much greater crush strength than traditional frac sand and they also provide high conductivity to increase the oil and gas production output. Successful commercialization of this process will lead to utilization of low grade materials and benefit the oil and gas sector.

***N-46 : An innovative and viable process for recovery of iron values from red mud and processing of non-iron material for developing value added products – Complete Utilization of red mud”. NALCO, Bhubaneswar (Jointly with IIMT Bhubaneswar & Eesavyasa Tech, Pvt Ltd. Telangana)***



### **Objectives:**

- Development of an innovative and viable process for recovering iron values from red mud generated at NALCO's alumina refinery.
- Value added utilization of non-magnetic tailing as insulating material.

### **Background:**

Red mud is produced in the process of alumina extraction from bauxite. Development of its effective handling, storage, usage and management therefore stands as a burning issue for the global community as a whole. Red mud is highly alkaline, which is a potential pollution threat to water and land of close proximity of the alumina refinery plant. Meanwhile, high costs are associated with the large area of land needed for storage of the residue and also the polythene lining on the surface in the storage pond provided to avoid ground water contamination. The disposal of red mud is a major problem in alumina plants throughout the world. Usually, the production of 1 tonne of alumina generates 1-1.5 tonnes of red mud depending upon the mineralogical composition of the bauxite and extraction efficiencies. The treatment and utilization of high volume red mud waste has been a major challenge for the alumina industry. A typical chemical analysis would reveal that red mud contains silica, aluminium, iron, calcium, titanium, as well as an array of minor constituents, namely: Na, K, Cr, V, Ni, Ba, Cu, Mn, Pb, Zn etc. Therefore, an in-depth R&D study was needed to utilize and recover the different mineral values from red mud. The main objective was to minimize the waste generation by recovering the mineral values. The iron phase minerals are almost 40-60% in the red mud. If 70-80% of iron values can be recovered, a good amount of waste generation can be minimized. The major challenge was to aim for bulk utilization of red mud in a reliable manner and iron recovery were undertaken through this project.

### **Outcome:**

The process steps involved in the enrichment and separation of iron bearing minerals were the reduction of red mud with non-coking coal at different operating condition by varying parameters followed by magnetic separation using Low Intensity Magnetic Separation (LIMS).

The major parameters studied in the process optimization were temperature, ratio of reducing agent with red mud and magnetic intensity. Preliminary reduction roasting studies were carried out in laboratory muffle furnace and at the optimized conditions; the large-scale studies were carried out in a rotary kiln. The iron concentrate of reduction roasting was crushed and powdered for separation by LIMS.



Two stage high gradient magnetic separation (HGMS) was carried out on LIMS non-mag fraction to reduce iron loss. The reduction roasting studies at 1050 °C achieved 60-63% Fe in mag fraction and 18-19 % Fe in non-mag fraction.

Magnetic separation and jigging method of beneficiation was also tested for improved iron recovery from red mud by incorporating nano-technology based low temperature heating. In order to achieve energy efficiency, inductive heating of red mud with nano fines at low temperature 600-800 °C was attempted in steel crucibles followed by separation of magnetic material from the non-magnetic material by magnetic separator. Nano particles / nano-fines were used for inducing enhanced magnetic susceptibility in iron bearing mineral phases for enhanced magnetic separation. The significance of the process lies in converting the iron oxides such as goethite and hematite to magnetite.

The tailing (low iron fraction) generated in both process (non-mag tailing) was further studied for making value added insulating materials apposite for construction and engineering applications. Heat treatment of the tailing material failed or product making and insulating blocks were prepared by geopolymerization with adequate addition of mineral active binding materials. The product obtained after geopolymerization is shown below.



1



2

Fig.1 Geopolymer brick made of non-mag tailing (nano-treatment of red mud)

Fig. 2 Geopolymer brick made of non-mag tailing of reduction roasting of red

The geopolymer blocks reported compressive strength 6-7 MPa, zero efflorescence and accepted range of water absorption (20-23 %). The prepared test blocks were tested for bulk density and true density and the test report indicated true density in the range 2.346 – 2.644  $\text{cm}^3$  and bulk density 1.760-1.771  $\text{g/cm}^3$ . Thermal conductivity of the sample was tested for verifying insulating properties.

The test report shows thermal conductivity of geopolymer block prepared with on-mag tailing (IMMT) against vespel standard in the range 0.402-0.412 watts per meter-Kelvin (W/(m·K)). The report confirmed the blocks are good insulating material suitable for building materials and other related applications.

The findings of the provided a viable process option for complete value added utilization of red mud. The draft final report has been submitted to NALCO.

## Ongoing Projects 2021-22 : 13 nos.

### Sponsored by Ministry of Mines (SSAG):

SN	Project details	Remarks / outcomes
1.	<p>S-31: Bench scale study on extraction of pure Silica and smelter grade Aluminium Fluoride from Coal Fly Ash (CFA)– S&amp;T (Mines)</p> <p>Zero date: Mar 2019</p> <p>Duration: 3½ yrs</p>	<p>Coal Fly Ash (CFA) is one of the solid waste generated in thermal power plants during the process of power generation. India's commercial energy demand is met through the country's vast coal reserves and the coal fly ash generating from all coal-based thermal power plants are accumulating over the years which typically contains 27-31% alumina (Al<sub>2</sub>O<sub>3</sub>), 56-60% silica (SiO<sub>2</sub>) and 9-13% oxides of elements (Ca, Mg, Na, Fe, Ti etc.).</p> <p>Pure silica is used in structural materials, microelectronics (as an electrical insulator, semiconductors etc.), and as components in the food and pharmaceutical industries.</p> <p>In this project work efforts are being carried out to study bench scale (0.5-1 kg CFA) extraction of pure silica and aluminium fluoride by treating CFA with appropriate mineral acid.</p>
2.	<p>S-33: Utilization of aluminium dross to achieve zero waste – A bench scale study project</p> <p>Zero date: Dec 2019</p> <p>Duration: 2 ½ yrs</p>	<p>The main objective of the project is to develop the bench scale process for preparation of Poly Aluminium Chloride (PAC) from waste aluminium dross and to prepare castable refractory from residual dross for industrial applications to achieve zero waste.</p> <p>The potential benefit in preparing PAC from aluminium dross is providing alternative source to primary material and reduction in waste disposed to landfills.</p>

SN	Project details	Remarks / outcomes
3.	<p>S-34: Production and certification of certified reference materials (CRMs) for the analysis of aluminium alloy.</p> <p>Zero date: Dec 2019</p> <p>Duration: 3 yrs</p>	<p>The main objective of the project is to produce certified reference materials (CRMs) for aluminium alloys at JNARDDC for the benefit of the aluminium industry and to provide import substitute. Being accredited with ISO 17025 by NABL for its analytical facilities, JNARDDC is well-placed to produce CRMs. In this regard, accreditation in accordance with ISO 17034 is under progress. Initially, the development of CRM for one wrought and one cast alloy will be taken up and the range will be expanded subsequently.</p> <p>This will be an import substitute to high quality CRMs for aluminium sector.</p>
4.	<p>S-35 : Geo-technological evaluation of Bauxite and Laterite deposits of Chhattisgarh State by using Geospatial technology under Smart Mining 4.0</p> <p>(with Chhattisgarh Council of Science &amp; Technology, Government of Chhattisgarh, Raipur)</p> <p>Zero date: Mar 2022</p> <p>Duration: 2 yrs</p>	<p>At present there is limited geo-technological information about Chhattisgarh bauxite and laterite deposits to confirm utilization for metallurgical and non-metallurgical applications. Accordingly, JNARDDC has joined hands with Chhattisgarh Council of Science &amp; Technology, Government of Chhattisgarh, Raipur to undertake this project. The project outcome will lead to creation of a digital database which will be highly useful to identify suitable deposits for industrial applications using geo-informatics technology. It will assist the state govt in auctioning of blocks. Efforts will be made to make the database available through Mobile APP.</p>
5.	<p>S-36 : Solid-state recycling of aluminium chips (waste) for production of billets for pilot scale extrusion</p> <p>Zero date: Mar 2022</p> <p>Duration: 2 yrs</p>	<p>The aim of this project is to utilize aluminium swarf/ chips (waste) of AA6063 and AA2024, which are generated during machining of components, for the production of aluminium billets for extrusion.</p>

SN	Project details	Remarks / outcomes
6.	<p>S-37 / P-63: Technology Development for Holistic Utilization of Red Mud for Extraction of Metallic Value &amp; Residue Utilization</p> <p>[with NML, Jamshedpur, IMMT, Bhubaneswar, NALCO, HINDALCO &amp; VEDANTA] under aegis of NITI Aayog</p> <p>Zero date: Oct 2021</p> <p>Duration: 3 yrs</p>	<p>Under the NITI Aayog initiative the primary industries and 3 R&amp;D labs have joined hands for development of feasible processing options for all metal extraction and REE enrichment from red mud and for further research, development and commercialization to other industries. The outcome will lead to development of a Master Flowsheet for selected grades of red mud with energy and material balance equipped with techno-economic feasibility.</p>
7.	<p>S-38 : Red mud valorization to achieve zero waste, conversion of residue into diagnostic x-ray shielding tiles after recovery of scandium (with CSIR-AMPRI, Bhopal) :</p> <p>Zero date: Mar 2022</p> <p>Duration: 2 yrs</p>	<p>The main objective of this project is to convert red mud into economically valuable very high energy X-ray and gamma ray shielding blocks, which is suitable for building radiation therapy bunkers, nuclear power plants, food sterilization plants, etc., and thereby to promote the zero-waste concept.</p>

**(B) Sponsored by Industry / other organizations (Ongoing)**

SN	Project Details	Remarks / Outcomes
8.	<p>N-47: Development of Process for 4N High Pure Alumina (HPA) and Substrate Making for its Validation in LED applications</p> <p>Mar 2021: 2½ Years</p> <p>NALCO, Bhubaneswar Odisha (Jointly with IIT, Bhubaneswar &amp; Anna University)</p>	<p>While India is one of the highest users of LEDs, neither the raw material is prepared nor is the product manufactured in India. All LEDs that are available in market are assembled after their import.</p> <p>The project aims to develop an indigenous process to prepare 4N (99.99%) pure grade alumina (HPA) that has potential for use in LED applications.</p>

SN	Project Details	Remarks / Outcomes
9.	<p>N-48 : Development of DC cast Al Alloy for Yoke in automobile applications, NALCO Bhubaneshwar (Jointly with ARAI Pune)</p> <p>Mar / May 2022: 2 Years</p>	<p>Automotive yoke is usually made of steel or cast iron. Aluminium alloys are widely used in automotive applications due to excellent strength-to-weight ratio which significantly reduces the fuel consumption and also enables to meet emission norms. The project aims to develop a new DC cast Al Alloy followed by development of the prototype yoke used in automobile applications.</p>
10.	<p>N-49 : Demonstration cum heat treatment, leaching-recycling and liming study of JNARDDC-NALCO process ( by utilizing 50-60 kg batch of 1st cut SPL); NALCO Bhubaneshwar</p> <p>Mar 2022: 9 months</p>	<p>Based on the success of bench scale studies (1kg) for detoxification of 1<sup>st</sup> cut SPL material and recovery of caustic and fluoride, JNARDDC has undertaken the Demonstration cum heat treatment, leaching-recycling and liming study of JNARDDC-NALCO process by utilizing 50-60 kg batch of 1st cut SPL. The project aims to provide the mass balance, CAPEX and OPEX for scaling up the process to commercial level.</p>
11.	<p>P-61: TPN:59025 Instrument for Realtime measurement of anode current distribution of aluminium electrolysis cell</p> <p>Mar 2021: 2 Years</p> <p>Dept of Science and Technology (DST, New Delhi)</p>	<p>Online current distribution measurement helps to observe changes in current distribution with changing conditions in the cell for a period of time which provides option to improve cell efficiencies and reduction in cell instabilities.</p> <p>The project aims to develop an instrument which will be able to make real-time continuous measurement of ACD in place of existing manual measurement system for its successful commercialization in industry.</p>

SN	Project Details	Remarks / Outcomes
12.	<p>P-62 : TPN:59031 Instrument for Instantaneous and onsite measurement of aluminium electrolysis bath parameters :</p> <p>Mar 2021: 2 Years</p> <p>Dept of Science and Technology (DST, New Delhi)</p>	<p>JNARDDC has already developed the methodology to establish the relationship of cooling curve with bath parameters on the basis of plant and lab experiments and has successfully developed the basic instrument for instantaneous measurement of important bath parameters. The project aims to develop the instrument which can be used in plants for regular measurements of bath parameters by addition/changes in the basic instrument in the terms of software &amp; hardware for its commercialization.</p>
13.	<p>P-64 : Development and Supply of an Instrument for Instantaneous Onsite Measurement of Bath Parameters</p> <p>Mar 2022: 3 months</p> <p>BALCO, Korba</p>	<p>JNARDDC has developed unique equipment capable of simultaneous measurement of vital bath parameters which will prove to be a boon to the aluminium smelters. Measurement time is around 5 minutes and all bath parameters are instantly available which otherwise are measured separately and requires sufficiently long time (12-14 hrs). The real time bath parameters information made available by the Instrument can easily be coupled with the other known pot operating conditions such as noise, voltage modifiers and state of feed control which helps in improved energy efficiency, current efficiency ultimately leading to enhanced cell performance.</p> <p>Studies shall be undertaken of the plant conditions for customizing the equipment design to meet Balco's requirements followed plant trials, fine-tuning, demonstration/ validation (50 measurements) and training to operators.</p>

## Collaborative Work



JNARDDC is collaborating with the following agencies for various R&D projects and assignments.

