

JNARDDC



2019-20

ANNUAL REPORT

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JNARDDC - 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 31st Annual Report of Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur for the year 2019-20.. With the dedicated efforts of our scientific & administrative work force, we have completed seven projects worth ₹413.42 lakhs. The Centre is executing seven Science & Technology projects approved by SSAG (Ministry of Mines) with a total value of ₹ 361.66 lakhs spread over 2-3 years. Three industry sponsored projects worth ₹ 229.72 lakhs are under execution. Furthermore, several new projects were proposed to various agencies in this year.

While carrying out the above R&D work, the Centre achieved an revenue generation (IEBR) of ₹ 441.30 lakhs. Our scientists have published / presented 32 papers in national & international journals / conferences. One patent applications was filed for indigenous R&D process developed by JNARDDC. One patent was granted to JNARDDC.

JNARDDC prepared the Draft Aluminium Scrap Recycling policy for the Ministry of Mines. Under the NITI Aayog initiative of resource efficiency of aluminium (REAL), JNARDDC conducted a capacity building program for the benefit of all stakeholders. Institute is also assisting NITI Aayog in establishing technologies for REE (Rare earth element) extraction from red Mud and fly ash.

The Centre successfully applied for upgradation of its accreditation (9T-4561) granted by National Accreditation Board of Testing and Calibration Laboratories (NABL, New Delhi) from ISO:2005 to ISO:2017.

JNARDDC is playing a key role in the Inter-Ministerial Committee (IMC) for import substitutes in Al-industry, Quality Control Order for aluminium products and AIMS (Aluminium import monitoring system).

The Institute conducted the Indo-European Meet on “Resource Efficiency in the Aluminum Industry for evolving global solutions for bulk utilization of red mud.

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. Similarly, the Centre assisted CPCB, Central Pollution Control Board for devising the guidelines for bulk utilization and safe disposal of red mud

Director, JNARDDC was awarded with Metal Asia Excellence award for his invaluable contribution in the field of aluminium and scientist of JNARDDC bagged the best paper award in the downstream category during 8th IBAAS International Conference & Exhibition (IBAAS–GAMI) China.

Bureau of Energy Efficiency (BEE), Ministry of Power has once again renewed the nomination of JNARDDC as a sector expert for the aluminium sector under the PAT-2 /PAT-3 (Perform, Achieve & Trade) Scheme in the National Mission for Enhanced Energy Efficiency (NMEEE) under Climate Change Project.

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 etc.).

The global aluminium market was expected to register 6.5% CAGR during 2020-2025 and reach a value of USD 235.8 Billion by 2025. The major factors for this growth was expected from automotive and building & construction industries. The impact of the COVID-19 pandemic on global economic activity is set to be profound, unfathomable and recession appears inevitable. Global aluminium demand and prices will be badly hit, with the automotive and aerospace sectors in particular feeling the force of the slump. But the indian industry will bounce back slowly steadily and JNARDDC will continue to play a key role in providing techno-economic R&D solutions in the above zeal.

The centre's visibility and footprint is increasing year after year. I look forward to continued excellent performance of JNARDDC in coming years.

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 35 crores rupees joint venture, supported almost equally by the Ministry of Mines, Govt. of India and UNDP. The Centre is located in its own sprawling campus just outside the orange city of Nagpur and became fully functional since 1996. With serene surroundings and housed in a modern technical complex with state of art equipments, provide just the right atmosphere for the scientists of the Centre to make creative contributions to the technological growth of the Indian aluminium industry. JNARDDC, 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 a 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 as a whole.

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



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

“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



The Centre offers technological services in the following areas:

- Beneficiation and up gradation of bauxites / laterites
- Characterization and technological evaluation of bauxites / laterites
- Process monitoring of aluminium electrolysis cell
- Characterization of carbonaceous raw materials CP Coke and CT Pitch
- Chemical, Physical and Physico-chemical analysis
- Energy auditing and PFC measurements
- Alloy development and forming of aluminium alloys
- Microstructural, mechanical, electrical, EBSD characterization
- Melt loss assessment and remedial measures
- Process modelling

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
- High temperature sintering furnace
- Lab flotation machine
- Hydrocyclone test rig
- Granulating instrument
- Rotary furnace
- Wet High Intensity Magnetic Separator
- Laboratory Ferrous Wheel Separator
- Rotap Sieve Shaker
- Bond Mill Index

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 Hardness Tester
- Brinell Hardness Tester
- Ultrasonic flaw detector
- Electro polishing machine
- Conductivity meter & Roughness meter
- Milling machine
- Hyperextrude software
- Extrusion modeling and simulation
- Annodizing lab & Erichsen cupping test

Analytical Division

- Wet Chemical Lab (WCL)
- X-Ray Diffraction (XRD)
- X-Ray Fluorescence Spectrometer (ED-XRF)
- Fusion bead making machine
- Glow Discharge Spectrometer (GDS)
- Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES)
- ICP-MS
- Ion Analyser
- Multi Gravity Separator (MGS)
- Milli-Q® Integral ultra-pure water purifier
- Planetary Ball Mill
- Microwave Digestor

Aluminium Electrolysis Division

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

Projects Completed in 2019-20 :: 7 nos.

(S-25) Nano Processing of Industrial Rejects for use as additives in Mix-designs for improved pozzolanic reaction efficiency, in association with VNIT, Nagpur (S&T- Mines)



Objective:

- To utilize the abundantly available industrial wastes; Red Mud, Fly Ash, Granulated Blast Furnace Slag, Lime Sludge, Sandstone Sludge in useful manner by making it nano using either top down or bottom up approach and increasing its surface to volume ratio to use it for industrial catalytic and adsorbent activities.
- To process the wastes in such a way to enrich any of the three major components and using that enriched residue as precursor to get either individual nano-particles or mixed nano-composites.
- To explore suitable applications of these nano-particles/nano-composites as additives in mix design for better pozzolanic reaction and overall reduced use of binding agent to promote the use of industrial wastes / rejects.
- To use a cost-effective way for preparation of nano-particles/nano-composites using industrial wastes as precursors rather than expensive chemicals

Background:

JNARDDC has been working on cost effective utilization of red mud by making hard and high strength building materials for the last 10 years. The concept of development of energy & environment sustainable materials in the past, the reduction in use of cement, sand and other naturally occurring clay minerals for saving the natural resources is the need of hour.

The pozzolanic properties plays an important role in building and construction materials. In view of the above the project was undertaken with VNIT, Nagpur for replacement of natural ingredients with research developed nano material with improved properties as an alternative for cement in the longer run.

Outcome:

JNARDDC selected Granulated Blast Furnace Slag (GBFS), Fly Ash (FA), Lime Sludge (LS), Red Mud (RM) and Sandstone Sludge (SS) for partial replacement of cement and developed process for preparation of building blocks with desired/enhanced physico-mechanical properties. Aluminium industrial waste i.e Red Mud (RM) was collected from alumina refinery NALCO, GBFS from Bhilai Steel Plant, Chhattisgarh whereas, other wastes (Fly Ash, Sandstone Sludge, Lime Sludge) were collected from local industries nearby Nagpur. Two different methodologies (chemical and mechanical) were used to carry out the nano processing of the collected industrial wastes.

During project investigation, it was observed that selected wastes were not toxic and these wastes after modification in nanomaterials could be secondary resource for building and construction with enhanced physico-mechanical properties i.e. GBFS and fly ash for building applications. The extracted nanoparticles from red mud and lime sludge could be used in other applications such as adsorbents, drug delivery applications etc.



The industrial rejects which has high percentage of alumina but low silica can be utilized for alkali activated concrete/building blocks with zero cement. This will reduce the GHG emissions as well as the embodied energy of the building products.

In the next stage, techno-economical process viability at pilot scale with aim for commercial utilization will be explored with industry to achieve the well advocated make in India program of Govt of India.

(N-42) Utilization of PLK (Partially Lateritised Khondalite) as a potential and value added filler material with specific reference to white ceramics and pigments: NALCO and CVRCE, Odisha



Objective:

- Develop a process for utilizing Partially Lateritised Khondalite (PLK) as a potential and value added filler material for manufacturing white Ceramics and pigments.
- Optimization of physic-chemical beneficiation separation/leaching process to reduce iron content in PLK
- Formulation of raw mix with an acceptable limit of iron of <5% ; Processing of treated PLK/raw mix for white ceramic products and pigments with validation of its suitability and preliminary economics study.

Background:

The major operating bauxite mine of India is Panchpatmali from which NALCO is mining over 6.3 million tons per annum of bauxite, which generates significant quantity of PLK during mining. PLK is lying below bauxite horizon up to about 6-7-meter depth and amount a significant reserve. PLK generally constitute medium to high percentage of alumina (35-45 %), Fe_2O_3 varying between 10-20 % and high amount of silica up to 15-24 %. Most of the silica present in PLK is associated with alumina in the form of Kaolinite making the material unsuitable to treat through Bayer process.

The demand for brighter (white) filler materials is increasing day by day due to increase in demand for white ceramics, refractory, paints, papers etc. in the consumer and industrial sectors. Simultaneously, natural reserves of such materials are also depleting. Hence it is necessary to search for alternate resources especially from the mining and metallurgical wastes or unused material for such applications. Good quality kaolin clay is one of the major raw materials suitable for filler in ceramic, refractory and paint

industries. The quantity of kaolin clay which occurs in patches throughout India is also depleting.

Keeping in view of the above, JNARDDC and CV Raman College of Engineering, Bhubaneswar (CVRCE) jointly proposed to National Aluminium Company Limited (NALCO), Bhubaneswar idea to develop a process through physicochemical treatment of PLK that considerably reduce iron minerals less than 3 % and 1% in the PLK matrix so that the processed material could be suitable to formulate with the raw mix for paint& pigments and white ceramics respectively. The treated PLK could be converted to a value added filler material so that the unused PLK can be a potential raw material for industries like, ceramics, paper, paint etc., and prove to be a bulk resource for suitable industrial start ups in near future.

Outcome:



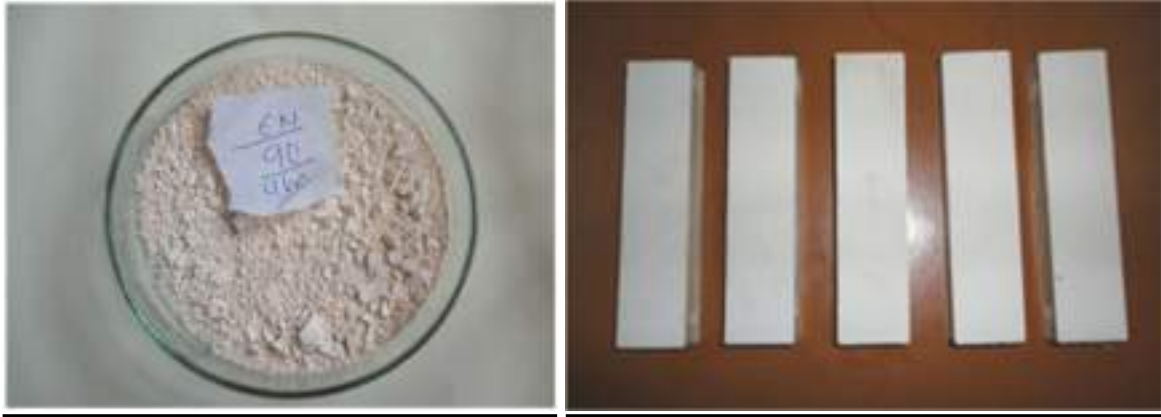
The collaborative R&D identified the best possible processing option for NALCO's PLK and developed a chemical treatment process for selective removal of iron oxide (Fe_2O_3) to generate low iron PLK material, which is useful as a resource at ceramic and paint/pigment industries. The efficacy and quality of low iron PLK material has been confirmed on the basis of product validation studies and confirmed the

suitability of material developed from NALCO's PLK as low-cost binder/filler.

Validation trials :



PLK leaching studies by JNARDDC personnel & validation of treated PLK for use as binder in paint & pigments



Validation of testing bars made of treated PLK for ceramics application

The final report recommended to NALCO that there is a wider R&D scope to explore further on the possibilities of utilizing NALCO's PLK material in many other non-metallurgical application, viz. preparation of Fused Alumina, Nano-silica etc. where bauxite is used as raw material. Since good quality bauxite reserves are available in the country for aluminium metallurgy, the alumino-siliceous reserves which are lying unutilized can to be used for non-metallurgical needs.

(N-43) Development of inline automated anode butt monitoring system to measure anode butt parameters, NALCO, Bhubaneswar



Objective:

The project aims to develop an automated visual inspection system of anode butts processed at the rod shop

Background:

Anodes in prebaked Hall-Heroult electrolysis cells are consumed during the smelting process and must be replaced at regular intervals, when they have reacted down to about one fourth of their original size. A typical prebaked anode is made from a mixture of petroleum coke, coal tar pitch, and butts. An anode butt is a remaining part of used anode removed from the cell during Anode changing. The butt's content in the new Anodes can vary, but normally it is between 15% to 25%. During aluminium electrolysis process, the anodes are consumed from contact with the oxygen ions that come from the dissolved alumina. These variations depend on many factors, such as anode fabrications, raw materials and electrolysis processing conditions. The thickness of anode butts is a very important parameter and can vary depending on several parameters.



