



CSIR-CBRI Newsletter



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CSIR-Central Building Research Institute, Roorkee-247 667 (UK)



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Research in Progress

Development of Multifunctional Thermal Insulating Coating System for Buildings

Organic and inorganic coatings on concrete offer an effective and reliable solution for the protection both of the concrete and the embedded steel, either for new construction or for rehabilitating deteriorating concrete. Several coating systems are reported in the literature for the corrosion prevention and thermal insulation. These include alkyds, acrylics, polyurethanes, polyesters and epoxies. Among these, acrylics are good choice for thermal insulation coatings and do not have inherent high inflammability as of epoxies.

Under this project, work on development of indigenous multifunctional thermal coatings having many features with more improved properties at one place was carried out. R&D work involved the development as well as the characterization of the multifunctional thermal coatings. Addition of nano materials on the coating behaviour was also studied.

In total, four coatings were prepared and studied during the course of this project. The formulations were based on acrylic

resin having non volatile content greater than 30%.

- Aliphatic Acrylic Emulsion: > 30%
- Pigments/Fillers: 10-20%
- Mineral system: 10-20%
- Other additives: 1-2%
- Solvent: 10-20%

The coating properties of the formulations were investigated for their morphological and physico-mechanical behaviour such as water vapour transmission, bond strength and tensile strength (Table 1).

Immersion and thermal studies were carried out to see their efficacy.

Chemical resistance of the systems was evaluated by immersion test in water, 5% sodium chloride, saturated urea, saturated DAP,



Fig. 1: Set up showing RILEM test tube method

Table 1 - Properties after Application on Substrate

Coating System	Bond Strength MPa	Adhesion & Flexibility 3.18 mm dia. mandrel	Dry & Wet Abrasion 1000 Strokes
1	3.00-3.20	No failure	No failure
2	3.40-3.80	No failure	No failure
3	3.00-3.60	No failure	No failure
4	3.24-4.00	No failure	No failure



Table 2 - Chemical Resistance Tests (100 days immersion results)

Coating system	1	2	3	1N
Immersion medium				
Water	No Change*	No Change	No Change	No Change
NaCl (5%)	No Change	No Change	No Change	No Change
HCl (20%)**	-	-	-	-
NaOH (30%)	No Change	No Change	No Change	No Change
Sat. Urea	No Change	No Change	No Change	No Change
Sat. DAP	No Change	No Change	No Change	No Change

*No change means no blistering, cracking, peeling off, discoloration, surface Cracking etc.

** Panels started to disintegrate & hence removed after 35 days.

HCl (20%) and NaOH (30%) solution (Table 2 & 3). The coatings were also subjected to accelerated laboratory test, i.e., humidity cabinet test to know their corrosion protection efficacy and heating cycles to know thermal resistance. Water resistance was carried out as per RILEM test tube method (Figure 1).

Experimental studies by us under this project had shown encouraging results with reference to addition of nano additive in coatings and there is strong need for more elaborate studies in this direction to develop multifunctional coatings for various building applications. Further work is needed to arrive at any final

**Table 3 - Thermal Stability
(temperature: $125 \pm 5^\circ\text{C}$)**

Coating System	After 90 days
1	O.K.*
2	O.K.
3	O.K.
4	O.K.

*O.K. - Means no debonding, blisters etc.

conclusion. Once, these detailed experimental results will be available the work on patent filing will be undertaken.

- P.C. Thapliyal

Studies of Phase Change Materials for Energy Efficient Buildings

Energy demand during summer months is created by building air conditioning. Energy consumption is ensuing to green house gas emissions and depletion of renewable resources. Present energy situation warrants use of advanced materials with low embodied energy to reduce the growing energy demand of buildings. Use of energy has been tremendously increasing during the peak hours in summer causing the problems of overloading, breakdown etc. This peak hour energy demand can be significantly reduced by using phase change materials (PCM). The PCMs have been successfully used as energy storage devices in heat pumps, solar engineering, space craft etc.

Various types of PCMs such as organic and inorganic are available for specific applications. Recently, these PCMs are being explored for reducing peak hour energy demand by incorporating them into building components/ products. However, selection of PCMs and incorporating them into building components are still challenging tasks. Researchers are mostly attempting to incorporate wax or fatty acid into building

products and encapsulation technique is being employed for such applications. Phase change materials are energy efficient to the buildings because these reduce heat flux entering into room and absorb more amount of latent heat at constant temperature. Reduction of heat flux entering into the room is directly proportional to the corresponding reduction in electrical energy consumption. It can enhance thermal properties of building component and undergo large temperature fluctuations due to cooling or heating load in building. PCM allows the reduction of temperature fluctuations.

