



CSIR

Annual Report

2012-2013



Council of Scientific and Industrial Research
New Delhi



**DWR at Cherrapunji
(CSIR-NAL)**

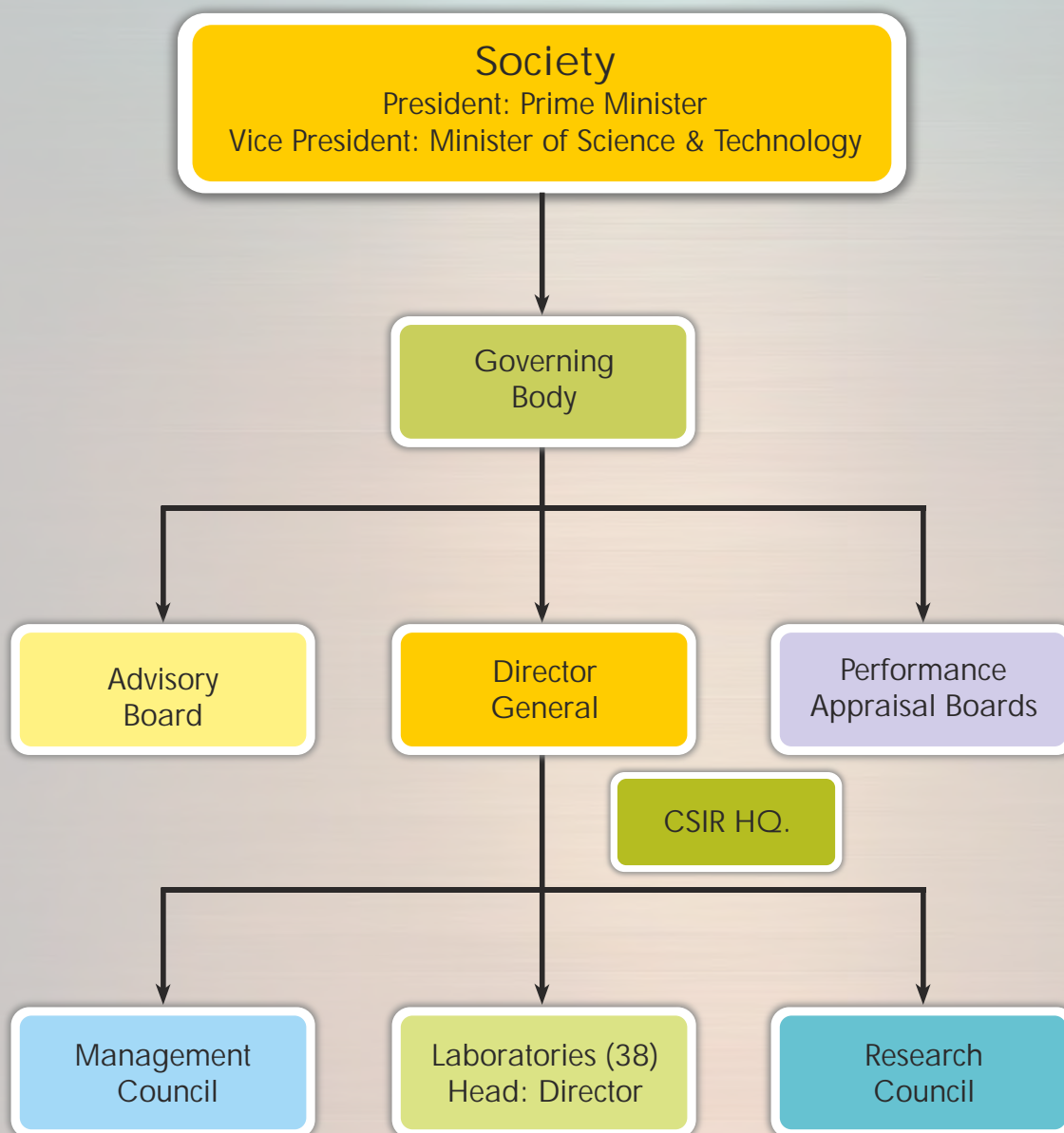


**Autonomous
Vertical Profiler
(CSIR-NIO)**



**Cyanide free Brass Coating
(CSIR-CECRI)**

CSIR ORGANISATIONAL STRUCTURE



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A close-up photograph of a fountain pen nib, likely a Montblaster Meisterstück, resting on a document. The nib is silver with a gold-colored collar and is positioned over a document that features a faint illustration of a mountain range. The background is a warm, wooden surface.