The physical configuration of anode butts varies depending on anode manufacturing, raw materials and electrolysis processing conditions. Thick anode butts mean that they could have been used longer in the cells to optimize the production cost and on the other hand, too thin carbon indicates a high risk of iron contamination in the electrolysis cell.

Accordingly, the project was undertaken for developing an automated visual inspection system for the acquisition of visual image of each anode butt of the Anode assembly, after shot blasting and before butt stripping machine. The developed automated visual inspection system will be helpful to calculate the net carbon consumption and to optimize the smelting process along with anode fabrication process for better efficiency.

Outcome:

An automated visual inspection system with software has been developed for Image acquisition and Image Analysis using Matlab. During the project period various image Analysis techniques has been tried to develop final software for determining the various parameters of the anode butt. Final Image Analysis software is measuring around 15 parameters for each anode butt assembly automatically through Image Analysis for calculating the desired anode butt parameters.



The software acquires four numbers of Images for each Anode from different locations and are saved with time stamp in the Desktop PC installed at the control room and the calculated results are stored in a CSV file.

Thus a user-friendly Image Analysis software package has been developed to represent the calculated anode butt parameters. The understanding gained through this project will help reduce net carbon consumption by adjusting anode manufacturing processes and optimizing aluminum electrolysis process.

(N-44) Development of Wi-Fi enabled sensor arrangement for online measurement of anode current distribution of aluminium electrolysis cell, NALCO, Bhubaneswar



Objective:

The objective of the project was to develop a wi-fi enabled sensor arrangement for online measurement of real time anode current distribution of individual aluminium electrolysis cell leading to reduction in cell instabilities and improvement in pot control and efficiency / energy savings.

Background:

The anode current is a very important parameter in the aluminium electrolysis production. In all the Indian aluminium smelters, current of individual anode are being measured manually by Fork type probe, which has shortcomings, such as low measurement precision, only one anode current distribution measurement at a time, not recorded, etc. and cannot be utilised for detailed interpretations. This approach can't meet the requirements of the modern management and production for aluminium electrolysis. Based on the principle of anode rod equidistant voltage drop sensing, JNARDDC has undertaken this project to design and develop the Wi-Fi enabled system for online measurement of anode current distribution.

Outcome:

JNARDDC successfully developed the wi-fi system which is capable to measure the individual anode currents for any of the 960 pots and transfer the data through Wi-Fi at the Control room of Potline-II. Master unit captures the current data through radio frequency from all sixteen-slave units installed at individual anodes.

After receiving the data from slave unit, master unit transmits the data to Potline-II through WiFi Network. Software has been developed and installed at Potline-II control office for acquisition, storage and representation of the current data of each anode of a particular cell in the tabular and graphical form. Experimental results at the site show that the measuring instrument has high measurement accuracy.



Online current distribution measurement helps to observe changes in current distribution with changing conditions in the cell for a period of time and in turn will help in understanding the cell phenomena and troubleshooting the problems, which will lead to improve cell efficiencies and reduction in cell instabilities. The continuous measurement of anode current distribution will open up many research gates with respect to the correlation with the unmeasurable and unpredictable events / aspects of the electrolysis process.

(P-55) Utilization and development of process for recovery of strategic rare earths from industrial waste – Bauxite Residue at lab scale in association with HINDALCO. (Dept. of Science & Technology, DST) & Industry partner- HINDALCO.



Objective:

The main objective of this research work is to develop a cost-effective process for recovery of rare earth elements from bauxite residue.

Process comprises of following process steps,

- Physical beneficiation/pre-concentration of bauxite residue (Red mud) using multi-gravity separator/Hydro cyclone
- Leaching and extraction of REEs using different mineral acids
- Recovery of rare earth elements i.e Scandium oxide

Background:

The generation of red mud is huge (55-65% of the bauxite processed) and the general practice is to rather store in artificial ponds or landfills. A number of strategies have been worked out by various alumina plants for its bulk utilization in terms of landfill, land reclamation, specific uses as building materials, inorganic chemicals, adsorbents and many others. However, the capacity of consumption and secondary utilization is seriously insufficient. Only economical and viable comprehensive utilization can resolve the problem effectively in the long term.

Bauxite residue contains very low concentrations of REEs but volume (>9MT) is sizeable. Therefore, the total amounts of REEs locked in them are very large and they can become a significant source for these elements. There is a very limited knowledge of REE with respect to their solution chemistry and mass balance in processing of Indian bauxite and red mud. Output of the study would help the industries in

developing a process for recovery valuable REE from red mud. Better understanding of REE distribution in process waste will enhance approaches to economical recovery.

Based on the total generation of bauxite residue and available stored mud total conservative estimate is around 3000-5000 tons of valuable REE could be recovered from waste red mud which saves billions of Indian rupees. The present work focuses to find a lasting solution for productive utilization of red mud. An efficient and cost-effective process to extract rare earth elements (REEs, mainly Sc, La and Ce) from Indian bauxite residue has been investigated.

Outcome:

- The Indian red mud (bauxite residue) used in this study was characterized thoroughly which contains 48.0 ± 4 ppm Sc, 58.5 ± 4 ppm La and 98.1 ± 8 ppm Ce.
- Among different REEs scandium is the most strategic one. There has been no record of scandium deposits with concentrations over 100 ppm.
- Resources with scandium content between 20 - 60 ppm can be considered as an ore. Sc_2O_3 (40-50 mg) was recovered from 1 kg red mud with promising purity in the first batch by precipitation with sodium hydroxide/oxalic acid followed by calcination.
- The understanding gained through this project will help to extract strategic metal values from red mud. A conceptual/experimental flow-sheet to recover scandium from red mud has been proposed for future process development and production.
- The flow sheet developed will be very useful for Aluminium industry in converting waste to wealth.

Physical Beneficiation/Pre-Concentration Studies

- Physical beneficiation technique such as hydrocyclone/multi-gravity separation was adopted to concentrate the REEs in the bauxite residue.
- Detailed beneficiation studies reveal that MGS could provide a better grade with reasonable recovery of REEs compared to hydrocyclone.

After hydrocyclone, there was enrichment of 7% Sc, 19% La and 23.0% Ce, while 22% reduction in iron content with 43% weight recovery.

With MGS, there was enrichment of 15 % Sc, 20.0 % La and 29.0% Ce, 24% reduction in iron content with 70% weight recovery.

- The rare earth pre-concentration plays a significant role in the economics of a rare earth extraction process. Pre-concentration followed by acid leaching showed high leaching efficiencies of REEs in the leachate and better selectivity against iron.



Beneficiation using MGS REEs

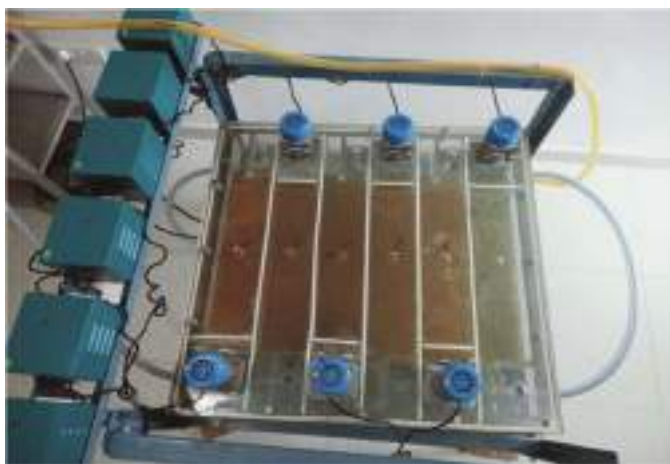
- The extraction degree of Sc, La and Ce was enhanced by an average of 15%, 5% and 4%, respectively. The iron co-extraction was also reduced from 15% to 11% after the red mud beneficiation which is an added advantage for the extraction of rare earth elements.

Leaching, Solvent extraction and recovery studies



- Leaching tests showed that H₂SO₄ acid gives highest scandium leaching efficiency amongst the three mineral acids used. The leaching studies carried out at optimized parameters and results obtained at leaching condition i.e. time of 2 hrs, S/L ratio of 1/10, temperature of 95-100°C. H₂SO₄ concentration, 2M was found to be most suitable conditions. Under optimized condition the leaching efficiencies for Sc, La and Ce were 60%, 68% and 76% respectively.

• In the solvent extraction study, bis(2-ethylhexyl) phosphoric acid (D2EHPA) in white kerosene (commercial) was used to extract scandium from leached solution. Scandium and impurities elements such as Fe, Ti and Al were co-extracted. The metals are extracted in the order of: Sc(III) > Ti (IV) > Fe(III) > Al(III). More than 95% scandium was extracted into the organic phase from aqueous leach liquor.



Six stage- Mixer-Settler



Scandium oxide (Sc₂O₃)

- Iron and titanium were scrubbed from scandium loaded organic phase with 2M of HCl and 3M of H₂SO₄ + 3-5% of H₂O₂ respectively.
- The Sc₂O₃ product with > 80% purity and > 95% recovery was obtained by precipitation of scandium with sodium hydroxide followed by calcination of scandium hydroxide precipitate.
- Crude Scandium oxide has been recovered from 1 Kg of red mud at lab scale using developed laboratory process was further purified.

A conceptual/experimental flow-sheet to recover scandium from red mud has been developed and proposed for future process development and production at pilot scale and commercialization.

(P-58) Technological characterization of Bauxite sample for establishing the mass balance of the process design of the expansion study at Vedanta Ltd, Lanjigarh, Kalahandi, Odisha



Objective:

To undertake technological characterization of bauxite for establishing the mass balance of the process design for the expansion of VEDANTA Alumina refinery at Lanjigarh, Odisha

Background:

Kodingamalli bauxite mines in Odisha is the main source of raw material for the 3rd stream being added in the existing Alumina refinery. This will raise the installed capacity of Alumina refinery at Lanjigarh from existing 2 million tons to 3.5 million tons per year. Before undertaking the expansion it was essential for VEDANTA to conduct technological studies on bauxite from Kodingamalli mines.

Accordingly, Vedanta Alumina refinery signed a letter of intent with JNARDDC for conducting technological studies on Kodingamalli bauxite. These studies were mainly aimed at thorough physical/ chemical characterization and optimizing parameters required for each unit operation of Bayer process to produce alumina. Process parameters thus established will be helpful to Worley Parsons (Technology supplier of Vedanta) in designing, manufacture and supplying the refinery equipment.

Outcome:

The Kodingamalli bauxite is gibbsitic in nature with good amount of alumina (44%) moderate in silica (2.78%) content, high in Fe₂O₃ content (25% - 26%) and low in TiO₂ content (2.47%). The TOC is also low around 0.11%. The average value of THA and MHA was 39.38% & 1.7% respectively. The reactive silica was 2.3% with about 0.5 % quartz. The bond work index determined showed a lower value of 9.26 kWh/ton and Rod Mill Index 7.78 kWh/ton indicating a lower energy requirement for grinding.



The pre-desilication studies carried out at 100°C at 800 gpl solids concentration with ROM bauxite indicates that a residence time of 4-6 hours can bring down silica level in desilicated liquor below 1 gpl. Further pre-desilication with a blend of 30% desilicated bauxite and 70% ROM, was carried out and the value of 1.0 gpl in the desilicated liquor is achieved in a span of 120-240 minutes for all the experiments. The addition of pre-desilicated bauxite as seed does not indicate a rapid desilication. The experimental studies on Pre-desilication has been conducted in a Batch mixed reactor, the kinetic studies for pre-desilication has been determined using ROM bauxite and mixture of 30 % Pre-desilicated bauxite + 70 % ROM bauxite. The time required for the liquor silica concentration in the liquor to fall below 1.0 gpl has been determined as 3-4 hours.



Thus JNARDDC provided the critical parameters to VEDANTA by undertaking bond-work index tests, impurities extraction test in plant and synthetic liquor, flocculant screening, pre-desilication studies, braking point digestion tests, bomb tests, scale up digestions tests, mud settling tests, lager settling tests, rheology tests etc.

This research findings of the technological evaluation of Kodingamalli bauxite which will be useful to VEDANTA and Worley Parsons (Technology supplier of Vedanta) in designing, manufacture and supplying the refinery equipment for establishing the mass balance of the process design of the expansion study at Vedanta limited, Lanjigarh, Kalahandi, Odisha.



