

NCB NEWS

April 2022 to June 2022

From the desk of Director General

Dear Readers,

A swift and comprehensive implementation of vaccination program has led to economic activity seeing a quick comeback to pre-pandemic levels. Green shoots of growth are visible in Indian cement industry also. Cement production in India is expected to increase by ~12% YoY, driven by rural housing demand and government's strong focus on infrastructure development like *PM Gati Shakti*. The industry is poised to add ~80 million tonne capacity by 2025. New players have emerged in a big way, recently. It is expected that following the US\$10.5 billion acquisition of ACC and Ambuja Cements from Holcim by Adani Group in May'2022, there would be healthy competition all around amongst all major players.

"Sustainability" today has taken center stage becoming a core purpose of doing business. As the requirement for resilient and sustainable communities to support a growing population becomes more pressing, cement and concrete will be essential in providing infrastructure and buildings that society needs. Achieving net zero concrete relies on a number of different groups playing their part, and as an industry we must not only look outwards but also inwards to see how modern technologies and innovations from the young and seasoned campaigners can support our goals.

Climate change has been an important issue and cement industry has adopted several carbon reduction levers like low clinker cement, energy efficiency, alternative fuels, WHRS and renewable energy resulting into reduction of direct CO₂. However, to meet the commitment of COP26 and achieve net zero by 2070, we must involve and support future generations who contribute innovative ideas and energy to the industry. At NCCBM, we are regularly interacting with academia and finding out newer ways and means to collaborate with colleges, institutes, etc. convening research and innovation and offering our support through guidance.

This edition of NCB e News covers latest ongoing R&D projects, workshops and interactions with industry in India and abroad, participation in important meetings and conferences, especially with a brief on new projects proposed and undertaken at 74th RAC meeting.

It is with great enthusiasm that I've announcing dates for our upcoming 17th NCB International Conference on Cement, Concrete and Building Materials which is scheduled to be held from 06th to 09th December 2022 at Manekshaw Centre, New Delhi the captains of cement and concrete sector, policy makers, academicians, professionals, engineers and scientists are expected to come under one roof and discuss future action plans aimed towards Net Zero Carbon Emissions for Indian Cement Industry.

I look forward to your presence in the Conference and wish you all a very innovative and successful future. Jai Hind!

Editor: Sh Saurabh Bhatnagar

Designed by: Sh Devender Baghel

Dr. B N MOHAPATRA

HEADLINES

Highlights of Ongoing R&D Projects

- Investigations on Development of Portland Composite Cements based on Fly Ash and Limestone
- Technical feasibility of using FGD gypsum in cement manufacture
- Ultra-High Performance Concrete (UHPC)
- Geopolymer Concrete

Workshops

- National Workshop on Carbon Capture, Utilization and Storage (CCUS)
- National Workshop on "Low Carbon Cement: NCB initiatives"
- Workshop on designing Inclusive Roadmap for Cement Sector decarbonization

Interaction with Industry

- Visit to Cement Plant in Slite, Sweden
- Visit to Steel Plant in Lulea, Sweden
- Visit to North Cluster at Ambuja Cement
- Visit of Adani Group
- Visit of Deputy Secretary, MoEF&CC

Important Days observed

- National Technology Day 2022
- World Environment Day 2022
- 08th International Day of Yoga (IDY)

Important Meetings and Conferences

- 74th Research Advisory Committee (RAC) meeting
- GCCA Report: Benefits of Blended Cement
- Development Council for the Cement Industry (DCCI)
- 18th Green Cementech 2022
- IDC Meeting 2021-22
- Expert Appraisal Committee (Industry-1)
- Research Council Meeting of NPL
- Organizing Committee (OC) Meetings
- Hindi Meeting
- Meeting with Hon'ble Education Minister Sh. Dharmendra Pradhan

MoU with LivNSense to accelerate Artificial Intelligence/Machine Learning Innovation for cement industry



Ballabgarh-Head Office



Hyderabad-Unit



Ahmedabad-Unit



Bhubaneswar-Unit



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एनसीबी समाचार

अप्रैल 2022 से जून 2022

महानिदेशक के डेस्क से



प्रिय पाठकों, टीकाकरण कार्यक्रम के तेजी और व्यापक कार्यान्वयन ने आर्थिक गतिविधियों को पूर्व-महामारी के स्तर पर एक त्वरित वापसी के रूप में प्रेरित किया है। भारतीय सीमेंट उद्योग में भी विकास के अंकुर दिखाई दे रहे हैं। ग्रामीण आवास की मांग और प्रधानमंत्री गति शक्ति जैसे बुनियादी ढांचे के विकास पर सरकार के मजबूत लक्ष्य (focus) से प्रेरित, भारत में सीमेंट उत्पादन में सालाना 12 फीसदी की वृद्धि होने की उम्मीद है। यह उद्योग 2025 तक ~80 मिलियन टन क्षमता जोड़ने की ओर अग्रसर है। हाल ही में नए कम्पनी बड़े पैमाने पर उभरे हैं। यह उम्मीद की जाती है कि मई 2022 में अदानी समूह द्वारा होल्सिम (holcim) से एसीसी (ACC) और अंबुजा सीमेंट्स के 10.5 अरब अमेरिकी डॉलर के अधिग्रहण के बाद, सभी के बीच स्वस्थ प्रतिस्पर्धा होगी।

“स्थिरता” आज व्यवसाय करने का एक मुख्य उद्देश्य बनकर केंद्र स्तर पर पहुंच गया है। बढ़ती आबादी का समर्थन करने के लिए लचीले और टिकाऊ संरचना की आवश्यकता अधिक हो जाती है, इसलिए सीमेंट और कंक्रीट समाज को आवश्यक आधारभूत संरचना और भवन उपलब्ध कराने में आवश्यक होंगे। शुद्ध शून्य कंक्रीट प्राप्त करने में कई अलग-अलग समूहों अपनी भूमिका निभाते हैं। उद्योग के रूप में हमें न केवल बाहर की ओर देखना चाहिए, बल्कि यह भी देखना चाहिए कि युवा और अनुभवी प्रचारकों की आधुनिक तकनीक और नई पद्धति कैसे हमारे लक्ष्यों का समर्थन कर सकती हैं।

जलवायु परिवर्तन एक महत्वपूर्ण मुद्दा रहा है और सीमेंट उद्योग ने कम क्लिंकर सीमेंट, ऊर्जा दक्षता, वैकल्पिक ईंधन, अपशिष्ट ऊर्जा वसूली प्रणाली (WHRS) और नवीकरणीय ऊर्जा जैसे कई कार्बन न्यूनीकरण को अपनाया है, जिसके परिणामस्वरूप प्रत्यक्ष कार्बन डाईऑक्साइड (CO₂) में कमी आई है। हालांकि, कॉन्फ्रेंस ऑफ द पार्टिज के 26वां सत्र (26th session of the Conference of the Parties & COP 26) की प्रतिबद्धता को पूरा करने और 2070 तक शुद्ध शून्य प्राप्त करना करने के लिए, आने वाली पीढ़ियों को शामिल कर उनका समर्थन करना चाहिए, जो उद्योग के लिए नवीन विचारों और ऊर्जा का योगदान करते हैं।