Executive Summary

1.0 Background

- 1.1 Established in 1942, the Council of Scientific and Industrial Research (CSIR), known for its cutting edge R&D knowledge base in diverse S&T areas, is a contemporary R&D organization. Having pan-India presence, CSIR has a dynamic network of 38 national laboratories, 39 outreach centres, 3 Innovation Complexes and 5 units. CSIR's R&D expertise and experience is embodied in about 4000 active scientists supported by about 8000 scientific and technical personnel.
- 1.2 CSIR covers a wide spectrum of science and technology – from radio and space physics, oceanography, geophysics, chemicals, drugs, genomics, biotechnology and nano technology to mining, aeronautics, instrumentation, environmental engineering and information technology. It provides significant technological intervention in many areas with regard to societal efforts which include environment, health, drinking water, food, housing, energy, farm and non-farm sectors. Further, CSIR's role in S&T human resource development is noteworthy.
- 1.3 Pioneer of India's intellectual property movement, CSIR today is strengthening its patent portfolio to carve out global niches for the country in select technology domains. CSIR is granted 90% of US patents granted to any Indian publicly funded R&D organization. On an average CSIR files about 250 Indian patents and 250 foreign patents per year. About 13% of CSIR patents are licensed - a number which is above the global average. Amongst its peers in publicly funded research organizations in the world, CSIR is a leader in terms of filing and securing patents worldwide.
- 1.4 CSIR has pursued cutting edge science and advanced knowledge frontiers. The scientific staff of CSIR only constitutes about 3-4% of India's scientific manpower but they contribute to 11% of India's scientific outputs. During the year 2012, CSIR published 5006 papers in SCI Journals with an average impact factor per paper 2.673.
- 1.5 For boosting entrepreneurship CSIR has operationalized desired mechanisms, which could lead to enhanced creation and commercialization of radical and disruptive innovations, underpinning the development of new economic sectors.