Title of project:

Technical feasibility study for extraction of Alumina as Aluminium Fluoride from Indian Bauxite

Objective:

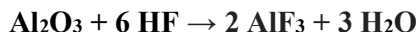
The major objective of project is to convert the aluminium compound (gibbsite, monohydrate) presents in Indian bauxite to aluminium fluoride using the fluoride reagents and see the process for its technical viability on laboratory scale in terms of

- Suitability of fluoride reagents (1-2).
- Impurities present in the products
- Probable waste generation

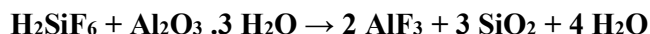
Background:

Worldwide primary aluminium is produced by electrolysis of alumina at high temperature (~960 °C) in molten Cryolite/AlF₃ bath. During the process of electrolysis Aluminium fluoride primarily used to maintain the bath ratio of electrolysis pot. Adding Aluminium fluoride to the production process lowers the consumption of electricity required and hence contributes to the reduction of production costs of Aluminium. It is estimated that on an average 15-20 kg of AlF₃ is required to produce one ton of metal Aluminium. Total production of metal Aluminium in India is 3.1 million tons per annum. So, total consumption of Aluminium fluoride in Indian smelters is in the range of 55,000-60,000 tons per annum. Hence Aluminium producers are the main users of Aluminium fluoride.

The majority of Aluminium fluoride on commercial scale is produced by treating high grade alumina with hydrogen fluoride gas at 700 °C



Aluminium fluoride may also be produced by using the Fluorosilicic acid, a waste from fertilizer industry with aluminium trihydrate..



Internationally ALCORE, Australia is researching on AlF₃ production from low grade bauxite on pilot scale. Considering the facts JNARDDC along with IBAAS decided to carry out experiments on laboratory scale at JNARDDC, to see the technical feasibility for extraction of alumina as aluminium fluoride from Indian Bauxite.

Outcome:

JNARDDC successfully carried out the technical feasibility on laboratory scale study using different fluoride reagents. During the study three routes are studied namely (i) HCl-HF route (ii) Fluorosilicic acid (H₂SiF₆) route and (iii) Hydrofluoric acid (HF) route. The final report contains the technical details of the bauxite and processes, which will help in deciding the process to be adopted based on availability of raw materials.

Ongoing Projects 2019-20 : 10 nos.

Sponsored by Ministry of Mines (SSAG) :

SN	Project details	Remarks / outcomes
1.	<p>S-26 : Fabrication of Advanced Ceramic Nano-coatings for Automotive Applications <i>with Christ University.</i></p> <p>Zero date: April 2018</p> <p>Duration: 2 yrs</p>	<p>The project aims 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). The outcome of the project could lead to overall import substitution in the field of automotive sector applications.</p>
2.	<p>S-29 :Techno-economic Survey of Aluminium Scrap Recycling in India <i>with MRAI (Metal Recycling Association of India)</i></p> <p>Zero date: Oct 2018</p> <p>Duration: 2 yrs</p>	<p>Indian aluminium recycling industry is currently considered as un-organized, represented by around 5,000 Micro Small and Medium Enterprises. Scrap collection is largely unorganised coupled with insufficient awareness, leading to a major proportion of scrap going to landfill rather than recycling. Current recycling rate in India is only 25% compared to the world average of 45%. The country has a long way to go before it can become a major aluminium recycler and feed the secondary metal market which is dependent on imports. Presently key concern areas of aluminium recycling are lack of structure for aluminium scrap handling and secondary metal recovery.</p> <p>On this background the survey report will assist the Ministry of Mines in establishing the techno-economic status of the aluminium recycling industry in the country and in due course help in formulation of policies pertaining to this industry.</p>

SN	Project details	Remarks / outcomes
3.	<p>S-30 :To study the fire retardancy of nano-ATH in polymers <i>with CIPET, Bhubaneswar (Central Institute of Plastics& Engineering Technology)</i></p> <p>Zero date: Oct 2018</p> <p>Duration: 2 yrs</p>	<p>Aluminium hydroxide is a common inorganic additive used in a wide range of industrial applications. One of its applications is its use as a fire retardant. Polymer based materials are now recognized as key components in many important industries such as construction, automotive, electronic and aerospace due to their outstanding physical and electronic properties, cost-effectiveness, high versatility, and portability. However, one severe problem with many polymers is that they are highly flammable and can produce large amounts of toxic smoke during combustion, which poses a great threat to human safety. In order to tackle this problem the project has been undertaken to explore the use of Nano-ATH as flame retardant fillers into polymer matrices because of its specific properties of high surface area and good dispersibility. The project aims to develop new process and product using aluminium trihydroxide and polymer matrix for various applications.</p>
4.	<p>S-31: Bench scale study on extraction of pure Silica and smelter grade Aluminium Fluoride from Coal Fly Ash (CFA)– S&T (Mines)</p> <p>Zero date: Mar 2019</p> <p>Duration: 1 ½ 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 (Al₂O₃), 56-60% silica (SiO₂) and 9-13% oxides of elements (Ca, Mg, Na, Fe, Ti etc.).</p>

SN	Project details	Remarks / outcomes
		<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 will be carried out to study bench scale (0.5-1 kg CFA) extraction of pure silica and aluminium fluoride by treating coal fly ash (CFA) with appropriate mineral acid.</p>
5.	<p>S-32: Optimization of digestion efficiency in Bayer process by ascertaining the ideal size fraction of bauxite feed.</p> <p>Zero date: Dec 2019</p> <p>Duration: 1 yr</p>	<p>The alumina refineries are presently operating upon the feed size of the bauxite to ball mill after conducting a series of experiments before setting up of plant. But over the years, bauxite characteristics may vary especially if there is a change in bauxite origin.</p> <p>Accordingly, to attain the same digestion efficiency a thorough investigation has been undertaken in the above project for recommending the optimum particle size of the feed bauxite to digestion.</p>
6.	<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 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
7.	<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: 2 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>

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

SN	Sponsoring agency	Project Details	Remarks / Outcomes
8.	NALCO, Bhubaneswar Odisha	N-45: Development of ceramic proppant from low grade materials (Partially Lateritised Khondalite -PLK, Fly ash, etc.) - Phase-II-Scale up studies : (Feb 2018) 2 ½ yrs	Based on the successful lab scale process already 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 has been undertaken. The process is an effort for converting unutilized materials into value added products. An effort towards ‘Make in India’ and ‘Swatch Bharat’ zeal.
9.	NALCO, Bhubaneswar Odisha (Jointly with <i>IIMT, Bhubaneswar & Eesavyasa Tech, Pvt Ltd. Telangana</i>)	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 Utilisation of red mud”. (Sept 2019) 1 ½ yrs)	Project aims to develop an innovative and viable process for recovery of iron values from red mud and processing of non-iron part for its application as an insulating product with an aim for complete utilization of red mud. JNARDDC will be the nodal agency and the deliverables shall include mass and energy balance of the developed process.

SN	Sponsoring agency	Project Details	Remarks / Outcomes
10.	Dept of Science and Technology (DST, New Delhi) in collaboration with IIT, Bhubaneswar & Anna University.	P-60: Development of a process technology (at lab scale) for low cost production of 3N (99.9%) pure alumina (Mar 2019) 1½ yrs	<p>The project aims to develop the process know how for the low-cost production of 3N pure alumina suitable for LED (Light Emitting Diode) and Semiconductor applications.</p> <p>Efforts are on to get the required product at much low temperature. Study of cost economics for 3N pure alumina synthesis process will also be evolved.</p> <p>The country 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 current proposal has a commercial potential to add to the vision of “Make in India” program.</p>

Collaborative work

JNARDDC is collaborating with the following agencies for various R&D projects of mutual interest and for the overall interest of the nation.

- 1. 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 to support the BEE in reducing energy consumption of aluminium sector. Presently evaluating PAT-2 scheme and supporting PAT-3 for data collection. 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/sites/default/files/Aluminium.pdf>.
- 2. Department of Science and Technology –DST** : JNARDDC successfully completed the project “Extraction of REEs from Red Mud”. A lab scale process for recovery of invaluable rare earth elements from industrial waste was developed. Another project has been undertaken to develop the process know how for the low-cost production of 3N pure alumina suitable for LED (Light Emitting Diode) and Semiconductor applications.
- 3. 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” has been undertaken in collaboration with IMMT, Bhubaneshwar and Eesavyasa Tech, Pvt Ltd. Telangana.
- 4. Christ University, Bangalore**: Christ University and JNARDDC have joined hands for development of 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.

5. **MRAI (Material Recycling Association of India):** JNARDDC organised a capacity building program in collaborating with MRAI. JNARDDC is also executing a joint project proposal “Techno-economic Survey of Aluminium Scrap Recycling in India”. The final survey report will assist the Government in formulating policies for the sector. A draft aluminium scrap recycling policy has been formulated by JNARDDC and posted on the Ministry of Mines website for inviting comments of the general public and pre-legislative consultation.
<https://www.mines.gov.in/writereaddata/UploadFile/policy27032020.pdf>
6. **NITI AAYOG :** In accordance with commitment of the Government of India to SDG vision 2030, NITI Aayog along with EU delegation released a Strategy on resource efficiency prepared by JNARDDC. The draft National Resource Efficiency Policy 2019 has been circulated by Ministry of Environment Forest & Climate Change (MoEF&CC). In this regard, a core committee has been constituted to undertake capacity building programs on aluminium recycling and waste management for promoting resource efficiency in aluminium sector. Such programs will generate awareness and assist the stakeholders in understanding and implementing the desired goals of resource efficiency / circular economy in the interest of aluminium industry and nation. https://www.eu-rei.com/pdf/publication/NA_MoM_Strategy%20on%20RE%20in%20Aluminium%20Sector_Jan%202019.pdf&https://niti.gov.in/sites/default/files/2019-03/RecyclingReport.pdf
7. **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
8. **Central Institute of Plastics Engineering & Technology CIPET, Bhubaneswar:** CIPET and JNARDDC are jointly executing the project titled “To study the fire retardancy of nano-ATH in polymers” sponsored by S&T (Mines). The effect of nano-ATH as fire retardant filler in polymers in particular the thermoplastics like PE/PP and Epoxy will be investigated with a view to replace/substitute the existing flame retardants used in polymer composites with nano-ATH. It will lead to new process and product development using aluminium trihydroxide and polymer matrix.

9. **Central Pollution Control Board (CPCB)** : The institute has submitted recommendations of aluminium industry for supporting CPCB in formulating guidelines for safe disposal and utilisation of aluminium industry waste (red mud)
10. **European Union – Resource Efficiency Initiative (EU – REI)** : The EU-REI is funded by the European Commission, a project consortium comprised of GIZ, adelphi, TERI and CII who are providing technical assistance to the Indian resource efficiency initiative. The EU developments in the sector and specifically about ongoing Horizon 2020 Program under three major projects (EnsureAl, RemovAl & SCALE) are in operation with aim to bulk utilize of bauxite residues (red mud). An Indo-European meet was organised in Sept 2019 at New Delhi. The delegation was a part of European Union’s Resource Efficiency Initiative for India (EU-REI) which aims at supporting India in the implementation of the United Nations global Sustainable Consumption and Production (SCP) agenda by way of adapting international standards and best practices in business on resource efficiency and fostering the efficient and sustainable use of natural resources.
11. **IIT, Bhubaneswar & Anna University** : The DST sponsored project “Development of a process technology (at lab scale) for low cost production of 3N (99.9%) pure alumina” 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.
12. **VNIT, Nagpur** : JNARDDC has collaborated with VNIT, Nagpur and successfully completed the project on nano processing of industrial rejects for use as additives in Mix-designs for improved pozzolanic reaction efficiency.
13. **C V Raman College of Engineering, CVRCE Bhubaneswar** : The project titled “Utilization of PLK (Partially Lateritised Khondalite) as a potential & value added filler material with specific reference to white ceramics and pigments” sponsored by NALCO was successfully completed by JNARDDC in collaboration with CVRCE. The findings provide alternate raw material source for developing filler material at low cost

14. **Ministry of Mines** : JNARDDC is the designated aluminium sector expert / nodal agency for the following key authorities :

- Draft Aluminium Scrap Recycling policy
- Techno-economic study of aluminium scrap
- Resource efficiency in aluminium sector
- IMC for import substitutes in Al-industry
- Quality Control Order for aluminium products
- AIMS (Aluminium import monitoring system)

Patents



The following final 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 of Filing & Inventors	Title of Patent
1.	<p style="text-align: center;">201921050658 dated 08.12.2019</p> <p>Dr Md Najar Amrita Karn, Paresh Nageshwar R N Chouhan, Anupam Agnihotri</p>	<p>A process for delamination of laminated multi-layer packaging industrial refuse and recovery of Aluminium at ambient conditions temperature</p> <p>The process will assist scrap recyclers to separate the plastic from aluminium foil before melting for enhancing the melt quality and lowering pollution.</p>



This process enables physical separation of different layers of materials (plastics and metal) for cost effective segregation of the layers in 3-5 hours depend on the v/v ratio of organic-aqueous combination of reagents

PATENTS GRANTED

SN	Sanction Number & Date	Title of Patent granted	Inventors
1	334205 09.03.2020 [2019-20]	Liquidus /Superheat Temperature Measurement System for Molten Cryolite Bath	R J Sharma (JNARDDC) V K Jha (JNARDDC) Binuta Patra, (NALCO) P Bandopadhyay (NALCO)



Direct measurements of the liquidus temperature in aluminium industrial cells by using the liquidus probe is more advantageous compared to the alternative methods (using empirical equation after measurement of bath composition) for determining the liquidus temperature.