एनसीबीईएम में, हम नियमित रूप से कॉलेजों, संस्थानों आदि के साथ सहयोग के नए तरीकों एवं साधनों की खोज तथा अनुसंधान और विकास के माध्यम से अपना समर्थन देने के लिए शिक्षाविदों के साथ बातचीत कर रहे हैं।

एनसीबीई—न्यूज के इस संस्करण में नवीनतम चल रही अनुसंधान और विकास परियोजनाओं, भारत और विदेशों में उद्योग जगत के साथ कार्यशालाएं और बातचीत, महत्वपूर्ण बैठकों और सम्मेलनों में भागीदारी, विशेष रूप से 74वीं अनुसंधान सलाहकार समिति की बैठक में प्रस्तावित और शुरु की गई नई परियोजनाओं पर एक संक्षिप्त जानकारी शामिल है।

मैं बड़े उत्साह के साथ घोषणा कर रहा हूँ, कि एनसीबी सीमेंट, कंक्रीट और भवन सामग्री पर आयोजित 17वें एनसीबी अंतर्राष्ट्रीय सम्मेलन, दिनांक 06 से 09 दिसंबर 2022 को मानेकशॉ सेंटर, नई दिल्ली में होने वाला है। इस सम्मेलन में सीमेंट एवं कंक्रीट क्षेत्र के अग्रिम नीति निर्माताओं, शिक्षाविदों, पेशेवरों, इंजीनियरों और वैज्ञानिकों का एक छत के नीचे आने और भारतीय सीमेंट उद्योग के लिए शुद्ध शून्य कार्बन उत्सर्जन पर भविष्य की कार्य योजनाओं पर चर्चा करने की उम्मीद है।

मैं सम्मेलन में आपकी उपस्थिति के लिए तत्पर हूँ और आप सभी के लिये एक बहुत ही परिवर्तनात्मक और सफल भविष्य की कामना करता हूँ।

जय हिन्द!

संपादक: श्री सौरभ भटनागर
डिजाइन: श्री देवेन्द्र बघेल

वैश्विक नरेश महापात्र

डॉ बी एन महापात्र

मुख्य बातें

चल रही आर एंड डी परियोजनाओं की मुख्य विशेषताएं

- फ्लाई ऐश और चूना पत्थर पर आधारित पोर्टलैंड कम्पोजिट सीमेंट के विकास पर जांच
- सीमेंट निर्माण में पलू गैस डिसल्फराइजेशन जिप्सम (FGD Gypsum) के उपयोग की तकनीकी साध्यता
- अल्ट्रा - हाई परफॉर्मेंस कंक्रीट (यूएचपीसी)
- जियोपॉलिमर कंक्रीट

कार्यशालाएं

- कार्बन कैप्चर, उपयोग और भंडारण पर राष्ट्रीय कार्यशाला (सीसीयूएस)
- “कम कार्बन सीमेंट: एनसीबी पहल” पर राष्ट्रीय कार्यशाला
- सीमेंट क्षेत्र के डीकार्बो—नाइजेशन के लिए समावेशी रोडमैप तैयार करने पर कार्यशाला

उद्योग के साथ बातचीत

- स्लाइट, स्वीडन में सीमेंट प्लांट का दौरा
- लूलिया, स्वीडन में स्टील प्लांट का दौरा
- अंबुजा सीमेंट में उत्तरी क्लस्टर का दौरा
- अदानी समूह का दौरा

उप सचिव, पर्यावरण एवं वन मंत्रालय का दौरा

- महत्वपूर्ण दिवस
- राष्ट्रीय प्रौद्योगिकी दिवस 2022
- विश्व पर्यावरण दिवस 2022
- 08वां अंतर्राष्ट्रीय योग दिवस

महत्वपूर्ण बैठकें और सम्मेलन

- 74वीं अनुसंधान सलाहकार समिति (आरएसी) की बैठक
- जीसीसीए रिपोर्ट: मिश्रित सीमेंट के लाभ
- सीमेंट उद्योग के लिए विकास परिषद (डीसीसीआई)
- 18वीं ग्रीन सीमेंट 2022
- आईडीसी बैठक 2021-22
- विशेषज्ञ मूल्यांकन समिति (उद्योग-1)
- एनपीएल की अनुसंधान परिषद की बैठक
- आयोजन समिति (ओसी) की बैठक
- हिंदी बैठक
- माननीय शिक्षा मंत्री श्री धर्मेंद्र प्रधान के साथ बैठक

सीमेंट उद्योग के लिए आर्टिफिशियल इंटेलिजेंस/मशीन लर्निंग इनोवेशन में तेजी लाने के लिए LivNSense के साथ समझौता ज्ञापन



बल्लभगढ़— मुख्यालय



हैदराबाद—इकाई



अहमदाबाद—इकाई



भुवनेश्वर—इकाई



राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद

(भारत सरकार के वाणिज्य एवं उद्योग मंत्रालय के प्रशासनिक नियंत्रणाधीन)
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Investigations on Development of Portland Composite Cements based on Fly Ash and Limestone

In this study, 140 Portland Composite Cement blends (PCC) were prepared with four types of clinker from different regions of India along with the regional available fly ash (15-35%) and limestone (5, 7 & 10%). Based on the results of cement mortar and concrete durability, a total of 35% replacement of clinker by fly ash and limestone (*keeping limestone content up to 7% in it*) was recommended. Hydration studies showed Monocarboaluminate ($\text{Ca}_4\text{Al}_2\text{O}_6 \cdot \text{CO}_3 \cdot 11\text{H}_2\text{O}$) was found in the samples containing fly ash and limestone and the intensity of these peaks tend to be stronger when the amount of limestone is increased. Draft code formulation for submission to BIS is in progress. Figure representing the results of accelerated carbonation depth in the concrete specimens prepared with PCC is compared with PPC. Here, WAU E is the control PPC with 35% fly ash. Carbonation depth is least in WAU D having 25 % fly ash and 10 % limestone.

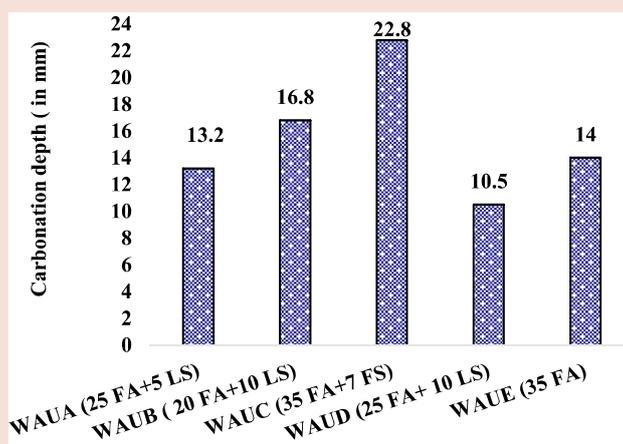


Fig.: Accelerated carbonation depth in the concrete specimens prepared with PCC is compared with PPC.

