



NCB NEWS

JANUARY 2021



Ballabgarh-Head Office



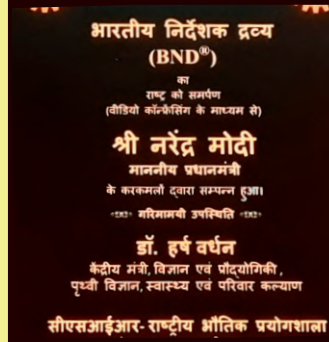
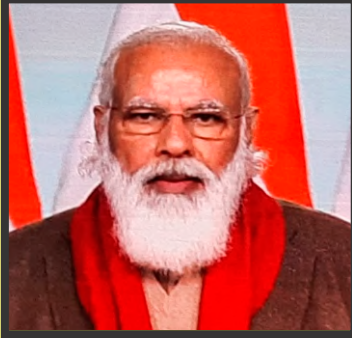
Hyderabad-Unit



Ahmedabad-Unit



Bhubaneswar-Project Office



NCB is proud to announce that four Bhartiya Nirdeshak Dravya (BNDs) developed by NCB for Cement & Cementitious materials in association with CSIR-NPL, Delhi were launched by Hon'ble Prime Minister of India on 04th January 2021. Earlier, 10 BNDs for Indian Cement Industry were developed by NCB in 2018-19 and 2 BNDs were developed in 2019-2020.

HEADLINES

- * **NCB in the service of nation**
 - NCB's B&D
 - Alignment of activities with schemes & missions of Govt.
- * **Bamboo Webinar**
- * **Training Programs & Presentations**
 - Intercem Asia
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- * **Sun dial at NCB-Ballabgarh**
- * **Interaction with academia & research institutes**
 - MoU with academic institutions
 - Visit to CBRI-Roorkee
 - Visit to CPPRI-Saharanpur
- * **Days observed & events celebrated**
 - Swachhata Pakhwada
 - Constitution Day
 - Vigilance Awareness Week
 - Jan Andolan for COVID-19
 - National Unity day
 - NCB day

Editor: Sh Saurabh Bhatnagar
Sh Lalit Yadav
Designed by: Sh Devender Baghel

From the desk of Director General

Dear Readers,

We've just gone through one of the most eventful years in recent history. I want to take a moment to wish Happy New Year 2021 to all our stakeholders. The year gone by was unprecedented in many ways. COVID-19 pandemic, one of the global health crisis of our times not only costed valuable lives but also dented the economies of the world in an untold manner.

But mankind yet again is on the verge of passing the test of resolve and solidarity. Our trust in science has paid off and our health experts are on the brink of finding a permanent solution to end this menace. However, we must not forget the words coined by our Hon'ble Prime Minister - "*Dawai bhi Kadai bhi*" (*Medicine also and caution also*), which means that COVID Appropriate Behavior has to be followed even as the vaccine has arrived.

It is expected that cement demand in the country will rise by 20% in FY'22, allowing local market to return to volumes previously seen before the pandemic. This growth is likely to be supported by rural demand, including affordable housing and recovery in infrastructure segment.

Now is the opportune moment to turn challenges into opportunities. We at NCB have set an internal target of becoming financially *AtmaNirbhar* by 2023. NCB has also compiled ideas of merit received from its staff on ways to expand activities to increase internal revenue generation.

In this version of NCB e-news, one can find details of National Metrology Conclave where Hon'ble PM dedicated Bhartiya Nirdeshak Dravyas (BND) developed by NCB along with CSIR-NPL to the nation. This edition also covers webinars organized by during the last quarter. The workshop on Utilization of Bamboo as an Alternative Fuel in cement industry is worth mentioning where we enlightened with ideas of Hon'ble Minister of MoRTH & MSME, Sh. Nitin Gadkari Ji. Further, highlights of select on-going research projects and abstracts of papers recently published in journals of International repute by our scientists and engineers are covered. I hope that the content in this edition invokes keen interest of readers on latest on-going research activities. In times to come, we look forward for support and to live up to the expectations of our stakeholders by delivering key sustainable ideas to help businesses and society grow.

I sincerely hope that you find this edition of NCB e-news quite interesting. Wishing you all happy, healthy and innovative future. Jai Hind!



Dr. B N MOHAPATRA

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

(Under the Administrative Control of Ministry of Commerce & Industry, Govt. of India)

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NCB's BND - dedicated to Nation by Hon'ble Prime Minister of India

NCB has developed 04 Bhartiya Nirdeshak Dravya (BNDs) for cement & cementitious materials in association with CSIR-NPL, Delhi. NCB's BNDs were dedicated to nation by Hon'ble PM of India Shri Narendra Modi Ji at a glittering function on National Metrology Conclave in CSIR-NPL on 04th January 2021 in the presence of Dr. Harsh Vardhan, Hon'ble Minister for Science & Technology, Dr. Shekhar C Mande (DG-CSIR), Dr. D K Aswal (Director-NPL), Dr. B N Mohapatra (DG-NCB), Sh. Amit Trivedi (Head, Centre for Quality Management, Standards & Calibration Services-NCB), NCB team and the scientific community of India. Bhartiya Nirdeshak Dravya (BND) is Indian Certified Reference Materials which are being used for Quality Control & Quality Assurance as well as for evaluating proficiency of analysts, evaluating various test methods and calibration of equipment. These BNDs derive their traceability to SI units from CSIR-National Physical Laboratory (NPL), India, the custodian of National Standards in India. These BNDs are equivalent to Standard Reference Materials (SRM) produced by NIST, USA and will substitute the import of International Standard products thus giving a boost to "Make in India" & "Atmanirbhar Bharat" programme to harmonize quality infrastructure within the country.