The greatest advantage of liquidus probe is the speed of the measurement. The almost instantaneous reading of the bath and liquidus temperature, also gives the bath's superheat directly. The duration of a measurement is about 1-2 minute, which makes it possible to run frequent measurements. Hence the probe can also be a useful tool in cell dynamics studies

JOURNALS

1. *Recovery of iron from bauxite residue using advanced separation techniques*, **SB Rai**, MT Nimje, MJ Chaddha, Sweta Modak, KR Rao, A Agnihotri; *Minerals Engineering (Elsevier) Vol.-134*: pp 222-231, 2019. April 2019.
2. *Recycling of Industrial Rejects of Value Addition and Resources Augmentation*; **Mohamed Najar P A**, Amrita Karn, Paresh Nageshwar; *MRAI Journal: Material Recycling 1(2)*, 50-53, April 2019.
3. *Effect of carbon nanotubes on solution treatment temperature and dissolution characteristics of precipitates in Al alloy produced by high-energy milling and hot extrusion*; **N.S. Anas**, S. B. Chandrasekhar, R. K. Dash, Tata N. Rao, R. Vijay; *Transactions of the Indian Institute of Metals, Vol-72*, 2687–2697, June 2019
4. *Microstructural characteristics and mechanical properties of CNT/Ni coated CNT–dispersed Al alloys produced by high energy ball milling and hot extrusion*; **N.S. Anas**, M. Ramakrishna R. Vijay; *Metals and Materials International, Vol-26*, 272–283, June 2019.
5. *Autogenous Dissolution and Nano-Processing of Iron in Red Mud: Green Chemistry for Value Addition and Recovery of Materials*; **Mohamed Najar P A**, Amrita Karn, Sneha Dwivedi, Priyanka Nayar, SP Puttewar, A Agnihotri; *Materials Today, Elsevier, Volume 26(2020), Part 1*, 69-76, July 2019 (<https://doi.org/10.1016/j.matpr.2019.05.378>)
6. *Comparative study of phase transformation of Al₂O₃ nanoparticles prepared by chemical precipitation and sol gel auto combustion methods*, **Priyanka Nayar**, Sayali Waghmare, Priyansh Singh, Mohamed Najar, Suresh Puttewar, Anupam Agnihotri, *Materials Today: Elsevier, Volume 26 (2020)*, 122-125. July 2019 (<https://doi.org/10.1016/j.matpr.2019.05.450>)
7. *Studies on beneficiation and leaching characteristics of rare earth elements in Indian red mud*, **Uendra Singh**, Sonali Thawrani, M.S. Ansari, SP Puttewar & Anupam Agnihotri, *Russian Journal of Non-Ferrous metals, 60(4)*:335-340, July 2019.

8. *Value added material for refractory application*, **Upendra Singh**, M.S. Ansari, DR Meshram, Sonali Thawrani, *MRAI Journal: Material Recycling*, Vol 1 Issue, 3, PP 62-65, June-July 2019.
9. *Innovative process for boehmite precipitation in Bayer circuit*, **SB Rai**, MJ Chaddha, KJ Kulkarni, MT Nimje, KR Rajshekhar, P Mahendiran, RJ Sharma, A Agnihotri; *Journal of Sustainable Metallurgy*, 6, 18–25 (2020). <https://doi.org/10.1007/s40831-019-00239-5> : Aug 2019.
10. *Disposal practices and utilization of red mud (bauxite residue): A review in Indian context and abroad*, **SB Rai**, S Bahadure, MJ Chaddha, A Agnihotri; *Journal of Sustainable Metallurgy*, DOI 6, 1–8 (2020). <https://doi.org/10.1007/s40831-019-00247-5> : Oct 2019
11. *Instrument for Instantaneous and onsite measurement of important bath parameters of aluminium electrolysis cell*, **Vimal K Jha**, Rajendra J Sharma, Anupam Agnihotri, *MRAI Journal: Material Recycling*, Vol 1, Issue 6, pp 34-36, January 2020
12. *Tribological performance of CNT/Ni coated CNT dispersed–Al alloys produced by mechanical milling and extrusion*; **N.S. Anas**, L. Rama Krishna, R. K. Dash, R. Vijay; *Journal of Materials Engineering and Performance* <https://link.springer.com/article/10.1007/s11665-020-04693-1>, March 2020

CONFERENCE PROCEEDINGS.

Recycling of Aluminium for Alloy Manufacturing & Extrusion Billet Casting, Pune (April, 2019)

13. *Quality of AA6063 Alloy Billets*, **R N Chouhan**, P Mahendiran, A Agnihotri; *Conference on Recycling of Aluminium for Alloy Manufacturing and Extrusion Billet Casting, Pune, 25-26 April, 2019.*

ICNFMM-2019, Kolkata (July 2019)

14. *Recovery of Mineral Values from Aluminium Industry Rejects by Chemical Treatment: Scope of Utilization and Product Development, Proceedings*, **Mohamed Najjar P A**, Amrita Karn, Kalyani Dhore, Sayali, Waghmare, Priyanka Nayar, PG Bhukte, MJ Chaddha, SP Puttevar and A. Agnihotri; *23rd International Conference on Non Ferrous Minerals and Metals (ICNFMM-2019), Kolkata 12-13 July 2019.*

15. *Technical assessment of lateritic bauxite - a case study of high-level bauxite deposits in Maharashtra: **Pravin Bhukte**, Mohamed Najar, G T Daware, S P Masurkar, S P Puttevar and A Agnihotri, 23rd International Conference on Non Ferrous Minerals and Metals (ICNFMM-2019), Kolkata 12-13 July 2019*
16. *Extraction of iron oxide from bauxite residue using Physical Beneficiation, **Upendra Singh**, M. S. Ansari, Sonali Thawrani, Rajnikant Borkar, Mayur Tirpude, S. P. Puttevar & A. Agnihotri, 23rd International Conference on Non Ferrous Minerals and Metals (ICNFMM-2019), Kolkata 12-13 July 2019*
17. *Utilization of Nano Processed Industrial Wastes/Rejects For Use As Supplementary Cementitious Materials (SCM) In Concrete Practice: **Priyanka Nayar**, Numanuddin Azad, Sayali Waghmare, Mohamed Najar, Suresh Puttevar, Anupam Agnihotri, 23rd International Conference on Non Ferrous Minerals and Metals (ICNFMM-2019), Kolkata 12-13 July 2019*

ASSOCHAM-2019, Bengaluru (Aug 2019)

18. *Prospects of Bauxite & Laterite deposits of Karnataka: **Pravin G Bhukte**, S P Puttevar, A Agnihotri, Conference ‘Mining in Karnataka’ -Raw material security for sustainable operations organized by The Associated Chambers of Commerce and Industry of India (ASSOCHAM), Bengaluru, 29 August 2019*

IBAAS-2019, China (Sep 2019)

19. *Supporting Low-Carbon Infrastructure: Consolidation of Industrial Rejects by Geopolymerization and Immobilization of Toxic Components for Utilization; **Mohamed Najar P A**, Vishakha Sakhare, Amrita Karn, Sayali Waghmare, SP Puttevar and A Agnihotri 8th International Bauxite, Alumina & Aluminium Conference & Exhibition (IBAAS), Guiyang, China, 4-6 September 2019.*
20. *Quality of AA6063 Alloy Billets, **R N Chouhan**, P Mahendiran, VNSUV Ammu, A Agnihotri, 8th International Bauxite, Alumina & Aluminium Conference & Exhibition (IBAAS), Guiyang, China, 4-6 September 2019.*
21. *Indian bauxite residue: studies on potential resource for rare earth elements, **Upendra Singh**, Sonali Thawrani, M.S. Ansari, S.P. Puttevar and Anupam Agnihotri, 8th International Bauxite, Alumina & Aluminium Conference & Exhibition (IBAAS), Guiyang, China, 4-6 September 2019.*

22. Die design and press validation for a complex profile produced by port hole dies using AA6063 alloy, **V.N.S.U. Viswanath Ammu**, P. Mahendiran, R.N. Chouhan, Samrat Ambade, Phiroze Dungore and Anupam Agnihotri; 8th International Bauxite, Alumina & Aluminium Conference & Exhibition (IBAAS), Guiyang, China, 4-6 September 2019.

REAL-2019, Bhubaneswar (Nov 2019)

23. SPL--Spent pot lining "A hazardous waste of Aluminium Industry" generation & utilisation of SPL in Smelters: Status & Technology: **M T Nimje**, S U Bagde, V K Jha, Anupam Agnihotri, Capacity building program- 'REAL- Resource Efficiency on Aluminium' (REAL-2019) Bhubaneshwar, 21-23 November 2019

24. Utilization of aluminium industry rejects for making building products, **Mohamed Najar P A**, Capacity building program- 'REAL- Resource Efficiency on Aluminium' (REAL-2019) Bhubaneshwar, 21-23 November 2019

25. Generation, reduction of waste in alumina refinery - Indian & Global Status, **SB Rai**, Capacity building program- 'REAL- Resource Efficiency on Aluminium' (REAL-2019) Bhubaneshwar, 21-23 November 2019

26. Bauxite scenario and status of India with emphasis on low grade utilization: **P G Bhukte**, Capacity building program- 'REAL- Resource Efficiency on Aluminium' (REAL-2019) Bhubaneshwar, 21-23 November 2019

27. Quality of AA6063 Alloy Billets, **R N Chouhan**, Capacity building program- 'REAL- Resource Efficiency on Aluminium' (REAL-2019) Bhubaneshwar, 21-23 November 2019

STAR-2019, Mumbai (Dec 2019)

28. Process optimization for leaching and extraction of Rare Earths from Indian Red Mud, **Upendra Singh**, Sonali Thawrani, Rajnikant Borkar, Jyoti Pendam, Mayur Tirpude & Anupam Agnihotri, National Conference on Science, Technology and Applications of Rare Earths (STAR-2019), Mumbai 5-7 December 2019

MPT-2019, Hyderabad (Dec 2019)

29. *A way forward in Waste Management of Red mud/Bauxite residue in Building and Construction Industry*, **SB Rai**, S Bahadure, MJ Chaddha, A Agnihotri, XVIII Mineral Processing Technology Conference (MPT-2019) on 'Mineral Processing for Global Economy: Concepts to Commercialization' Hyderabad, 16-18th December 2019.

IMME-2019, Tiruchirappalli (Dec 2019)

30. *Preparation of Calcium Oxide Nanoparticles from Industry Rejects: Recovery and Value Addition of Mineral Values*; **Priyanka Nayar**, Sayali Waghmare, Numannudin Azad, Paresh Nageshwar, Mohamed Najjar, Anupam Agnihotri: 2nd International Conference on Recent Trends in Metallurgy, Material Science and Manufacturing (IMME-2019), NIT Tiruchirappalli, December 27-28, 2019.

GREEN ASHCON-2020, Bhopal (Feb 2020)

31. *Recovery of silica from Coal Fly Ash (CFA)*, MT Nimje, **SB Rai**, VK Jha, SU Bagde, S Kowe, A. Agnihotri, Conference on "Fly ash utilisation & Green building materials", Green AshCon-2020 & Green BuildCon-2020, Bhopal, 13-15th February 2020

Advanced Light-weight Materials & Structures, Hyderabad (Mar 2020)

32. *Comparison of metalflow characteristics in aluminium extrusion die using numerical simulations for AA6063 and AA7075*, V.N.S.U. Viswanath Ammu, Samrat Ambade, Anas N S, R N Chouhan, Dr. Anupam Agnihotri, "First International Conference on Advanced Light-weight Materials and Structures" held at CMR Technical Campus, Hyderabad 6- 7, March 2020.

INVITED LECTURES

1. *Industry & Environment: Consolidation of Industrial Rejects by Geopolymerization and Immobilization of Toxic Components for Supporting Low-Carbon Infrastructure*, **Mohamed Najar P A**; Department of Chemical Engineering, Priyadarshini Institute of Engineering and Technology Nagpur, 26th September 2019
2. *Metals & alloys: Synthesis & applications, 5 Days Workshop on “Recent Advancement in Polymer Materials and Nano Materials for Engineering Applications (RAPNEA 2019)*, **R N Chouhan**, NIT Raipur, 13th December, 2019
3. *Bayer process for alumina production: Heat Transfer and Energy Consumption*, **SB Rai**, Department of Chemical Engineering, VNIT, Nagpur, 20th February 2020.
4. *International conference on advances in physical, chemical and mathematical sciences (ICAPCM-2020)* **Upendra Singh**, Department PCM of Laxminarayan Institute of Technology, Rashtrasant Tukadoji Maharaj Nagpur University; 15 Feb 2020
5. *Aluminium alloy-carbon nanotube composites: Challenges and Applications*, **N.S. Anas**, Government Engineering College, Kozhikode, 25th February 2020
6. *Nanostructured Materials: Discussion and Case Study*, **N.S. Anas**, Government Engineering College, Wayanad, 26th February 2020

Academic Events

1. **23rd International Conference on Non-Ferrous Minerals and Metals – 2019 (ICNFMM – 2019) July 2019, Kolkata** was organized by Corporate Monitor in association with JNARDDC, Aluminium Association of India (AAI) and CSIR-CGCRI at Kolkata for promoting recycling and utilization of non-ferrous metal processing wastes. 4 research papers were presented by JNARDDC at the event.