A research study is attempted at CSIR-CBRI with incorporation of PCM in bricks. The temperature profiles of indoor air temperature are also studied by using a C-16 fatty acid as PCM. Fatty acids are preferred due to large latent heat and low cost. Fatty acids have superior properties over many PCM such as melting congruency, good chemical stability. More important characteristics are their smaller volume change during phase transition and high latent heat of fusion per unit mass. Thermal properties i.e melting point and heat of fusion of C-16 fatty acid was 40°C and 227.1 kJ/kg





Fig 1: Experimental Set up of ordinary and PCM incorporated brick

respectively and thermal stability were investigated by differential scanning calorimeter (DSC). An experimental set up has been prepared with three identical chambers consisting of ordinary, perforated and PCM incorporated in experimental setup (Fig.1).

Thermocouples were placed in each chamber for indoor air temperature measurement and connected to digital temperature indicator during May 2011 to August 2011. Experimental room maintained steady state temperature 40°C with the help of heater and controller. Generated temperature profile of each chamber was measured during 700 hrs to 1900 hrs. The results observed 6-8°C temperature difference between ordinary and PCM incorporated chamber at 4000gm of PCM load (Fig.2).

The temperature differences observed due to partial melting of PCM during 700 - 1100 hrs.

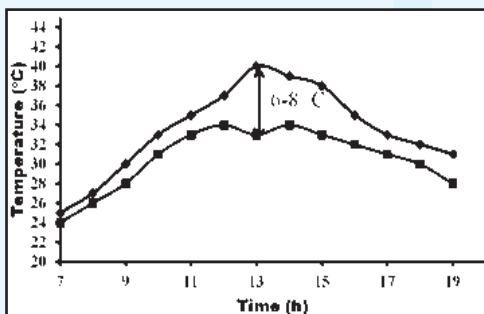


Fig 2: Temperature profile of ordinary and PCM incorporated brick

Maximum temperature difference observed due to complete melting of PCM during 1100 - 1300 hrs. The temperature was increased due to discharging of heat entering into PCM room during 1400 - 1500 hrs. After that temperature difference observed due to more heat is transferred into the experimental room by opening of room door and heater off. Studies on thermal performance of mass effect on incorporated PCM varied 1000 gm to 4000 gm are also undertaken.

Studies on thermal performance of mass effect on incorporated PCM varied 1000 gm to 4000 gm were also undertaken. The results observed that when mass is increased, melting time of PCM is also increased due to heat resistance offered by the brick. If PCM load is increased more than 4000 gm, melting time is increased but at specific PCM load it behaves as insulator due to lack of heat source and time taken to the melt and PCM does not effect on indoor air temperature. Excess time period can be reduced by mixing thermal conductivity additives such as Graphite, Copper etc. We can maintain thermal comfort level in the room by adding these additives and increase heat transfer rate (from indoor air temp to PCM). When PCM load increased, thermal storage (91 to 373 kJ) and temperature difference is also increased (2 - 8 °C) due to melting of PCM i.e outdoor air temperature does not allow through the room (Fig. 3).

When mass is increased thermal storage (Q) and temperature difference is increased. Fig.4 states that PCM installed bricks are better than the ordinary and grooved bricks. If the bricks are installed with PCM, they can reduce the heat entering the room more than ordinary bricks. When compared with the ordinary and perforated bricks, perforated bricks reduce the heat transfer by 38% than ordinary bricks. When compared with the ordinary and PCM bricks, PCM bricks reduce the heat transfer by 87% than ordinary bricks.

When compared with the PCM bricks and perforated bricks, PCM bricks reduced the heat transfer by 80% than perforated bricks. This is due to absorption of heat by the phase change material while heat is entering into the room. Further research is going on in the direction of studying the engineering and thermal properties of PCM incorporated bricks and evaluating temperature profile of the prototype building.

- Srinivasarao Naik B.