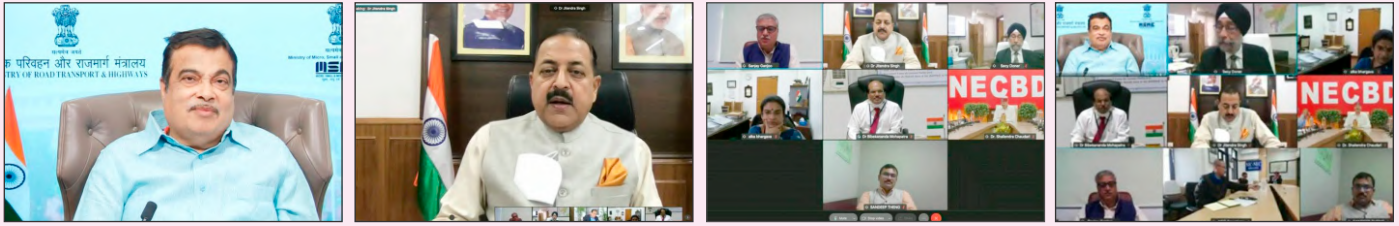


NCB's activities aligned with schemes and missions of Govt. of India

 Skill India कौशल भारत - कुशल भारत	Skill India Mission	NCB's Centre for Continuing Education (CCE) and Centre for Industrial Information Services (CIS) has been organizing various industry oriented training programmes and Seminars / Workshops / Online Training/Webinars for cement, concrete, construction and building material sectors. Beneficiaries: Entire Cement Industry, IAF, RBI, BRO, Indian Post, Indian Railways, CPWD, PWD & Water Resources Department of various State Governments, BPCL, HPCL, IOCL, DMRC, NBCC India Ltd., NHPC Ltd., Power Grid Corp. of India Ltd., NTPC, GAIL India Ltd.
	Make in India	To promote "Atma Nirbhar Bharat" and "Make in India" programme by reducing the import of foreign Standard Reference Materials, NCB's Centre for Quality Management, Standards & Calibration Services (CQC) developed 12 Bhartiya Nirdeshak Dravya (BNDs) for cement and cementitious materials. CQC provides Proficiency Testing services as well as Calibration services traceable to National / International Standards in various fields of force, temperature, mass & volume, dimension, pressure and RPM.
	Reduction of CO₂ intensity by 33-35% by 33 to 35 per cent by 2030 below 2005 levels	NCB's Centre for Cement Research and Independent Testing (CRT) has undertaken extensive research for Clinker Substitution to achieve specific CO₂ emissions to 0.35 tCO₂/t of cement by development of: <ul style="list-style-type: none"> • Low Carbon Clinker • Portland Composite Cement based on fly ash and Limestone • Portland Limestone Cement and • Portland Dolomite Cement • Multi component blended cement
	Swachh Bharat	NCB's Centre for Construction Development and Research (CDR) has done extensive research on utilization of C&D waste as well as other industrial waste as an alternative to natural fine and coarse aggregates. Development of Geopolymer Cement and Concrete systems. NCB's CRT & CME centres are actively working with cement industry for utilization of various wastes as Alternative Fuels and Raw Materials to enhance %TSR from 4% to 25% by 2030.
	PAT Scheme of BEE	NCB's Centre for Mining, Environment, Plant Engineering and Operations (CME) has carried out over 150 Energy Audits of cement plants for improving Energy Efficiency under the Perform Achieve & Trade (PAT) scheme of Bureau of Energy Efficiency (BEE), Ministry of Power, Govt. of India. CME is also carrying out research on ways to maximize Waste Heat Recovery and utilize Renewable Energy in cement related operations
	Smart Cities Mission	NCB's Centre for Construction Development and Research (CDR) is providing reliable technical services to ensure durable and sustainable infrastructure by undertaking Third Party Quality Assurance and Audit of Construction Projects such as Convention Centres, Buildings, Bridges, Roads etc. for CPWD, PWD, IDCO Odisha, Telangana, Power Grid Corp. Ltd., ITPO (Pragati Maidan), International Convention Centre Dwarka, Ambedkar Memorial, NTPC, Bhakra Dam, AIIMS etc



**NCB, IFGE & NECBDC jointly organized webinar on
“Utilization of Bamboo as Alternate Fuel Resource for Cement Plants in India”
Bamboo Technology | Products | Services Exhibition**



NCB in association with IFGE and North East Cane & Bamboo Development Council, under North Eastern Council, Ministry of DoNER, Govt. of India organised a Webinar on “*Utilization of Bamboo as Alternate Fuel Resource for Cement Plants in India*”. The webinar was inaugurated by Shri Nitin Jairam Gadkari, Hon'ble Minister, MoRTH & Ministry of MSME, GoI, and Dr. Jitendra Singh, Hon'ble MoS (I/C), Ministry of DoNER, GoI.

The objectives of Webinar were

- * To deliberate on characterization and availability of different bamboo species to be used as AFR in Cement Plants.
- * To understand the acceptability of the Cement Industry for bamboo as AFR.
- * Policy advocacy for utilization of waste land for bamboo plantation by Cement Industry for their use.
- * National demonstration plantation of Bamboo as “Energy Crop”.

The targeted beneficiaries for the Webinar were

- * Indian Cement Industry.
- * National & State Bamboo Missions.
- * R&D institutes working in cement & bamboo sector.
- * Experts from the bamboo sector who are working on bamboo as “Energy Crop”.
- * Forest Department & Climate Change Experts.
- * Other energy intensive industries like power plants, iron & steel plants who are using bamboo as fuel substitute.

During the inaugural session, key information and ideas were also shared by:

- * Dr. Inderjit Singh, IAS, Secretary, Ministry of DoNER, Govt of India, New Delhi.
- * Shri K Moses Chalai, IAS, Secretary, North Eastern Council, Govt of India, Shillong.
- * Dr. Alka Bhargava, Addl. Secretary, NBM, Ministry of Agriculture and Farmers' Welfare, Govt of India, New Delhi.
- * Shri Annasaheb M K Patil, Former Union Minister for Rural Development, Govt. of India and Founder Chairman, IFGE, New Delhi
- * Dr. Shailendra Chaudhari, MD, NECBDC
- * Shri Mahendra Singhi, Chairman, NCB
- * Dr. B N Mohapatra, DG, NCB

Speaking at the Inaugural session, Sh. Nitin Gadkari expressed his happiness for the initiative taken to accelerate the use of Bamboo. He emphasized upon the need of more intensive use of bamboo resources of the country and asked various sectors to utilize various modes and methods to bring down logistics costs including choosing more cost-efficient transit mode like water, rail or road. Sh. Gadkari called for producing high yielding bamboo varieties. The greater yield and wider bamboo usage will open up more employment generation especially in Northeast India.

Dr. Jitendra Singh said that Ministry of DoNER and North Eastern Council is taking all measures for tapping bamboo resources and technical know-how at all India level. He also said that it is imperative to make bamboo a pan India perspective, for its growth and utilization adding that his ministry is already exploring bamboo reserves in different parts of the country. Dr. Jitendra Singh said that bamboo has great potential for its use as a clean source of energy and can also replace single use plastic, thus promoting the environment and climate cause in India.

Shri Mahendra Singhi shared his thoughts and expressed that more utilization of Bamboo is important for the development of North East. He said that Bamboo can transform rural life, transform Climate and transform profitability of an industry.

Dr. B N Mohapatra, DG-NCB highlighted the activities of NCB carried out under the missions and schemes of Govt. of India like development of low carbon cements for reduction of carbon footprint, training imparted to personnel of cement and construction industry under Skill India, developments of BNDs under Make in India, waste utilization as AFR in cement industry and C&D waste as aggregates in construction industry under Swachh Bharat Mission etc.



Webinar organized

One-day workshop on '**Low Carbon Cements-Options and Opportunities**' was organized by Expertise Group, "Low Carbon Cement (*EG-3-LCC*)", led by Sh. S K Agarwal on October 20, 2020, with more than 70 participants, from cement and construction industry, under the guidance of leadership of DG-NCB and Dr. S K Chaturvedi (*HoC-CRT*) covering wide range of topics like Low Carbon Technology Road Map, Blended Cements, Geopolymer, Belite, Calcium Sulfoaluminate, BYF Clinkers, Carbonated Calcium Silicate Binders, CO₂-cured concrete etc., to mitigate carbon and energy footprint for greener cement industry.

Feedback from Cement Industry Experts

Today's Session was really excellent with so many exciting technologies being shared. I can say that NCB is doing lot of work in this direction. I would further say that please keep continuing the hard work in this direction and lets us arrive at break through technology which can help the Indian Cement Industry in reducing the Carbon foot prints going ahead.
Shashi Gaggar, Vice President, Ultratech Cement Ltd.