1. **NITI AAYOG:** Development of effective handling, storage, usage and management of red mud is a major concern for the global community as a whole. In order to make India self-reliant in Rare Earth Extractions ("REEs"), NITI Aayog has identified many secondary resources for rare earth extraction among which Red Mud is the only known resource of scandium, a REE, which is more enriched as compared to native bauxite. Under the aegis of NITI Aayog multiple institutions including JNARDDC are involved in development of feasible processing options for all metal extraction from Red Mud.
2. **Department of Science and Technology (DST):** JNARDDC has undertaken 2 projects (i) Instrument for Realtime measurement of anode current distribution of aluminium electrolysis cell & (ii) Instrument for Instantaneous and onsite measurement of aluminium electrolysis bath parameters under various R&D programs of DST.
3. **Chhattisgarh Council of Science & Technology : (CCOST), Raipur** an autonomous body of Government of Chhattisgarh joined hands with JNARDDC for Geo-technological evaluation of Bauxite and Laterite deposits of Chhattisgarh State by using Geospatial technology under Smart Mining 4.0. The joint venture activity for Bauxite Mining 4.0 will open up new vistas for utilization of advance RS, GIS, GPS technology in the area of laterite and bauxite ore utilization by the aluminium industries.
4. **CSIR - Advanced Materials and Processes Research Institute AMPRI, Bhopal** : JNARDDC and AMPRI, Bhopal have undertaken a joint project which aims to convert red mud into economically valuable very high energy X-ray and gamma ray shielding blocks, which is suitable for building radiation therapy bunkers, nuclear power plants, food sterilization plants, etc., and thereby to promote the zero-waste utilization of red mud.
5. **MRAI (Material Recycling Association of India):** JNARDDC successfully completed a joint project "Techno-economic Survey of Aluminium Scrap Recycling in India" with MRAI. The final survey report will assist the Government in formulating policies for the sector.



6. **CSIR - Institute of Minerals and Materials Technology, IIMT Bhubaneswar:** A joint project titled “An innovative and viable process for recovery of iron values from red mud and processing of non-iron material for developing value added products – Complete Utilisation of red mud- sponsored by NALCO” was completed in collaboration with IMMT, Bhubaneshwar and Eesavyasa Tech, Pvt Ltd. Telangana. A multi-institutional project “Technology Development for Holistic Utilization of Red Mud for Extraction of Metallic Value & Residue Utilization” is also under process”.
7. **Christ University, Bangalore:** Christ University and JNARDDC successfully developed a technology to prepare nano sized plasma spray powder from nano ceramic (commercial) compositions involving alumina and zirconia (in line with Make in India Concept). The outcome of the project could lead to overall life enhancement of automobile components. Two patents were filed for the process.
8. **Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India**  
JNARDDC is the aluminium sector expert under PAT-2 / PAT-3 (Perform, Achieve & Trade) Scheme in the National Mission for Enhanced Energy Efficiency (NMEEE) under Climate Change of Bureau of Energy Efficiency (BEE), Ministry of Power. The Centre has successfully carried out technical evaluation under PAT-1 & 2 to support the BEE in reducing energy consumption of aluminium sector. Presently evaluating PAT-3 scheme. The recommendation will help BEE in generation and trade of e-certificates under PAT scheme. It will also be useful in setting up energy reduction targets for PAT-3 scheme. The scheme details are available on :- <https://beeindia.gov.in/content/nmeee-1> and <https://beeindia.gov.in/sites/default/files/Aluminium.pdf>
9. **Bureau of Indian Standards (BIS):** JNARDDC is in the process of formulating recommendations for BIS regarding setting up standards for aluminium scrap and other aluminium alloys. The Centre is assisting BIS to develop methods and methodology for testing and analysis of materials related to aluminium sector.
10. **IIT, Bhubaneswar & Anna University:** The NALCO, Bhubaneshwar sponsored project “Development of Process for 4N High Pure Alumina (HPA) and Substrate Making for its Validation in LED applications” is being executed in collaboration with IIT-Bhubaneswar and Anna University. India does not have a production base of LED due to import of 3N and 4N alumina. In view of the market, product potential and availability of raw materials in India, the project outcome has a commercial potential to add to the vision of Make in India program suitable for LED (Light Emitting Diode) and Semiconductor applications.

11. **CSIR - National Metallurgical Laboratory NML, Jamshedpur** : Under the aegis of NITI Aayog multiple institutions including NML, Jamshedpur are involved in development of feasible processing options for all metal extraction from Red Mud “Technology Development for Holistic Utilization of Red Mud for Extraction of Metallic Value & Residue Utilization”
12. **Automotive Research Association of India (ARAI), Pune** is the leading automotive R&D organization of the country affiliated to the Ministry of Heavy Industries, Government of India. ARAI is the prime Testing and Certification Agency notified by Government of India under Rule 126 of Central Motor Vehicle Rules, 1989. JNARDDC and ARAI have taken a joint project with NALCO for development of a new DC cast Al Alloy followed by development of the prototype yoke used in automobile applications. The prototype forging of yoke will be carried out at ARAI.
13. **Ministry of Mines: JNARDDC** is the designated aluminium sector expert / nodal agency for the following key authorities:
  - Nonferrous Scrap Recycling framework
  - Zero waste policy for nonferrous primary and secondary sector
  - NMIMS (Aluminium & Copper import monitoring system)
  - Metal Recycling Authority (MRA) - to carry out the non-statutory functions earmarked for MRA as stipulated in the “National Non-Ferrous Metal Scrap Recycling Framework 2020”
  - Resource efficiency in aluminium sector

# Patents



The following patent applications were filed/ granted under the Patents Act, 1970 for various indigenous R&D process developed by JNARDDC under various research projects.

Sn	Details	Title of Patent
1.	<p>202241011004 [2021-22] Dated 11.03.2022</p> <p><b>Filed</b></p>	<p>Synthesis of spray dried nano 8YSZ plasma sprayable powder and plasma sprayed thermal barrier coating</p> <p>Dr S. Gowtham Sanjai &amp; Parvati Ramaswamy, (Christ University); Dr Priyanka Nayar, Dr Upendra Singh &amp; Dr Anupam Agnihotri (JNARDDC)</p> 
2.	<p>202241005098 [2021-22] Dated 31.01.2022</p> <p><b>Filed</b></p>	<p>A method to obtain upto 150<math>\mu</math> thick nano-structure Al<sub>2</sub>O<sub>3</sub> coatings by plasma spraying.</p> <p>Dr S. Gowtham Sanjai &amp; Parvati Ramaswamy, (Christ University); Dr Priyanka Nayar, Dr Upendra Singh &amp; Dr Anupam Agnihotri (JNARDDC)</p> 

Sn	Details	Title of Patent
3.	<p>Patent no. 378743 Dated 06.10.2021</p> 	<p>Determination of calcium in alumina hydrate, calcined alumina and process liquor</p> <p>Dr Mohamed Najar, Mr M T Nimje, Dr S P Puttewar, Dr Anupam Agnihotri (JNARDDC) &amp; Mr Subrat Kar, Mr V Krishna Kumari and Mr P K Behera (NALCO)</p> 
4.	<p>Patent no. 391928 Dated 14.03.2022</p> 	<p>A process for rapid analysis of reactive silica in bauxite and laterite based on selective autogenous dissolution at ambient temperature</p> <p>Dr Mohamed Najar, Shama Wadsariya, Amrita Karn, Prajakta Ogale, S P Puttewar and Anupam Agnihotri (JNARDDC)</p> 

## Technical Papers Presented / Published & Conferences



### JOURNALS

1. Converting Sapolite (a low-grade unutilized material) into refractory aggregates: A viable substitute for calcined clay in the refractory industry; **P. G. Bhukte**, G. T. Daware, S. P. Masurkar, M. J. Chaddha & A. Agnihotri (2021); **Journal of Mining, Metallurgy & Exploration**, Springer, 38, 1589-1595, Apr 2021; <https://link.springer.com/article/10.1007%2Fs42461-021-00407-w>
2. Comparison of metal flow characteristics in aluminium extrusion die using numerical simulations for AA6063 and AA7075; **VNSUV Ammu**; Samrat Ambade, N.S. Anas, R.N. Chouhan, Anupam Agnihotri ; **International Journal of Vehicle Structures & Systems**; June 2021 ; <https://doi.org/10.4273/ijvss.13.2.09>
3. Value Addition of Alumino-Silicates: Consolidation of Mining Rejects and Industrial Slag by Geo-Polymerization; **P. A. Mohamed Najar**, Amrita Karn, Vishakha Sakhare, Mukesh Jitsingh Chaddha, Anupam Agnihotri, Book Chapter in Innovations in Sustainable Mining pp 57-70, **Springer-Nature, Part of the Earth and Environmental Sciences Library book series** (EESL), Jul 2021; [https://doi.org/10.1007/978-3-030-73796-2\\_4](https://doi.org/10.1007/978-3-030-73796-2_4)
4. Utilization of Aluminium Industry Solid Waste (Red Mud/Bauxite Residue) in Pollution Control. In: **Suchita B Rai**, Bahadure S., Chaddha M.J., Agnihotri A. (2021) Randive K, Pingle S, Agnihotri A. (eds) Innovations in Sustainable Mining. pp 21-43 Earth and Environmental Sciences Library. Springer, Cham. Jul 2021 [https://doi.org/10.1007/978-3-030-73796-2\\_2](https://doi.org/10.1007/978-3-030-73796-2_2)
5. Beneficiation of low-grade Bauxite: A case study of Lateritic Bauxite of India; Innovations in Sustainable Mining; **P G Bhukte**, G T Daware, S P Masurkar, M J Chaddha, A Agnihotri (2021); **Springer, Balancing Environment, Ecology & Economy**; pp 85-98, Jul 2021; [https://link.springer.com/chapter/10.1007%2F978-3-030-73796-2\\_6](https://link.springer.com/chapter/10.1007%2F978-3-030-73796-2_6)
6. A study on the impact of material synergy in geopolymer adobe: Emphasis on utilizing overburden laterite of aluminium industry; **Mohamed Najar**, Vishakha Sakhare, Amrita Karn, Mukesh Chaddha, Anupam Agnihotri, **Open Ceramics, Science Direct, Elsevier**, Vol-7, Sept 2021, 100163 pp 1-8  
<https://www.sciencedirect.com/science/article/pii/S2666539521001097>
7. Method development and validation for quantification of trace elements in aluminous ore (Bauxite) using ICPOES; **Upendra Singh**, Sonali, Thawrani, Jyoti Pendam, Anupam Agnihotri; **Journal of Analytical Chemistry**: Springer USA (pp 1395-1398, Volume 76, No. 12, Dec 2021, <https://link.springer.com/article/10.1134/S106193482112011X>

8. Rare earth elements recovery from red mud. **Upendra Singh**, Sonali A. Thawrani and Anupam Agnihotri, January 2022, pp 131-149 IWA Publishing Unit, Export Building, London, UK; [https://doi.org/10.2166/9781789062236\\_0131](https://doi.org/10.2166/9781789062236_0131)
9. [Innovations in Sustainable Mining](https://www.springerprofessional.de/en/aluminum-dross-value-added-products-to-achieve-zero-waste/19320812) Aluminum Dross: Value Added Products to Achieve Zero Waste, **Upendra Singh** pp 45-56, July 2021, Springer ; <https://www.springerprofessional.de/en/aluminum-dross-value-added-products-to-achieve-zero-waste/19320812>
10. Value-Added Geopolymer Product to Offset Expenditure on Waste Management and Sustainability; **Mohamed Najar**, Vishakha Sakhare, Amrita Karn, Mukesh Chaddha, Anupam Agnihotri; Journal of Chemical Technology and Metallurgy, Jan 2022 57, 1, 2022, 141-152, Bulgaria, [https://dl.uctm.edu/journal/node/j2022-1/18\\_20-153p141-152.pdf](https://dl.uctm.edu/journal/node/j2022-1/18_20-153p141-152.pdf)

### CONFERENCE PROCEEDINGS

#### *Interactive Virtual Meet on Proppants; JNARDDC Nagpur on 30<sup>th</sup> July 2021*

11. Prospective raw materials for the development of ceramic proppants; **P G Bhukte**, M. J. Chaddha, G. T. Daware, S P Masurkar & A. Agnihotri

#### *25<sup>th</sup> International conference on Nonferrous Metals (ICNFM-2021) New Delhi; 03-04 Sept 2021*

12. Microstructural and thermal stability studies on cast Al-Ce alloy for high temperature automobile applications; **Papa Rao Mondi**, V. N. S. U. Viswanath Ammu, R. N. Chouhan, Anupam Agnihotri, In. Proc. pp. 138-143.
13. Extrudability and process parameters selection in extrusion of AA2024 alloy, **V N S U Viswanath Ammu**, K Immanuel Raju, R N Chouhan, A Agnihotri
14. Waste aluminium dross: an alternative resource for PAC, **Jyoti Pendam**, Sonali Thawrani, Mayur Tirpude, Upendra Singh, A Agnihotri,
15. Rheological investigations of Bayer plant liquor, **Prachiprava Pradhan**, M J Chaddha, Suchita B Rai, Kishore J Kulkarni, Megha Panchal, A Agnihotri

#### *7<sup>th</sup> Edition of International Conference on Nanotechnology for Better Living NBL-2021, 07-11<sup>th</sup> September 2021.*

16. Growth and Characterization of Single Crystal Alumina using 3N Pure Alumina Powder; **Priyanka Nayar**, Janakiraman Kumar, Upendra Singh, A Agnihotri

#### *Bauxite Miner's Meet (BMM-2021)", JNARDDC Nagpur on 29<sup>th</sup> September 2021.*

17. Lateritic Bauxite Deposits - Status & value addition of low-grade materials; **P G Bhukte** - G. T. Daware, M. J. Chaddha & A. Agnihotri

*International Conference on Energy & Advanced Materials ICEAM 2021, Jaypee Institute of Information Technology, Noida, 21-23<sup>rd</sup> October 2021.*

18. Milling route for synthesis of nano-aluminium hydroxide for development of low-density polymer composites, **Suchita B Rai**, M. J. Chaddha, M. T. Nimje, Sneha Bahadure, Smita Mohanty, A. Agnihotri.