2. **An interactive meet on “Waste To Wealth - productive utilization of red mud (bauxite residue)” July 2019, New Delhi** was organized at Hotel Le Meridien to review current status of red mud generation and its safe disposal / utilization for



identifying the research gaps and suggest remedial action. NALCO, VEDANTA and HINDALCO actively participated in the event.

3. Interactive Indo-European Meet on “Resource efficiency in the aluminum industry with a focus on effective utilization of red mud (bauxite residue)” Sep 2019, New Delhi

Ministry of Mines in association with Ministry of Environment Forest & Climate Change (MoEFCC), JNARDDC, European Union-Resource Efficiency Initiative (EU-REI) & European Union (EU) organized an interactive Indo-European Meet on “Resource Efficiency in the Aluminum Industry with a Focus on Effective Utilization of Red Mud (Bauxite Residue)” on 19th September, 2019 at Hotel Taj Mansingh, New Delhi. The meet was inaugurated by Shri Anil Kumar Nayak, Joint Secretary (Mines) in the presence of industry heads and Dr. Dieter Mutz, Team Leader, EU-REI.



The delegation of experts from European Union enlightened about global and EU developments in the sector and specifically about ongoing Horizon 2020 Program under which three major projects (EnsureAl, RemovAl & SCALE) are in operation with aim to bulk utilize of bauxite residues (red mud). The delegation is part of European Union’s Resource Efficiency Initiative for India (EU-REI) which aims at supporting India in the implementation of the United Nations global Sustainable Consumption and Production (SCP) agenda by way of adapting international standards and best practices in business on resource efficiency and fostering the efficient and sustainable use of natural resources. The European perspective was put forward by EU experts - MsKaty Tsesmelis, International Aluminium Institute (IAI) ; MrGyörgy (George) Bánvölgyi, Hungary ; Mr Ugo Miretti, ITRB Group ;

Mr Casper van der Eijk, SINTEF, Norway ; Dr. Papadimitriou Konstantinia, Greece and summarized by Dr. Dieter Mutz, EU-REI.



The EU team during lab visit of JNARDDC on 20th September 2019

4. **8th IBAAS International Conference & Exhibition (IBAAS–GAMI) Sept 2019 China**

JNARDDC was the associate organizer of the IBAAS-GAMI conference on Technological Advances in



Alumina, Aluminium Smelter, Downstream Fabrication, Energy Conservation, Environmental Protection and Smart Manufacturing with Special Reference to China” held during 4–6th September, 2019 at Guiyang, China. Along with JNARDDC, CHINALCO, CHALIECO, International Aluminium Institute (IAI), IBAAS etc. also participated. Scientists from JNARDDC presented their papers in the areas of downstream applications, utilization of industrial rejects and bauxite residue, out of which, one was adjudged as the best paper in downstream category. JNARDDC team also visited Huajin Alumina, Guizhou Huaren Aluminium and Chongqing Huaфон Aluminium Corporation and Nanping Aluminium.

5. Resource Efficiency in Aluminium (REAL), Nov 2019, Bhubaneswar

A two and half day Capacity Building program on Resource Efficiency in Aluminium (REAL) was organized during 21–23rd November, 2019, at Bhubaneswar, by JNARDDC under the aegis of Ministry of Mines and NITI Aayog in association with Aluminium Association of India (AAI), Material Recycling Association of India (MRAI) and Aluminium Secondary Manufacturers Association (ASMA). Shri Ratan P Watal, Secretary, Economic Advisory Council to the Prime Minister (EAC-PM), GoI inaugurated the program along with Dr B N Satpathy (Senior Consultant, Office of PSA to GoI) and executives from primary/secondary aluminium industry and Ministry of Mines. During the programme, there were various deliberations on status of REAL in primary and secondary aluminium production, current status and technology available for utilization of industrial wastes like dross, spent pot lining (SPL) and bauxite residue (red mud) at both global and domestic markets. The event witnessed over 150 participants from Ministry of Mines, EAC-PM and Office of Principal Scientific Advisor (O/o PSA), GoI, NITI Aayog, NALCO, HINDALCO, Vedanta group, regulatory bodies like Odisha SPCB, BIS, various secondary aluminium producers and manufacturers affiliated to MRAI, ASMA, All India Non-ferrous Metal Exim Association (ANMA) and Federation of All India Aluminium Utensil Manufacturers (FAIAUM).



Training programs

Summer training for Engineering students at JNARDDC

Students from Visvesvarya National Institute of Technology (VNIT, Nagpur) were offered summer orientation training covering areas right from bauxite to aluminium downstream processing. The training imparted will come handy to those students who wish to pursue career in aluminium industry.



Lab visit by Educational Institutes

To spread scientific awareness among the young minds, interactions of students with scientific community and laboratory visits was arranged by JNARDDC for various educational institutes.



Students of Nagpur Institute of Technology and MSB Educational Institute, Nagpur

Awards / Achievements

Metal Asia Excellence Award



Metal Asia is a global journal profusely relevant to non-ferrous metal industries – aluminium, zinc, copper, nickel etc. Dr Anupam Agnihotri, Director, JNARDDC was felicitated with Metal Asia Excellence award during the 23rd International Conference on Non-Ferrous Minerals and Metals 2019 (ICNFMM-2019) for his invaluable contribution in the field of aluminium.

Best paper award in IBAAS-2019, China.

Mr R N Chouhan, Principal Scientist from JNARDDC bagged the best paper award in the downstream category during 8th IBAAS International Conference & Exhibition (IBAAS–GAMI) held on 4-6 September, 2019 at Guiyang, China for his paper titled “Quality of AA6063 Alloy Billets”.



JNARDDC is the designated aluminium sector expert / nodal agency for the following key authorities :

- **NITI Aayog -**
 - REE (Rare earth element) from red Mud and coal fly ash
 - Strategy paper on Resource efficiency in aluminium sector

- **Bureau of Energy Efficiency (BEE), Ministry of Power –**
 - Sector expert for “National Mission for Enhanced Energy Efficiency”-PAT 2/3 cycle

- **BIS, Bureau of Indian Standards for standards-**
 - Guidelines for Al-scrap
 - Standard for aluminium alloys

- **CPCB, Central Pollution Control Board –**
 - Guidelines for bulk utilization and safe disposal of red mud

- **DST, TIFAC (Dept of Science & Technology) –**
 - “Bauxite-Status, Challenges, Opportunities & Road Ahead” for addressing the technological issues of bauxite.

- **European Union -**
 - Resource efficiency program in aluminium sector
 - Bulk utilization of red mud

- **MoM (Ministry of Mines) –**
 - Draft Aluminium Scrap Recycling policy
 - Techno-economic study of aluminium scrap
 - Resource efficiency in aluminium sector
 - IMC for import substitutes in Al-industry
 - Quality Control Order for aluminium products
 - AIMS (Aluminium import monitoring system)

PERC review meeting at JNARDDC



The 19th PERC (Project Evaluation & Review Committee) meeting was held under the Chairmanship of Shri Alok Chandra, Economic Adviser, Ministry of Mines, during 6-7th August, 2019 at JNARDDC. Around 30 proposals covering different

areas were evaluated, out of which 11 project proposals were recommended to SSAG for approval. The committee also reviewed 4 ongoing and of 13 completed projects. Similarly the review meeting of PERC) was held under the Chairmanship of Shri Satendra Singh, Joint Secretary, Ministry of Mines on 21-22 January 2020 at JNARDDC, Nagpur. 35 projects were reviewed under the following categories. (i) Exploration and Geo-Sciences & Mining, Mineral processing and Recovery waste and (ii) Extraction, Alloys, Products & Specialty Materials. The PERC members provided their valuable inputs to the presenters for the various ongoing and completed projects.



PERC Members along with dignitaries

Review of JNARDDC by JS (Mines)



Shri Satendra Singh, Joint Secretary, Ministry of Mines visited the JNARDDC labs on 22nd January, 2020. It included the inauguration of two new capital facilities viz (i) High temperature rotary kiln for production of

ceramic proppant from waste material at pilot scale and (ii) Crush test press instrument. The R&D activities were reviewed by Shri Singh.

International Yoga Day



JNARDDC organized International Yoga Day on 21 June, 2019 with great enthusiasm. On this occasion, eminent yoga educator, Shri Nagesh Ghodki from Janardan Swamy Yogabhyasi



Mandal, Ram Nagar, Nagpur demonstrated different yogasanas and enlightened the participants about rich benefits of making yoga as integral part of one's life

Vigilance Awareness

JNARDDC & NIMH jointly observed Vigilance Awareness Week from 28th October to 2nd November 2019 with “Integrity -A way of Life” as the theme. Shri Vinod Dayashankar Godghate, Chief Vigilance Officer (CVO), MECL, Nagpur was the chief guest in presence of Director,



JNARDDC and Vigilance Officers of JNARDDC and NIMH. The week function commenced with the Integrity Pledge by all employees of JNARDDC and NIMH.

Implementation of Right to Information Act, 2005



The Centre received 21 applications? and there were no 1stand 2nd appeal under the RTI Act in the financial year 2019-20. All of them were disposed off within the schedule time frame. The

Centre is regularly updating the website with regards to RTI data.

Welfare for Persons with Disabilities, SC, ST and OBC.



The Centre is following the various government guidelines w.r.t PWD, SC, ST & OBC reservation. The Institute is well equipped with wheel chairs and ramps with a view to make the office accessible to the specially disabled. Persons with disabilities actively participated in various programs such as Hindi week, sports day etc

Swachatha Pakhwara



JNARDDC continued the zeal to implement the Swachh Bharat Abhiyan launched by Hon'ble Prime Minister Shri Narendra Modi. Swachatha pakhwara was observed in Nov 2019. The following activities were undertaken :-

- Cleanliness of all labs and office premises etc which includes repair & maintenance.
- Office lighting systems have been changed with LED lights in a phase-I.
- 264 Kwp rooftop solar panel installed and clean power generation commenced from Jan 2019.
- Eco friendly vending machine installed in ladies wash rooms during the Swachatha week
- Plastic drinking water bottles have been replaced with re-useable glass bottles and drinking glasses.



- Bamboo Plantation scheme undertaken with Department of Forest, Govt of Maharashtra covering 4 kms boundary with a project cost of Rs. 22 Lakhs funded by State Govt. This is under the 33 crore nos of plantation scheme of Maharashtra.

- Plantation drive undertaken under CSR

scheme by Adani Group in 1.5 acres land in JNARDDC with a project cost of Rs. 7 Lakhs funded by Adani Group.

- Van-moutsav undertaken with Social Forestry Division and Department of Forest, Govt of Maharashtra on 23rd July 2019.



Progressive use of Hindi

JNARDDC celebrated Hindi Pakwada during 13th to 27th September. Shri Sunil Kumar Varun of MECL graced the occasion as the chief guest of the inaugural function.



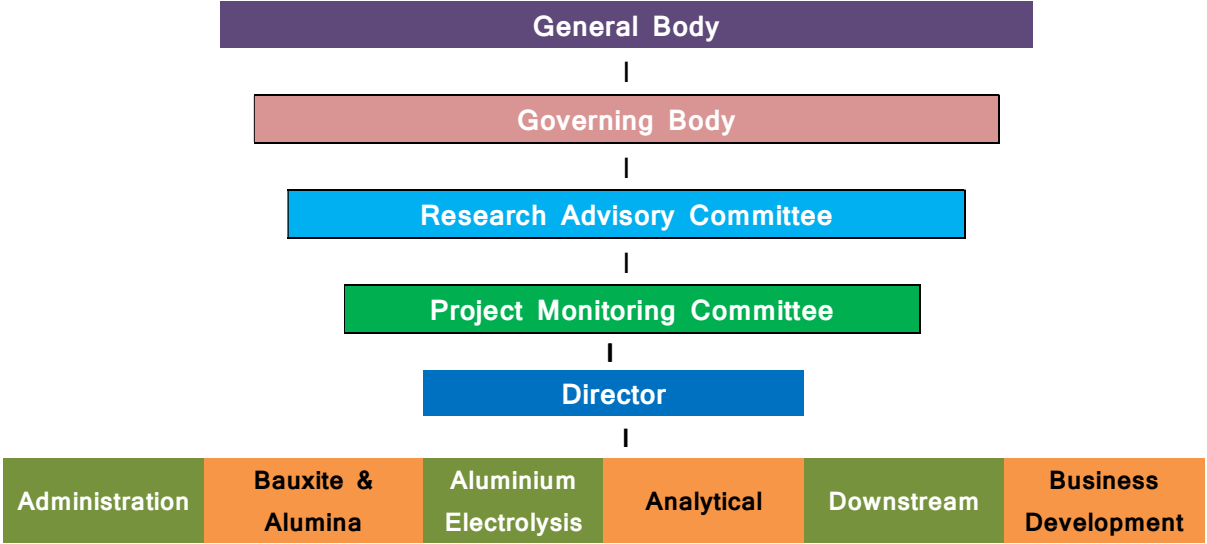
The Institute is actively pursuing the annual targets for communication in Hindi. A workshop on Hindi was conducted under the able guidance of Mr Purshottam Prasad Sahu, Asst Director (Rajbhasha), GSI in April 2019.