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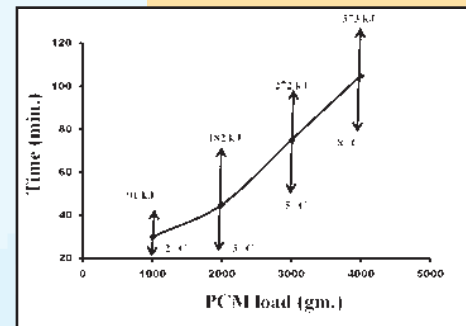


Fig 3: PCM load on Chamber

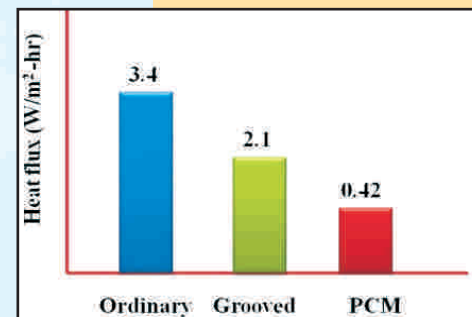


Fig 4: Heat flux entering into the room



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Republic Day



The Republic Day of the nation was celebrated with a deep sense of patriotism combined with gaiety on January 26, 2013. Prof S.K. Bhattacharyya, Director, hoisted the National Flag and addressed the gathering and took the salute at the March Past performed by the security Guards. The school children from Bal Vidya Mandir presented various cultural programmes on patriotic themes. A cricket match was also arranged.

Foundation Day

67th CSIR-CBRI Foundation Day was celebrated at Central Building Research Institute, Roorkee on February 10, 2013. The whole campus had a festive look and the main function was organized in the morning. On this auspicious occasion Mr. Mangu Singh, Managing Director, Delhi Metro Rail

Corporation Ltd. (DMRC), New Delhi graced as chief guest and Prof. Prem Krishna, Vice President, Indian National Academy of Engineering & Chairman, Research Council, CSIR-CBRI as the guest of honour while Prof. S.K. Bhattacharyya, Director, CSIR-CBRI presided over the function. Many dignitaries and superannuated staff of CBRI also witnessed the occasion. Mr. R.K. Garg, chief scientist and chairman of the committee welcomed all the dignitaries and highlighted glorious past of the institute.

Prof. S.K. Bhattacharyya, Director addressed the gathering and touched upon the considerable achievements to the credit of the institute in the area of Building Science and Technology since its inception. He remembered the words of Pandit Nehru during one of his visits to CBRI and stated that,

'It is science alone that can solve the problem of hunger and poverty....who indeed could afford to ignore science today? At every turn we have to seek its aid.... The future belongs to science and to those who make friends with science'. Prof. Bhattacharyya said in

line with this, what is practiced today at CSIR is science for engineering and engineering for science. He also said that CSIR-CBRI, always in its endeavor, extended its cooperation and support to different states of the country in order to propagate its proven technologies for upliftment of rural and semi-urban poor under various plans and projects of Government of India. The applications of technologies developed at CBRI have brought down the construction cost considerably. Keeping the national missions in mind the focus areas of R&D have been identified namely Development of advanced construction materials; Health monitoring of building structures, diagnostics & retrofitting; Engineering of disaster mitigations-fire, landslide, earthquake & cyclone; and Energy efficient building systems. He hoped that CSIR-CBRI may be able to serve the society in an effective manner through the generation of new knowledge, new ideas with the help of new generation of people.

Mr. Mangu Singh, Managing Director, DMRC, New Delhi appreciated the work done by CSIR-CBRI and stressed the need to develop clean technologies that are cost effective and affordable in the rapidly changing scenario. He shared his experience of Delhi Metro project highlighting the successful Clean Development Mechanism (CDM), the only successful project in Railway Transportation Sector in the world and various steps taken in achieving the energy efficiency and use of such technologies.

Prof. Prem Krishna, Vice President, Indian National Academy of Engineering & Chairman, Research Council, CSIR-CBRI expressed his satisfaction over the R&D efforts made by the institute and stressed on the right mix of enthusiasm and experience in achieving the desired results.



**Arrival of the Chief Guest,
Guest of Honour and
Director CSIR-CBRI**



**Address by Prof. Prem Krishna,
Chairman RC, CSIR-CBRI**





Release of 'CBRI News Letter' and 'Bhavanika'

Diamond Jubilee Director's Award for development of best Technology which had maximum impact on the society was given on "Development of Cable Penetration Seal System (Cable Fire Stop)" jointly to Dr. Suvir Singh, Dr. N.K. Saxena, Mr. Sushil Kumar and Mr. Rajiv Bansal.