*National Conference on “Present and future prospective of minerals and mining industry in changing economic environment (PFPMICEE-2021)”; P G Department of Geology, RTMNU, Nagpur, 23-24<sup>th</sup> December 2021*

19. Geo-technological evaluation of bauxite deposits and its significance in auctioning of bauxite blocks; **P G Bhukte**, M J Chaddha, G T Daware, A Agnihotri
20. Process for Recovering Unused Mineral Values of Industrial Rejects: Scope of Physico-Chemical Treatment for Mineral Augmentation, **Mohamed Najar**, Amrita Karn, P G Bhukte, M J Chaddha, and A Agnihotri,

*74th Annual Session of Indian Institute of Chemical Engineers; CHEMCON-2021, Bhubaneswar, Odisha, 27-30<sup>th</sup> December 2021.*

21. Red mud supported co-catalyst for biodiesel production using waste cooking oil and its economic assessment, **Prachiprava Pradhan**, M J Chaddha, Vinod Ganvir, Amit Agrawal, Anand Shende, Suchita B Rai, K J Kulkarni and A Agnihotri
22. Non-reinforced High-strength Geopolymer from Industrial Rejects for Sustainable Engineering, **Mohamed Najar**, V Sakhare, N Azad, Amrita Karn, M J Chaddha, A Agnihotri

*International e-Conference “Innovations in Science, Technologies, Humanities, Management and e-Commerce for Sustainable Rural Development”, Anand Niketan College of Science, Arts and Commerce, Anandwan, Warora, District Chandrapur, Maharashtra, 14-15<sup>th</sup> March 2022.*

23. Synthesis of 3N Pure Alpha Nano Alumina from Aluminium Foil, **Priyanka Nayar**, Pooja Yadav, Sandeep Kowe, Upendra Singh and Anupam Agnihotri.

## INVITED LECTURE



• Extrusion of Aluminium Alloys-Application of numerical simulation tools for deformation zone of die" Online Faculty Development Programme, "Recent Advances In Materials and Challenges in Manufacturing Techniques" Jawaharlal Nehru Technological University, Kakinada, Andhra Pradesh, 22<sup>nd</sup> March to 3<sup>rd</sup> April, 2021. **VNSU V Ammu**

- Introduction to Chemical Engineering and its scope in Nonferrous Industries, Chemical Engineering, Department, Parul University, Vadodara, Gujarat, 10<sup>th</sup> July 2021. **Prachiprava Pradhan,**
- Characterization of nano materials, department of Materials Science and Nanotechnology, Yogi Vemana University, Andhra Pradesh, 22<sup>nd</sup> November 2021, **Dr. Papa Rao Mondi.**
- Aluminium Industry Waste-Value Addition and Product Development, National Seminar on "New Horizons in Chemistry", RTM Nagpur University Campus, Nagpur, 29<sup>th</sup> November 2021. **Dr Upendra Singh**
- Heat Transfer and Energy consumption in Bayer's process, Department of Chemical Engineering, VNIT, Nagpur, Maharashtra, 31<sup>st</sup> January 2022. **Dr Suchita Rai**
- Industry waste Residue: Process to achieve zero waste. Indian Analytical Science congress (ISAS), Munnar, Kerala Chapter, March 10-12, 2022, **Dr.Upendra Singh**

# Academic Events

**National Extruders Meet on 30<sup>th</sup> April 2021: [www.jnarddc.gov.in/Extruders Meet.aspx](http://www.jnarddc.gov.in/Extruders_Meet.aspx)**

National Extruders Meet” organised by JNARDDC on 30th April 2021 witnessed participation of around 80 attendees and experts including 35 extruders, 15 equipment suppliers, 201 researchers and academicians, 5 billet casters and others from all over the country. The event stressed upon the need for developing new aluminium alloys and extruded profiles for building and construction, automobile and also for strategic applications for growing needs of the country. The deliberations included best practices to achieve quality and productivity, emerging needs of aluminium extrusions in India, developments and requirements of aluminium extrusions for aerospace applications, new energy saving or green technologies followed by a live demonstration of 14 MN extrusion press.



**Bauxite Miner’s Meet (BMM-2021)-Virtual Organized on 29<sup>th</sup> Sept 2021: [www.jnarddc.gov.in/Programs And Events.aspx](http://www.jnarddc.gov.in/Programs And Events.aspx)**

Was held on 29th Sept 2021 and widely participated by bauxite miners, Academia experts, VEDANTA, SCABAL, NALCO, OMC, GMDC, Caldreys, Dharti Minerals, Swati Minerals, Kalyani Systems, Ashapura Minechem, Shivam Minerals, Amba Mine, Panditrao Mines, Katni Bauxite, Gujarat Credo, Ln Indtech, IBM, IMMT, CGCR, DGM, IBAAS, Pune University, ISR Infomedia etc.



It provided the perfect forum to the stakeholders involved in bauxite mining and its subsequent users in understating each others requirement leading to enhanced business opportunities.

## 25<sup>th</sup> International symposium on Non-ferrous Metals (ICNFM-2021), New Delhi (3-4 Sept 2021)

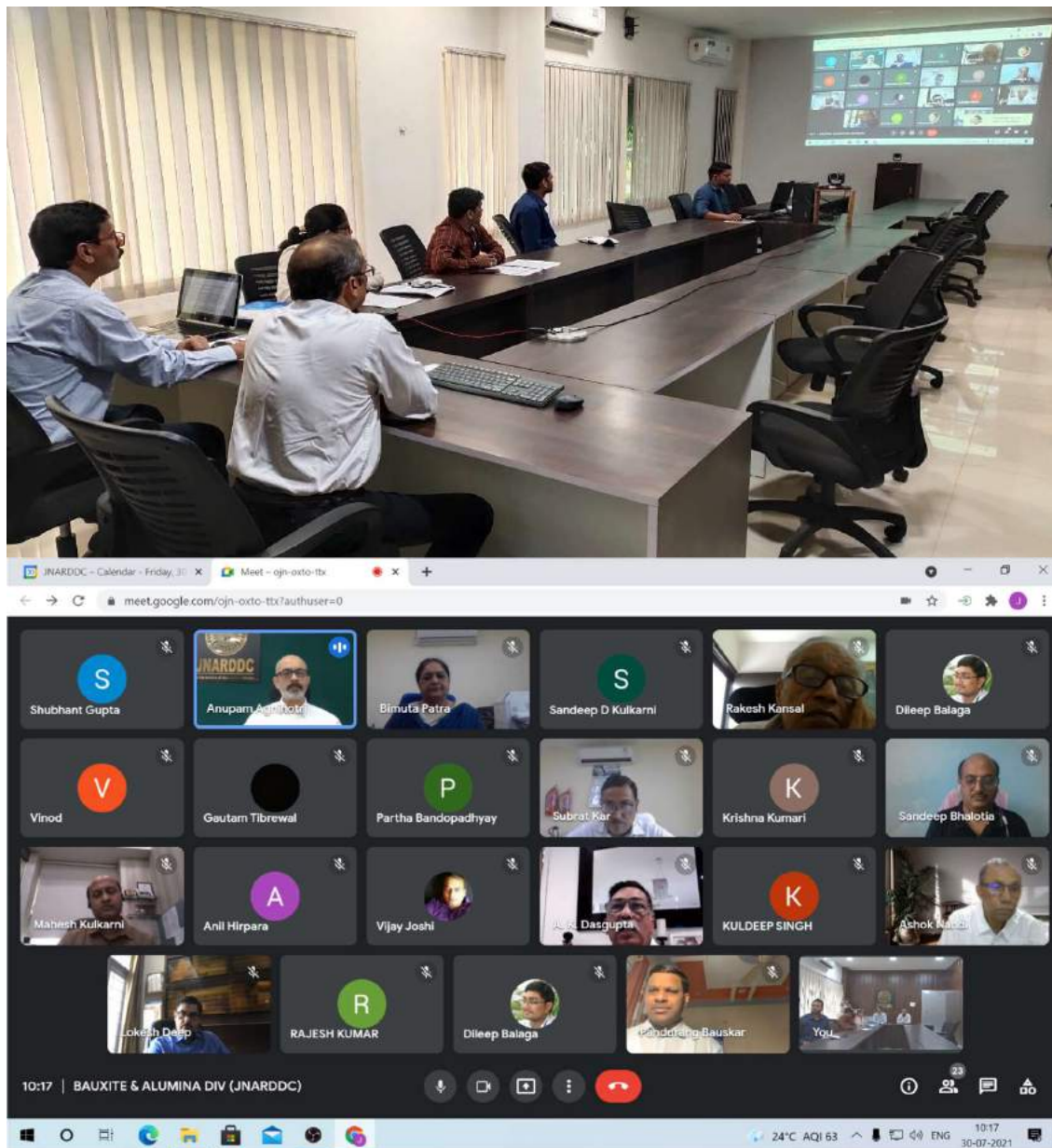
The 25<sup>th</sup> ICNFM-2021 was organized by Corporate Monitor in association with JNARDDC, Aluminium association of India (AAI) and Material Recycling authority of India (MRI) at New Delhi on 03-04 September 2021 for promoting environmental-friendly technologies for primary & secondary metal extraction. The event was inaugurated by Mr Sanjay Lohiya (IAS), Additional Secretary, Ministry of Mines in the presence of the chiefs of public and private sector organization dealing with nonferrous metals.



Four research papers were presented by JNARDDC during the event. The event also provided an excellent platform to bring together the Indian non-ferrous industry with the international metal world and provided an opportunity to discuss the best practices, benchmarks, technological advancement, innovations and the opportunities of collective empowerment, to promote the overall development of nonferrous industry, all of which will culminate to inspire the aim for “Atmanirbhar Bharat”. Other participants included NALCO, Hindustan Copper, IIT BHU, CSIR-NML, Aditya Birla group, Vedanta group.

### Interactive meet on Proppants : 30th July 2021

A virtual interactive meet on proppants was organized by JNARDDC on 30<sup>th</sup> July 2021 with sole aim to provide an up-to-date comprehensive review of recent developments in the field of proppants and refractory.



The meet addressed the issues of current status of raw materials for production of proppants, mineral reserves of high-grade bauxite, issues and challenges - alternative materials for development of proppants, consumption, import & export scenario of proppants, value addition prospects and hindrances and focus on utilization of low-grade materials

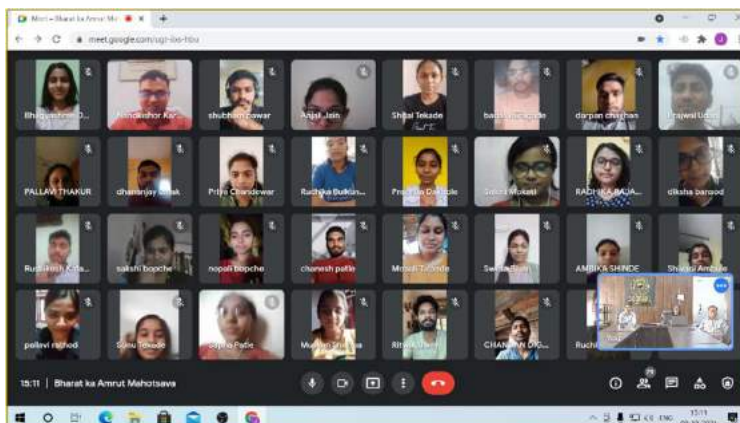
## Azadi ka Amrit Mahotsav



Government of India has initiated Azadi Ka Amrit Mahotsav to celebrate and commemorate 75 years of progressive India and the glorious history of its people, culture and achievements. Keeping in line with the Govt initiative, JNARDDC has undertaken the following programs under AKAM.

- **Online lecture series to 75 colleges**

JNARDDC, Nagpur is conducting an online lecture series on "Aluminium - From Mine to Metal" to selected departments of NITs, IITs, regional and reputed colleges (75 colleges). The lecture series commenced from the week starting from 12th March 2021 with VNIT, Nagpur.



JNARDDC is also in the process of making a 3-5 minutes video film, factsheets, leaflets on the growth of Aluminium Industry of India covering all segments and sectors.