JNARDDC Organisational Chart : 2019-20



Shri Sushil Kumar, IAS, Secretary to the Government of India, Ministry of Mines is the **Ex-officio chairman** of the **General Body** and **Governing Body** of JNARDDC. **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 SP 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: 2019-20

Chairman

Shri Sushil Kumar, IAS

Secretary to the Government of India
Ministry of Mines, 3rd 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. Prof. Ashutosh Sharma
Secretary to the Govt of India,
Department of Science & Technology
Technology Bhavan, New Mehrauli Road
New Delhi - 110 016
3. Dr Girish Sahni
Director General, CSIR
Council of Scientific & Industrial Research
Anusandhan Bhawan 2, Rafi Marg
New Delhi - 110 001
4. Dr K Rajeswara Rao, IAS
Additional Secretary to the Govt. of India,
Ministry of Mines,
3rd Floor, Shastri Bhavan
New Delhi - 110001
5. Shri Satendra Singh, IAS
Joint Secretary to the Govt of India,
Ministry of Mines
3rd Floor, Shastri Bhavan
New Delhi - 110001
6. Ms Reena Sinha Puri, 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
3rd Floor, SK Ahire Marg, Worli
Mumbai - 400030
8. Shri Abhijit Pati
Chief Executive Officer
Bharat Aluminium Company Limited
PO: BALCO Nagar KORBA - 495684
Chhattisgarh
9. Shri Chhavi Nath Singh
President & COO
VEDANTA Aluminium & Power
Vill.: Bhurkamunda
Jharsuguda - 768 202, Odisha
10. Shri Atul Bhatt
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: 2019-20

Chairman

Shri Sushil Kumar, IAS

Secretary to the Government of India
Ministry of Mines, 3rd 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 | 8. Shri Abhay Bakre
Director General
Bureau of Energy Efficiency
Ministry of Power
4th Floor Sewa Bhawan, Sector-1
RK Puram, New Delhi-110066 |
| 2. Dr K Rajeswara Rao, IAS
Additional Secretary to the Govt., of India
Ministry of Mines,
3 rd Floor, Shastri Bhawan
New Delhi - 110001 | 9. Dr Vikas Kumar
Director
Defence Metallurgical Research
Laboratory, P.O. Kanchanbagh
Hyderabad - 500 058 |
| 3. Shri Satendra Singh, IAS
Joint Secretary to the Govt of India,
Ministry of Mines,
3 rd Floor, Shastri Bhawan, New Delhi -110001 | 10. Prof SP Mehrotra
Indian Institute of Technology
Gandhinagar, Palaj Campus,
Gandhinagar, Ahmedabad – 382 424 |
| 4. Ms Reena Sinha Puri, IRS
Financial Advisor to Government of India
Ministry of Mines
Shastri Bhawan, New Delhi - 110001 | 11. Prof S Subramanian
Department of Materials Engineering
Indian Institute of Science
Bangalore – 560 012 |
| 5. Shri Abhijit Pati
Chief Executive Officer
Bharat Aluminium Company Limited
PO: BALCO Nagar KORBA – 495684
Chhattisgarh | 12. Shri Ajay Aggarwal
Scientist-E & Member, CPCB
Central Pollution Control Board
Parivesh Bhawan, East Arjun Nagar
Delhi – 110 032 |
| 6. Shri Satish Pai
Managing Director
HINDALCO Industries Limited
Aditya Birla Centre B-Wing, 3 rd Floor,
S.K. Ahire Marg, Worli, Mumbai – 400030 | 13. Prof NS Vyas
Department of Mechanical Engineering
Indian Institute of Technology Kanpur
IIT, Kanpur.
Kanpur – 208 016 |
| 7. Shri Chhavi Nath Singh
President & COO
VEDANTA Aluminium & Power
Vill.: Bhurkamunda
Jharsuguda – 768 202, Odisha | 14. Dr Anupam Agnihotri
Director
Jawaharlal Nehru Aluminium Research
Development and Design Centre
Amravati Road, Wadi, Nagpur - 440023 |

List of Research Advisory Committee: 2019-20

Chairman

Prof. S.P. Mehrotra

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

Members

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

List of Project Monitoring Committee: 2019-20

Chairman

Prof. S. Subramanian

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

Members

1. Shri Ravinder Gaur
Scientist-D / 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 S.K. Roy
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- General Manager (R&D), NALCO
Plot No. 803
JaydevVihar
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 31.03.2019

Dr. Anupam Agnihotri, Director

Scientists : 18

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 Mondri	Scientist
Mr P R Dungore	Principal Scientist	Dr Priyanka Nayar	Junior Scientist
Dr Md Najar P A	Principal Scientist	Mr Ramavajjala Anil Kumar	Junior Scientist
Dr (Mrs) S Rai	Principal Scientist	Ms Prachiprava Pradhan	Junior Scientist
Dr P G Bhukte	Principal Scientist	Mr Kola Immanuel Raju	Junior Scientist
Mr R N Chouhan	Principal Scientist	Ms Jyoti G Pendam	Junior Scientist
Dr U Singh	Principal Scientist	Mr Anas N S	Junior Scientist

Scientific & Technical Supporting Staff : 17

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

Administrative Staff : 9

Mr R Srinivasan	Sr Admin Officer	Ms R Tembhrne	Personnel Officer
Ms R Vishakha	Admin Officer	Mr N D Pethe	Personal Asst
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		

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: 49

New Equipments / facilities

RHEOMETER

Rheometer is used study the stress-deformation behaviour of different solutions and slurries. Equipped with advanced software to analyse the data and temperature control from -40 to 200°C, 5.0 nNm - 225 mNm (Torque range) this instrument of Malvern UK



Make (Model- Kinexus pro+) can determine various parameters of slurries like plastic viscosity, yield point, flow behavior index, flow consistency etc. In particular, rheometer find applications in alumina refinery to understand the rheological characteristics of bauxite slurries during different stages of processing including pre-desilication, digestion, settler and washer units.

DENSITY KIT



Make : Metler Toledo

Applications : Determination of density, specific gravity of ores, rocks and other materials.

CRUSH TEST PRESS

Make : FLOXLAB, France

Applications : Determination of crushing strength of ceramic, sand proppants and other materials.



HIGH TEMPERATURE ROTARY KILN

Make : Kinc Mineral Technologies Ltd, Vadodara

Capacity : 5-20 kg/batch

Maximum temperature :
1550°C

Applications : Calcination of proppant granules and other materials for development of products



ANNUAL ACCOUNTS

2019-20



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



23/11/2020

To,
The Director,
Jawaharlal Nehru Aluminium Research
Development & Design Centre
Amravati Raod
Nagpur-440023

Dear Sir,

I have completed the Audit of your Centre for the financial year **2019-20**. I am enclosing herewith the Audited Balance Sheet and Income and Expenditure accounts along with Auditor's Report for the approval of Governing Body.

During the course of Audit, I have received full co-operation from your staff for which I am thankful.

Thanking you,

Yours faithfully,

For P. S. SAHU & CO.
Chartered Accountants



CA PURUSHOTTAM SAHU
Proprietor
Mem No.: 129802
FRN: 129249W

Place : NAGPUR



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 2020**

(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**

2019-2020

(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 or 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 P. S. SAHU & CO.
Chartered Accountants

Place : NAGPUR
Date :

CA PURUSHOTTAM SAHU
Proprietor
Mem No. : 129802
FRN : 129249W



THE BOMBAY PUBLIC TRUSTS ACT 1950
SCHEDULE IX C

Statement of income liable to contribution for the year ending 31st March 2020
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)		11,23,53,529/-
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	7,30,34,103	
	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 : 2019-2020)

ix). Deductions out of income from lands used for non Agricultural purposes :	NIL	
(a) Assessment, Cesses and other Government or Municipal Taxes, Land tax etc	80620/-	
(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)		3,92,38,806

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 P. S. SAHU & CO.
Chartered Accountants

Place : NAGPUR
Date :

CA PURUSHOTTAM SAHU
Proprietor
Mem No. : 129802
FRN : 129249W



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 31.03.2020

"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.

Sr. No.	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	Sr. No.	Acknowledgement No.	Year
		1	542220111290318	AY 2017-18
		2	354539541291018	AY 2018-19
		3	396497011140720	AY 2019-20
4	PAN of All Trustees	Sr. No.	Name Of Trustee	PAN No.
		1	Dr Anupam Agnihotri (Director)	ABCPAB526E
		2	R Srinivasan (Secretary)	AQIPS8639P
		3	All others are Ex-Officio	-

Place : Nagpur
Dated :

For P. S. SAHU & CO.
Chartered Accountants

CA PURUSHOTTAM SAHU
Proprietor
Mem No. : 129802
FRN : 129249W

THE BOMBAY PUBLIC TRUST ACT - 1950
SCHEDULE VII (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)

Balance Sheet as at 31.03.2020 | 2019-20

LIABILITIES & ADVANCES	SCH	AMOUNT	AMOUNT	PROPERTY AND ASSETS	SCH	AMOUNT	AMOUNT
Trust Funds or Corpus :- Balance as per last Balance Sheet Add: For life Membership		-	-	Fixed Assets :- Balance as per last Balance Sheet Add: Immovable - Movable Properties	C	209,616,732 (2,341,601)	207,275,131
Other Earmarked Funds :- As per last Balancesheet Add: Add this year (Govt Grant - Capital / S&T) (Created under the provision of the trust deed or scheme or out of the income) Depreciation Fund Sinking Fund Reserve Fund		590,514,667 32,200,000	-	Utiensils :- Balance as per last Balance Sheet Additional during the year Less: sales during the year Depreciation up to date		-	-
Loans (Secured or Unsecured) :- From Trustees Balance as per last Balance Sheet Add: during the year From Other		-	-	Income / Other Outstanding :- Rent Interest Other Income (Sundry Debtors)	D	54,397,388	54,397,388
Liabilities :- Fee Expenses Fee Advances Fee Rent and Other Deposits Fee Sundry Credit Balance		-	-	Investments :- TDR With YES Bank TDR with IEBI Bank Add: Accrued Interest Cash and Bank Balances :- a) Cash In Hand b) BANK BALANCE AS PER SCH c) with the trustee d) with the Manager		9,803,910 12,000,000 - 10,162 3,488,408 -	21,803,910
Provision :- Balance as per last Balance Sheet Add: during the year (Audit Fees) Paid during the year	A B	22,148,058 17,680,457	-	Income and Expenditure Account :- Bal. as per last Balance Sheet Less: Appropriation, if any Add: Surplus Less: Deficit (As per I & E A/c)	E	309,174,323 66,393,850	3,498,570
Total		662,543,182	662,543,182	Total		662,543,182	662,543,182

As per our report of even date attached, The above balance sheet to the best of my/our belief contains 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 P S Saha & Co

Chartered Accountant

For Jawaharlal Nehru Aluminium Research Development & Design Centre (Nagpur)

0

CA PURUSHOTTAM SAHU

Proprietor

Mem No 129810, FRN 129249W

UDIN No. _____

Dated : _____

AME KUNJAR JAIN

CHAIRMAN

ANUPAM AGNIHOTRI

DIRECTOR

R. SRINIVASAN

Secretary cum Sr. Admin Officer

JAWAHARLAL NEHRU ALUMINUM RESEARCH
DEVELOPMENT & DESIGN CENTRE :NAGPUR

SCHEDULE-A

RENT AND OTHER DEPOSITS(2019-20)

Previous year	PARTICULARS	(Amt. in ₹)
14059936	Earnest Money Deposit	16275307
85194	Security Deposit :Rajesh S Badkhal	69761
193848	Security Deposit :Media Elevators & Engg Co.	89828
119136	Security Deposit : Mayur Services	155751
490217	Security Deposit : Ganga Security	790836
602492	Security Deposit : Bajaj Steel	288312
2950000	Security Deposit : SMS India Pvt Ltd	2950000
200000	Security Deposit : Libra Agencies	200000
356316	Security Deposit : Sameer Ghadge	907787
1396723	Security Deposit : Enkey Electricals Pvt Ltd	0
0	Security Deposit: Phoenix Power Nagpur	50000
0	Security Deposit:Floxlabs France	370476
20453862	SUB TOTAL (1)	22148058

SUNDRY CREDITORS / OTHER LIABILITIES

SCHEDULE-B

Previous year	PARTICULARS	(Amt. in ₹)
25000	Audit Fee Payable	50000
5384219	Outstanding Liabilities (ANNEXURE A-1)	15172075
5000	Unitech (I) System & Services	5000
8600	Calderys India	0
28710	Bhagwati Trading of Automobiles	28710
84296	Vedatna Aluminium Langigarh	0
6567	Employees EPF	0
21240	Sharp Control Equipment Pvt Ltd	0
129719	Libra Agencies	129719
15500	Chennai Metco Pvt Ltd	15500
121028	TDS GST Payable	0
2950	Castwel Industries	0
16520	MPM Pvt Ltd	0
4248	Graphic Paper Products Limited	0
7660	Tal Manufaxturing solutions ltd	0
2640	Hind Aluminium Ltd Silvasa	0
5310	Carborundum Universal Ltd	0
0	Rahsan Engineering Nagpur	39400
0	Perkin Elmer Singapore Ltd	2247060
5869207	Total-2	17680457
26323069	GRAND TOTAL 1+2	39828515

OUTSTANDING LIABILITIES AS ON 31/3/2020

Previous year	PARTICULARS	(Amt. in ₹)
179813	Water charges bill	65757
260445	Staff Medical bill	0
166490	Rajesh S Badkhal for Gardening contract	197189
169260	Media Elevator co ltd for Elect contract	187921
0	Telephone charges	13716
4056	Courier Charges	0
325355	Mayur Service Housekeeping Contract	343010
464702	Electricity charges	171730
490098	Ganga Security services	599330
20000	Dr Sanjay Marathe	70000
54000	Salary Allowances(CEA)	0
3250000	The Trust Group Grauity JNARDDC A/c	8450000
0	Salary for 03-2020	3943531
0	E P F	1129891
5384219	Total Outstanding Liabilities	15172075

ANNEXURE 'B' OF FIXED ASSETS ATTACHED TO & FORMING PART OF BALANCE SHEET AS AT 31ST MARCH-2020

SCHEDULE - C

(Amt. in ₹.)