Technical feasibility of using FGD gypsum in cement manufacture

Globally, Flue Gas Desulfurisation (FGD) systems have been installed in many thermal power plants in developed countries and FGD plants have been in operation in the US since 40 years. In India also the standards set by the MoEF & CC for coal-based thermal power plants came into force by which FGD systems needs to be installed in them. Accordingly, a R & D project on technical feasibility of using FGD gypsum in cement manufacture is taken up. In this project, FGD gypsum was obtained from thermal power plants and other raw materials were obtained from cement industries. The FGD was characterized for its chemico-mineralogical properties. Figure represents a X ray diffractogram of FGD gypsum. Preparation and evaluation of different cement blends using above materials at different proportion and fineness levels are underway to study the effect of the by-product gypsum, FGD on properties of cements and concrete.

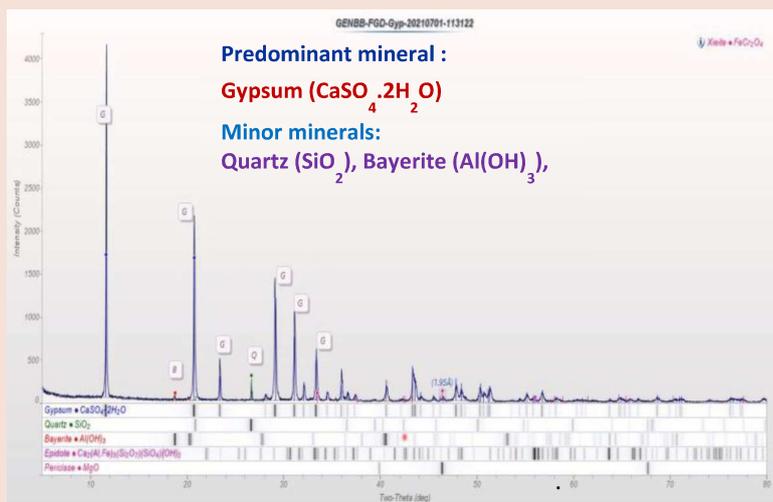


Fig.: X ray diffractogram of FGD gypsum.

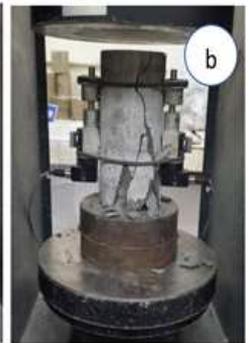
Ultra-High Performance Concrete (UHPC)

NCCBM conducted studies in past on normal and High Strength Concrete (HSC) using different indigenous aggregates for concrete grades from M35 to M100. NCCBM has also completed an R&D project for development of Ultra High-Performance Concrete (UHPC) with compressive strength in excess of 150 MPa. Based on knowledge and expertise gathered in these studies, a new study was taken to evaluate mechanical and time-dependent properties of UHPC which includes Very High Strength Concrete (100 to 130 MPa) and Ultra High Strength Concrete (130 to 180 MPa). Currently, Indian Standard under revision covers concrete grade M100 and outcome of this study will provide data for up-gradation of Indian Standard of design for higher-grade concrete above M100. One of the important aspects of structural design using higher strength concrete is development of stress block parameters and their standardization. Development of stress block parameters requires an extensive study on stress-strain response for developed mix. Based on performed experimental examination, results from stress-

strain study suggested that a change in compressive strength changes stress-strain behaviour of concrete. For strength rise from 40 MPa to 80 MPa strain at peak stress increased by 18% whereas for strength rise to 110MPa, 130MPa, and 140MPa the increase is 31%, 52%, and 58% of strain values for concrete with 40MPa strength. Also, stress-strain curves obtained gets steeper with an increase in strength of concrete. At a higher strength, curves follow a straight-line path, contrary to the parabolic path for normal and some extent for HSC. With increase in strength of concrete, post-peak behaviour shrinks and finally coincides with Very High Strength Concrete. This results in approximately equal strain at peak stress and ultimate strain at failure. The decrease in ultimate strain and increase in strain at peak stress of high to Very High Strength Concrete will have a direct impact on depth of neutral axis for a balanced section which is directly related to maximum capacity of member. It was also found that LVDT and compressometer give slightly different strain values for same load and same concrete material. This is due to difference in gauge length ratio used in these strain measuring devices. Compressometer is incapable of capturing post-peak behaviour of concrete, whereas LVDT shows errors at starting of loading in experiment.



Testing setup for stress strain curve (a) View-1 (b) View-2



Failure mode of tested concrete specimen (a) View-1 (b) View-2

Fracture parameters are evaluated for concrete mixes with different w/b ratios without and with 1% steel fiber by volume. The three-point bending test method with central point loading is used in study. Adding steel fibers significantly increases fracture energy. The observed increase in fracture energy was 850%, 770% and 450% respectively for a w/b ratio of 0.47, 0.36 and 0.20. Comparing concrete with different w/b ratios, with increase in strength of concrete a consistent increase in fracture energy is observed. The addition of fiber increases strain carrying capacity of concrete and with increase in concrete compressive strength, peak load in load-deformation curve increases. Stress intensity factor and energy release rate shows a similar trend and these two parameters improve with addition of steel fiber but observed increase is less when compared to increase in fracture energy. Results suggest that compressive strength of concrete is an equally important factor for increase in values of these parameters along with addition of fiber. Characteristic length of concrete shows an opposite trend from other parameters when concrete with different strengths is compared. For higher-strength concrete characteristic length is less. Comparing normal concrete with fiber reinforced concrete for a particular w/b ratio, a significant increase in characteristic length of order of increase in fracture energy was observed. From the study, it can be concluded that adding steel fiber tremendously increases amount of energy needed for fracture of beam. It also helps in arresting cracks by increasing characteristic length. But formation of initial crack is much more closely related to grade of concrete as fiber action can only be observed after onset of initial cracks. The fracture performance of hybrid fiber reinforced concrete with strength in three different ranges is being studied. The obtained fracture parameters are being compared with findings for a similar mix of plain and steel fiber reinforced concrete.

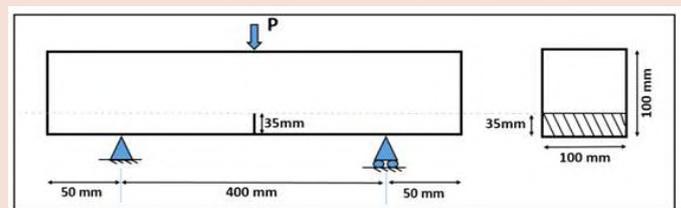


(a) Polypropylene fibre



(b) Steel Fibre

Addition of hybrid fibers (0.25% Polypropylene + 0.75% steel by volume of concrete) in concrete reduces compressive strength marginally when compared to plain concrete and concrete with steel fiber (1% by volume of concrete). Maximum reduction was observed in case of HSC with lowest w/c ratio.