Thanks to Dr Mohapatra and the entire NCCBM team for organising an excellent one Day online workshop on "Low Carbon Cement - Option & Challenges", during Covid 19. Excellent presentations on various topics related to developments in the Low Carbon Cement systems. The contents of the presentation were nicely designed and were very elaborative with relevant details related to the technology, chemistry & mineralogy, reactivity etc. with focus on development of various cement types, ongoing research and updates at NCCBM laboratory. Sincerely appreciate the reorganisation of the expert groups at NCCBM, under the leadership of Dr Mohapatra. In future, I think NCCBM will be at par with the various international agencies. The recent steps from NCCBM to have further collaboration & coordinations with the industry experts and the premier academic institutes like IITs, will reduce the gap between actual practical issues faced at industry and academic theoretical concepts, this will have win-win and supplementary to each other. Ram Chawal, Head- Production & Process Development, CEM Asia

"Thanks to entire NCCBM team for the excellent presentations on various topics related to developments in the Low Carbon Cement systems. The contents of the presentation were nicely designed and were very elaborative with relevant details related to the technology, chemistry & mineralogy, reactivity etc. of the respective system and I am sure that all the participants would have learnt a lot from these insightful sessions. This workshop made us realize the expertise NCCBM has developed in this new area of Low Carbon Cement systems under the leadership of Dr Mohapatra and now going forward I think NCCBM is at par with the various international agencies and with further collaboration with the industry experts, we can foresee some new types of cement being worked on, getting approved by BIS and commercialized with a view to make our cement manufacturing far more sustainable."
Manish Kuchya, Manager, Central R&D | UltraTech Cement Ltd.

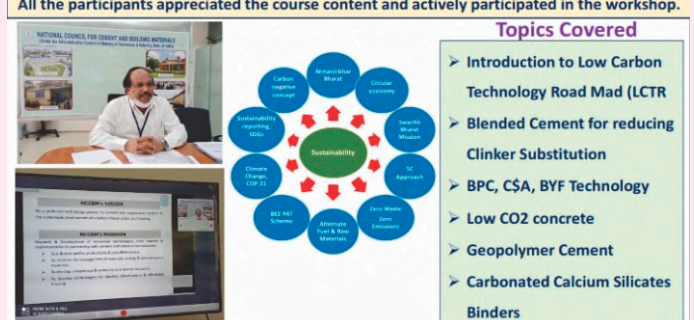
"LOW CARBON CEMENT - OPTION & CHALLENGES"

The Workshop was attended by total 80 participants comprising of 70+ Senior and other officials of cement plants and 10 NCB officials.

All the participants appreciated the course content and actively participated in the workshop.

Topics Covered

- Introduction to Low Carbon Technology Road Mad (LCTR)
- Blended Cement for reducing Clinker Substitution
- BPC, C₃A, BYF Technology
- Low CO₂ concrete
- Geopolymer Cement
- Carbonated Calcium Silicates Binders




DG-NCB gave a presentation in **Intercem Asia- Pacific** webinar series on NCB's role towards sustainability of Cement and Construction Sector where spoke of steps taken by Indian cement industry for reduction of carbon footprint and studies taken at NCB on Low Carbon Cements and Resource Conservation for enhancing sustainability. He also talked about usage of Alternative Fuels in Indian Cement Industry, energy efficiency improvement and latest technologies like carbon capture and utilization. A similar presentation was given by DG in India Construction Week 2020 where he also told the industry about the NCB's expertise groups of scientists and engineers formed to serve the construction sector.

DG-NCB also gave a presentation on **World Standards Day 2020** with the theme of "Protecting the Planet with Standards. He talked about the recent standardizations which were carried out by BIS based on research at NCB. He made the participants aware about the challenges faced by Indian cement industry which are:

- * High carbon footprint during cement manufacture
- * Depletion of Cement Grade Limestone & fossil fuel
- * Utilization of Industrial wastes
- * Maximize the use of total generation of Fly Ash
- * Lower Thermal Substitution Rate in Indian cement kilns
- * Timely formulation/revision of BIS Standards

NCB is playing a key role in validating variety of industrial wastes as mineral component in cement manufacturing and it is incorporated in number of BIS specifications at right time. More than 40 NCB officials are serving BIS committees, sub committees and panels as Chairmen, Convenors and Members.

Training programmes organized at NCB-Hyderabad

One day online training programme on "**XRF: Fundamental Principles and Calibration**" was organized in December 2020, NCB Hyderabad. DG-NCB inaugurated the training programme which was attended by 80 participants from various cement plants in India. CTL Group- US, IRTECH-India and NCB Scientists were the key faculties for the program.

Two days online training program on "**Performance Evaluation of Concrete Structures**" was organized in October 2020, by NCB Hyderabad. 34 participants from Construction Industry & Cement plants i.e. Highways Research Station, KCP Limited, Larsen & Toubro Limited, Madras Atomic Power Station, Marshal Geo Test Laboratory, My Home Ind. Pvt. Ltd, NLC India Limited, National fertilizers Limited, RITES Ltd, RBI attended the training programme.

Two days online training program on "**Optimisation of Raw mix to Improve Clinker Productivity**" was organized in October 2020, by NCB Hyderabad. DG-NCB inaugurated the training programme, Opening remarks by Sh. K V Rao, Scientist -E & Head, BIS - Hyderabad 60 participants from various cement plants in India attended the training programme. BIS and NCB scientists were the key faculties for the program.



Atmanirbhar NCB

COVID-19 has impacted lives and economy across the globe including India. This has negatively impacted the finances of Govt. of India which has resulted in reduced financial support to autonomous organizations from Govt. of India. As NCB is also one of such organization under DPIIT, therefore, it is expected from NCB to become financially self-sustainable or Atma Nirbhar.

DG-NCB has initiated work in direction of “*Atmanirbhar NCCBM*” in line with the mission and vision of Hon'ble PM. He has set a target of internal revenue generation of Rs 50 crore in the year 2022-23 to meet the establishment and recurring expenditure of NCB.

In this regard, a competition amongst staff of NCB was organized wherein innovative ideas to make it financially self-reliant were submitted as scripts and later on presented to a panel of jury comprising of distinguished experts from the industry. Around 60 scientists, engineers and support staff participated in the competition comprising of 20 teams and gave valuable ideas to enhance the internal revenue generation of NCB.

A select list from the many ideas received is:

01. Starting Project Management Consultancy (PMC) Services in Construction projects as well as Cement projects.
02. Audit of RMCs unit in India by collaboration with BIS or QCI.
03. To enter into MOU with NTPC plants for monitoring of their fly ash quality.
04. Tie-up with Equipment suppliers for the supply of Plant Specific XRF/XRD Standard Samples.
05. Utilisation of Artificial Intelligence.
06. Development of New CRM for Alternative Fuels.
07. Setting up of Third Party Quality Assurance laboratory for structural steel/ piping works.
08. Setting up of Bitumen testing Laboratory.
09. Annual contracts with cement plants, for solving their market related cement quality issues.
10. Restructuring of NCB Centres: More focus on Sustainability, Renewable Energy divisions, Material Testing Division, and Alternate Building Materials
11. Online portal for technical services.
12. Alternate Sources of funding for R&D projects by applying for grants from DST, MoEFCC, Ministry of Steel etc.
13. Certification of Ceramic and Refractory Materials.
14. Sustainability Awards for Cement and Construction Industry.
15. Enhancing the present scope of testing in Test House.
16. MoU with IITs and NITs for Research Collaboration.
17. Dissemination of NCB R&D work by online Symposia/Workshop which will help in enhancing footprint of NCB.
18. Organisation of International Conferences in Middle East and other countries.

Meeting International Standards

NCB is consistently benchmarking itself with top R&D institutes, world over. It's vision is to become top institute of Asia and to be with in top 3 R&D institutions in cement & concrete in the world.

Institutional Linkage & Networking

To have research & technical collaboration with prestigious educational institutes/ universities and reputed Research Organizations of India to enhance R&D activities in the field of cement & concrete.