- **Fit India Freedom Run 2.0**

JNARDDC launched the "Fit India Freedom Run 2.0 - Azadi Ka Amrit Mahotsav" on 13.08.2021 from the JNARDDC technical complex. Around 55 employees and staff participated in the inaugural run of 3 kms.



- **Drawing competition**

A drawing competition was organized on 15.08.2021 for children of all employees and staff with the theme- “Azadi Ka Amrit Mahotsav”. The 75 participants were awarded participation prizes by Director, JNARDDC during the independence day celebrations.



- **National sports day**

JNARDDC, Nagpur celebrated the National Sports Day to honour the legacy of the wizard - Major Dhyan Chand and acknowledge the importance of sports in our life. It included a brief lecture about the legend on 30th August 2021 as a part of the “Azadi Ka Amrit Mahotsav” celebration. This was followed by a badminton and table tennis exhibition match between the last year winner and runners up with a view to highlight the significance of sports for physical and mental fitness.



- **Blood donation camp-1**



A blood donation camp was organized in JNARDDC premises on 16th August 2021. Around 31 employees and staff donated blood in the camp conducted by the State Government Medical College & Hospital (IGMCH) conducted the camp

- **Plantation program**

A Plantation Program was undertaken in JNARDDC premises on the eve of Mahatma Gandhi birth anniversary wherein employees and staff planted 75 nos of saplings under Phase II of the plantation program on 1st & 2nd Oct 2021.



- **Inter-School Quiz Contest**

An Inter-School Quiz Contest was organized on 12th Nov 2021 for school children between Class 8 to 10. The quiz covered the topics of science and India's independence. The top 3 winners were awarded cash prizes along with trophy and certificates. Around 75 school children from the top 19 schools of Nagpur and Wardha participated. BHAVAN's school Trimurti Nagar emerged the winners followed by Kendriya Vidyalaya, Ambazari and Sacred Heart Academy, Patansaongi.



- **75km Cycling event (12.12.2021)**

A "75 kms Cycling Event" was conducted on 12th December 2021 at 05:30 hours from the office of JNARDDC, Nagpur to Kondhali which included renowned cyclist Dr Amit Samarth who is the only man in Asia to have completed the two longest cycling races in the world — Race Across America (RAAM) and Trans Siberian Extreme (TSE). 130 cyclists participated in the mega event which includes Shri Sachin Shirbawikar and Shri Pannalal Sevak both of them have completed deccan cliff-hanger (Pune to Goa).



- **Inter-office Rangoli competition**

An “Inter-office Rangoli competition” was held on 17th December 2021 in the office of JNARDDC, Nagpur. Around 50 participants from SBI, IDBI, Bank of Baroda, MECL, LIC, Social Forestry, Army, IBM, JNARDDC etc prepared spectacular and colourful rangoli. All the participants covered the theme of Azadi ka Amrit Mahotsav ranging from patriotism to festival and different culture of India.



- **Blood donation camp-2**



The phase-2 of blood donation camp was organized in JNARDDC on 7<sup>th</sup> Jan 2022. Around 54 employees & staff donated blood in the camp conducted by the State Government Medical College & Hospital (IGGMCH).

## Training Programs

### **Refresher course by GSI**

JNARDDC officials attended “Refresher Course on Petrological and Geochronological Laboratory Techniques” conducted online by Geological Survey of India (RTD-ER) Kolkata during May 10-15, 2021. The course, aimed to develop an understanding on the working principles and applications of the advanced petrological and geochronological instruments, covered wide ranging topics with focus on stages of sample preparation, analytical setup and methodologies as well as interpretation of acquired data.

### **Participation in an e-Course organized by GSI, Shillong**

JNARDDC officials participated in “e-Course on PGRS using ArcGIS for pre-field studies” conducted by Geological Survey of India (RTD-NER), Shillong from 4<sup>th</sup> to 10<sup>th</sup> June 2021. The course covered GIS and digital remote sensing data, Geodetic coordinate system and projections, geo-referencing of raster image, editing, vectorization of raster data, Digital Image Processing in GIS, interpretation of satellite data, drainage, morphometric, lineament studies in ARC-GIS, alteration zone mapping using ASTER data and other associated aspects.

## Awards / Achievements

### ***JNARDDC endorsed as Referee Lab for Coal Analysis***

Subsequent to evaluation by Expert Committee (set up under Third Party Coal Sampling Project) Members (comprising of officials from CSIR-CIMFR, NTPC, MAHAGENCO and WCL), JNARDDC has been included in the prestigious list of Referee Labs for the analysis of coal samples. NABL Accreditation Scope has been successfully expanded to include coal analysis also. Centre has started receiving Referee Coal Samples for analysis from various CIMFR Laboratories and others since late October, 2021 and CCR Lab at JNARDDC is working in full swing with total commitment and dedication. This has given tremendous boost to our continued efforts for sustainability

**Technology Transfer to Shakti Plastics, Mumbai**

Chemical delamination process developed at JNARDDC for Multi-Layer Plastic Waste (MLPW), that enables improved purity of materials for making quality products from multilayers of rejects. JNARDDC sold the developed recycling process to M/s Shakti Plastics, Mumbai for processing different types of MLPs they collect from various collection centers across the country for recycling.

**Transfer of In-house R&D Technology**  
developed for delamination of packaging refuse to Shakti Plastics, Mumbai

**PATENT: Recovery of Aluminium & Plastic from layered laminated industrial refuse**  
 Features: Non energy use, environment friendly, process at room temperature, no toxic emission  
 Output: Process for separation of pure aluminium metal from PE & PP layers

**PROCESS RAW MATERIAL**

SOURCE / REJECTS → Room temperature Organic/Aqueous medium → Plastic Free Al + PE Layer + Al Free Plastic

The Shakti Plastic Industries established in the year 1969 are the foremost Manufacturer, Exporter, Importer, Supplier and Trader of Acrylonitrile Butadiene Styrene, Styrene Acrylonitrile, High Impact Polystyrene, Recycle Plastic Granules, PPCP Granules, HDPE Granules, LDPE Granules and Poly Propylene Granules. They make these products employing qualitative raw material and the latest machines. Presently the physical methods of recycling involving granulation of the reject MLPs are largely contaminated with metallic and other impurities. Paper cup recycling is a new area in which Shakti plastics will be establishing with R&D input from JNARDDC for recovering PE and paper at their recycling plants.

## Events

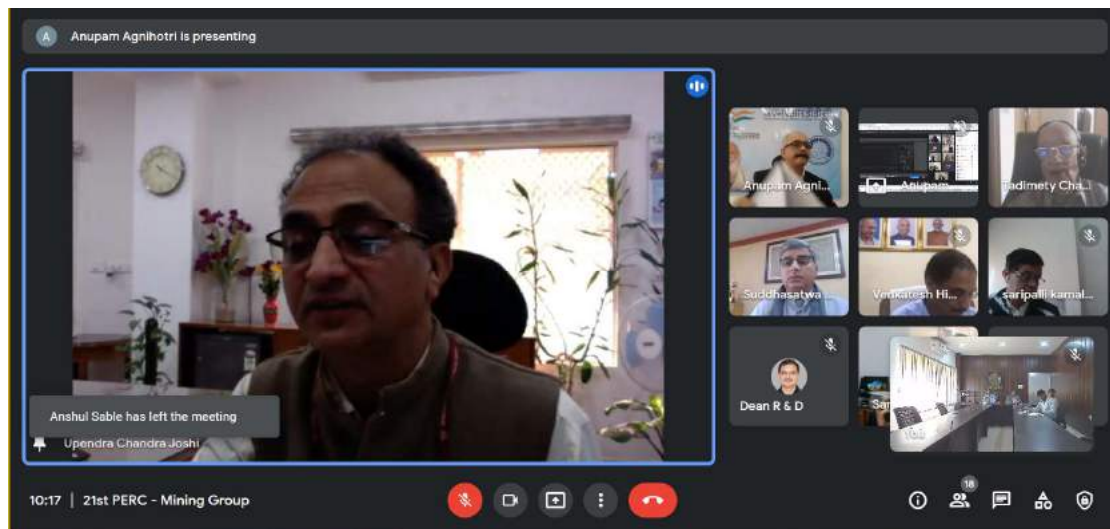
### Inauguration of CCRL (sample conditioning) lab at JNARDDC

The coal lab (sample conditioning) was inaugurated by Shir Sanjay Lohiya, IAS and Additional Secretary (Mines) on 11<sup>th</sup> Oct 2021.



### PERC review meeting at JNARDDC

The 21<sup>st</sup> Project Evaluation & Review Committee (PERC) Meeting was held under the Chairmanship of Shri U C Joshi, Joint Secretary, Ministry of Mines during 13-14 Dec 2021 through video conference.



### International Yoga Day

The International Yoga Day was celebrated by JNARDDC on 21.06.2021 wherein employees joined live online Yoga training sequence of Janardanswami Yogabhyasi Mandal, Nagpur from 7.00 AM daily from 14<sup>th</sup> to 21<sup>st</sup> June 2021. While some staff performed the yoga sequence in the office canteen by following COVID-



19 protocols of social distancing, several others joined virtually from their homes along with their family for practicing and propagating the benefits of Yoga.

### Welfare for Persons with Disabilities (PWD), Women, SC& ST.

The Centre is following the various government guidelines w.r.t PWD, SC, ST and OBC reservation.

### Progressive use of Hindi



JNARDDC continued its efforts to promote the progressive use of Hindi. The Centre celebrated Hindi Pakhwada during 14-28 September 2021 which included several competitions.

Director,

JNARDDC emphasized the need for further

use of hindi in day to day official use of the Centre's activities.

### Vigilance Awareness Week organized at JNARDDC

Vigilance Awareness Week was organized during 26<sup>th</sup> Oct to 1<sup>st</sup> Nov 2021 keeping in view the theme of "Independent India @ 75: Self Reliance With Integrity". The program included physical integrity pledge by all employees and staff followed by online pledge on Central Vigilance Commission website - <https://pledge.cvc.nic.in/>



### Swachh Bharat Abhiyan

JNARDDC undertook a pledge to implement the Swachh Bharat Abhiyan launched by Hon'ble Prime Minister Shri Narendra Modi. JNARDDC has already undertaken the cleanliness of all labs and office premises, toilets etc.



Swachatha pakhwara was observed in Nov 2021 with a view to encourage the zeal of the above program.



*Afforestation programs undertaken under Swachh Bharat Abhiyan & AKAM*



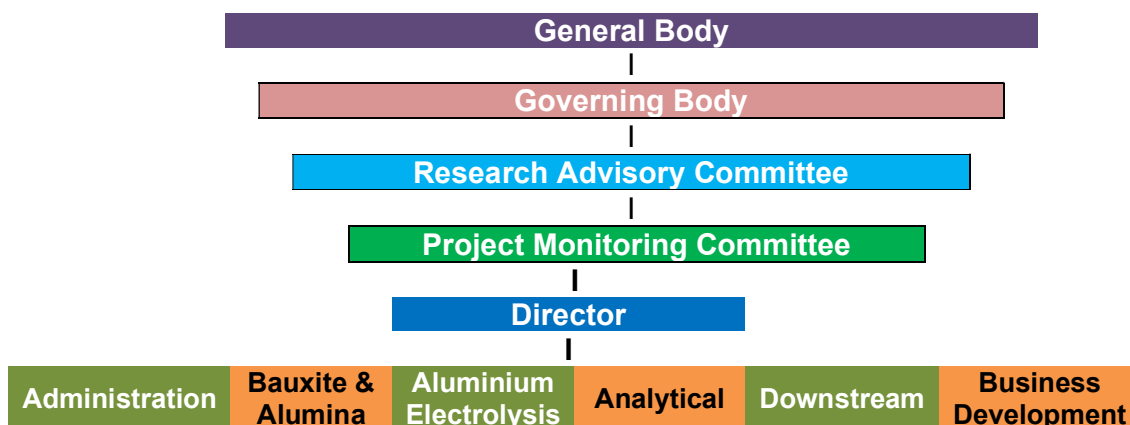
JNARDDC undertook the re-carpeting of office road of technical complex followed by plantation programs to maintain the thick green cover adjoining the office.