2.0 The Performance - A Summary

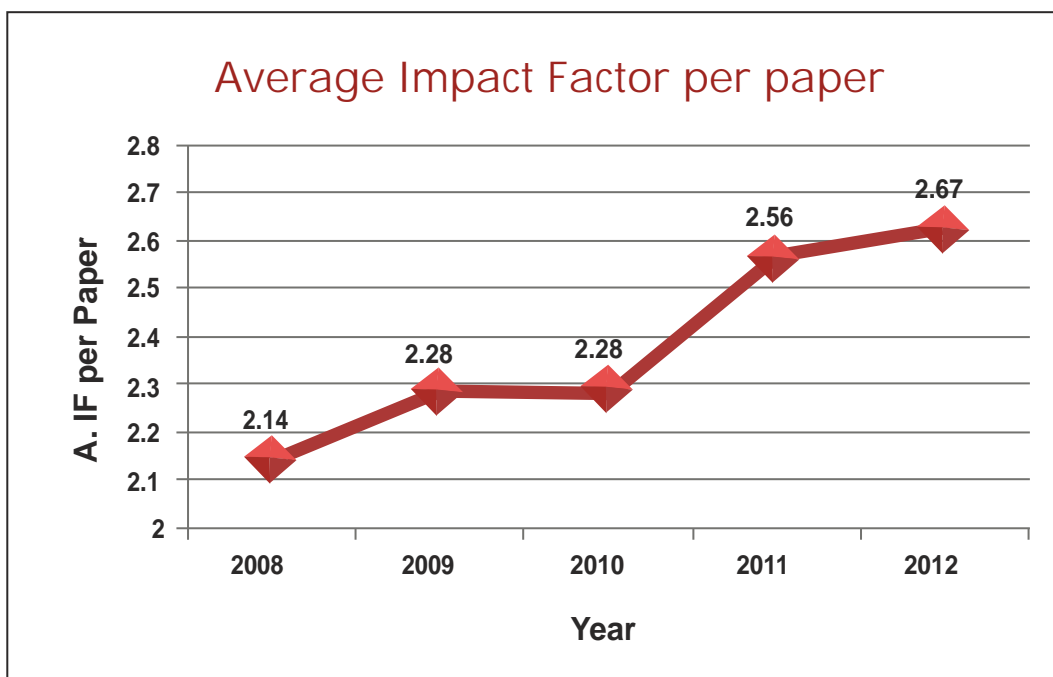
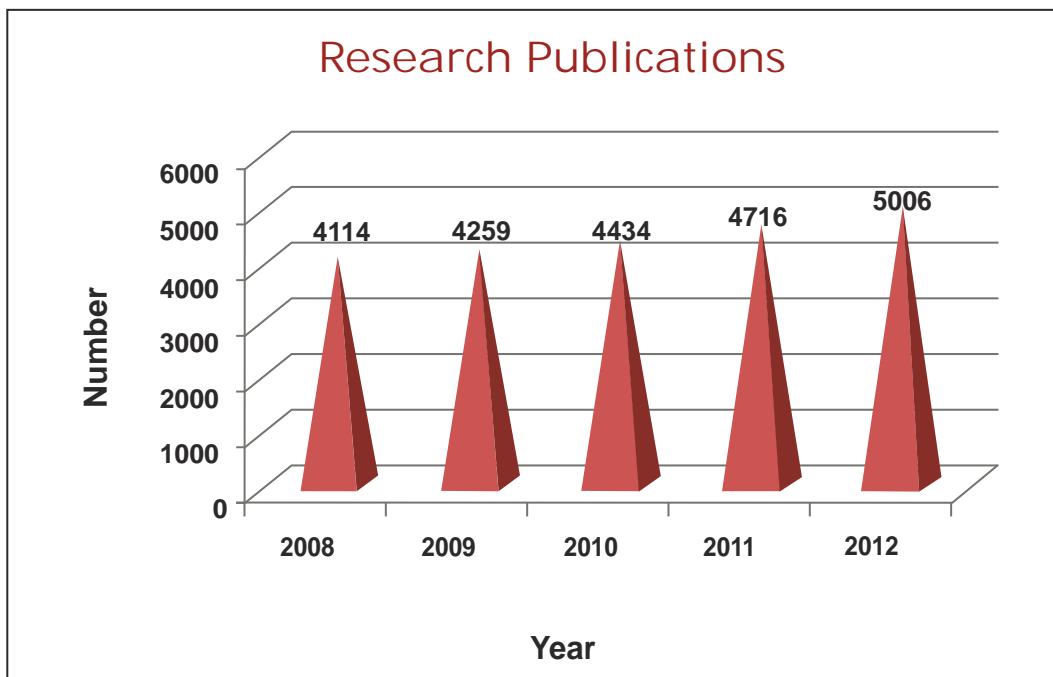
The year saw the beginning of the 12th Five Year Plan. CSIR's 12th Five Year Plan aims for Prosperity of People while Protecting the Planet. It thus has people centric approach with focus on Scientific & Technological Developments & Interventions for Economic and Social Empowerment through organizational, leadership and national focus. Concerted R&D efforts are being pursued in the domains of: (i) Affordable Healthcare; (ii) Agri-food technologies; (iii) Sustainable Energy; (iv) Chemistry and Environment (v) Smart and Functional materials; (vi) Engineering Structures/ design and Electronics; (vii) Civil Aviation; (viii) Climate Change and Earth System Sciences; (ix) CSIR 800; and (x) Scientific Entrepreneurship. During the year, CSIR's performance was very imposing. The report has encapsulated significant accomplishments along with most notable activities taken up by the Council which are structured in chapters 1, 2 and 3. Following paragraphs highlight some most cogent achievements.

2.1 CSIR's Global Positioning

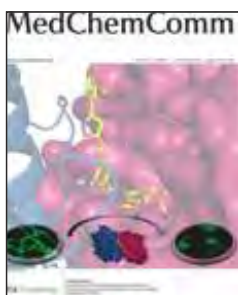
Ranked at 81st among 2740 institutions worldwide, CSIR is the only Indian organization among the top 100 global institutions, according to the SCImago Institutions Ranking World Report 2013. CSIR holds the 16th rank in Asia and leads the country at the first position. CSIR's average output per scientist is not far behind in comparison to the other leading publicly funded organizations in the world. With a budget of about 4.34 Billion USD, CNRS, France average output per scientist is about 10.99, RIKEN, Japan with 1.07 Billion USD at 5.11 and CSIR with only 0.61 Billion USD is at an admirable 4.71.