Practical Oriented Research projects

To carry out more applied research projects aimed towards Sustainability, reduction in carbon footprint, Renewable Energy, Carbon Capture and Utilization, development of admixtures, advanced building materials and Total Quality Management.

Meet criteria for Innovation Excellence Indicators of Public Funded R&D Institutions

- * To increase publications in reputed International Journals with high Impact Factor.
- * To increase number of citations of published papers.
- * To register more number of patents based on R&D work at NCB.
- * To organize more number of Symposia/Seminars.
- * To incubate Start-Ups.
- * To start Ph.D program.
- * To increase number of interns getting trained at NCB.

Enhance visibility of NCB

- * To increase the visibility of NCB amongst its stake holders which are Govt. of India, Cement Industry, Construction Industry, DPIIT, Ministry of Coal, MoEF & CC, BIS, CPCB, Academia and Society.





VISION 2023 FOR NCB

Infrastructure Development

- * Setting up of Alternate Fuel and Raw Materials (AFR) Laboratory.
- * Repair and Renovation of NCB colony quarters.

Expansion of Bhubaneswar Units

- * Setting up of chemical testing laboratory, obtaining NABL scope extension & getting BIS laboratory recognition is targeted before the end of financial year 2020-21.

Expansion of Hyderabad Unit

- * Establish NABL accredited Calibration Laboratory.
- * Expansion of Concrete Laboratory.
- * To increase the activities by shifting to bigger premises.
- * Expansion of Calibration and testing activities.


Develop Competency and Productivity in HRD

- * Total Employee Involvement to improve the quality culture of the Institute.
- * Implementation of transparent Key Result Area (KRA) and Appraisal System.
- * Instant Appreciation by immediate recognition of good works carried out.
- * Employee Motivation.

56th AGM OF NCB

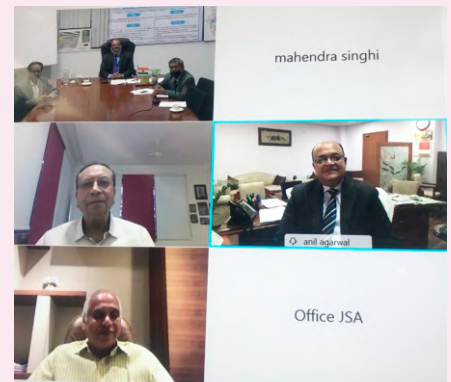
The 56th Annual General Meeting of NCB was successfully held virtually under the chairmanship of Sh. Mahendra Singhi, President-Cement Manufacturers' Association and MD & CEO, Dalmia Cement (B) Ltd. The AGM was attended by senior Cement Industry Experts from UltraTech Cement, Dalmia Cement, ACC Ltd, Ambuja Cement, JK Cement, JK Lakshmi Cement, Star Cement, Orient Cement, The KCP Ltd., Gujarat Sidhee Cement, My Home Ind., Prism Johnson, AKS University and senior NCB officials. DG-NCB gave a detailed presentation on the NCB activities during the last one year, highlighting the important projects undertaken, webinars/ workshops organized, new equipment facility added and increased interaction with Academia & Industry.

Chairman-NCB in his address thanked Sh. Anil Agrawal, Joint Secretary and other officials of DPIIT for their constant guidance and support to research activities of NCB. He emphasized that the achievements of NCB are due to the support of various stakeholders viz. Government, Cement Industry, Construction Industry etc. He highlighted that NCB has completed 11 R&D projects on waste reduction, improved sustainability & reduction in carbon footprint of cement industry and trained about 1065 cement & construction industry professionals through 64 training programmes. He thanked cement and construction industry professionals for supporting and banking on NCB services. He complimented DG-NCB and his team for efforts and commitment for providing quality services to cement and construction industry.

NCB's Services	NCB's Centres	NCB's Stakeholders
Programmed R&D Projects	 <ul style="list-style-type: none"> Cement Research and Independent Testing (CRT) Construction Development and Research (CDR) Quality Mgmt, Standards & Calibration (CQC) Continuing Education Services (CES) Mining, Environment, Plant Engineering & Operations (CME) Industrial Information Services (CIS) 	Govt of India (MoCI, MEA, MoEF&CC, Niti Aayog etc)
Sponsored R&D Projects		Central Govt. Regulatory bodies like BIS, CPCB, CWC etc.
Independent Testing Lab		Central and State Govt. Organizations/Bodies like Mines Deptt, ITPO, Delhi Metro, PWD, MCD, IDCO etc
Optimization of Raw Mix Design		Cement Industry
Alternate Fuels and Waste Utilization		Construction industry
Limestone Consumption Factor	Other Building Materials industry	
Non-Destructive Testing / Diagnostic studies for Distressed Structures	PSUs like NTPC, NHPC, IOC, SAIL etc	
Durability Studies	Laboratories	
Concrete Mix Design	Overseas Cement Industry	
Third Party Quality Assurance		
Independent Calibration		
Proficiency Testing		
BNDs and CRMs		
Process Optimization		
Project Management Consultancy		
Energy Audits		
Life Cycle Assessment Studies		
Techno-Economic Feasibility studies		
Performance Evaluation of APCEs		
PG Diploma in Cement Technology		
Training and Skill Development		
Seminars / Workshops		

BOG MEETINGS

The 119th & 120th Board of Governors (BoG) meetings were held on 29th September 2020 & 23rd December 2020 under the Chairmanship of Sh. Mahendra Singhi, Chairman-NCB & Managing Director & CEO, DCBL. BoG is the highest decision making body of NCB and is aided by various committees like Administrative and Finance Committee (AFC), Infrastructural Development Committee (IDC) and Research Advisory Committees (RACs) of NCB to make informed decisions on multiple issues relating to finance, manpower, service matters and rules. Many important discussions were held during the meetings which led to key decisions made in both the BoG meetings.



Performance evaluation of organic bipolar corrosion inhibiting admixture

P N Ojha , Puneet Kaura , Piyush Mittal, ICJ, Edition: November 2020

Reinforcement corrosion is the most important durability threat and cause of premature failure of reinforced concrete structures. Ingress of chlorides and atmospheric CO₂ are the two important phenomena promoting the reinforcement corrosion. Various corrosion prevention techniques are available to delay, decrease or control the corrosion of reinforcement in concrete. However, the most common is the use of inhibitors. The aim of this paper is to evaluate the performance of nine numbers of commercially available admix type organic bipolar corrosion inhibitors through short-term and long-term test. Short term tests like JIS Z1535, immersion test (*as per ASTM G1*) and accelerated chloride induced corrosion test using polarization technique were conducted to investigate the effectiveness of inhibitors and evaluate their corrosion inhibiting efficiency. For long term performance study, RCC slabs were exposed to field environment and laboratory environment, after a conditioning regime of two years during which the specimens were kept in sheltered environment. One set of RCC slabs with and without corrosion inhibitor were kept under laboratory exposure i.e. 3.5% NaCl solution for another one year and corrosion rate for these slabs were measured at an interval of two months. Similarly, another set of RCC slabs with and without corrosion inhibitor were exposed to field environment for one year and corrosion rate for these slabs were also measured at an interval of two months as well. Other short-term test like electrical resistivity and half-cell were also carried out to supplement the corrosion rate results. The test results indicate good relationship between corrosion rate of concrete samples exposed to field and accelerated laboratory environment. This study also exhibits a linear relationship between short-term corrosion inhibiting efficiency and long-term corrosion inhibiting efficiency.