Diamond Jubilee Director's Award for best research paper which had maximum impact on the society was given on "Composite Boards from Isocyanate Bonded Pine Needles" jointly to Dr. Manorama Gupta, Ms. Monika Chauhan, Ms. Naseeba Khatoon & Dr. B. Singh.

On this occasion 'CBRI News Letter' and 'Bhavanika' were released by the chief guest



Mr. Mangu Singh, Chief Guest, presenting the Diamond Jubilee Tehnology Award 2013 to CSIR-CBRI Scientists

and the guest of honour. Sri R.K.Garg, chief scientist proposed a vote of thanks.

There have been a number of activities, organized to celebrate CSIR-CBRI Foundation Day 2013 including outdoor games such as badminton, volleyball and indoor games like table tennis, chess and carrom. Also, a friendly cricket match was organized on 26th January 2013. A cultural programme was organized in the evening by the staff club and ladies club of the institute and the prizes were distributed. The illumination of the main building, auditorium and rangoli made especially for this occasion were highly appreciated beside the cultural evening programme.



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International Conference on Advanced Materials for Energy Efficient Buildings

The international conference on Advanced Materials for Energy Efficient Buildings (AME²B-2013) was organized by CSIR-Central Building Research Institute, Roorkee during Feb. 13-15, 2013 at New Delhi. The conference was inaugurated by Prof. Samir K. Brahmachari, DG-CSIR, New Delhi. Prof S P Shah Northwestern University, USA was the Guest of Honour and Prof SK Bhattacharyya, Director CSIR - CBRI, Roorkee presided over the function. The three days long conference had deliberations on advanced materials so as to achieve energy efficiency in buildings. Different thematic sessions such as Nanotechnology based Advanced Materials, Energy Efficient Coatings, Energy Efficient Building Materials & Technologies, Composite Building Materials, Waste to Wealth, Nano-technology based Cementitious Materials, Sustainable Concrete etc. had presentations by distinguish speakers viz., Prof. I. Manna, Director, IIT Kanpur; Prof. Mark Irle, France; Prof. Chi-sun Poon, Hong Kong; Prof. K. Sobolev, USA; Prof. P. Rohatgi, USA; Prof. LI Zongjin, Hong Kong; Prof. J. Provis, UK; Prof. S.H. Kwon, South Korea etc.



Since Materials and Energy are the core research areas for sustainable growth the conference was organized at the time when the construction of energy efficient building to save energy is at the core in the country's long term growth planning. In recent years awareness of environment aspects has grown up for building construction sector too. Manufacturing process of building material contribute Green House Gasses such as CO₂ to the atmosphere to a great extent. Therefore, there is a great concern and



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necessity in reducing the GHG emission into environment in order to control adverse ecological effect. Energy requirement of building in developed and developing countries are just opposite to each other. In developed countries a large quantity of energy is used for heating and cooling thus, energy is a recurring requirement whereas, in developing countries most of the energy of a building is in the form of embodied energy of materials and manufacturing processes. Therefore, the research gap for both developed as well as developing countries are different but ultimately leading to energy conservation only. This conference had speakers/ delegates from both the segments thus, provide an excellent opportunity to discuss and share their views.

In the rapidly changing scenario of building sector planners, architects, engineers and builders are looking for new materials and

technologies to adopt in future constructions that benefits like energy efficiency, resources & water conservation, improved indoor air quality, life cycle cost reduction and durability. Therefore, to attain these objectives, application of the

latest advancements in various technologies including developments in material science, use of environment friendly building materials, obtaining energy efficiency while producing such materials are of prime concern. Considering the devastating effect of climate change the government has launched one approach to reduce the magnitude of these problems is to construct "Green Buildings" that ensure basic living requirement without imposing stress on non-renewable resources. These buildings should be cost effective and time-efficient, while also being environmental friendly with maximum use of "Green Materials".