2.2 Scientific Excellence

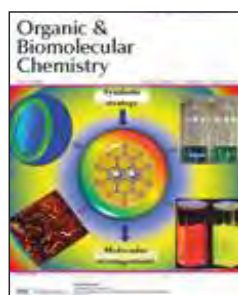
- CSIR has published 5006 research papers during 2012 with an average impact factor per paper as 2.673 in SCI journals of national and international repute contributing to 10% of Indian R&D literature.
- Several research papers were in high impact factor journals like 'Chemical Reviews' (IF 41.298), 'Lancet' (IF 38.278), 'Nature' (IF 38.597), 'Science' (IF 31.20), 'Chemical Society Reviews' (IF 28.76) etc. Following Graphs show the trend of research publications by CSIR over the last few years.



- Some of the Research Articles from CSIR appeared on the cover page of the journals.



'Synthesis of tetrazole-soxazoline hybrids as a new class of tubulin polymerization inhibitors' CSIR-IICT



'Recent progress of core-substituted naphthalenediimides' CSIR-IICT



'Glu121-Lys319 salt bridge between catalytic and N-terminal domains is pivotal for the activity and stability of scherichia coli amino peptidase N' CSIR-IICT



'Mixotrophic operation of photo-bioelectrocatalytic fuel cell under anoxygenic micro environment enhances the light dependent bio electrogenic activity' CSIR-IICT



'Porphyrin having high quantum yields of triplet and singlet oxygen. It exhibits apoptosis mediated photo dynamic activity in cancer cells and acts as a probe for NIR fluorescence imaging of live cell nucleus' CSIR-CCMB



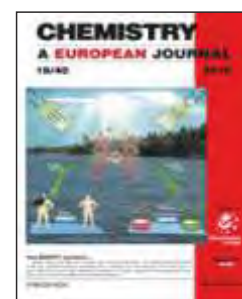
'Thermally assisted photonic inversion of supra molecular handedness' CSIR-NIIST



'Oligo(p-phenylene-ethynylene)- Derived Super-p-Gelators with Tunable Emission and Self-Assembled Polymorphic Structures' CSIR-NIIST



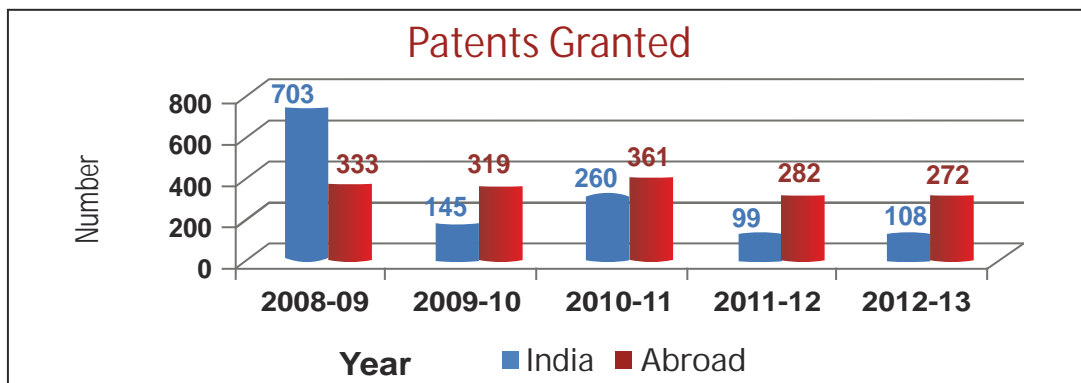
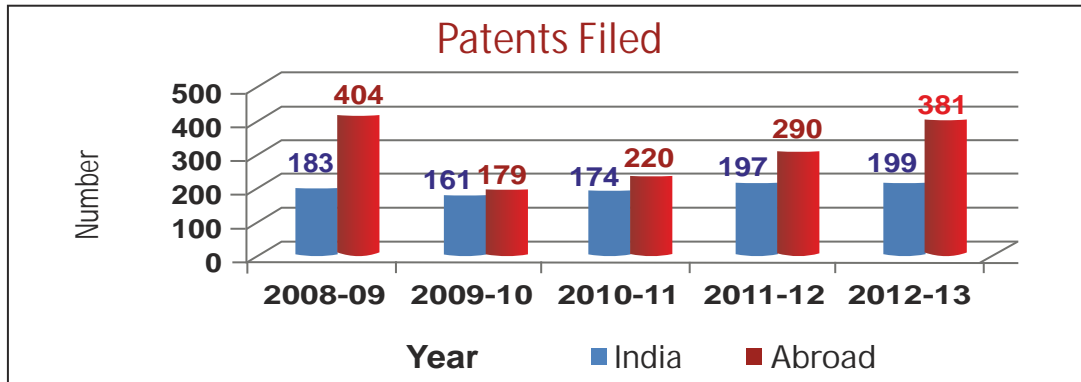
'Aza-BODIPY Derivatives: Enhanced Quantum Yields of Triplet Excited States and the Generation of Singlet Oxygen and their Role as Facile Sustainable Photo oxygenation Catalysts' CSIR-NIIST