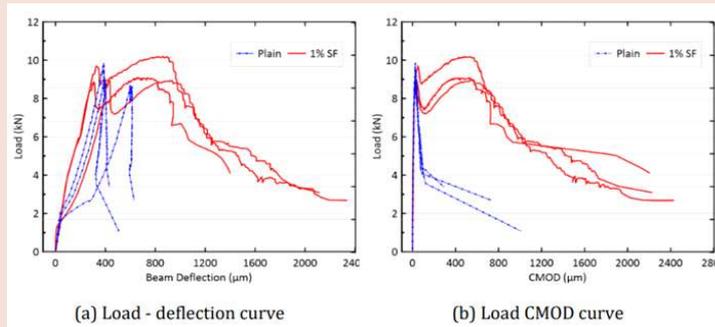
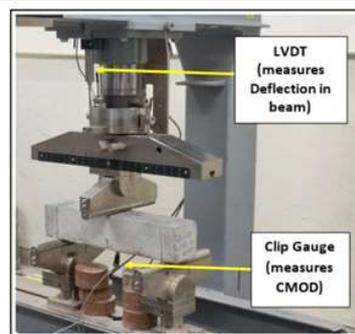
Three-point bend test on notched beam

This reduction in strength for HSC can be attributed to disturbance created in optimized cementitious material and aggregate matrix for HSC due to addition of hybrid fiber. Also, HSC consists of silica fume whose functionality in matrix is most likely to get affected by these hybrid fibers. Such significant alteration in split tensile strength is not observed in mix with hybrid fiber and it can be concluded that fiber action helped in compensating for matrix strength reduction.

The load-deflection and load CMOD curves for hybrid fiber reinforced concrete shows similar behaviour to steel fiber reinforced concrete and show a significant improvement in peak load, and maximum deflection compared to plain concrete. For normal and normal to HSC, hybrid fibers even show a higher peak load but in case of HSC, curves were located in between curves for plain and steel fiber reinforced concrete. The reason is similar to compressive strength reduction. The addition of hybrid fiber tends to disturb cementitious materials and aggregates matrix, giving a slightly lower peak in curves. The fracture parameters—fracture energy, stress intensity factor, energy release rate, and characteristic length show similar trends. For high and normal to high strength concrete addition of hybrid fibers gave slightly better results than steel fiber reinforced concrete. This can be attributed to an improvement in cementitious matter-aggregate matrix in these mixes due to filling up of voids by hybrid fibers.



Four Point Bend test on Reinforced Concrete Beams



steel fiber reinforced concrete and show a significant improvement in peak load, and maximum deflection compared to plain concrete. For normal and normal to HSC,

On the contrary, already optimized mix for HSC gets disturbed by addition of hybrid fiber. Although for densely packed HSC fracture parameters reduced by replacement of a small amount of steel fiber by polypropylene fiber, reduction is marginal. Also, for all mixes studied hybrid fiber reinforced concrete performed much better than plain concrete without any fiber addition. Also, for normal and normal to HSC, fracture parameters improved marginally by hybrid fibers compared to steel fiber. Further, to evaluate and compare difference between the flexural and shear behaviour of conventional and geopolymer beams a full-scale four-point bend test on reinforced conventional concrete and reinforced geopolymer beams has been performed.

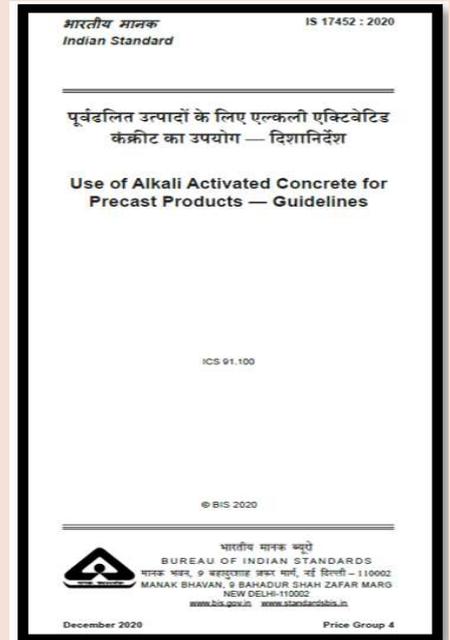
Geopolymer Concrete

Alkali activated (*Geopolymer*) concrete is an excellent and viable alternative to Portland cement based concrete as it can be produced using industrial by-products such as Ground Granulated Blast Furnace Slag (*GGBFS*) and fly ash (*source of reactive aluminosilicates*) along with less energy craving ingredients such as alkali activators (*for ex. Sodium Hydroxide, Potassium Hydroxide, Sodium Silicate, Potassium Silicate etc.*). In view of enhancing the utilisation of industrial byproducts and lack of standard guidelines for development and design of geopolymer concrete, NCCBM took an initiative to conduct a research study on development of geopolymer concrete and study its properties for precast products. Out of various industrial byproducts, fly ash and GGBFS were selected as cementitious binder for geopolymer concrete, due to their uniform availability across the country. Several mix trials were conducted for development of geopolymer concrete mixes of different strength range, by varying GGBFS and fly ash proportions in total cementitious content, at different concentrations of chemical activators.

Geopolymer Concrete

Some of the optimised geopolymer concrete mixes were evaluated for various fresh, hardened and long term durability properties. An experimental pavement stretch was casted in NCCBM premises using geopolymer paver blocks. Based on study, a patent has been filed for interlocking paver blocks which is under consideration. NCCBM drafted guidelines for developing geopolymer concrete mixes for precast products. Based on guidelines and recommendations, IS 17452 (*Use of alkali activated concrete for precast products- Guidelines*) was formulated in 2020. Based on expertise gathered in previous study, a new research project titled “**Studies on Mechanical and Durability Properties of High Strength Geopolymer Concrete**” was taken up with an aim to study the hardened and durability properties of normal and high strength geopolymer concrete and preparation of guidelines for structural design using geopolymer concrete based on its mechanical properties, whose validation has been done by limited testing on reinforced geopolymer concrete beams of selected grades.

Around 50 mix trials were conducted for development of normal and high strength geopolymer concrete mix with varying proportion of GGBFS and fly ash (GGBFS: fly ash as 70:30, 50:50 and 30:70), by varying the total Na_2O (% by weight of total cementitious binder) from 5% to 9% and keeping activator modulus (ratio of SiO_2 and Na_2O) as 1 and varying water to binder ratio to achieve mixes of required strength and desired level of workability. In present study, Sodium Hydroxide (NaOH) and Sodium Silicate (Na_2SiO_3) were used as chemical activators for development of normal and high strength geopolymer concrete mixes.