## JNARDDC Organizational Chart: 2021-22



**Shri Alok Tandon**, IAS, Secretary to the Government of India, Ministry of Mines is the **Ex-officio chairman** of the **General Body** and **Governing Body** of JNARDDC. **Shri Sridhar Patra**, CMD, NALCO is the Ex-officio Vice Chairman 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:



**Vice Chairman  
JNARDDC**



**Sridhar Patra**  
CMD, NALCO

**Chairman  
Research  
Advisory  
Council (RAC)**



**Prof S P Mehrotra**  
IIT, Gandhinagar

**Chairman  
Project  
Monitoring  
Committee  
(PMC)**



**Prof S Subramanian**  
IISc, Bangalore

**Director  
JNARDDC**



**Dr Anupam Agnihotri**  
JNARDDC, Nagpur

## List of General Body Members: 2021-22

### Chairman

#### Shri Alok Tandon, IAS

Secretary to the Government of India  
Ministry of Mines, 3<sup>rd</sup> Floor, Shastri Bhavan  
Dr. Rajendra Prasad Road, New Delhi - 110001

### Members

1. Shri Sridhar Patra  
Vice Chairman, JNARDDC  
Chairman-cum-Managing Director  
National Aluminium Company Limited,  
NALCO Bhawan, P/1, Nayapalli  
Bhubaneswar - 751 013
2. Dr. Srivari Chandrasekhar  
Secretary to the Govt of India,  
Department of Science & Technology  
Technology Bhavan, New Mehrauli Road  
New Delhi - 110 016
3. Dr Shekhar C. Mande  
Director General, CSIR  
Council of Scientific & Industrial Research  
Anusandhan Bhawan2, Rafi Marg  
New Delhi - 110 001
4. Sanjay Lohiya, IAS  
Additional Secretary to the Govt. of India,  
Ministry of Mines,  
3<sup>rd</sup> Floor, Shastri Bhavan  
New Delhi - 110001
5. Shri Upendra C. Joshi, IRTS  
Joint Secretary to the Govt of India,  
Ministry of Mines  
3<sup>rd</sup> Floor, Shastri Bhavan  
New Delhi- 110001
6. Ms. Nirupama Kotru, IRS  
Financial Advisor to Government of India  
Ministry of Mines  
Shastri Bhavan  
New Delhi - 110001
7. Shri Satish Pai  
Managing Director  
HINDALCO Industries Limited  
Aditya Birla Centre B-Wing  
3<sup>rd</sup> Floor, SK Ahire Marg, Worli  
Mumbai – 400030
8. Shri Abhijit Pati  
Chief Executive Officer  
Bharat Aluminium Company  
Limited, BALCO Nagar  
KORBA – 495684
9. Shri Sunil Gupta  
Chief Executive Officer  
VEDANTA Aluminium  
Vill.: Bhurkamunda  
Jharsuguda – 768 202, Odisha
10. Shri Salil Kumar  
Chairman-Managing Director  
Metallurgical & Engineering  
Consultants (India) Limited,  
Doranda  
Ranchi - 834 002 (Jharkhand)
11. Shri Abhay Bakre  
Director General  
Bureau of Energy Efficiency  
Ministry of Power  
New Delhi.
12. Dr Anupam Agnihotri  
Director  
Jawaharlal Nehru Aluminium  
Research Development and  
Design Centre Amravati Road,  
Wadi, Nagpur- 440 023

## List of Governing Body Members: 2021-22

### Chairman

#### Shri Alok Tandon, IAS

Secretary to the Government of India  
Ministry of Mines, 3<sup>rd</sup> Floor, Shastri Bhawan  
Dr. Rajendra Prasad Road, New Delhi - 110001

### Members

1. Shri Sridhar Patra  
Vice Chairman, JNARDDC  
Chairman-cum-Managing Director  
National Aluminium Company Limited,  
NALCO Bhawan, P/1, Nayapalli  
Bhubaneswar- 751 013
2. Sanjay Lohiya, IAS  
Additional Secretary to the Govt. of India,  
Ministry of Mines,  
3<sup>rd</sup> Floor, Shastri Bhawan  
New Delhi - 110001
3. Shri Upendra C. Joshi, IRTS  
Joint Secretary to the Govt of India,  
Ministry of Mines  
3<sup>rd</sup> Floor, Shastri Bhawan  
New Delhi- 110001
4. Ms. Nirupama Kotru, IRS  
Financial Advisor to Government of India  
Ministry of Mines  
Shastri Bhawan  
New Delhi - 110001
5. Shri Abhijit Pati  
Chief Executive Officer  
Bharat Aluminium Company Limited  
PO: BALCO Nagar KORBA – 495684  
Chhattisgarh
6. Shri Satish Pai  
Managing Director  
HINDALCO Industries Limited  
Aditya Birla Centre B-Wing, 3<sup>rd</sup> Floor,  
S.K. Ahire Marg, Worli, Mumbai – 400030
7. Shri Sunil Gupta  
Chief Executive Officer  
VEDANTA Aluminium  
Vill.: Bhurkamunda  
Jharsuguda – 768 202, Odisha
8. Shri Abhay Bakre  
Director General  
Bureau of Energy Efficiency  
Ministry of Power  
4th Floor Sewa Bhawan, Sector-1  
RK Puram, New Delhi-110066
9. Dr G Madhusudhan Reddy  
Director  
Defence Metallurgical Research  
Laboratory, P.O. Kanchanbagh  
Hyderabad- 500 058
10. Prof S P Mehrotra  
Indian Institute of Technology  
Gandhinagar, Palaj Campus,  
Gandhinagar, Ahmedabad – 382 424
11. Prof S Subramanian  
Department of Materials Engineering  
Indian Institute of Science  
Bangalore – 560 012
12. Dr Prashant Gargava  
Member Secretary, CPCB  
Central Pollution Control Board  
Parivesh Bhawan, East Arjun Nagar  
Delhi – 110 032
13. Prof NS Vyas  
Department of Mechanical Engineering  
Indian Institute of Technology Kanpur  
IIT, Kanpur.  
Kanpur – 208 016
14. Dr Anupam Agnihotri  
Director  
Jawaharlal Nehru Aluminium Research  
Development and Design Centre  
Amravati Road, Wadi, Nagpur - 440023

## List of Research Advisory Committee : 2021-22

### Chairman

#### Prof. S.P. Mehrotra

Indian Institute of Technology, IIT Gandhinagar  
Palaj Campus, Gandhinagar  
Ahmedabad – 382 424 (Gujarat)

### Members

- |   |   |
|---|---|
| <p>1. Prof S Subramanian<br/>Department of Materials Engineering<br/>Indian Institute of Science<br/>IISc<br/>Bangalore – 560 012</p>                             | <p>6. Shri Abhijit Pati<br/>Chief Executive Officer<br/>Bharat Aluminium Company Limited<br/>PO: BALCO Nagar KORBA – 495684<br/>Chhattisgarh</p>  |
| <p>2. Dr Pramod Shanker<br/>Scientist-C / Advisor,<br/>Department of Science &amp; Technology,<br/>Technology Bhavan, New Mehrauli Rd,<br/>New Delhi- 110 016</p> | <p>7. Shri Satish Pai<br/>Managing Director<br/>HINDALCO Industries Limited<br/>Aditya Birla Centre B-Wing<br/>3<sup>rd</sup> Floor, S.K. Ahire Marg, Worli<br/>Mumbai – 400030</p>                                 |
| <p>3. Shri M P Mishra<br/>Director (P&amp;T)<br/>National Aluminium Company Limited,<br/>NALCO Bhawan,<br/>P/1, Nayapalli,<br/>Bhubaneswar- 751 013</p>           | <p>8. Shri Shailender Sinha<br/>Director (Exploration)<br/>Odisha Mineral Exploration Corporation.<br/>OMECL, 3rd floor, Bayan Bhawan, Unit-3,<br/>Pandit Jawaharlal Nehru Marg<br/>Bhubaneswar, 751001, Odisha</p> |
| <p>4. Shri Sunil Gupta<br/>Chief Executive Officer<br/>VEDANTA Aluminium<br/>Vill.: Bhurkamunda<br/>Jharsuguda – 768 202, Odisha</p>                              | <p>9. Dr BK Satpathy<br/>Ex- Executive Director, NALCO<br/>Plot No. 803<br/>Jaydev Vihar<br/>Bhubaneswar- 751 013 Odisha</p>  |
| <p>5. Dr AK Mukhopadhyay<br/>Ex-Outstanding Scientist<br/>DRDO, Defence Metallurgical<br/>Research Lab, PO : Kanchanbagh,<br/>Hyderabad - 500 058</p>             | <p>10. Dr Anupam Agnihotri<br/>Director<br/>Jawaharlal Nehru Aluminium Research<br/>Development and Design Centre,<br/>Amravati Road, Wadi, Nagpur- 440 023</p>   |

## List of Project Monitoring Committee: 2021-22

### Chairman

#### Prof. S. Subramanian

Department of Materials Engineering  
Indian Institute of Science (IISc), Bangalore – 560 012

### Members

1. Dr Pramod Shanker  
Scientist-C / Advisor,  
Department of Science &  
Technology, Technology  
Bhavan, New Mehrauli Road,  
New Delhi- 110 016
2. Prof. D.R. Peshwe  
Head, Department of  
Metallurgical & Materials  
Engg.  
VNIT, Nagpur – 440 010
3. Shri M P Mishra  
Director (P&T)  
National Aluminium Company  
Limited, NALCO Bhawan,  
P/1, Nayapalli,  
Bhubaneswar- 751 013
4. Dr. T.R. Ramachandran  
Emeritus Scientist  
Nonferrous Materials Technology  
Development Centre (NFTDC)  
P.O. Kanchanbagh  
Hyderabad- 500 058 (AP)
5. Dr. B.K. Satpathy  
Ex- Executive Director, NALCO  
Plot No. 803  
Jaydev Vihar  
Bhubaneswar- 751 013 Odisha
6. Dr. Anupam Agnihotri,  
Director,  
Jawaharlal Nehru Aluminium Research  
Development and Design Centre  
(JNARDDC)  
Amravati Road, Wadi,  
Nagpur- 440 023

## Scientists and Staff as on 31.03.2022

### Dr. Anupam Agnihotri, Director

#### Scientists: 17

Mr M T Nimje	Sr Principal Scientist	Mr VNSU Viswanath Ammu	Senior Scientist
Mr M J Chaddha	Sr Principal Scientist	Mr V K Jha	Senior Scientist
Mr R J Sharma	Sr Principal Scientist	Dr Paparao Mondli	Scientist
Mr R N Chouhan	Sr Principal Scientist	Dr Priyanka Nayar	Junior Scientist
Dr U Singh	Sr Principal Scientist	Mr Ramavajjala Anil Kumar	Junior Scientist
Dr Md Najar P A	Principal Scientist	Ms Prachiprava Pradhan	Junior Scientist
Dr (Mrs) S Rai	Principal Scientist	Mr Kola Immanuel Raju	Junior Scientist
Dr P G Bhukte	Principal Scientist	Ms Jyoti G Pendam	Junior Scientist
		Dr Anas N S	Junior Scientist

#### Scientific & Technical Supporting Staff: 19

Mr K R Rao	Sr Scientific Officer Gr-II	Mr Sandeep Kowe	Scientific Asst I
Mr S K Thokal	Sr Scientific Officer Gr-II	Mr Suman Mukherjee	Scientific Asst I
Ms K Janbandhu	Sr Scientific Officer Gr-II	Ms V Meshram	Technical Asst IV
Mr N Warhadpande	Sr Scientific Officer Gr-II	Mr P Manthana	Technical Asst III
Mr K J Kulkarni	Sr Scientific Officer Gr-I	Mr K B Gour	Technical Asst III
Ms M Panchal	Scientific Officer	Mr V B Wankhede	Technical Asst III
Mr D R Meshram	Scientific Asst IV	Mr V Kshirsaut	Technical Asst III
Mr A S Gijare	Scientific Asst IV	Mr S Yadav	Technical Asst II
Mr S Bagde	Scientific Asst II	Mr V P Naik	Technical Asst I
Mr Gopal Daware	Scientific Asst II		

#### Administrative Staff: 10

Mr R Srinivasan	Sr Admin Officer	Ms R Tembhone	Personnel Officer
Ms R Vishakha	Admin Officer	Mr N D Pethe	Personal Secy
Mr S R Barhanpurkar	Personnel Officer	Ms D Seshukumari	Personal Asst
Mr G Bhaskar	AAO (Accounts)	Mr K Kishore	Sr Accountant
Mr R K Meshram	Personnel Officer	Mr Lalit Mohan	Sr Purch-Stores Asst

#### Supporting Staff: 4

Mr Ashok J Hatwar	Driver-cum-Lab Attendant Sr Grade
Mr R C Patley	Driver-cum-Lab Attendant Sr Grade
Mr Raju Khobrgade	Driver-cum-Lab Attendant Grade- I
Mr Deochand S Thakare	Peon-cum-Messenger

**Total Staff Strength: 51**

## New Equipments / Facilities

### 1. IR Pyrometer

Model : MW-20-20C

Make : Williamson Corp. USA

IR Pyrometer is a non-contact optical device that calculates a temperature value based on measured infrared energy. The amount of energy collected by a sensor is influenced by the emissivity characteristics of the target and the transmission characteristics of any intervening optical obstructions between the sensor and the measured target. With thoughtful wavelength selection, Williamson can dramatically reduce or even eliminate application errors due to optical obstructions, emissivity variation, background reflections, and misalignment



IR Pyrometer installed near extrusion press exit

### 2. Bomb calorimeter



Model: 6400

Make: Parr

The automatic Isoperibol Calorimeter is used for coal analysis and determination of calorific value of fuel.

### 3. TGA (Thermo Gravimetric Analyzer)

Model: Thermogravimetric analyzer TGA Thermostep ML  
Make: ELTRA

ELTRA's TGA Thermostep ML is a thermogravimetric analyzer which determines various parameters such as moisture, volatiles and ash at user-defined temperatures and atmospheres in a single analysis.



# ANNUAL ACCOUNTS

2021- 22



**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](http://www.jnarddc.gov.in)

**AUDITED BY**



CA.RAJAT MODI



**RAJAT MODI & CO.**  
**CHARTERED ACCOUNTANTS**  
 502, Suryakiran Complex, Opp. VNIT Gate  
 Abhyankar Nagar Square  
 NAGPUR-440010  
 Cell : 9370212220,7387186933  
 E-mail : rajatmodica@gmail.com

REPORT OF AN AUDITOR RELATING TO ACCOUNTS AUDITED UNDER  
 SUB-SECTION (2) OF SECTION 33 & 34 AND RULE 19 OF BOMBAY PUBLIC TRUST ACT.