Comparison of creep models and experimental verification of creep coefficients for normal and high strength concrete

P N Ojha, Brijesh Singh, Abhishek Singh, Vikas Patel, Journal of Asian Concrete Federation Vol. 6, No. 2, pp. 24-36, December 2020

A concrete structure when subjected to sustained load presents progressive strain over time, which is associated with the creep phenomenon. The creep characteristic of highstrength concrete assumes importance in the back drop of increase in pre-stressed concrete constructions. The paper covers the comparison of creep coefficients with different creep models like Bazant's B-3, ACI, AASHTO, GL-2000 and FIB model code 2010 for concrete mixes having water to cementitious ratio of 0.47, 0.36, 0.27 and 0.20. The comparison of different models are done for a relative humidity of 60 percent and design life of 100 years. For comparison of creep coefficient using different models the age at loading are kept as 7, 28 and 365 days. Thereafter, values are compared with experimentally obtained results of concrete mixes having water to cementitious ratio of 0.47 and 0.20 for age at loading of 28 days and up to 180 days loading period. Time induced creep strain of high strength concrete is determined using creep rig of capacity 2000 kN. Creep strains are measured at regular time intervals on concrete designed with water to cementitious ratio of 0.47 and 0.20 wherein fly ash and silica fume were also used.

Effect on mechanical properties and stress strain characteristics of normal and high strength concrete at elevated temperature

Vikas Patel, Brijesh Singh, P N Ojha, B N Mohapatra, Journal Of Building Materials & Structures (2020) 7 : 199-209

High Strength Concrete (HSC) has some disadvantages such as brittleness and poor resistance to fire. Fire exposure affects the concrete in way that the disintegration of concrete starts and a severe surface spalling occurs at very high temperatures. Therefore, the structural behaviour or response to the load will change after fire exposure and the structural members may not behave as they were designed. Further, the basics of flexural design depend on the stress- strain response of the concrete which is also affected upon fire exposure. Hence, this study is carried out to provide useful input to aid the provision of a fire resistance for exposure to high temperatures up to 600°C and establishing a stress-strain relationship. The concrete



cylinders of size 100 mm x 200 mm were exposed to the temperature of 200°C, 400°C and 600°C after which the residual compressive strength, split tensile strength and flexural strength were recorded. For stress strain characteristics, 100 × 200 mm cylinders with polypropylene fiber content of 0.5% by volume of concrete were subjected to temperature exposure of 600°C for durations of 1 hour. Curves for reduction factors of strength and stress strain characteristics after fire/elevated temperature exposure has been established. Just consideration of reduced strength for assessment after fire exposure will not serve the purpose as the change in load response and increased deformation capacity also needs to be addressed properly.

Evaluation of mechanical and durability properties of concrete made with Indian bottom ash as replacement of fine aggregate

P N Ojha, Amit Trivedi, Brijesh Singh, Abhishek Singh Journal of Asian Concrete Federation Vol. 6, No. 2, pp. 50-65, December 2020

Bottom ash is a major by-product of the coal-based power generation process and it has particle size ranging from 45 µm to 150 µm. As per current provisions of IS: 383-2016, bottom ash can be used as replacement of natural fine aggregate up to 25% in case of lean concrete (*less than M15 Grade*) only. However, its use in reinforced and plain concrete is not permitted. Therefore, it is imperative to study the feasibility of using coal based bottom ash as a replacement of conventional fine aggregates (*i.e., natural and crushed sand*) in plain and reinforced concrete to increase the utilization of this industrial byproduct. In this study, natural and crushed sand were replaced with bottom ash at various percentages for preparation of concrete and study its effect on fresh, hardened and durability properties of concrete. Bottom ash was collected from Vindhyachal Thermal Power Plant of India. Experimental studies were conducted at w/c ratio of 0.65 and 0.40. Concrete mixes were studied and analyzed for various mechanical and durability properties. Based on fresh concrete properties *i.e.* workability, slump retention and strength development, it was observed that up to 50% replacement of conventional fine aggregate with bottom ash is technically feasible.

A review on tertiary cementitious systems: Limestone and Fly ash based Composite Cements

Suresh Palla, Suresh Vanguri, Varsha Liju, S K Chaturvedi and B N Mohapatra accepted on 25th November 2020 to be published in ZKG Cement Lime Gypsum

The purpose of this literature review is to assist the development of composite cements to better understand the state-of-the-art of the use of Portland-Limestone-Fly ash Cement (*PCC*). In order to appreciate the environmental benefits of the product, review was carried out to distill, capture, and summarize the performance characteristics.

In the finishing mill, the limestone portion is generally more finely ground than clinker since it is softer. This leads into higher overall Blaine for the product, a typical broadening of the gradation, and a uniform distribution of the limestone particles, resulting in better particle packing. Note that even though the Blaine is typically higher, this does not mean that the water demand is increased. Early hydration products nucleate on the limestone particles. Additional hydration products beyond the calcium-silicates, carbo-aluminates, form due to reactions between limestone and aluminates and can provide a synergistic effect when used with Supplementary Cementitious Materials such as fly ash and slag cement. Due to the improvement in the overall particle packing, the finishability of concretes made with PLC may be improved. In the last edition of Newsletter, we gave an insight on three out of twelve new R&D projects approved by the 72nd Research Advisory Committee of NCB.



Study of carbonation and carbonation induced reinforcement corrosion in new cementitious system

Carbonation is one of the major problems for concrete structures located in tropical environment. The phenomenon of carbonation involves complex physical and chemical reactions between hydration products of cements and atmospheric CO_2 and it is affected by several internal and external environmental factors. One of the prominent issues associated with low carbon cements as well as new cementitious system with low clinker factor is “carbonation” as it affects the performance and service life of concrete structure. So, there is a need to study the effect of various environmental factors such as relative humidity, temperature etc. on concrete carbonation performances in combination with field and laboratory study for the sake of better evaluation on concrete endurance, disclosure of the carbonation mechanism and prediction of the service life of the concrete engineering structure made with new cementitious system.

- Effect of new cementitious systems over the rate of carbonation.
- Effect of environmental parameters like Relative humidity, temperature and alternative wetting and drying phenomenon over the rate of carbonation and corrosion rate.
- Effect of new cementitious systems over the carbonation induced corrosion rate and to determine the various factors affecting the corrosion rate in propagation phase.
- To correlate the laboratory studies with the field studies.
- Validation of existing carbonation model for the new cementitious system.

Cathodic Protection (CP) of RCC structures to enhance service life of new & existing structures using three systems (*Sacrificial anode, ICCP & hybrid system*).