IS 17452:2020

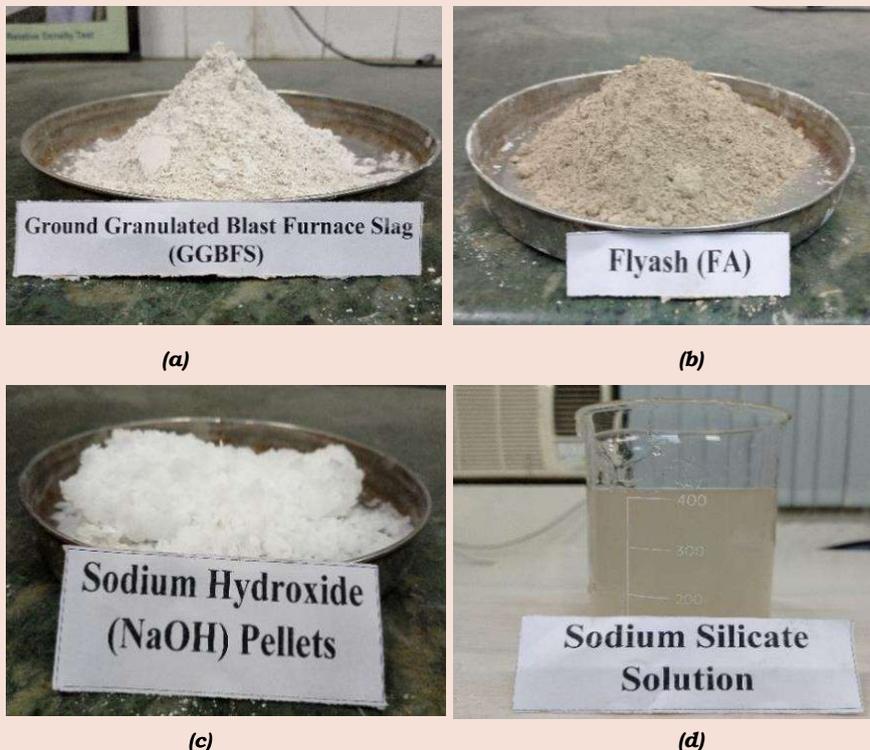


Figure: Cementitious binder and alkali activators used for development of geopolymer concrete mix: (a) Ground granulated blast furnace slag (b) Fly ash (c) Sodium Hydroxide (d) Sodium Silicate solution

The finalised geopolymer concrete mixes were evaluated for fresh properties of concrete (*slump and air content*) along with mechanical properties of hardened concrete such as compressive strength, flexural strength, split tensile strength, Modulus of Elasticity, drying shrinkage etc. Performance of geopolymeric concrete mixes was

also evaluated for their long term durability behaviour in terms of accelerated carbonation, rapid chloride penetration test, chloride diffusion, water permeability, abrasion resistance, sorptivity etc. Reinforced geopolymer concrete beams (*both normal and high strength*) were cast to study their behaviour in flexure and shear to analyse its failure pattern, ductility, yield moment, crack propagation characteristics, deflection, load at maximum deflection etc. Paste samples prepared using GGBFS: Fly ash as 70:30, 50:50 and 30:70 were subjected to microstructure analysis using XRD, SEM, OM & MIP.

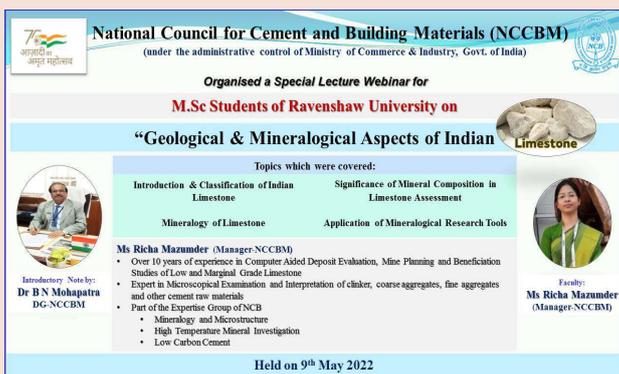


Testing of reinforced geopolymer concrete beam to study its behaviour in flexure under progress

Based on studies conducted till date, it can be concluded that fresh, hardened and durability properties of geopolymer concrete mixes of equivalent strength will be different for geopolymer concrete prepared using different types of binders and activators and will depend upon the proportion of individual cementitious binders, type and dosage of chemical activators. Based on experimental study, it can be concluded that geopolymer concrete of a particular strength/grade can be developed at significantly lower binder content in comparison to cementitious binder required to produce conventional Portland cement based concrete of equivalent strength/grade which leads to development of sustainable concrete with low CO₂ footprint. Early age compressive strength of normal strength high calcium geopolymeric concrete mixes is higher in comparison to conventional concrete mix.

Higher early strength in case of geopolymeric concrete mixes can be attributed to quick dissolution of reactive alumino silicate ions (*present in fly ash and slag*) in alkaline media and occurrence of geopolymeric reactions at early age in geopolymer concrete mix. The ratio of split tensile strength to compressive strength is same for both Portland cement concrete and high calcium geopolymer concrete. In case of normal strength concrete, tensile strength may go up to 10 % of compressive strength; however, for higher strength it reduces to about 5 % of compressive strength. Modulus of elasticity and Poisson's ratio of geopolymeric mixes of both normal and high strength are observed to be lower in comparison to their corresponding conventional concrete mixes. The lower value of modulus of elasticity for geopolymer concrete than conventional concrete can be attributed to the low intrinsic modulus of N-A-S-H gel and higher initial micro-cracks formulation in geopolymer concrete. In case of drying shrinkage, geopolymer mixes of normal and high strength showed drying shrinkage comparable to their corresponding conventional concrete mixes. Cementitious binder required to produce conventional Portland cement based concrete of equivalent strength/grade which leads to development of sustainable concrete with low CO₂ footprint. Early age compressive strength of normal strength high calcium geopolymeric concrete mixes is higher in comparison to conventional concrete mix.

Linkage with Academia



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

Organised a Special Lecture Webinar for
M.Sc Students of Ravenshaw University on
“Geological & Mineralogical Aspects of Indian Limestone”

Topics which were covered:

Introduction & Classification of Indian Limestone	Significance of Mineral Composition in Limestone Assessment
Mineralogy of Limestone	Application of Mineralogical Research Tools

Ms Richa Mazumder (Manager-NCCBM)
• Over 10 years of experience in Computer Aided Deposit Evaluation, Mine Planning and Beneficiation Studies of Low and Marginal Grade Limestone
• Expert in Microscopical Examination and Interpretation of clinker, coarse aggregates, fine aggregates and other cement raw materials
• Part of the Expertise Group of NCB
• Mineralogy and Microstructure
• High Temperature Mineral Investigation
• Low Carbon Cement

Faculty:
Ms Richa Mazumder (Manager-NCCBM)

Introduction Note by:
Dr. B.N. Mohapatra DG-NCCBM

Held on 9th May 2022

NCCBM organized a Special Lecture Webinar on 09th May 2022 for M.Sc Students of Ravenshaw University on **“Geological & Mineralogical Aspects of Indian Limestone”**. Detailed presentations were covered on the topics namely:

- Introduction & Classification of Indian Limestone.
- Significance of Mineral Composition in Limestone.
- Assessment, Mineralogy of Limestone &
- Application of Mineralogical Research Tools. .

The talk was well received by the students of Ravenshaw university. During the feedback session, they requested DG-NCCBM to organize more of such informative lectures in near future.

74th Research Advisory Committee (RAC) meeting

74th RAC was held on 06th April 2022 was held under the chairmanship of Sh. J N Cooper, CEO & MD, Heidelberg Cements which advised NCCBM's scientists and engineers on aspects pertaining to ongoing programmed R&D and industrial support services, with particular reference to technology forecasting, technology planning, programs, strategies, methodologies and overall project program. Some new projects of importance that were approved by the RAC are:



- Investigations on development of Portland Dolomitic Cements (PDCs) using high MgO limestone and dolomitic grade limestone from different geographical regions.
- Investigation on mineral carbonization mechanism of various industrial waste and by-products.
- Effect of Fire on the Residual Mechanical Properties of reinforcing bars and structural performance of Reinforced Concrete Beams in flexure & shear.
- Evaluation of concrete surface coatings for their effectiveness in service life enhancement of RCC elements under: Carbonation induced corrosion & chloride induced corrosion.
- Utilization of CO₂ in fresh concrete and study on fresh and hardened properties of CO₂ induced concrete.