'High quality NMP exfoliated graphene nano sheet-SnO₂ composite anode material for lithium ion battery' CSIR-CECRI

2.3 Value Generation through Intellectual Property

CSIR has filed 381 patents abroad and 199 patents in India during 2012-13. It is maintaining a portfolio of 2767 patents abroad and 1746 patents in India as on 31.03.2013 with 13.86% utilization as on 20.09.2012. The following charts provide data on patents filed and patents granted over the last few years.



2.4 Creating and Nurturing S&T Human Resource

CSIR has been systematically creating and nurturing highly qualified S&T manpower in the country. It is presently supporting more than 9000 Research fellows, 169 Senior Research Associates and more than 1200 research schemes to various universities.

2.5 CSIR Scientists in Frontier of Science

CSIR scientists are well recognized and are awarded prestigious fellowships and conferred awards regularly. A glimpse of these recognitions is given below:

Shanti Swarup Bhatnagar Prize 2012



Dr. Shantanu Chowdhury
CSIR-IGIB



Dr. Gangadhar J Sanjayan
CSIR-NCL

Infosys Foundation Award-2012



Dr. A. Ajayaghosh
CSIR-NIIST



Dr. Ashish Lele
CSIR-NCL

INSA Fellows 2013



Dr. P. S. Ahuja
CSIR-IHBT



Prof. Gautam Biswas
CSIR-CMERI



Dr. Madhu Dikshit
CSIR-CDRI



Dr. Yogendra Singh
CSIR-IGIB



Dr. R. Sankaranarayanan
CSIR-CCMB



Dr. A. K. Giri
CSIR-IICB



Dr. G. Parthasarthy
CSIR-NGRI



Dr. A. Ajayaghosh
CSIR-NIIST



Dr. S. K. Krishna
CSIR-NIO

3.0 Some noteworthy accomplishments

3.1 CSIR-Fourth Paradigm Institute

CSIR has repositioned its unit namely CSIR-Centre for Mathematical Modeling & Computer Simulation (CSIR-CMMACS) as CSIR-Fourth Paradigm Institute (CSIR-4PI) in order to empower high end computational and data intensive scientific research. CSIR-4PI operates in a hub and spoke model. The hub is located in Bengaluru and the spokes are located in Chandigarh, Chennai, Delhi, Hyderabad, Kolkata, Nagpur, and Pune, each focusing on a specific domain/cluster to support the planned objectives of CSIR-4PI. CSIR has setup a High Computing facility (360 TFOPS peak with 304 TFLOPS sustained on LINPACK). Access to this computing facility, is through National Knowledge Network.

3.2 Council of Scientific and Industrial Research (CSIR) and National Innovation Council (NInC) Partnership on Micro, Small and Medium Enterprises Cluster Innovation Programme

CSIR & NInC have entered into a Memorandum of Understanding (MoU) to enhance the innovation capability and capacity of 26 million MSMEs of the country, through establishment of 'Cluster Innovation Centres' at 150 identified MSME clusters. The initiative is creating enabling frameworks for technological interventions / innovations, which will in turn contribute to enhanced productivity and competitiveness of MSMEs. Six Pilot Clusters have been made operational namely: (i) Mango Cluster, Krishnagiri; (ii) Brass Cluster, Moradabad; (iii) Bamboo Cluster, Agartala; (iv) Auto Cluster, Faridabad; (v) Ayurveda Cluster, Thrissur; and (vi) Life Sciences Cluster, Ahmedabad. As a part of this focused effort, CSIR scientists have developed: protocols for Mango Cluster for enhancing the storage life of Krishnagiri mangoes from 7 days to 35 days; for the Brass Cluster Moradabad, a lacquer has been developed to give more shine to Moradabad Brass artifacts vis-à-vis Chinese Products and an efficient furnace has been developed and handed over for commercial use; and at Agartala Bamboo Cluster, cheaper alternative to Jiget binding material for making Agarbatties has been developed. CSIR has also decided to take up additional 62 MSME Clusters for seeding innovations.