For last six decades CSIR-CBRI has been engaged in research work on various aspects of building technology. In the process, the institute has developed its core strength in the development of alternative building materials and technologies besides significant contribution in other areas. Over the years, several technologies related to building materials have been developed and successfully commercialized, such as wood substitute, building products, protective coatings for concrete & steel structures, bricks from inferior soils, energy efficient brick kilns, brick making machines, building products and components from argillaceous and siliceous industrial wastes etc. Accordingly, it is essential to develop advanced construction materials using technologies such as nanotechnology, bio-materials, cement-free geopolymer concrete, high performance composite technologies and energy conservation concepts. Further, it is important that the work on use of industrial solid wastes for making green materials and sustainable construction.

NATIONAL SCIENCE DAY

The CSIR-Central Building Research Institute has celebrated National Science Day on 28th February, 2013 to commemorate Raman Effect of the Nobel Laureate Sir C.V. Raman. The day celebration offers an opportunity to bring issues of science to the centre stage and provide awareness to the public of immediate concern.

Prof. S.K. Bhattacharyya, Director, CSIR-CBRI narrated the contribution of Sir C.V. Raman in the field of Spectroscopy for a wide range of scientific investigations and industrial applications. He stressed the role of National Science Day's objectives in transforming our society under the theme of "Genetically Modified Crops and Food Security". He felt that it is an opportunity to take stock on the status of science in India.

Such introspection is necessary as science and technology have become the most important drivers of the economy of the country.

On the occasion of National Science Day, an Innovation Exhibition on new ideas in building science and technology was organized at the Institute. The posters of various ideas were exhibited at the Display Center of RABINDRANATH TAGORE auditorium. Prof. Pradipta Banerjee, Director, IIT Roorkee graced the ceremony. He along with Prof. Bikas Mohanty and Prof. S.K. Bhattacharyya, Director, CSIR-CBRI evaluated the posters and screened the ideas through presentation for taking them up as a project. Prof. Banerjee appreciated the initiatives of Prof. Bhattacharyya in this direction and also praised the exhibited ideas of the participants. The final short-listed projects were Structures on





Mr Nagesh expressing his INNOVATIVE IDEA in front of the jury

Living Ground by Sri Anindya Pain, Foldable Portable Structures by S/Sri Soju Alexander, Subash Gurram and Ravindra Bisht, Silk Wall by S/Sri Subham Dastidar and Soumitra Maiti and Carbon Nanotube/



Mr Ravindra Bisht presenting his idea on "FOLDABLE PORTABLE STRUCTURES"

Fiber by Sri B. Srinivas Rao Naik. Prof. S.K. Bhattacharyya and Prof. Bikas Mohanty encouraged the young scientists and students to come up with new ideas and to develop new work culture in the institute.



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Annual Flowers & Vegetables Show

CSIR-CBRI Staff Club organized 46th Annual Flowers & Vegetables Show at CSIR- CBRI premises on 17th March, 2013. CSIR-CBRI and various Organisations located in Roorkee such as IIT, NIH, BEG&C, Roorkee, Power Grid, Puhana, Nurseries located in Roorkee etc, participated in the Flower Show. In addition to this, many individuals' participants and staff members of CSIR-CBRI participated in the Annual Flowers & Vegetables Show. Six types of categories were made for participants covering gardens, pot plants, cut flowers, vegetables and flower arrangements etc. The provision of category (i) for all institutions, offices, clubs and nurseries; category (ii) for all individuals' participants; category (iii) exclusively for CBRI staff; category (iv) for Mallies; category (v) for Queen & King of the Show and category (vi) for flower arrangement were made for participants. More than 1500 entries in various categories of pot plants, cut flowers and vegetables were received.

The show was inaugurated by Prof. S.K.Bhattacharyya, Director CSIR-CBRI and the prizes were distributed by the Chief Guest Mr. P.K.Gupta, Chief General Manager, BSNL (Uttarakhand) and the Guest of Honour Mrs. Kajol Bhattacharya, Patron, CBRI Ladies Club. Prof. Gopal Ranjan, Director General CoER, Prof. D.K.Gautam, Director General, Roorkee College of Engineering, Mr. Isam Singh, GM (BSNL) Hardwar and many other dignitaries visited the Flower Show. Family members of staff of CBRI, their friends and relatives were also present on this occasion.