GCCA Report: Benefits of Blended Cement



GCCA India presented its report released by Sh Anil Agrawal, Addl. Secretary, DPIIT, MoCI, GoI on **Benefits of Blended Cement** (Virtual Launch held on 13th April 2022) in collaboration with NCCBM & inputs from IIT-Madras as well as GCCA India member companies. The report presents advantages of blended cement over OPC in terms of environment, emissions and longevity; and misapprehensions about the use of blended cement, which affect its acceptance.

Development Council for the Cement Industry (DCCI)



The first meeting of newly constituted Development Council for Cement Industry (DCCI) was held under the chairmanship of Sh Puneet Dalmia on 17th February 2022 on virtual platform. During the meeting, six working groups were formed for sustainability of Indian Cement Industry viz. De-Carbonisation, Innovation, Ease of Doing Business, Capacity Utilisation, Inclusion and Energy Efficiency. The first meeting of DCCI Innovation working group was held under the chairmanship of Sh

Madhav Singhania, Dy. MD & CEO, J K Cement Ltd on 5th May, 2022. In the meeting, the following points emerged as the major thrust areas to work:

- Reduction of Clinker factor in the existing product.
- Identifying new cements which are having low clinker factor and will help in reduction of carbon foot print. Expediting approval of newer cements from BIS.
- Identifying various standards from other countries which are already been approved and in operation.
- Construction and demolition (C&D) waste is area of concern and study need to done from for its uses in Cement & concrete application.
- As AFR is playing a big role in sustainability journey of cement industry and to increase it further many plants are going for installation of kiln bypass system. Therefore, a sustainable and effective solution is required for utilization of chlorine bypass dust.

18th Green Cementech 2022



Confederation of Industry (CII-GBC) and Cement Manufacturers' Association (CMA) jointly organized 18th edition of Green Cementech 2022, annual conference for cement sector, as a virtual event on 26th & 27th May 2022. The theme for event was '**Preparing for a Net Zero Carbon Future**'. DG-NCCBM participated during the inaugural session of the event where he discussed on low carbon cements. As per commitment at COP26 given by our Hon'ble Prime Minister, for India to become Net Zero, reduction of carbon intensity by 45% and reduction of 1 billion tonnes of CO₂ emissions by 2030 is required for which, Indian Cement Industry is gearing up to contribute its share in achieving the target.

Indian cement industry is proactively reducing its carbon footprint as specific CO₂ emission has reduced to 0.58 tonnes/tonne of cement. Main contribution in this is from clinker substitution as India is blessed with industrial byproducts like fly ash and slag. Further, efforts are being made to develop new low carbon cements for future as renewable energy will be main source of energy instead of coal based thermal power plants.

Infrastructural and Development Committee (IDC) Meeting 2021-22



IDC 2021-22 (held on 06th July 2022) advises the Board of Governors (BoG) on various aspects of land, building services, equipment and facilities at various units of NCCBM. It's aim is to assist BoG in conducting the affairs of the units in such a manner as to fulfill the set objectives with the programs, policies and guidelines laid down by the board.

Expert Appraisal Committee (Industry-1)



DG-NCCBM attended the meeting of Expert Appraisal Committee (Industry-1) at Ministry of Environment, Forest and Climate Change, Paryavaran Bhawan, Delhi on 14th - 15th July 2022.

Research Council Meeting of NPL



CSIR-National Physical Laboratory (NPL-India) is mandated to be India's "National Metrology Institute" (NMI) and is custodian of "National Standards" with a responsibility of dissemination of measurements to the needs of the country.

Organizing Committee (OC) Meetings



Regular OC meetings are conducted for organizing forthcoming 17th NCB International Conference on Cement, Concrete and Building Materials. Such OC meetings are presided by DG-NCCBM who is also the Chairman for OC.

After highly successful culmination of 16th NCB International Seminar, we are happy to announce that final dates for forthcoming 17th NCB International Conference on

Cement, Concrete and Building Materials from 06-09 December 2022 at Manekshaw Centre. The theme for this year's Conference is "Moving Towards Net Zero Carbon Emission".

हिंदी बैठक



महानिदेशक – एनसीसीबीएम की अध्यक्षता में 04 जुलाई 2022 को राजभाषा विभाग, गृह मंत्रालय, भारत सरकार के प्रशिक्षण कार्यक्रम के तहत एनसीसीबीएम में हिन्दी शिक्षण योजना के अंतर्गत – पारंगत पाठ्यक्रम शुरू किया गया। इसमें कार्यालय के 22 अधिकारी / कर्मचारी (02 अधिकारी एवं 20 कर्मचारी) इस प्रशिक्षण में भाग ले रहे हैं। परांगत पाठ्यक्रम का प्रशिक्षण, हिन्दी अधिकारी, राजभाषा विभाग, गृह मंत्रालय, भारत सरकार द्वारा दिया जा रहा है।

Meeting with Hon'ble Union Minister Sh. Dharmendra Pradhan



DG-NCCBM met Hon'ble Union Minister of Education and Minister of Skill Development and Entrepreneurship Shri Dharmendra Pradhan Ji, and apprised him about NCCBM activities contributing in bridging gap between academia and industry by signing MoUs with institutions of repute like IITs, NITs, BITS, KIIT, MRU, GLA, MITS etc., providing internship to more than 150 students, organizing national conferences, expert lectures, carrying out joint R&D projects and workshops etc. in last 3 years.

Viewing the positive response received from bright young minds, NCCBM has planned to organize **Innovation Challenge for a Sustainable Bharat (ICSB)** where students from multiple disciplines of science and technology shall get the platform to showcase their innovations to the industry.

NCCBM and LivNSense signs MoU for collaboration to implement and accelerate AI/ML Innovation for Cement Industry

NCCBM entered in a MoU with LivNSense Technologies Private Limited, a pioneering Industrial AI Platform venture that serves the manufacturing industry globally across Chemical, Oil & Gas, Energy & Utilities, Life Sciences & Automotive domains. Its flagship product, GreenOps™ addresses the "Net Zero" challenge with its deep decarbonization platform leveraging Digital Twins and AI technologies across process value chain. This MoU was signed with a



vision to drive the cement industry towards Industry 4.0 with a mission to reduce GHG emissions by leveraging Artificial Intelligence, Digital Twins and IoT technologies. Cement Industry is proactively working towards decarbonization by improving alternative fuels usage and energy efficient technologies to meet the "Net-Zero" target. The product innovation will drive industry towards higher usage of alternate fuels and improve productivity, process optimization and energy efficiency by leveraging Artificial Intelligence. The objective is to accelerate decarbonization through process-engineering based AI to get full visibility into cement manufacturing process with "**Digital Twins**" to identify performance anomalies, quality and productivity issues in real time.