Background

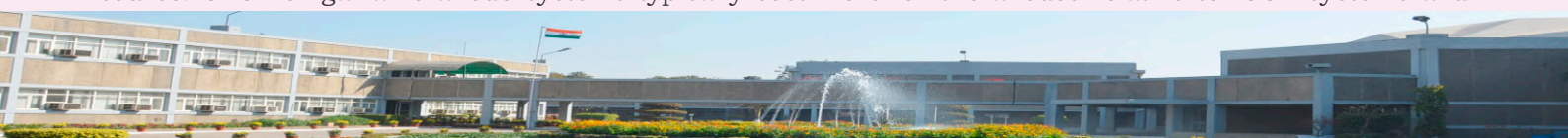
In India, RCC has been extensively used in last 50-60 years and during this period, we have created large number of infrastructure assets in terms of buildings, bridges etc., which are lifeline for the nation. These have been created with huge investment of resources and it cannot be even dreamed of recreating such assets out of limited natural resources. Corrosion of reinforcement is one of the major durability problems which significantly affects the serviceability and load carrying capacity of reinforced concrete structures. Corrosion of steel reinforcement in concrete imposes great financial burden over the country's economy. In general, steel reinforcements in concrete structures remain in passive condition, which is protected by a thin layer of ferric oxide stabilized by the alkaline environment of the concrete. Initiation of corrosion generally takes place when this passive layer gets destroyed. De-passivation generally occurs in two ways: a) carbonation of concrete, i.e., the reaction of atmospheric CO_2 with cement paste, which lowers the pH and causes general corrosion; b) Chloride induced corrosion i.e., the presence of chlorides at the steel surface in concentration higher than that of critical threshold value, generally considered in the range of 0.4–1% by weight of cement. Following initiation of corrosion, the electrochemical process of corrosion can continue up to the total deterioration of the reinforced concrete structure. Both the anodic and cathodic areas are located on the steel surface.

In order to overcome the issue of reinforcement corrosion, there is an urgent need of innovative technology that could provide a cost effective solution to this problem. Many prevention methods are adopted when severe environmental conditions occur, or on structures requiring very long service life, as well as in rehabilitation. These methods include the coating to the concrete surface, coating to the reinforcement, re-alkalisation (*used for carbonated concrete*), Electrochemical Chloride extraction (*used for chloride contaminated concrete*), corrosion inhibitors and cathodic protection.

Loss of metal due to the process of corrosion always occurs at anodic sites formed on the steel reinforcement. Cathodic protection addresses this problem electrochemically by preventing the formation of these anodic sites and making the steel behave like a cathode. The objective of cathodic protection is to shift the steel/concrete potential into a region where a) the initiation of corrosion or b) if corrosion has already started, the propagation of corrosion; is so far suppressed that a corrosion failure is unlikely during the lifetime of the structure.

Current work

Cathodic Protection (CP) limits the corrosion of a metal surface by making it the cathode of an electrochemical cell. This can be achieved either by using a more active sacrificial anode (SACP), which can corrode preferentially to steel, to create a driving current, or by using inert anodes and impressing a current (ICCP, i.e., *Impressed Current Cathodic Protection*) onto the cathode surface using an external Direct Current (DC) source. SACP or galvanic anode systems typically cost more for the anodes relative to ICCP systems and



have a shorter design life of 15-20 years (*hence may need replacing*). However, they have significantly lower design, installation and monitoring costs compared to ICCP systems. Typically, SACP systems are more cost effective for shorter ($\leq 20\text{yr}$) design lives or smaller repair areas where the cost of design, wiring, control system and maintenance make ICCP system uneconomic. ICCP systems are more cost effective for longer design lives or larger repair areas. ICCP needs a constant DC power supply that is usually provided through a grid connection or independent generators. For CP of reinforced concrete, research has either centered on the anode materials and types used or monitoring systems or examining current distribution within the reinforcement. Different types of anodes have been developed worldwide for its use in Cathodic Protection of RCC structures, which includes organic coating, metallic coating, activated titanium, adhesive Zinc sheets and many more.

Impressed Current Cathodic Protection (ICCP) is usually the most appropriate technique to stop corrosion in different severe circumstances like structures with high concrete resistivity, and high chloride present in the environment of the structures due to the high voltage, reached to 100V, that can be generated by this system between the anode and the cathode. The two major criteria to control the performance of Cathodic Protection are the potential of the steel (*Instant-off potential*) and potential decay (*depolarization*). Past study indicated that after steel passivity has been restored, the protection current may be interrupted, as illustrated by Broomfield and Tinnea. Study looked at steel potentials prior to the application of an ICCP system and compared them with the potentials after the structure was protected for approximately 1 year and the Cathodic Protection system turned off for 3 months. It was observed that the application of ICCP shifted the steel potentials towards more positive values.

The present research work will aim to provide new information and will help to achieve a better understanding of Cathodic Protection under chloride aggressive environment and carbonation induced corrosion. These techniques will be assessed for both the conditions i.e. to protect the old structure in which corrosion has already initiated and also for new structures to prevent or reduce further corrosion to extend their service life.

Project outline

This project will be focused on study of the use of Cathodic Protection (CP) in the repair of corrosion damage in existing concrete structures. The use of Cathodic Protection for prevention of corrosion in new RCC structures will also be investigated. The following types of cathodic protection systems will be investigated under Chloride induced and Carbonation induced corrosive environment for one grade of concrete:

- * Embedded and surface applied Discreet Sacrificial Anode Cathodic Protection
- * Hybrid type Cathodic Protection: Hybrid system combines both an impressed and galvanic system to arrest ongoing corrosion and prevent future initiation

This study will be more focused on sacrificial type galvanic anode systems. Most of the current standards are more geared towards ICCP systems and the performance and evaluation criteria for sacrificial galvanic anodes are not that well established. At this stage, only sacrificial type galvanic anode systems will be considered. If time permits, Impressed Current Cathodic Protection (ICCP) system will also be included for study at a later stage.

Utilization of coarser flyash (having fineness between $250\text{ m}^2/\text{kg}$ to $320\text{ m}^2/\text{kg}$) in concrete as a cementitious material

Background of the project

The Indian coal is of low grade having high ash content of the order of 30-45% producing large quantity of fly ash at coal/lignite based thermal power stations in the country. The fly ash generation during 2019-20 is 226.13 million tonnes due to combustion of 678.68 million tonne Coal/Lignite and fly ash utilization is around 187.81 million tonne which suggests an effective usage of 83.05% respectively.

The disposal of such huge quantity of ash is a serious issue as the management of fly ash has been troublesome in view of its disposal because of its potential of causing pollution of air and water. In the past decade, there has been tremendous increase in the generation of fly-ash since more than 70% of country's demand for electricity is met by coal-based thermal power plants. Presently, fly ash is being used in the construction industry on a large scale like in the manufacturing of Portland Pozzolana cement, construction of roads, dams, stabilization of slopes, etc.

Following are some of the official figures published by the Central Electricity Authority (CEA) in the annual report of 2019-20.



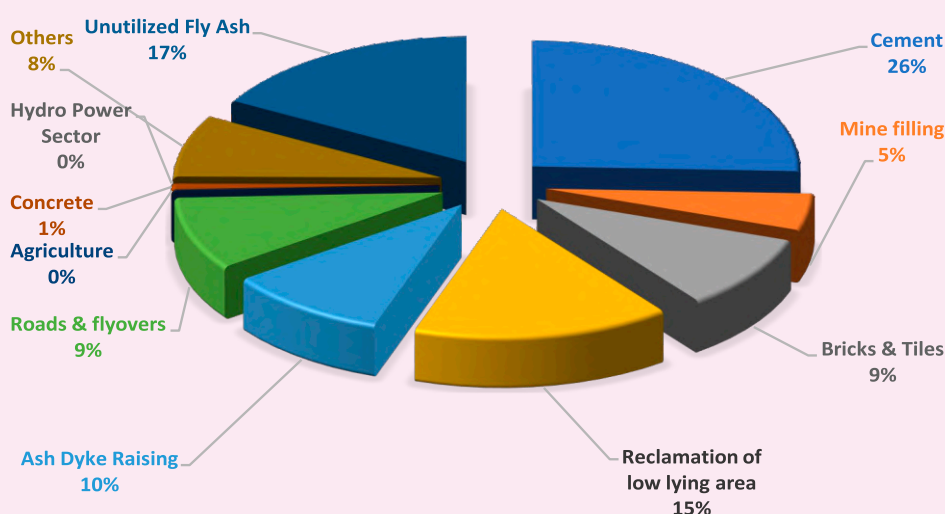
HIGHLIGHTS OF ONGOING RESEARCH PROJECTS



Description \ Year	2015-16	2016-17	2017-18	2018-19	2019-20
Number of Thermal Power Stations	151	155	167	195	197
Coal Consumed (Million Tons)	536.64	536.4	624.88	667.43	678.68
Fly Ash Generation (Million Tons)	176.74	169.25	196.44	217.04	226.13
Fly Ash Utilization (Million Tons)	107.77	107.10	131.87	168.40	187.81
% Utilization	60.97	63.28	67.13	77.59	83.05

Utilisation of fly ash

There are a number of areas where fly ash has been used in all these years and some figures outlining the actual sector-wise usage is mentioned below.