Particulars	Rate of Dep %	Cost as at 01.04.2019		Gross Block		Depreciation		Net Block		
		Cost as at 01.04.2019	Address upto 31/03/2020	Depreciation 31/03/2020	Adjustments 31/03/2020	Cost as at 01.04.2019	Dep for the year upto 31/03/2020	Dep on sold items	Cost as at 31.03.2020	Cost as at 31.03.2019
Immovable properties										
Technical Buildings	3.24	51991705	0	0	51991705	1738523	0	43757138	8234567	9971060
Office Buildings	5.63	15644525	0	15544525	1611554	2452726	0	6466780	8637745	8632871
Land		2615177	0	2615177	0	0	0	0	2615177	2615177
Fire Fighting System	4.75	1370062	0	1370062	1270062	0	0	1270062	0	0
Electrical Installation	3.24	31812357	0	31812357	17472357	738533	0	16200690	3611467	4340600
Residential Buildings	5.63	31442316	0	31442316	11885384	512510	0	11637894	19744422	20256632
Large Scale Alumina Lab	4.75	6949295	0	6949295	6924368	24927	0	6949295	0	24927
Air Conditioning	4.75	5645941	0	5645941	3031040	261720	0	4170778	876163	1116953
Sub Total		136172378	0	136172378	86965368	3487449	0	92452837	43719541	47206690
Previous Year		136172378	0	136172378	85172774	3745614	0	85172774	47206690	50999454
Motorable Properties										
Motor Vehicles	11.31	5551497	0	5551497	5138312	415185	0	5551497	0	415185
Furniture and Fixtures	6.33	8353027	60170	8353027	5253027	3068	0	5286435	50362	0
Office Equipments	4.75	2491781	0	2491781	2172355	114085	0	2286440	115341	259426
Telecommunication system	4.75	2021667	0	2021667	1591065	96029	0	1687034	334833	430662
Books and Periodicals	100	6349332	0	6349332	5249332	0	0	5249332	0	0
Lab Equipments Installed	4.75	132566525	6988959	14017447	108531116	6840629	0	115361945	28619502	34045499
Lab equip (SSAG Govt Grants)	4.75	14629395	2240353	16869448	4763928	861259	0	5565237	11334211	8865437
Lab Equip (Nalco Capital grants)	4.75	16396319	0	16396319	693008	913325	0	7914333	11481986	17403311
Lab Equip (Madras)	4.75	18772746	0	18772746	8574108	8617956	0	9455814	5398932	16188637
Lab equipment under-con	4.75	105779406	0	105779406	9448169	5034522	0	14472691	91396715	85331237
Lab equipment DST P-55	4.75	4480171	0	4480171	423718	211836	0	655574	3824597	4036455
Lab Equipments not installed		4453963	7160311	0	4453963	0	0	0	7160311	4453963
Computers	18.21	8210502	0	8210502	6210502	0	0	6210502	0	0
Technical research equip(UNDP)	4.75	70494011	0	70494011	70494011	0	0	70494011	0	0
Sub Total		367206641	1646483	0	412697634	15310845	0	330141445	163059990	162469742
Previous Year		369163114	11272534	0	398163114	822241	0	186651230	162469742	8357151
Gross Total		633402919	16466493	0	549866412	323786188	0	342594282	207275131	209616732

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

SCHEDULE : D - 1/2

F Y 2019-2020

PRE YEAR	PARTICULARS	(Amt. in ₹)
	1). SUNDRY DEBTORS	
3114886	Nalco, Bhubaneswar (Project)	5645994
290995	Energy Efficiency Services Limited Delhi (BEE)	290995
134813	Minex Metallurgical co Ltd	113924
594277	M E C L Nagpur	254163
33446	NEERI	61395
2850	ACE Calderys Ltd	2850
666700	Sesa Sterlite Limited(Vedanta)	0
292300	Swamalata Holding Pvt ltd Raipur	(27065)
0	Ceraflux India Pvt ltd	(900)
11500	Yes Environmental Services	11500
14319000	Ministry of Mines (AMDF Fund /Salary etc) receivable	13383000
130206	GSI Nagpur	130206
59000	Spectris Technologies Pvt Ltd	59000
176000	Vedanta Alu & Power Jharsugda SEZ	176000
0	Tal Manufacturing Solutions Ltd Nagpur	(7660)
2450523	N I M H Nagpur	3026562
200880	Seminar and coference	444278
9879658	GST Credit balance	8841159
47200	Ashapura Minechem Ltd	(600)
103696	Bry Air Asia Pvt ltd	60896
9440	Gharda Chemicals Ltd Mumbai	0
185850	Nalco Angul Testing	185850
1475	Thakkar Inorganics Pvt Ltd	0
11800	MMP Industries Limited Nagpur	11800
30090	Zim Laboratories Ltd	(14750)
2065	Vipra Cenosphere India Nagpur	2065
472000	Hi Tech Matafluxes Raipur	472000
6608	Ran Chemicals Pvt ltd	8968
1180	Anand Mine Tools Pvt ltd	1180
2360	Associated Aluminium Industries Ltd	0
4720	Phonix Amalgams Pvt Ltd	4425
17700	Hindalco Industries Ltd Belgavi	17700
860	Bajrang Power & Ispat Ltd Raipur	5000
12744	Trshakti Alloys Pvt Ltd	(960)
0	Castwel Industries	19470
0	Vedanta Alumina Ltd Langigarh	(143688)
0	Sark Chemicals Pvt ltd	2655
0	MPM Pvt ltd	(14160)
0	National Aluminium Co (Testing)	265500
0	Gujrat Credo Minerals	2655
0	Calderys India Refractories ltd	(10960)
0	MMP Durrans Refracaot Pvt ltd	21400
0	Bill Graphis Paper Product	(4248)
0	Brisil Technologies Pvt ltd	11800
0	Hind Aluminium Industries	(5000)
0	Hindalco Industries Ltd Sambalpur	4720
0	RSA Industries Ltd Nagpur	2360
0	Bhandra Minerals	(5360)
0	Gujrat Credo Alumina Chemical Ltd Katch	2250
0	Bureau of Energy Efficiency New Delhi	87280
0	Thermochem Process Pvt ltd	4130
0	Pratika Dandare	20650
0	MFR Minerals Chindwara	1180
0	Qualab	120
0	Director Geology and Mining Chattisgarh	810872
0	Payable to other party	(300397)
33266822	(Total ' 1 ')	33932205

**JAWAHARLAL NEHRU ALUMINUM RESEARCH
DEVELOPMENT & DESIGN CENTRE :NAGPUR
(2019-2020)**

SCHEDULE : D- 2/2

2). INVENTORIES

90215	STORES(Closing Stock)	110081
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PRE YEAR	PARTICULARS	AMOUNT
196083	Departmental Advances (Annx C-3)	355043

PRE YEAR	PARTICULARS	Amount
109000	Telephone Deposit	109000
315000	Deposit with MSEB	315000
1000	Deposit with Vimal Gas Agency	1000
102410	Deposit with M.S.Water Board	102410
1000	M/s Khurana Gases P. Ltd.	1000
5000	Deposit Speciality Gas Services	5000
11576889	TDS Amt receivables From I tax office	12752373
1500000	Prepaid Expenses	0
127494	Accrued Interest receivable from MSEB/SBI/IDBI	138537
13997	Adv to Track Cargo Pvt Ltd Delhi	28181
3986	Adv Active Cargo Solution Pvt Ltd	3986
725000	Adv Shree Enterprises Nagpur	0
1505460	Adv Sameer Ghadge	0
1157603	Deposit with MSEB for new Connaction	1157603
0	Adv Ashok Hotel	10000
0	Adv to KINC Mineral Technology Pvt Ltd	1940700
0	Adv to Unique Automation Nagpur	234500
0	Adv Shahu Engineering Co Nagpur	55990
0	Adv to Nalco Bhubaneswar for Billets	234623
0	Adv to Navyug Cement Producgts Nagpur	65490
0	Adv to Jeol India Pvt ltd	17700
0	Adv to Kabir Instruments & Technology	13000
0	Adv to Micromeritics USA/Mumbai	541323
0	Adv to Teledyne Instruments Inc USA	536896
0	Adv to Malvern Panalytical Singapore	1735547
17143839	(TOTAL-4)	20000059
50696956	GRAND TOTAL	54397388

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

ANNEXURE OF ADVANCES TO EMPLOYEES ATTACHED TO AND FORMING PART OF

Annexure 'D-3' TO SCHEDULE : D : 2019-20

SCHEDULE D-3

PRE YEAR Amount	PARTICULARS	Current Year Amt
	1: DEPARTMENTAL ADVANCES- EMPLOYEES	(Amt in ₹)
10279	M.J.Chaddha	47000
5000	A.J.Hatwar	5000
5000	R.C. Patley	5000
10000	R.N.Chouhan	5000
5000	R.Srinivasan	20000
5000	Sandeep Barhanpurkar	5000
9820	M.T.Nimje	5272
5000	S.K.Thokal	5000
10000	S.P.Puttewar	0
36000	Viswanath Ammu	51000
25050	Upendra Singh	10050
2928	Vimal Kishore Jha	7074
5000	Dr Anupum Agnihotri	5000
24198	Dr P G Bhukte	15000
2988	R J Sharma	0
5020	Vinod Kshirsaut	5830
5000	Raju Khobragade	17700
0	TA Adv Project staff	15728
5000	R K Meshram	5000
5000	D R Meshram	0
0	Priyanka Nayar	(57)
10000	Rajasekhar Rao	0
0	N D Pethe	47000
5000	K J Kulkarni	1446
0	R Vishakha	5000
0	Suchita Rai	20000
0	Paparao Mondi	5000
0	Anas N S	5000
0	Altaf Hussain	12000
0	Gopal Daware	15000
0	Prabhakar Hedao	15000
196083	Total	355043

JAWAHARLAL NEHRU ALUMINIUM RESEARCH
DEVELOPMENT & DESIGN CENTRE NAGPUR

SCHEDULE-E

5) CASH & BANK BALANCES
F.Y.2019-2020

PRE YEAR	PARTICULARS	AMOUNT
2971271	SBI Chhaoni Nagpur	71271
26237365	I D B I Bank Ltd Nagpur	1124872
2313427	Axis Bank Limited, Nagpur	339136
3031205	YES Bank Saving account(764)	818958
1535611	YES Bank Tax payment Account(901)	0
17380	YES Bank e-Tender Account (830)	19198
52949	YES BANK DST A/c (624)	0
1138462	IDBI Onlice A/c No.(4688)	1114974
37297670	Total	3488408



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

**SIGNIFICANT ACCOUNTING POLICIES AND NOTES ON ACCOUNTS
ATTACHED TO BALANCE SHEET AS ON 31ST MARCH, 2020**

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. 6,63,93,860/- 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. Capital expenses incurred for the various specific projects are directly debited to project expenses and they are not capitalized, since the life of such types of assets are only few years. During the financial year a sum of Rs.35.03 Lakhs incurred for purchase of assets for various project are debited to Income & Expenditure account.
6. 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.
7. Interest from AMDF is yet to be released by the Ministry of Mines. Accordingly, a provision has been made for 2017-18 , 2018-19 & 2019-20 (40.70 + 45 + 48.13) = Rs. 133.83 Lakhs as receivable from the Ministry.