NCCBM brings in the domain and functional expertise with six decades of experience in cement engineering, manufacturing and technical services knowledge of plant process, operations and energy data analysis and process simulation. With this Research & Development collaboration with LivNSense, it will enable NCCBM to help in successful digital transformation of cement companies and improvement in plant process, energy efficiency and product quality. NCCBM and LivNSense are working to collaborate with cement companies in India and at Global level to accelerate the implementation of futuristic technology for development of sustainable cement manufacturing.

WORKSHOPS

National Workshop on Carbon Capture, Utilization and Storage (CCUS)

NITI Aayog organized a National Workshop on Carbon Capture, Utilization and Storage (CCUS) on 30th March 2022, in hybrid mode. Workshop brought together government officials, industry leaders and the academia to discuss the role of CCUS in enabling a circular economy for India. The Indian Power/ Steel/ Cement/ Refinery and other Heavy Industrial sectors rely heavily on coal and petroleum products. In the long-term, deep decarbonization scenarios through CCUS play an important role to achieve Net-Zero emissions in energy systems. DG-NCCBM and Sh Anupam, General Manager-NCCBM participated in the National Workshop on CCUS & shared NCCBM's thoughts on **Carbon Capture and Utilization (CCU) in Cement Industry**. DG-NCCBM was also been felicitated by Dr V K Saraswat, Member, S&T and Energy, NITI Aayog during the workshop.



National Workshop on “Low Carbon Cement: NCB initiatives”



NCCBM organized a National Workshop on “**Low Carbon Cement: NCB Initiatives**” on 20th April 2022 at NCB Ballabgarh. The workshop was organized in the backdrop of Hon'ble Prime Minister Shri Narendra Modi's commitment for India to become Net Zero by 2070 at Glasgow in the COP26 Summit.

The workshop was inaugurated by Shri C Kamraj, IAS, Managing Director- TANCEM; Dr. S S Gupta, Sr.

Development Officer-DPIIT, MoCI, GoI, Shri Neeraj Sinha, Sr. Advisor, Science and Technology, NITI Aayog, DG-NCCBM and Dr. S K Chaturvedi, Joint Director-NCCBM. It was attended by about 200 participants including senior officials from major cement companies of India like UltraTech Cement Ltd, Dalmia Cement (B) Ltd, Nuvoco Vistas Corp Ltd., J K Cement Ltd., J K Lakshmi Cement Ltd., Prism Johnson Ltd., JSW Cements, Ambuja Cements, ACC Ltd., Star Cement, India Cement; experts from DPIIT, NITI Aayog, BIS, BEE and PG Diploma students of Cement Technology course .

DG-NCCBM in his address highlighted the activities of NCB and Dr. Chaturvedi put forward the perspective of organizing national workshop on Low Carbon Cement. Scientists and Engineers of NCCBM gave presentations on (i) Portland Limestone Cement (PLC) and (ii) Composite Cement based on fly ash and slag and also presented the outcome of study on Portland Composite Cement (PCC) based on fly ash and limestone. They also presented the highlights of activities carried out on Low Temperature clinker (BCSA clinker).

A panel discussion was also organized after the technical presentations.

The deliberations in panel discussion were held on standardization of newer low carbon cements, importance of durability aspects, interconnect of sustainability and durability, usage of cements based on its performance and suitability, availability of supplementary cementitious materials for low carbon cements, readiness of cement industry for manufacturing of low carbon cements, possibility of 100% blended cement production in India, and raising awareness amongst the users.



Codal formulation/modification at BIS, collaboration of cement plant R&D centers / labs with NCCBM, covering durability aspects before formulation of new standards for low carbon cements, promoting masonry cement utilization in masonry work, BCSA clinker based cement utilization for fast setting applications as well as repair work in structures were key take aways from the workshop.

Workshop on designing inclusive roadmap for cement sector decarbonization



Leadership Group for Industry Transition (*LeadIT*) and The Energy Resource Institute (*TERI*) invited DG-NCCBM as a stakeholder to a participatory workshop on designing an inclusive Roadmap for Cement Sector Decarbonization in India. The workshop was held on the 11th April 2022, between 10 am - 4.30 pm at Hotel Le Meridien in New Delhi. DG-NCCBM highlighted the 5 levers to foster decarbonization in the Indian Cement Industry, policy recommendations, financial instruments and technology needed to achieve the decarbonization.

Visit to Cement Plant in Slite, Sweden

Leadership Group for Industry Transition (*LeadIT*) is a voluntary initiative for promoting low-carbon transition especially in hard-to-abate sectors like Iron & Steel, Aluminium, Cement and Concrete, petrochemicals, fertilisers, bricks, heavy-duty transport, etc. through active participation of private sector companies. LeadIT gathers countries and companies that are committed to reaching net zero carbon emissions from industry by 2050. As a part of this initiative, DG-NCCBM along with Indian delegation visited cement plant which is a subsidiary of Heidelberg Cement, located in Slite, Gotland, Sweden. Slite cement plant is Sweden's largest cement factory with a production capacity of 2.5 million tonnes per year and is currently second-largest source of greenhouse gas emissions in Sweden, responsible for 3% of all its overall CO₂ emissions.

Heidelberg Cement is upgrading its Slite cement plant to develop it into world's first Carbon-Neutral cement plant having facility to capture up to 1.8 million tonnes of CO₂ annually, which corresponds to plant's 100% CO₂ emissions and store the same in an underground long storage facility. Carbon capture plant is targeted to start full scale operation by 2030 to capture the plant's 100% CO₂ emissions. The plant officials informed the visiting team that a 400,000 t/yr CCS system is being built by Norcem, a subsidiary of Heidelberg Cement, at its Brevik cement plant in Norway. CSS facility at Brevik is presently under construction and will start operating by 2024. Slite cement plant will have four times the capacity of that at Brevik plant. Additionally, use of bio-based fuels in cement production at Slite will be increased.



Visit to Steel Plant in Lulea, Sweden



As part of tour to Sweden under LeadIT initiative, DG-NCCBM along with Indian Delegation visited SSAB's steel plant and pilot plant of HYBRIT Project located in Lulea, Sweden. HYBRIT is a partnership between LKAB (*Europe's largest iron ore producer*) and Vattenfall (*one of Europe's largest energy companies*) & SSAB formed to develop hydrogen based production of fossil free sponge iron production, in order to reduce negative climate effects of steel production. Steel industry contributes about 7% of anthropogenic CO₂ emissions. During production of steel, about 1.8 tonnes of CO₂ is emitted and to meet commitments of decarbonization, 90% lower carbon intensity in steel production is required. This won't be possible with incremental improvements of old technologies and requires a new metallurgy. Using HYBRIT technology, SSAB aims to replace coking coal, traditionally needed for ore-based steelmaking, with fossil-free electricity and hydrogen. The result will be world's first



fossil-free steelmaking technology, with virtually no carbon footprint. The first of its kind direct reduction pilot plant at SSAB site in Luleå, Sweden started in 2020. In the pilot plant, development of process of reducing iron ore using fossil-free hydrogen is taking place. Adjoining the pilot plant, an underground hydrogen storage pilot facility is operational from 2022. This facility demonstrates feasibility and scalability of new technology replacing coal by hydrogen in steel production process and aims to produce 1.3 million tonnes of steel by 2026.