Major modes of fly ash utilization during the year 2019-20 (Source: CEA annual report 2019-2020)

The Indian Standard code (IS 3812) gives the specification of pulverized fuel ash to use in concrete, where it is mentioned that the minimum required fineness of flyash should be $320 \text{ m}^2/\text{kg}$. However, it is noticed that in India there is large amount of coarser flyash (having fineness 250 to $320 \text{ m}^2/\text{kg}$) available. As this coarser flyash is not satisfying the minimum requirement of fineness as per IS3812, they are not being utilized in concrete making. Various BIS committees demand the study to be carried out on use of flyash having fineness in the range of 270 to $280 \text{ m}^2/\text{kg}$ and if possible make the amendment in the specifications of flyash to be used as pozzolanic material. Similarly, Central Electricity Authority (CEA) in their meeting also demands for the reduction of fineness of fly ash to enhance the use of coarser fly ash in mass concreting.

Expected benefit/ End result

- (1) Utilization of coarser fly ash in concrete, and minimisation of unutilised fly ash.
- (2) Recommendation for modification in specification of fly ash to use coarser fly ash as cementitious material.

SUN DIAL AT NCB-BALLABGARH



A team of distinguished experts from the cement and construction sector (members of Standing Selection Committee for promotion activities) led by Dr. S S Gupta (SDO, DPIIT, MoCI, Govt. of India) visited the Sun dial constructed recently at NCB-Ballabgarh. They appreciated the efforts that were made by DG-NCB towards beautification of NCB-B campus by utilizing waste materials.





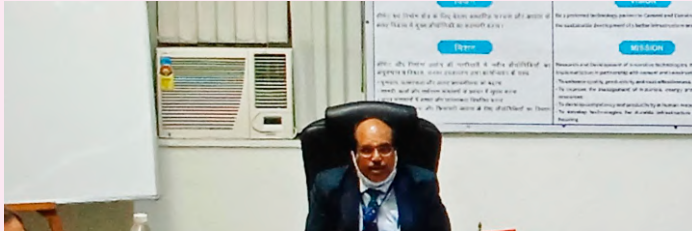
INTERACTION WITH ACADEMIA & RESEARCH INSTITUTES

DG-NCB en route to his vision and mission to collaborate with pioneer research institutes and carry out frontline research in field of cement and concrete visited prestigious institutes like IIT-Roorkee, CBRI-Roorkee and CPPRI Saharanpur. He discussed with research fraternity about niche areas of collaboration and furthering the collaboration. NCB has recently entered in to MoUs with various IITs and NITs in India which aims for: Facilitation of internship/ training for students, sharing facilities like laboratory, library, proprietary software & in house developed components, exchange ideas and manpower to enhance R&D activities, explore possibility of conducting joint seminars / workshops explore opportunities for securing funding for joint research projects.

MoU with academic institutions



DG-NCB signed a **MoU with** Dean Research SRIC, **IIT Roorkee** for recognition of NCB as extended research centre for IIT Roorkee. The MoU will surely increase the pace of research and expedite in expanding NCB's footprint in cement and construction sector. DG-NCB also visited IIT Roorkee facilities and explored opportunities for further areas of collaboration.



A **MoU** was signed by DG-NCB and Prof. B S Murty Director, **IIT Hyderabad** in presence of representatives from both the institutions.



A **MoU** was signed by DG-NCB and Prof. Dr.) Bibhuti Bhusan Biswal, Director, **National Institute of Technology- Meghalaya** in presence of representatives from both the institutions.

A **MoU** was signed by DG-NCB and Prof. (Dr.) K U Rao, Director, **National Institute of Technology- Surathkal** in presence of representatives from both the institutions.

Visit to CBRI-Roorkee

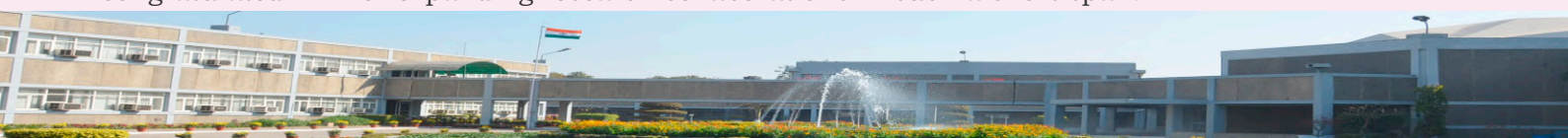


During his visit to CSIR-CBRI, DG-NCB discussed with Director CBRI about the opportunities emerging out in building materials area and explored possibilities of joint working. He also visited facilities of CBRI.

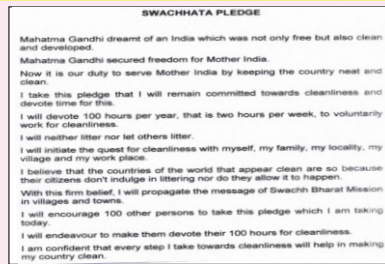
Visit to CPPRI-Saharanpur



The visit concluded with visit to CPPRI Saharanpur. Director CPPRI explained activities to DG-NCB and congratulated him for expanding research collaborations in such a short span.



Swachhata Pakhwada



NCB observed “Swachhata Pakhwada” from 01st to 15th November 2020. Swachhata Pledge was administered online on 02nd November 2020 by DG-NCB to officials/staff via virtual platform.

Constitution Day



71st Constitution Day (*Samvidhan Diwas*) was observed at NCB on 26th November 2020. The day commemorates adoption of Constitution of India as on this day in 1949; the Constituent Assembly of India formally adopted the Constitution of India that came in to effect on 26th January 1950. DG-NCB and Dr. S S Gupta (*SDO, DPIIT*) lead the reading of Preamble of the Constitution of India to all officials/staff of NCB. The occasion was graced by Shri Shailesh Kumar Agrawal (*Executive Director, BMPTC*), Dr. D K Aswal (*Director, CSIR NPL*), Dr. Bipin Thapliyal (*Director, CPPRI*), and Dr. Nasim Akhtar (*Sr. Principal Scientist, CRR*). DG-NCB highlighted the importance of Constitution day stating that it is observed as a mark of respect to the makers of the Constitution of India who played a pivotal role in drafting the Constitution and promote Constitutional values amongst citizens. Dr. Aswal told interesting facts about the specifications of the Constitution books, the materials used and the methodology in which NPL is contributing in ensuring proper preservation of these books in the Central Library of the Parliament of India.

Vigilance Awareness Week



Vigilance Awareness Week was observed from 27th October to 02nd November 2020 on the theme of “*Satark Bharat, Samridh Bharat (Vigilant India, Prosperous India)*”.