For P S SAHU & CO
Chartered Accountants

For Jawaharlal Nehru Aluminium Research Development
& Design Centre, Nagpur

(P.S. SAHU)
Partner
Member No.129802
F.R.No.129249W

(ANIL KUMAR JAIN)
Chairman

(ANUPAM AGNIHOTRI)
Director

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

Income and Expenditure Account for the year ending 31.03.2020 | 2019-20 |

EXPENDITURE	SCH	AMOUNT	AMOUNT	INCOME	SCH	AMOUNT	AMOUNT
To Expenditure in respect of properties :-							
Rates, Taxes, Cesses		80,620		By Rent (Accrued) (realised)		-	-
Repairs and maintenance	F	4,701,391				-	-
Salaries	G	108,793,352		By Interest (Accrued)		-	-
Insurance		52,666					
Depreciation		18,808,094		Interest on FDR		1,781,553	1,781,553
Other Expenses	H	11,821,887	144,258,010	Interest Received on SB A/c		-	-
To Audit Fees / Expenses		35,429		On securities		-	-
To Printing & Stationery Expenses		180,639		On Loans		-	-
To Postage & courier charges		213,753		On Bank account		-	-
To Project expenses	I	33,155,721	33,777,620				
To Travelling Expenses		192,078		By Dividend		-	-
To Provision for Audit Fees & IT return fees				By Donations in cash or kind		-	-
To Miscellaneous Expenses	J	711,760	711,760				
To Depreciation		-		By Donation from Trustees		-	-
To Amount transferred to Reserve or specific funds.		-		By Grants	K	73,034,103	73,034,103
To Expenditure on object of the Trust :-							
a. Religious		-		By Income from other sources			
b. Educational		-		Technical Testing Fee		9,779,981	
c. Medical Relief		-		Income from Research Projects	L	21,562,800	
d. Relief of poverty		-		Miscellaneous Receipts	M	3,705,093	
e. Other Charitable objects		-		Technical Seminars / Training Program			
		-		Receipts	N	2,489,999	
		-		Prior Period Income Against Sundry Debtor		-	
		-		By Amount Written off		-	
		-		By Contribution For Visit		-	
		-		Excess of expenditure over income carried over to B/S		-	
To Surplus carried over to B/S.							37,537,873
TOTAL			178,747,389	TOTAL			178,747,389

AS PER OUR REPORT OF EVEN DATE ATTACHED FOR P. S. SAHU & Co

For Jawaharlal Nehru Aluminium Research Development & Design Centre.

G.A. PURSHOTTAM SAHU
 PROPRIETOR
 Member No.128932 FRN.128/49
 UDIN : _____

ANIL KUMAR JAIN
 CHAIRMAN

ANUPAM AGNHOTRI
 DIRECTOR

R SRIVIVASAN
 SECRETARY CUM SR ADMIN OFFICER

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

(F.Y.2019-2020)

SCHEDULE - F

PRE YEAR	REPAIRS AND MAINTENANCE	AMOUNT
16014	Township	0
159665	Electrical Works	26209
75218	Office building /Technical complex	100647
107649	Rep & Maint Office Vehicles	121069
25501	Rep & Maint Guest house	8997
20987	Rep & Maint Office Furniture	19856
405034	TOTAL	276778
12802273	Rep & Maint (Major Non Recurring civil work)	4424613
13207307	GRAND TOTAL REPAIR & MAINT	4701391

SCHEDULE - G

PRE Year	PARTICULARS	AMOUNT
	SALARY COMPONENT	
57807655	Salary and Allowances	65881174
891000	Children Education Allowance (CEA)	945000
6000000	Gratuity Contribution to LIC	7200000
117436	Staff Bonus	133258
1364637	Medical Reimbursement	1811481
5759254	Employer's Contribution to EPF	6622671
699350	Leave Encashment	3189883
251340	Administrative charges on EPF	276156
0	Administrative charges on EDLI	7425
39750	Employer's Contribution to EDLI	37050
171147	Group Insurance scheme (GIS)	176092
1289154	LTC expenses	343614
2613563	TA expenses	2846974
2062579	Salary / wages paid to Electrical contract staff	2189823
2029151	Salary / wages paid to office & Campus Maint contract staff	2132871
4032182	Salary / wages paid to Office boys/Peons contract staff	4526409
5617779	Salary / wages paid to Security Services contract staff	7055859
305357	Salary paid to Consultant (Admin / Stores)	598500
871200	Salary paid to Consultant (Technical)	871200
253000	Salary paid to Lab Asst. (Contractual)	351599
359262	Salary Scientific Asstt (Contractual)	1144667
92400	Salary (Admin. IT / Lib.)	451646
92627196	Total Salary Exp.	108793352

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

F.Y : 2019-20

SCHEDULE-H

PREVIOUS YEAR	PARTICULARS	AMOUNT
	ESTABLISHMENT EXPENSES	
556894	Printing & Stationery	0
212690	Postage & Courier charges	0
86677	Telephone / Fax charges	119321
163703	Internet/ Broadband charges	72502
237905	Office Expenses	217214
253775	Fuel and Oils (Vehicle)	0
7195	Subscription to Periodicals	3940
80620	Rent, Rates and Taxes	0
12564	Entertainment	0
0	Legal Expenses	236500
1528713	Seminars and Conferences	3535622
238613	Staff Canteen / welfare exp.	289579
41589	Advertisement	7366
217726	Meeting expenses	194607
21264	Computer Stationery/Consumable /Anti-Virus Kit	37323
24247	Republic / Independence day / Foundation day	29104
40664	Audit Expenses	0
52658	Hindi Programme exp	37196
0	Patent filling exp	113000
112305	Plantation Expenses	77997
188370	Library & Information Expenses	5776
30120	Bank Charges	16406
123159	Recruitment expenses	0
7000	Honorarium	0
1910155	GST Payment	0
0	Professional fees (CA) for itax, gst work etc	60000
0	Travelling exp project staff	26466
6148606	TOTAL (Establishment Exp)	5079919

6475004	UTILITY EXPENSES	6741968
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12623610	GRAND TOTAL (Other Exp)	11821887
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**JAWAHARLAL NEHRU ALUMINUM RESEARCH
DEVELOPMENT & DESIGN CENTRE :NAGPUR**

FY : 2019-2020

SCHUDULE - I

PRE YEAR	PROJECT EXPENSES(2019-2020)	AMOUNT
30477	S-18 Development of Super thermal Al. alloy (STAL) (SSAG)	0
189277	S-19 Devlopment of refractory material from saprolite (SSAG)	0
9474531	S-20 Development of process model etc using porthole dies (SSAG)	0
1938889	S-21 Synergistic Utilise of aluminium waste (SSAG)	0
1060445	S-22 Devp Strip Casting (SSAG)	0
1766478	S-23 Effect of Modified seed properties (SSAG)	0
975455	S-24 Large scale Digital Database of bauxite(SSAG)	0
386652	S-25 Fabrication of adv ceramic nanocoatings for automotive(SSAG)	245127
786322	S-26 Febrication of Adv Ceramic nanocoatings for automotive appl (SSAG)	114740
1087849	S-27 Estimation of Morphodynamicity (SSAG)	175140
1514390	S-28 Status report on work carried out on Red mud Project (SSAG)	181228
404510	S-29 Al scrap recycling (SSAG)	2506272
521634	S-30 Fire Retardacny Nano (SSAG)	1009755
0	S-31 Bench scale study of AlF3 extraction CFA (SSAG)	1782443
0	S-32 Digestion Efficiency project(SSAG)	140003
0	S-33 Dross Utilisation Bench Scale(SSAG)	40655
0	S-34 CRMS for Analysis of Aluminium Alloys(SSAG)	37196
5000	N-38 NALCO Otmisation of Parameter	0
144000	N-39 NALCO Strip Casting project	0
171542	N-40 NALCO Mechanical Activation of Bauxite	5000
996612	N-41 NALCO Studies on trace impurities project	40084
630014	N-42 NALCO Utilization of PLK project	923134
700944	N-43 NALCO Devp of Inline Automates anode	1206108
780332	N-44 NALCO Devp of A Wi Fi enabled sensor	1482040
814397	N- 45 NALCO Devp of ceramic Proppant from PLK	727187
0	N-46 Iron values from Red Mud	2684805
269683	Nalco Training Programme	160242
4000	P 49 VEDANTA / Sesa Sterlite SPL Project	0
1879632	P-55 DST Utilization and Devp of process for recovery of rare earth	1344883
47552	P-56 Hi Tech Metal raipur: Characterisation studies of raw matts- dross	0
989465	P-57 Measurement of bath parameters for Hindalco Hirakund	90491
205190	P-58 Vedanta Technological testing of Bauxite	463103
0	P-59 IBAAS Extraction of ALF3 from Low grade Bauxite	73917
15057	P-60 3N Pure alumina LED(DST)	1615374
0	BEE (EESL) Project	14668
803285	MECL Nagpur Testing Project work	419620
8272122	DPR grant expenses	12955201
25435	In house R & D Work	0
748503	G S I Tesing work	370346
1800089	NABL Certification	379271
0	Extrusion press/Rolling and billet casting setup exp	1940710
0	Odisha Mining Testing exp	16978
39439763	TOTAL (Project Exp)	33155721

LAB OPERATIONAL EXP(2019-2020)

SCHEDULE - J

PRE YEAR	PARTICULARS	AMOUNT
51750	Lab Operational & Consumables / Spares	503760
181000	AMC Computers	208000
232750	TOTAL	711760

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

F Y: 2019-2020

SCHEDULE - K

GOVERNMENT GRANTS

PRE YEAR	PARTICULARS	AMOUNT
4500000	GOVT REVENUE GRANT FROM AMDF	4813000
55473000	GOVT SALARY GRANT	56427000
59973000	Sub Total-1	61240000
	Ministry of Mines Govt. Grants for Science & Technology Projects	
58317	S-19 Development of refractory material from saprolite (SSAG)	0
1817100	S-23 Effect of Modified seed properties (SSAG)	0
1297053	S-24 Large scale Digital Database of bauxite(SSAG)	0
0	S-25 Nano Processing of industrial rejects (SSAG)	572103
648000	S-26 Fabrication of adv ceramic nanocoatings for automotive(SSAG)	0
800000	S-27 Estimation of Morphodynamicity project	0
1684891	S-28 Status report on work carried on Red mud Project (SSAG)	0
2050000	S-29 Techno Eco Survey of Al Scrap (SSAG)	2769500
699000	S-30 fire retardancy Nano(SSAG)	847700
3820500	S-31 Bench scale study of AlF3 extraction from CFA(SSAG)	0
0	S-32 Digestion efficiency(SSAG)	1738800
0	S-33 Dross Utilization Bench Scale(SSAG)	3097000
0	S-34 CRM's Analysis of Aluminium Alloy	1769000
0	Grant-IEC for Seminar - ICNFMM-	1000000
160600	DST TIFAC Bauxite Seminar	0
13035461	Sub Total-2	11794103
73008461	Grand Total 1+2	73034103

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

INCOME FROM RESEARCH PROJECT

F.Y- 2019-2020		SCHEDULE - L
PRE YEAR	PARTICULARS	AMOUNT
	B).Other Research Projects//Thermography	
2770560	N-40 Mechanical Activatin of Bauxite, NALCO	0
2250000	N-41 Studies on trace Impuurities Project, NALCO	0
0	N-42 Utiliszatin of PLK Project NALCO	2550000
0	N-43 Development of inline automated andoe project, NALCO	1242720
0	N-44 Development of a Wi Fi enabled sensor, NALCO	1184640
0	N-45 Development of Ceramic Propant PLK project, NALCO	2401440
0	N-46 Value from red Mud Project NALCO	4284000
1476000	P-55 DST Utiliztion and Devp of process for recovery of rare earth	0
400000	P-56 Characterization study Hi Tech metal Raipur	0
2000000	P-57 Equip for online bath Hindalco	0
6600000	P-58 Vedanta Technolgical testing of Bauxtie	9900000
500000	P-59 Extraction of ALF3 from low Grade Bauxite,(IBAAS)	0
3141994	P-60 DST on 3N pure Alumina LED	0
19138554	TOTAL (Income from Research Projects)	21562800

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

**Miscellaneous Receipts
2019-2020**

SCHEDULE-M

PRE YEAR	PARTICULARS	AMOUNT
81435	Misc.Receipts	402983
40438	Licence fees and water charges	75023
249558	Guest house/ Qtr. rent / charges received	246974
137000	Tender Fees	17420
2396523	15 % common facility & HRA charges of NIMH	2787042
31000	Vendor registration fees	11000
0	Sale of store materials/unservisable	26555
13000	Application fees	0
228421	Liquidated damages (LD)	138096
764315	Prior period income against written off of payble Amt EMD	0
196089	Prior period income not payable to Sundry debtor	0
4137779	TOTAL (Miscellaneous Receipts)	3705093

Program Receipts : Technical Seminar/Training Program

2019-20

SCHEDULE - N

PRE YEAR	PARTICULARS	AMOUNT
1323000	Training fees from Nalco	0
50000	Training fees Spectris etc	0
73898	Seminar on WEM-2018	0
0	Seminar/Meet on Red mud-2019	1500000
0	Seminar on Capacity Building Programme-2019	974746
0	Seminar BMM-2020	15253
1446898	Total (Program Receipts)	2489999



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