Results Achieved: India is the second largest producer of cement as well as crude steel. In order to meet the commitment of becoming Net Zero by 2070 given by Hon'ble Prime Minister at COP 26, Glasgow Summit such demonstration projects of CCU and application of Hydrogen are also required in at least one cement and steel plant in India. The experience gained from these demonstration projects will be helpful for operating full scale CCU plants in India. To disseminate the knowledge acquired during the tour and to create awareness on Carbon Capture and Utilization in Indian Cement Industry, webinars are planned to be organized.

Visit to North Cluster at Ambuja Cement



DG-NCCBM visited North Cluster at Ambuja Cement, Ropar from 6th to 7th June 2022. He gave a detailed presentation on NCCBM activities to Unit Heads and Senior officials of cement plants in North cluster and discussed on novel methods to carry out research projects work in collaboration with the industry.

Visit of Adani Group

Sh Satish Kumar Tanwar, Head-Ash Management Adani Power Ltd, Adani Corporate House visited NCCBM Ballabgarh for discussions & interacted with Scientists and Engineers to jointly work on various projects in coming future. He visited Centre for Cement Research & Independent Testing (CRT) & appreciated NABL accredited testing facilities available in the area of cement & building materials.



Visit of Deputy Secretary, MoEF&CC

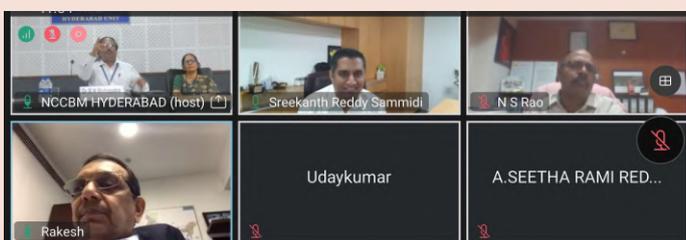
Ms Ruchika Drall, Deputy Secretary, MoEF & CC, GoI visited NCCBM for discussions with DG-NCCBM on LeadIT initiatives & activities of NCCBM. She interacted with Scientists and Engineers to follow up on the action plan on dissemination of findings of Sweden visit amongst cement industry in India. She visited Centre for Cement Research & Independent Testing (CRT) & appreciated NABL accredited testing facilities available in the area of cement & building materials.



Visit to NCCBM-Hyderabad Unit



Dr B N Mohapatra, DG NCCBM visited Hyderabad unit during 23-24 June 2022. During his visit, he reviewed R&D projects and Sponsored projects. DG visited NCB-H laboratories and training facilities and suggested for further improvements. DG interacted with NCB-H officials and also reviewed the revenue generation of NCB-H. DG interacted with ACH Chairman and Senior executives of South Cement plants and briefed about upcoming 17th NCB International Conference.



National Technology Day 2022

NCCBM celebrated National Technology Day 2022 on 11th May 2022. This year's theme was Integrated Approach in Science & Technology for Sustainable Future. Chief Guest for the occasion, DG-IMD, Dr. Mrutyunjay Mohapatra (*connected online*) delivered the keynote address thru video conferencing. DG-NCCBM presided over the event. DG-IMD presented a short presentation about the technological advancement of IMD dedicated for weather forecasting of the Indian Sub-Continent & briefed NCCBM about the role of technology for the betterment of society as well as Nation at large. He quoted “*There is paradigm shift in the modus operandi of IMD, from Nirbharta to Aatm Nirbharta*”.

Later, DG-NCCBM visited India Meteorological Department (IMD) Head Office in Delhi & met with DG-IMD to express his gratitude for addressing and motivating NCCBM's Scientist and Engineers on the occasion of National Technology Day 2022.



World Environment Day 2022

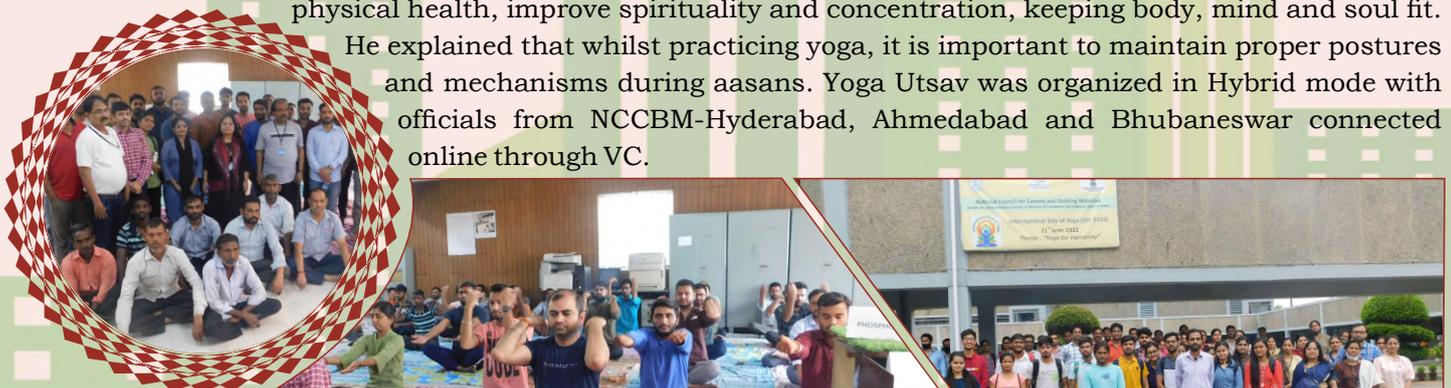
NCCBM celebrated World Environment Day (WED) 2022 on 03rd June 2022 with sapling plantation at Ballabgarh campus. This year, World Environment Day 2022 was hosted by Sweden. “**Only One Earth**” was the campaign slogan, with the focus on “*Living Sustainably in Harmony with Nature*”.



08th International Day of Yoga (IDY)

NCCBM organized yoga programs for its staff to mark 73rd day and 12th day of the countdown to 08th IDY 2022 by organizing yoga session and health talk by Dr. Ankush Kaushik, Chief Yoga Guru and Ayurveda Yoga Acharya, HoD, Patanjali where benefits accrued from yoga were explained to NCCBM staff. Dr. Kaushik, also gave demonstration of a few *asanas* which could be practiced during busy work schedule to maintain mental & physical health, improve spirituality and concentration, keeping body, mind and soul fit.

He explained that whilst practicing yoga, it is important to maintain proper postures and mechanisms during asanas. Yoga Utsav was organized in Hybrid mode with officials from NCCBM-Hyderabad, Ahmedabad and Bhubaneswar connected online through VC.



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Delegates from 18 Countries

👉 **193 Technical Papers Presented in
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👉 **120 Stalls by 79 Exhibitors in the
Technical Exhibition**





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 premier 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 Independent Testing Services.

Centre for Mining, Environment, Plant Engineering & Operation (NCB-CME) - Process Optimization & Productivity Enhancement, Energy Management, Project Engineering & System Design, Environmental Sustainability and Climate Change.

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

Centre for Industrial Information Services (NCB-CIS) - Integrated IT Solutions, Publications & Image Building, Seminars & Conferences, International & National Linkages, Technical Insights.

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.

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