Registration No. : F -6778 (NAGPUR)

Name of Public Trust : **JAWAHARLAL NEHRU ALUMINIUM RESEARCH  
 DEVELOPMENT AND DESIGN CENTRE : NAGPUR**

(An Autonomous Body Under Ministry of Mines, GOI. )

Amravati Road Wadi, Opp. Wadi police station Nagpur

Post : Wadi (440 023)

For the year ending : **31st March 2022**

(a)	Whether accounts are maintained regularly and in accordance with the provisions of the Act and the rules	YES
(b)	Whether receipts and disbursements are properly and correctly shown in the accounts	YES
(c)	Whether the cash balance and voucher in the custody of the manager or trustee on the date of audit were in agreement with the account	YES
(d)	Whether all books, deeds, accounts, vouchers or other documents or record required by the auditor were produced before him	YES
(e)	Whether a register or movable and immovable properties is properly maintained, the changes therein are communicated from time to time to the regional office and the defects and inaccuracies mentioned in the previous audit report have been duly complied with	YES
(f)	Whether the Manager or trustee or any other person required by the auditor to appear before him did so and furnished the necessary information required by him	YES
(g)	Whether any property or funds of the Trust were applied for any object or purpose other than the object or purpose of the Trust	NO
(h)	The amount of outstanding for more than one year	YES
(i)	The amounts written off if any	YES
(j)	Whether tenders / quotation were invited for repairs or construction involving expenditure exceeds Rs.25,000/-	YES
(k)	Whether any money of the public trust has been invested contrary to the provisions of Section 35	NO
(l)	Alienations. If any, of the immovable property contrary to the provisions of Section 36 which have come to the notice of the auditor	NIL

**JAWAHARLAL NEHRU ALUMINUM  
RESEARCH DEVELOPMENT & DESIGN CENTRE**

**2021-22**

(m)	All cases of irregular, illegal or improper expenditure, or failure or omission to recovery moneys or other property belonging to the public trust or of loss or waste of money or other property thereof, and whether such expenditure, failure, omission, loss or waste was caused in consequence of breach of trust or misapplication or any other misconduct on the part of the trustees or any other person while in the management of the trust.	NIL
(n)	Whether the budget has been filed in form provided by rule 16-A	YES
(o)	Whether the maximum and minimum number of the trustees is maintained	YES
(p)	Whether the meeting are held regularly as provided in such instrument	YES
(q)	Whether the minute of books of the proceedings of the meeting is maintained	YES
(r)	Whether any of the trustees has any interest in the investment of the trustees	NO
(s)	Whether any of the trustees is a debtor or creditor of the trust	NO
(t)	Whether the irregularities pointed out by the auditors in the accounts of the previous year have duly complied with by the trustees during the period of audit	YES
(u)	Any special matter which the auditor may think fit or necessary to bring to the notice of the Deputy or Assistant Charity Commissioner	NO

**For RAJAT MODI & CO.  
Chartered Accountants**

**Place : NAGPUR**

**Date :**

**CA RAJAT MODI  
PARTNER  
Mem No. : 161252  
FRN : 126024W**

CA.RAJAT MODI



**RAJAT MODI & CO.**  
**CHARTERED ACCOUNTANTS**  
 502, Suryakiran Complex, Opp. VNIT Gate  
 Abhyankar Nagar Square  
 NAGPUR-440010  
 Cell : 9370212220,7387186933  
 E-mail : rajatmodica@gmail.com

**THE BOMBAY PUBLIC TRUSTS ACT 1950**  
**SCHEDULE IX C**

**Statement of income liable to contribution for the year ending 31st March 2022**  
**Name of Public Trust : Jawaharlal Nehru Aluminium Research Development**  
**and Design Centre Nagpur.**

**Registration No. : F-6778 (NAGPUR)**

		Rs.	Rs.
I	Income as shown in the Income and Expenditure Accounts ( Schedule IX)		15,71,64,872/-
II	Items not chargeable to contribution under sec.58 and Rule 32 :		
	i.) Donations received from other Public Trusts and Dharmaday	NIL	
	ii) Grants Received from Government & Local Authorities	9,11,80,237/-	
	iii) Interest on Sinking or Depreciation Fund	NIL,	
	iv) Amount spent for the purpose of secular education	NIL	
	v) Amount spent for the purpose of Medical relief	NIL	
	vi) Amount spent for the purpose of veterinary treatment of Animals	NIL	
	vii) Expenditure incurred from donation for relief of distress Caused by scarcity, drought, flood, fire or other natural Calamity	NIL	
	viii) Deductions out of income from lands used for Agricultural purposes:	NIL	
	(a) Land Revenue local Fund Cess	NIL	
	(b) Rent Payable to superior land lord	NIL	
	(c) Cost of production, if lands are cultivated by Trustee	NIL	

JAWAHARLAL NEHRU ALUMINIUM RESEARCH  
DEVELOPMENT & DESIGN CENTRE ,NAGPUR

( F Y : 2021-22 )

ix). Deductions out of income from lands used for non Agricultural purposes :	NIL	
(a) Assessment, Cess and other Government or Municipal Taxes, Land tax etc	80,620/-	
(b) Ground rent payable to the superior landlord	NIL	
(c) Insurance Premium	NIL	
(d) Repairs at 10 percent of gross rent of building	NIL	
(e) Cost of collection 4 percent of gross rent of building let out	Nil	
(x) Cost of collection of income or receipts from Securities, stocks etc. At 1 percent of such income	NIL	
(xi) Deductions on account of repairs in respect of building not rented and yielding no income at 10 percent of the estimated	NIL	
Gross Annual Income Chargeable to advance Contribution ( Payable to Dy Charity Commissioner)		6,59,84,635/-

Certified that while claiming deductions admissible under the above schedule, the Trust has not claimed any amount twice, either wholly or partly, against any of the items mentioned in the Schedule which have the effect of double deductions.

**For RAJAT MODI & CO.**  
**Chartered Accountants**

**Place : NAGPUR**  
**Date :**

**CA RAJAT MODI**  
**PARTNER**  
**Mem No. : 161252**  
**FRN : 126024W**

CA.RAJAT MODI



**RAJAT MODI & CO.**  
**CHARTERED ACCOUNTANTS**  
 502, Suryakiran Complex, Opp. VNIT Gate  
 Abhyankar Nagar Square  
 NAGPUR-440010  
 Cell : 9370212220,7387186933  
 E-mail : rajatmodica@gmail.com

**NAME OF THE PUBLIC TRUST:**  
**JAWAHARLAL NEHRU ALUMINIUM RESEARCH DEVELOPMENT &  
 DESIGN CENTRE NAGPUR**  
 (Autonomous Body under Ministry of Mines, Govt of India)  
 Reg No. F -6778 (NAGPUR)  
 As On 31.03.2022

**"SCHEDULE IX-D"**

[See Rule 19 (2A)]

Information to be submitted by the Auditor along with Audit Report under sub-section (1) of section 34 of the Maharashtra Public Trust Act.

SN	Particulars	Details		
1	PAN No. of Trust	AAATJ2814M		
2	Registration No. with Date of Registration u/s 12AA of Income Tax Act, 1961 (43 of 1961)	CIT- IV 12A / P-,/P-2007-08 dated 22.11.2007		
3	Acknowledgement No. With Date of filing of the Return of Income for Earlier Three Years	<b>Sr. No.</b>	<b>Acknowledgement No.</b>	<b>AY Year</b>
		1	262041940261119	2018-19
		2	303522531140220	2019-20
		3	326618991310321	2021-22
4	PAN of All Trustees	<b>Sr. No.</b>	<b>Name Of Trustee</b>	<b>PAN No.</b>
		1	Dr Anupam Agnihotri (Director)	ABCPA8526E
		2	R Srinivasan (Secretary)	AQIPS8639P
		3	All others are Ex-Officio	-

**For RAJAT MODI & CO.**  
**Chartered Accountants**  
**CA RAJAT MODI**  
**PARTNER**  
 Mem No. : 161252  
 FRN : 126024W

Place : NAGPUR  
 Date :

THE BOMBAY PUBLIC TRUST ACT-1960  
SCHEDULE VIII (VIDE RULE (17(1))  
NAME OF THE PUBLIC TRUST: JAWAHARLAL NEHRU ALUMINIUM RESEARCH DEVELOPMENT & DESIGN CENTRE NAGPUR (Autonomous Body under Ministry of Mines, Govt of India)

LIABILITIES & ADVANCES	SCH	AMOUNT	PROPERTY AND ASSETS	SCH	AMOUNT	AMOUNT
<b>Trust Funds or Corpus :-</b>			<b>Fixed Assets :-</b>			
Balance as per last Balance Sheet		0	Balance as per last Balance Sheet	C	214437683	221811441
Add : For life Membership		0	Add : Immovable - Movable Properties	C	7373758	
<b>Other Earmarked Funds :-</b>			<b>Ustensils :-</b>			
As per last Balancesheet		654914667	Balance as per last Balance Sheet			
Add: Add this year (Govt Grant - Capital / S&T)		35000000	Additional during the year		0	
(Created under the provision of the trust deed or scheme or out of the Income)			Less : sales during the year		0	
Depreciation Fund		0	Depreciation up to date		0	0
Sinking Fund		0				
Reserve Fund		0				
<b>Loans (Secured or Unsecured) :-</b>			<b>Income / Other Outstanding :-</b>			
From Trustees:			Rent		0	
Balance as per last Balance Sheet		0	Interest		0	
Add: during the year		0	Other Income (Sundry Debtors)	D	51659987	51659987
From Other		0				
<b>Liabilities :-</b>			<b>Investments :-</b>			
For Expenses		0	TDR With YES Bank		20963110	
For Advances		0	TDR with IDBI Bank		2882240	
For Rent and Other Deposits	A	39542201	TDR with SBI Ravinagar Branch		32500000	
For Sundry Credit Balance	B	29384910	Add : Accrued Interest		0	56345350
<b>Provision :-</b>			<b>Cash and Bank Balances :-</b>			
Balance as per last Balance Sheet		0	a) Cash in Hand		88	
Add: during the year (Audit Fees)		0	b) BANK BALANCE AS PER SCH	E	2036880	
Paid during the year		0	c) with the trustee		0	
			d) with the Manager		0	2036968
<b>Income and Expenditure Account :-</b>			<b>Income and Expenditure Account :-</b>			
Bal. as per last Balance Sheet		0	Bal. as per last Balance Sheet		410616772	
Less : Appropriation, if any		0	Deficit (As per I & E A/c)		16371260	426988032
Add : Surplus		0				
Less : Deficit (As per I & E A/c)		0				
<b>Total</b>		<b>758841778</b>	<b>Total</b>		<b>758841778</b>	<b>758841778</b>

As per our report of even date attached. The above balance sheet to the best of my/our belief contain a true account of the funds & liabilities and of the property and Assets of the trust  
AS PER OUR REPORT OF EVEN DATE ATTACHED  
For RAJAT MODI & Co  
Chartered Accountant

CA RAJAT MODI  
Partner  
Mem No.161252, FRN:126024W

(ANUPAM AGNIHOTRI)  
Director

( R SRINIVASAN )  
Secretary cum Sr Admin Officer

( VIVEK BHARADWAJ )  
Chairman

0.00

## SCHEDULE-A

## RENT AND OTHER DEPOSITS (2021-22)

Previous year	PARTICULARS	(Amt. in ₹ )
13282384	Earnest Money Deposit	26740953
72261	Rajesh S Badkhal	185823
195045	Media Elevators & Engg Co.	307603
130048	Mayur Services	387346
1122672	Ganga Security	1127322
2950000	SMS India Pvt Ltd	2950000
200000	Libra Agencies	0
1250676	Sameer Ghadge	830610
0	Phoenix Power Nagpur	4425
370476	Floxlab France	0
39400	Rohsan Engineering Nagpur	0
675000	Masibus Automation Gujrat	18750
38220	Multicut Machine Tools	0
2000000	Orbit Technology Pvt ltd Hyderabad	290265
1558340	XRF Scientific Ltd	0
2291400	Thermo Fisher Mumbai	2291400
315000	Kinc Mineral Technology	315000
735926	Naskar & Company	735926
15500	Chennai Metco Pvt Ltd	0
0	Greenspace Corporation Nagpur	1277350
0	Matrix Trade Link Pvt Tld	1561905
<b>27242348</b>	<b>SUB TOTAL (1)</b>	<b>39542201</b>

## SUNDRY CREDITORS / OTHER LIABILITIES

## SCHEDULE-B

Previous year	PARTICULARS	(Amt. in ₹ )
25000	Audit Fee Payable	50000
20634663	Outstanding Liabilities (ANNEXURE A-1)	27302039
741399	TDS ded. from salary bill and contractor's bill	0
601932	Employees EPF cont	680462
48683	LIC Premium	0
9000	Professional Tax	0
0	TDS As per 26 AS ded. by various parties	1352409
<b>22060677</b>	<b>Total-2</b>	<b>29384910</b>
<b>49303025</b>	<b>GRAND TOTAL 1+2</b>	<b>68927111</b>