Activities Undertaken under Vigilance Awareness Week at NCB were:

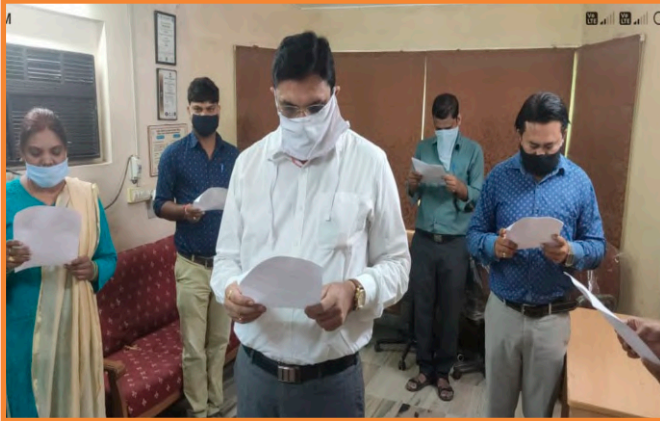
1. Banners displayed at all NCB units to create awareness on Vigilance Awareness Week among officials/staff of NCB
2. DG-NCB and officials / staff at all units / centres of NCB took Integrity Pledge on the inaugural day of Vigilance Awareness Week.
3. Online Lecture on the theme "Satark Bharat, Samridh Bharat" (Vigilant India, Prosperous India) was organized On 28th October 2020 from 1500 hrs to 1550 hrs. The online talk was given by *Dr T. Krishna Prasad, IPS (Retd.), Former DGP & Chairman-Road Safety Authority, Telangana State, Hyderabad*. The lecture was attended by DG-NCCBM, senior officials and other NCCBM officials/staff.





In his lecture, Dr Prasad emphasized on:

- To make internal process – Simple, Clean & Transparent.
- Time-bound disposal of project / task.
- Systematically improve internal processes by leveraging IT.
- Evidence based approach coupled with digitization.
- Process driven Management – minimum subjectivity – minimizes corruption
- Vendor Process Management.
- Transparent Process of Recruitment & Promotion.
- Being Vigilant will lead to peace of mind and prosperity of the employees.



Jan Andolan for COVID-19

DG-NCB administered the pledge to all officials of NCB for their commitment to wear mask, follow physical distancing and maintain hand hygiene all the time. We have entered into a phase where our country has to open up society and economy. In these times, the spread of virus can be very fast. Therefore, it is a must to follow COVID Appropriate Behaviour and NCB calls on people to exercise extreme vigilance. Keeping hands clean, wearing a mask and continuing to maintain physical distance are the main *mantras* to keep away from the disease as our health experts at the stroke of finding a permanent solution to end this disease. NCB, is leaving no stone unturned to ensure safety of our employees and their families by keeping strict monitoring through regular meetings.



Although we may have to be physically apart from each other for a while, we have to come together in ways we never have before, not only for ourselves but also for others.



IMPORTANT DAYS/EVENTS CELEBRATED



National Unity Day

DG-NCB administered Rashtriya Ekta Diwas pledge to officials of NCB on 31st October 2020 through virtual platform. About 116 officials / staff of NCB connected online and took the Rashtriya Ekta Diwas pledge in English and Hindi.

राष्ट्रीय एकता दिवस
Rashtriya Ekta Diwas
National Unity Day

31st October 2020



National Council for Cement and Building Materials
(under the administrative control of Ministry of Commerce & Industry, Govt of India)



58th NCB Day

NCB is the apex R&D organization in the field of cement, building materials and construction technologies. In order to provide the much needed technical and technological support to the cement and allied building materials industry, it was registered as Cement Research Institute of India (CRI) under the Societies Registration Act 1860 on 24th December 1962.

The 58th NCB day was celebrated in NCB-Ballabgarh and its units on 24th December 2020 in the august presence of Chief Guest, Sh Anil Agrawal, Joint Secretary, DPIIT, Ministry of Commerce and Industry, Govt. of India (*connected online*). Dr. S S Gupta, Guest of Honour for the occasion was present physically at NCB premises to grace the occasion. Other dignitaries connected online were Sh. Mahendra Singhi (*Chairman-NCB*), Sh. Ashwani Pahuja (*Chairman, Research & Advisory Committee-NCB*) Dr. V S Narang (*Chairman, Advisory Committee, Hyderabad*), Sh Rajendra Chamaria (*Chairman-Admin. & Finance Committee, NCB*), members of the Board of Governors of NCB and ex-officials of NCB. After invocation and lamp lighting ceremony by the Guest of honour and dignitaries on the dais, DG-NCB highlighted the current Research and Innovation activities being carried out at NCB, which are in line to the current requirements of the cement and building materials sector. All the dignitaries present congratulated all NCB officials on the day and motivated the scientists and engineers of NCB to continue work towards carrying out quality research in the field of cement and concrete.

Sh. Anil Agrawal motivated the scientists and engineers by asking them to be the forerunners in the field of research. He told that small steps towards improvement everyday lead to a bigger change finally and NCB staff should keep on taking such small steps to change for better for their stakeholders and themselves. He also told that NCB has the potential to become a Centre of Excellence in research on cement & concrete. He expressed his satisfaction on the progress of various activities at NCB and also gave new targets to scientists and engineers, assuring them of the support of DPIIT in achieving them. Awards for best scientist for the year, best employee- technical & support staff and various other competitions held in the year 2020 like Atmanirbhar NCCBM, Swachhta Pakhwada, Vigilance Awareness week and Hindi Pakhwada were given to NCB staff by Dr. S S Gupta. Special recognition was given to the housekeeping staff of NCB who have worked tirelessly during the pandemic to ensure cleanliness of the office, safety of staff as well as beautification of NCB-B campus.





ABOUT THE COUNCIL

National Council for Cement and Building Materials (NCB), set up in 1962, then known as Cement Research Institute of India, is the apex body in India under the administrative control of Department for Promotion of Industry and Internal Trade, Ministry of Commerce and Industry, Government of India, devoted to research, technology development and transfer, education and industrial services for cement, building materials and construction industries. Its multi-disciplinary activities are performed in an integrated and coordinated manner through its units that are located at Ballabgarh (Near Delhi), Hyderabad, Ahmedabad and Bhubneswar. The six corporate centres of the council guide the activities at different units. The centre and their main areas of activity are :

Centre for Cement Research & Independent Testing (NCB-CRT) - Fundamental and Basic Research, Cement and other Binders, Waste Utilization, Refractories & Ceramics and Testing Services.

Centre for Mining, Environment, Plant Engineering & Operation (NCB-CME) - Geology, Mining & Raw Materials, Process Optimization & Productivity Enhancement, Energy Management, Plant Maintenance, Project Engineering & System Design, Environmental Management.

Centre for Construction Development & Research (NCB-CDR) - Structural Optimization & Design, Structural Assessment & Rehabilitation, Concrete Technology and Management.

Centre for Industrial Information Services (NCB-CIS) - Industrial Information and Data Bank, Integrated IT Solutions, Publication, Seminars & Conferences, International & National Linkages, Image Building.

Centre for Continuing Education Services (NCB-CCE) - Long-Term & Short-Term Courses, Special Group Training Programmes, Simulator Based Courses, Workers' Development Programmes.

Centre for Quality Management, Standards & Calibration Services (NCB-CQC) - Total Quality Management, Calibration Services, Development and Supply of Certified Reference Materials.

ABOUT THE COUNCIL

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