Chief Scientist and Convener of the show Dr. P.K. Bhargava told that Mrs. Aruna

Bhargava won the Dinesh Mohan Trophy for best overall performance in all categories of the show and thus won the maximum prizes of the Flower & Vegetable Show. The overall trophy in institution category and individual category was awarded to Director NIH Roorkee and Prof. Pradipta Banerji, Director IIT Roorkee respectively. Mrs. Aruna Bhargava also won the Shankar Kapse Memorial trophy restricted to CBRI staff for best performance in cut flower & pot plants and vegetable garden. Mrs. Laxmi Rao w/o Dr. B.K.Rao won the large flower garden trophy. Km Mahalaxmi won the Rangoli trophy in children category and Mrs. Madhu Yadav won the trophy of miniature flower arrangement.

The flower Dahelia of Prof. Pradipta Banerjee, Director IIT Roorkee and flower Rose of Mr. Amit Chatkara won the prizes of King & Queen of the show respectively.

The judges who judged the beauty of flowers and gardens include Mrs. Pratibha Arya, Mr. T.C.Phatak, Mr. K.D. Dhariyal, Mrs. & Mr. A. Siddiqui and Prof. P.N. Agarwal.

The event was also sponsored by Vijaya Bank, State Bank of India (CBRI Roorkee branch), State Bank of Patiala, Roorkee and Punjab National Bank, IIT Roorkee.



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Staff News



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Colloquium

S.NO.	DATE	SPEAKER	TITLE
1	02/01/13	Prof. S.K. Bhattacharyya Director, CSIR-CBRI, Roorkee	Tall Buildings-Research Issues
2	09/01/13	Prof. Prem Krishna Chairman, RC, CSIR-CBRI, Roorkee	Cable Roofs-An Overview
3	30/01/13	Prof. S.C. Handa DG, Quantum Global Campus, Roorkee	Architecture and Engineering of Taj Mahal
4	06/02/13	Sh. Srinivasarao Naik B. Scientist, CSIR-CBRI, Roorkee	Phase Change Materials for Energy Efficient Buildings.
5	13/03/13	Sh. Subhas Chandra Bose Gurram Scientist, CSIR-CBRI, Roorkee	Pervious Concrete

AWARDS

Vishwakarma Award

Shri Amitava Ghosh, Chief Scientist, CSIR – Central Building Research Institute, Roorkee has been awarded the prestigious Construction Industry Development Council (CIDC) 5th Vishwakarma Award. The ceremony was held at India Habitat Centre. Dr. Pronab Sen Chairman of the Jury, Chairman, National Statistical Commission & Former Principal Adviser, Planning Commission, Government of India was the Chief Guest for the ceremony. Shri Ghosh received the award in the category of Scientists/academician/innovator.

Recognising the achievements and contributions made by Shri Ghosh through his R&D efforts on the utilization of solid industrial wastes as resource geo-material and its implementation in the field through the construction industries the award was conferred to Shri Ghosh. The award carries certificate, citation and a trophy.

National Geoscience Award

Dr Shantanu Sarkar, Senior Principal Scientist, CSIR-Central Building Research Institute, Roorkee has been awarded the prestigious National Geoscience Award by the Ministry of Mines, Govt. of India. The award was conferred by the Hon'ble Minister of Mines, Shri Dinsha Patel at Vigyan Bhawan, New Delhi. The National

Geoscience award which was previously known as the Mineral Award was instituted in the year 1966. The objective of the award is to honour individuals and teams of scientists for their extraordinary achievements and outstanding contributions in the field of fundamental/ applied geosciences, mining and allied areas.

In recognition of his significant contribution in the field of Disaster Management the award was conferred upon Dr S. Sarkar. Dr Sarkar has contributed extensively towards landslide studies with special reference to hazard and risk assessment, geological investigation, database creation, slope monitoring and stability assessment. The award carries a certificate, citation, trophy and cash prize of Rs. 2,00,000/-.

Ph.D. Awarded

Sri Susanta Kumar Senapati, Library Officer has been awarded Doctor of Philosophy by Punjabi University, Patiala for his Thesis on "Bibliographic Control of Periodical Literature on Building Materials Published in India: A Scientometric Study" in the faculty of Education and Information Science on December 11, 2012.



Congratulations!

Editor

Dr Atul Kumar Agarwal
Senior Principal Scientist

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Superannuation

Sri Ajay Singh Pr. Tech. Officer 28.02.13

We wish a peaceful & happy retired life!

Transfer

Sri Mehrajdeen Khan Gp. C (Non Tech.) 01.03.13
CSIR-IIIM, Jammu to CSIR-CBRI, Roorkee

Welcome!