## Annexure : B-1

## OUTSTANDING LIABILITIES AS ON 31/3/2022 (Annexure A-1)

Previous year	PARTICULARS	(Amt. in ₹ )
118628	Water charges bill	74247
194302	Rajesh S Badkhal for Gardening contract	190346
183263	Media Elevator co ltd for Elect contract	196292
9939	Telephone charges	9759
78127	Courier Charges	0
844978	Mayur Service Housekeeping Contract	410408
97050	Electricity charges	331901
596900	Ganga Security services	633648
10100	Dr Sanjay Marathe	0
17721000	The Trust Group Gratuity JNARDDC A/c	26221000
589021	Employer's contribution to EPF	670973
191355	LIC Premium for Group Insurance	0
0	Lanwin It Solution	19000
0	GST Credit Balance	(1455535)
<b>20634663</b>	<b>Total Outstanding Liabilities</b>	<b>27302039</b>

ANNEXURE 'B' OF FIXED ASSETS ATTACHED TO & FORMING PART OF BALANCE SHEET AS AT 31ST MARCH-2022													SCHEDULE - C		(Amt. in ₹)	
Particulars	Rate of Dep %	Gross Block			Depreciation			Net Block			Dep as at 31.03.2022	Cost as at 31.03.2022	Cost as at 31.03.2021			
		Cost as at 01.04.2021	Additions upto 31.03.2022	Deletions 31.3.2022	Adjustments 31.3.2022	Cost as at 31.03.2022	Dep for the year upto 31/3/2022	Dep on sold items	Adjustments	Dep as at 31.03.2022				Cost as at 31.03.2022		
Immovable properties																
Technical Buildings	3.34	51991705	0	0	0	51991705	45493661	1736523	0	47230184	4761521	6498044				
Office Buildings	1.63	15044525	0	0	0	15044525	6652006	245226	0	6897232	8147293	8392519				
Land		2615177	0	0	0	2615177	0	0	0	0	2615177	2615177				
Fire Fighting System	4.75	1270062	0	0	0	1270062	1270062	0	0	1270062	0	0				
Electrical Installation	3.34	21812357	0	0	0	21812357	18929423	728533	0	19657956	2154401	2882934				
Residential Buildings	1.63	31442316	0	0	0	31442316	12210404	512510	0	12722914	18719402	19231912				
Large Scale Alumina Lab	4.75	6949295	0	0	0	6949295	6949295	0	0	6949295	0	0				
Air Conditioning	4.75	5046941	35749	0	0	5082690	4410508	241428	0	4651936	430754	636433				
Sub Total-I		136172378	35749	0	0	136208127	95915359	3464220	0	99379579	36828548	40257019				
Previous Year		136172378	0	0	0	136172378	92452837	3462522	0	95915359	40257019	43719541				
Movable Properties																
Motor Vehicles	11.31	5551497	0	0	0	5551497	5551497	0	0	5551497	0	0				
Furnitures and Fixtures	6.33	5313197	0	0	0	5313197	5260403	52794	0	5313197	0	52794				
Office Equipments	4.75	2401781	132204	0	0	2533985	2400525	7535	0	2408060	125925	1256				
Telecommunication system	4.75	2021667	0	0	0	2021667	1783063	96029	0	1879092	142575	238604				
Books and Periodicals	100	5249532	24937	0	0	5274469	5249532	24937	0	5274469	0	0				
Lab Equipments Installed	4.75	144017447	0	0	0	144017447	122202774	6840829	0	129043603	14973844	21814673				
Lab equip S & TI (Govt Grants)	4.75	46669713	16489088	0	0	63158801	7782048	3000043	0	10782091	52376710	38887665				
Lab Equip (Nalco Capital)	4.75	21601319	0	0	0	21601319	8940396	1026063	0	9966459	11634860	12660923				
Lab Equip (Modrobs)	4.75	1872746	0	0	0	1872746	10357519	891705	0	11249224	7523522	8415227				
Lab equipment under (NPT/Cram)	4.75	105779406	0	0	0	105779406	19497213	5024522	0	24521735	81257671	86282193				
Lab Equipments not Installed	4.75	4460171	0	0	0	4460171	847432	211858	0	1059290	3400881	3612739				
Lab Equipments not Installed		2214590	13546905	0	0	(2214590)	13546905	0	0	0	13546905	2214590				
Computers	16.21	6210502	0	0	0	6210502	6210502	0	0	6210502	0	0				
Technical research equip(UNDP)	4.75	70484011	0	0	0	70484011	70484011	0	0	70484011	0	0				
Sub Total-II		440747578	30193134	0	0	468726122	266566915	17176315	0	283743230	184982893	174180664				
Previous Year		413697034	27050544	0	0	440747578	250141445	16425470	0	266566915	174180664	163555590				
Grand Total/Sub Total I+II		578919956	30228883	0	0	604934249	362482274	20640535	0	393122809	221811441	214437683				

## SCHEDULE : D - 1/2

F Y 2021-2022		
PRE YEAR	PARTICULARS	(Amt. in ₹ )
	<b>1) . SUNDRY DEBTORS</b>	
486925	Nalco, Bhubaneswar (Project)	(266773)
115724	Minex Metallurgical co Ltd	0
3888936	M E C L Nagpur	899768
90895	NEERI	146945
(27065)	Swarnalata Holding Pvt Ltd Raipur	0
(22140)	Ceraflux India Pvt Ltd	(48100)
13383000	Ministry of Mines (AMDF Fund /Salary) receivable	19391000
130206	GSI Nagpur	0
59000	Spectris Technologies Pvt Ltd	0
176000	Vedanta Alu & Power Jharsugda SEZ	(86262)
(7660)	Tal Manufacturing Solutions Ltd Nagpur	0
149278	Seminar and conference	0
8534321	GST Credit balance	0
(23610)	Ashapura Minechem Ltd	0
60896	Bry Air Asia Pvt Ltd	73596
189290	Nalco Angul / Damajjod Testing	522858
(9440)	MMP Industries Limited Nagpur	0
(17700)	Zim Laboratories Ltd	0
472000	Hi Tech Matafluxes Raipur	0
8968	Ran Chemicals Pvt Ltd	0
1180	Anand Mine Tools Pvt Ltd	0
4425	Phonix Amalgams Pvt Ltd	8850
17700	Hindalco Industries Ltd Belgavi / Lapanga	1500
5000	Bajrang Power & Ispat Ltd Raipur	0
(960)	Trshakti Alloys Pvt Ltd	0
(8555)	Castwel Industries	2950
(220835)	Vedanta Alumina Ltd Langigarh	0
(14160)	MPM Durrns Refracoat Pvt Ltd	(12911)
265500	National Aluminium Co (Testing)	0
2655	Gujrat Credo Minerals	0
(105360)	Calderys India Refractories Ltd	(6860)
(10031)	MMP Durrans Refractories Pvt Ltd	0
11800	Brisil Technologies Pvt Ltd	10325
(5000)	Hind Aluminium Industries	0
7080	Hindalco Industries Ltd Sambalpur	3288
2360	RSA Industries Ltd Nagpur	0

(Contd...)

PRE YEAR	PARTICULARS SUNDRY DEBTORS (Contd...)	(Amt. in ₹ )
(4180)	Bhandara Minerals Pvt Ltd	0
2250	Gujrat Credo Alumina Chemical Ltd Kutch	0
66880	Bureau of Energy Efficiency New Delhi	0
4130	Thermochem Process Pvt Ltd	0
20650	Pratika Dandare	0
1180	MFR Minerals Chindwara	0
120	Qualilab	0
(26007)	Received from other party	(888024)
13260	Economics Explosives Limited	0
(70)	Sanvira Industries Limited Vishakhapatnam	0
25720	Hindalco Industries Ltd Hirakud Sambalpur	0
(6195)	Carborundum Universal Ltd Kerala	20191
17110	Kastwel Foundries Ahmedabad	0
7670	Unijules Life Sciences Ltd	0
(8260)	Apar Industries Ltd Sambalpur	0
18880	Industrial Batteries inc	0
3297	Riyaj Traders Wadi	0
12095	M S P G C Ltd Bhusawal	30682
21240	CSRI Adv MPRI Bhopal	21240
1041184	Odisha M E Corp Ltd Bhubaneswar	2952904
(225)	Lupin Limited Pune	0
0	Jindal Steel and power limited	12508
0	NTPC Limited Moudha	18762
0	SLM Metal Pvt Ltd	(25960)
0	Thriveni Earth movers Pvt Ltd	307410
0	G S I Hyderabad	4662180
0	MOIL Limited	97350
0	Receivable from coal Sample testing sample	7570083
<b>28801353</b>	<b>(Total ' 1 ' )</b>	<b>35419500</b>

(2021-2022)

SCHEDULE : D- 2/2

**2). INVENTORIES**

<b>85554</b>	STORES( Closing Stock)	<b>69302</b>
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PRE YEAR	PARTICULARS	AMOUNT
<b>189159</b>	<b>Departmental Advances (Ann D-3)</b>	<b>80019</b>

PRE YEAR	PARTICULARS	Amount
109000	Telephone Deposit	109000
315000	Deposit with MSEB	315000
102410	Deposit with M.S. Water Board	102410
7444561	TDS Amt receivables From I tax office	12455913
1157603	Deposit with MSEB for new Connection	1157603
0	Adv to Unique Automation Nagpur	61750
197297	Adv to Jeol Ltd	197297
10000	Adv to Ashok Hotel New Delhi	0
57900	Adv to Mohil Chordia Nagpur	96500
49613	Adv to Central Engineering Corporation	0
7250	Adv to Global Power	0
0	Prepaid expenses	1546294
0	Adv to B M Ghawade & Associated Nagpur	49400
<b>9450633</b>	<b>Total</b>	<b>16091167</b>
<b>38526699</b>	<b>Grand Total</b>	<b>51659987</b>

**ANNEXURE OF ADVANCES TO EMPLOYEES**  
Annexure 'D-3' TO SCHEDULE : D : 2021-22

**SCHEDULE D-3**

<b>PRE YEAR Amount</b>	<b>PARTICULARS</b>	<b>Current Year Amt</b>
	<b>1: DEPARTMENTAL ADVANCES- EMPLOYEES</b>	<b>(Amt. in ₹ )</b>
5000	M.J.Chaddha	0
5000	A.J.Hatwar	0
5000	R.C. Patley	0
5000	R.N.Chouhan	0
17600	R.Srinivasan	0
5000	Sandeep Barhanpurkar	0
5272	M.T.Nimje	0
5000	S.K.Thokal	0
5000	Viswanath Ammu	0
10050	Upendra Singh	0
5000	Vimal Kishore Jha	55800
15000	R J Sharma	0
20020	Vinod Kshirsaut	0
10132	Raju Khobragade	0
5728	TA Adv Project staff	0
-57	Priyanka Nayar	0
5000	R Vishakha	0
5414	Paparao Mondi	0
5000	Anas N S	0
0	Prabhakar Hedao	0
15000	Anil Kumar	0
25000	V B Wankhede	0
10000	A S Gijare	0
0	K Kishore	9800
0	Vipin Naik	0
0	Phiroze Dungore	14419
<b>189159</b>	<b>Total</b>	<b>80019</b>

**SCHEDULE-E****5). CASH & BANK BALANCES**

<b>PRE YEAR</b>	<b>PARTICULARS</b>	<b>AMOUNT</b>
536039	SBI Chhaoni Nagpur	501723
13997347	I D B I Bank Ltd Nagpur (392)	922304
9136	Axis Bank Limited, Nagpur	9136
243145	YES Bank Saving account (764)	131054
70957	IDBI Online A/c No. (4688)	382621
0	State Bank of India Ravinagar	90041
<b>14856624</b>	<b>Total</b>	<b>2036880</b>

CA.RAJAT MODI



**RAJAT MODI & CO.**  
**CHARTERED ACCOUNTANTS**  
 502, Suryakiran Complex, Opp. VNIT Gate  
 Abhyankar Nagar Square  
 NAGPUR-440010  
 Cell : 9370212220,7387186933  
 E-mail : rajatmodica@gmail.com

**JAWAHARLAL NEHRU ALUMINIUM RESEARCH DEVELOPMENT  
 AND DESIGN CENTRE: NAGPUR**

SIGNIFICANT ACCOUNTING POLICIES AND NOTES ON ACCOUNTS  
 ATTACHED TO BALANCE SHEET AS ON 31<sup>ST</sup> MARCH, 2022

**PART A: SIGNIFICANT ACCOUNTING POLICIES**

1. The Centre is following Mercantile System of Accounting
2. Depreciation is provided on assets put to use, on Straight Line Method as per the rates specified under the Companies Act, 1956.
3. Fixed Assets are stated at cost of acquisition, inclusive of freight, Octroi, Duties and taxes and incidental expenses related to the acquisition.

**PART B: NOTES ON ACCOUNTS**

1. The Centre being established as an R & D Centre is not self-sufficient. The expenditure over and above the income generated is bridged by the Revenue Grant provided by the Government of India. The depreciation on assets put into use is not reimbursed in the Revenue Grant.
2. The excess of expenditure over income amounting to Rs. 1,63,71,260/- has been carried over as Excess of Expenditure over Income in the Balance Sheet. The deficit is due to depreciation & provision for sundry liabilities and accounting of major project expenses (work in progress) in current year for which funds were received in previous years.
3. Since this is a trust with registration under section 12(A)(a) of IT Act-1961, Income tax is not payable.
4. Previous year figures have been regrouped wherever necessary
5. Salary & Projects grants are released by Ministry of Mines, Govt of India on half yearly or annual basis normally. Thus, the Centre utilizes the available funds /Grants (which is received for specific purposes) on temporary basis to meet the various committed expenditure which are recouped later on receipt of the allocated budget.

**For RAJAT MODI & Co**  
**Chartered Accountants**

**For Jawaharlal Nehru Aluminium Research Development  
 & Design Centre, Nagpur**

( CA Rajat Modi )  
**Partner**  
 Member No. 161252  
 F.R.No. 126024W

( R SRINIVASAN )  
**Secretary cum Sr Admin Officer**

( ANUPAM AGNIHOTRI )  
**Director**

( VIVEK BHARADWAJ )  
**Chairman**

THE BOMBAY PUBLIC TRUST ACT-1950  
SCHEDULE IX (VIDE RULE 17(1))  
NAME OF THE PUBLIC TRUST: JAWAHARLAL NEHRU ALUMINIUM RESEARCH DEVELOPMENT & DESIGN CENTRE NAGPUR (Autonomous Body under Ministry of Mines, Govt of India)

**Income and Expenditure Account for the year ending 31.03.2022 [ 2021-22]**

EXPENDITURE	SCH	AMOUNT	AMOUNT	INCOME	SCH	AMOUNT	AMOUNT
To Expenditure in respect of properties :-							
Rates, Taxes, Cesses		80620		By Rent (Accrued) (realised)		0	0
Repairs and maintenance	F	794200				0	0
Salaries	G	123223923		By Interest (Accrued)		0	0
Insurance		143309					
Depreciation		20640535		Interest on FDR		1497757	
Other Expenses	H	5883686	150766273	Interest Received on SB A/c		0	1497757
To Audit Fees / Expenses		25000					
To Printing & Stationery Expenses		145343		On securities		0	
To Postage & courier charges		72234		On Loans		0	
To Project expenses	I	21714491		On Bank account		0	0
To Travelling Expenses		203824	22160892				
To Provision for Audit Fees & IT return fees				By Dividend			0
To Miscellaneous Expenses	J	608966	608966	By Donations in cash or kind			0
To Depreciation		0	0				
To Amount transferred to Reserve or specific funds.		0	0	By Donation from Trustees			0
To Expenditure on object of the Trust :-				By Grants	K	91180237	91180237
a. Religious		0					
b. Educational		0		By Income from other sources			
c. Medical Relief		0		Technical Testing Fee		54506670	
d. Relief of poverty		0		Income from Research Projects	L	9137400	
e. Other Charitable objects		0		Miscellaneous Receipts	M	762808	
e. Other Charitable objects		0		Technical Seminars / Training			
		0		Program Receipts	N	80000	
				Prior Period Income Against Sundry Debtor		0	
				By Amount Written off		0	
				By Contribution For Visit		0	
To Surplus carried over to B/S.				Excess of expenditure over income carried over to B/S		0	64486878
<b>TOTAL</b>			<b>173536132</b>	<b>TOTAL</b>			<b>16371260</b>
<b>AS PER OUR REPORT OF EVEN DATE ATTACHED FOR RAJAT MODI &amp; CO</b>							<b>173536132</b>

For: Jawaharlal Nehru Aluminium Research Development & Design Centre.

(ANUPAM AGNIHOTRI  
Director

( R SRINIVASAN)  
Secretary cum Sr Admin Officer

( VIVEK BHARADWAJ  
Chairman

CA RAJAT MODI  
Partner  
Mem No.161252, FRN:126024W

(F.Y. 2021-2022)

SCHEDULE - F

PRE YEAR	REPAIRS AND MAINTENANCE	(Amt. in ₹ )
45877	Township	31855
10955	Electrical Works	20322
126069	Office building /Technical complex	452901
62794	Rep & Maint. Office Vehicles	120122
0	Rep & Maint. (Land Survey)	169000
<b>245695</b>	<b>TOTAL</b>	<b>794200</b>

SCHEDULE - G

PRE Year	PARTICULARS	(Amt. in ₹ )
	SALARY COMPONENT( 2020-2021	
65683011	Salary and Allowances	75120875
837000	Children Education Allowance (CEA)	891000
9846000	Gratuity Contribution to LIC	13500000
132634	Staff Bonus	131252
1330514	Medical Reimbursement	1706101
6629944	Employer's Contribution to EPF	7511307
785187	Leave Encashment	1326859
276097	Administrative charges on EPF	285914
7350	Administrative charges on EDLI	0
33075	Employer's Contribution to EDLI	45225
191355	Group Insurance scheme ( GIS)	900316
1309565	LTC expenses	770577
163237	TA expenses	828868
2109128	Salary / wages paid to Electrical contract staff	2289651
2102345	Salary / wages paid to office & Campus Maint contract staff	4846871
4354717	Salary / wages paid to Office boys/Peons contract staff	2281482
6648918	Salary / wages paid to Security Services contract staff	7371883
571500	Salary paid to Consultant (Admin / Stores)	193210
1100574	Salary paid to Consultant (Technical)	1395135
300000	Salary paid to Lab Asst. (Contractual)	300000
440199	Salary Scientific Asst (Contractual)	635506
634560	Salary (Admin. IT / Lib.)	783504
<b>105486910</b>	<b>Total Salary Exp.</b>	<b>123223923</b>

## F.Y : 2021-22

## SCHEDULE-H

PREVIOUS YEAR	PARTICULARS	(Amt. in ₹ )
	<b>ESTABLISHMENT EXPENSES</b>	
176398	Telephone / Fax charges	142177
34385	Internet/ Broadband charges	39429
81403	Office Expenses	142129
8627	Subscription to Periodicals	8867
14160	Legal Expenses	76700
42181	Seminars and Conferences	588853
115683	Staff Canteen / welfare exp.	235292
5460	Advertisement	13849
34905	Meeting expenses	40212
8525	Computer Stationery/Consumable /Anti-Virus Kit	79411
0	Republic / Independence / Foundation day/ AKAM	261736
0	Hindi Program exp	26393
6209	Library & Information Expenses	5987
2486	Bank Charges	10758
121250	Professional fees (CA) for I tax, GST work etc	80750
5900	Tender Cost	0
0	Recruitment exp	98165
<b>657572</b>	<b>TOTAL (Establishment Exp)</b>	<b>1850708</b>

<b>3576586</b>	<b>UTILITY EXPENSES</b>	<b>4032978</b>
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<b>4234158</b>	<b>GRAND TOTAL (Other Exp)</b>	<b>5883686</b>
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Year	Schedule of exp shown in I & E A/c(Schedule-IX)	AMOUNT
25000	Audit Expenses	25000
53200	Printing & Stationery	145343
105937	Postage & Courier charges	72234
128665	Fuel and Oils (Vehicle)	203824
80620	Rent, Rates and Taxes	80620
145121	Insurance	143309
<b>538543</b>	<b>TOTAL</b>	<b>670330</b>

FY : 2021-2022		SCHEDULE - I
PRE YEAR	PROJECT EXPENSES(2021-2022)	(Amt. in ₹ )
0	S-18 SSAG : STAL Devp of Super Thermal Al. Conductor	480000
735926	S-19 SSAG : Devp of refractory material from saprolite	0
398500	S-20 SSAG : Devp of process model etc using porthole dies	0
584771	S-26 SSAG : Fabrication of Adv Ceramic nano coatings	201441
728257	S-29 SSAG : Al scrap recycling survey	442313
647568	S-30 SSAG : Fire Retardancy Nano ATH	0
771068	S-31 SSAG : Bench scale study of AlF <sub>3</sub> extraction CFA	2247508
1539673	S-32 SSAG : Digestion Efficiency project	188342
1395776	S-33 SSAG : Dross Utilization PAC Bench Scale	3962392
792819	S-34 SSAG : CRMS for Aluminium Alloys	3429528
397627	N-42 NALCO Utilization of PLK project	0
316497	N-43 NALCO Devp of Inline anode	0
642559	N-44 NALCO Devp of A Wi Fi enabled sensor	0
1158479	N-45 NALCO Devp of ceramic Proppant from PLK	72256
407266	N-46 NALCO Iron values from Red Mud	562802
0	N-47 NALCO Devp of process for 4N HPA	4152358
0	N-48 NALCO Devp of DC Cast Al Alloy for Yoke application	111691
0	N-49 NALCO Heat treatment study 1st cut SPL	37153
1005815	P-55 DST Utilization and devp of process for REE	0
0	P-56 Characterization study (Hi Tech Meta Raipur)	472000
1819551	P-60 DST 3N Pure alumina LED	250437
0	P-61 DST Instrument for Realtime of anode current	846961
0	P-62 DST Instrument for onsite bath parameters	1453420
0	P-64 BALCO Instrument for onsite bath parameters	23224
171438	MECL Nagpur Testing Project work	271846
1365897	DPR / S&T grant CAPEX expenses	2403687
147161	NABL Certification	105132
<b>15026647</b>	<b>TOTAL (Project Exp)</b>	<b>21714491</b>

LAB OPERATIONAL EXP(2021-2022)		SCHEDULE - J
PRE YEAR	PARTICULARS	AMOUNT
52202	Lab Operational & Consumables / Spares	50281
192000	AMC Computers	195000
0	AMC CCTV Camara	19200
130518	Prior Period expenditure	344485
<b>374720</b>	<b>TOTAL</b>	<b>608966</b>

F Y: 2021-2022

SCHEDULE - K

## GOVERNMENT GRANTS

PRE YEAR	PARTICULARS	(Amt. in ₹ )
0	GOVT REVENUE GRANT FROM AMDF	6008000
67000000	GOVT SALARY GRANT	74000000
<b>67000000</b>	<b>Sub Total-1</b>	<b>80008000</b>
	<b>Ministry of Mines Govt. Grants for Science &amp; Technology Projects</b>	
535200	S-20 SSAG : Devp of process model etc using porthole dies	0
546000	S-21 SSAG : Synergistic utilization of Geopolymer	0
201900	S-23 SSAG : Effect of Modified seed properties	0
762000	S-26 SSAG : Fabrication of Adv Ceramic nano coatings	0
1424700	S-30 SSAG : Fire Retardancy Nano ATH	0
1202500	S-31 SSAG : Bench scale study of AlF <sub>3</sub> extraction CFA	0
1960200	S-32 SSAG : Digestion Efficiency project	0
1876000	S-33 SSAG : Dross Utilization PAC Bench Scale	0
1949000	S-34 SSAG : CRMS for Aluminium Alloys	0
0	S-18 SSAG : STAL Devp of Super Thermal Al. Conductor	480000
0	S-35 SSAG : Geo-Tech Evaluation of Bauxite and Laterite	2730800
0	S-36 SSAG : Solid state recycling of aluminium chips	3724700
0	S-37 SSAG : Tech Devp for Holistic Utilization of Red Mud	2097800
0	S-38 SSAG :Red mud Valorization to get zero waste for x-ray	1638937
0	Govt Grant for Seminar (ICNFM)	500000
<b>10457500</b>	<b>Sub Total-2</b>	<b>11172237</b>
<b>77457500</b>	<b>Grand Total 1+2</b>	<b>91180237</b>

## INCOME FROM RESEARCH PROJECT

F.Y- 2021-2022		SCHEDULE - L
PRE YEAR	PARTICULARS	AMOUNT
	<b>B). Other Research Projects/ Thermography</b>	
592320	N-44 NALCO Devp of A Wi Fi enabled sensor	0
5525200	N-47 NALCO Devp of process for 4N HPA	0
5180889	P-61 DST Instrument for Realtime anode current	0
6489068	P-62 DST Instrument for onsite bath parameters	0
0	N-48 NALCO Devp of DC Cast Al Alloy for Yoke application	2626000
0	N-49 NALCO Heat treatment study 1st cut SPL	3608400
0	P-63 Vedanta project on Tech Devp of Holistic Utilization	1147000
0	P-63 Hindalco project on Tech Devp of Holistic Utilization	1147000
0	P-63 Nalco Project on Tech Devp for Holistic Utilization	109000
0	Process for Delamination of Multi layered packaging materials (Shakti Plastic)	500000
<b>17787477</b>	<b>TOTAL (Income from Research Projects)</b>	<b>9137400</b>

Miscellaneous Receipts  
2021-2022

## SCHEDULE-M

PRE YEAR	PARTICULARS	(Amt. in ₹ )
112966	Misc. Receipts	12387
71235	License fees and water charges	80150
439282	Guest house/ Qtr. rent / charges received	277529
11800	Tender Fees	0
4547839	15 % common facility & HRA charges of NIMH	0
9000	Vendor registration fees	5000
668843	Sale of store materials/ unserviceable	36658
56006	Liquidated damages (LD)	58323
5000	Prior period income against written off of payable Amt EMD	57495
28710	Prior period income not payable to Sundry debtor	39755
0	Application fees	195510
<b>5950681</b>	<b>TOTAL (Miscellaneous Receipts)</b>	<b>762808</b>

## Program Receipts : Technical Seminar/Training Program

2021-2022		SCHEDULE - N
PRE YEAR	PARTICULARS	AMOUNT
0	Seminar on Aluminium Extrusion	80000
61770	Seminar IBAAS-2020	0
<b>61770</b>	<b>Total (Program Receipts)</b>	<b>80000</b>



**33 years of commendable service to the aluminium industry**

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