3.3 DHVANI for Indian Army

CSIR-NAL has developed an indigenous system for Detection and Hit Visualization using Acoustic N-wave Identification (DHVANI) for locating bullet hits on targets for the Indian Army. This involved the deployment of an array of acoustic sensors under the general flight path of such projectiles, acquiring and analyzing the signal in real-time and instantaneous display of results in a graphical form at the shooter's end. The system is cost effective and reduces training time.

3.4 Drishti Systems at Main Runway 28-10 of IGI Airport

Based on the excellent performance of Drishti installed at Indira Gandhi International Airport, New Delhi in December 2011, Indian Meteorological Department requested CSIR-NAL to install three more systems on a priority basis at the main Runway 28 of IGI Airport. The systems were needed to handle the urgent requirement of the winter season of 2012-13. In a record time of three weeks, three systems were fabricated and installed at the touchdown, mid and take-off points of runway 28 in the first week of January 2013. Presently there are five Drishti systems at IGI airport, the only Cat III B airport in the country wherein aircrafts have to land under conditions of lowest visibility of 50 meters. Drishti system is capable of measuring visibility down to 5 meters and meets all the stipulations of International Civil Aviation Organisation & World Meteorological Organisation. In December 2012, one more system was installed in Netaji Subhash Chandra Bose International Airport, Kolkata. The systems have been awarded International Class I certification. As on today, seven latest state of the art Drishti systems are working in three international airports viz., Lucknow, New Delhi and Kolkata.

3.5 CSIR-NCL technology on BrahMos to save huge foreign exchange

The country will now be able to save huge amount of foreign exchange by developing the BrahMos supersonic missile system indigenously, thanks to a polyimide resin technology by CSIR-NCL. This technology is critical for ensuring highly durable airframes of BrahMos missile system in high temperature Indian conditions. The BrahMos supersonic missile technology is a joint venture projects between India and Russia. The key, critical non-metallic components, polymerisable monomeric reactant (PMR) type polyimide resin, and 14 other chemicals were successfully developed by CSIR-NCL. These are critical for ensuring highly durable airframes of BrahMos missile system in high temperature conditions. The non-metallic components to be used in the BrahMos system are from 200 different materials. The key composites were successfully prepared and cleared all the tests. For this endeavour CSIR-NCL has been adjudged 'Best Laboratory Award' by DRDO.

3.6 Simultaneous Production of US Grade Gasoline and Pure Benzene from FCC C6 Heart Cut

CSIR-IIP carried out substantial experimental and simulation studies with feedstock provided by M/s Reliance Industries Limited (RIL) and demonstrated that US grade gasoline and pure benzene can be simultaneously produced from a FCC C6 heart cut stream using extractive distillation (ED) route with aqueous NMP as the solvent. The gasoline thus produced has sulphur content < 10ppm and benzene < 0.3%. The technology has been transferred to RIL which is setting up 600,000 MTPA unit costing Rs. 160.00 crore. The annual gasoline production from this unit would equal to a prospective export monetary value of around 682 Million USD per annum with an additional profit of around 102 Million USD per annum from the sales of the recovered high purity benzene (Current market Value of Gasoline and Benzene ~ 1400 US \$/ MT).

3.7 Advanced Soaker Visbreaking Technology

CSIR-IIP developed advanced soaker visbreaking technology has been transferred to M/s Hindustan Petrochemicals Limited (HPCL) and M/s Indian Oil Corporation Limited (IOCL). Test run has successfully been carried out at HPCL and IOCL. It is expected to increase the profit of HPCL by Rs. 935 lakh per annum and that of IOCL by Rs. 845 lakh per annum. CSIR has earned a fee of Rs. 270 lakh.

4.0 Cluster-wise significant achievements

Some significant achievements are presented below.

4.1 Biological Sciences Cluster

4.1.1 Photo Dynamic Therapy (PDT)

In a joint effort with CSIR-NIIST, CSIR-CCMB has developed a photo dynamic therapy agent which is about two times more potent (in in vitro investigations) than the currently available FDA approved PDT drug. Considering the potential of this molecule a patent has been filed. Photodynamic therapy (PDT) is used as a treatment against cancer where cells are first exposed to a photosensitizer molecule followed by exposure to near-infrared light, resulting in the release of ROS leading to sub-cellular damage and ultimately cell death. Scientists of CSIR-CCMB and CSIR-NIIST have evaluated several indigenously developed photosensitizers, including derivatives of porphyrins and chlorins as potential PDT molecules and found that two molecules, BMR102 and SJR103, showed a better photo-toxic effect on several cancer cell lines when compared to the US-FDA approved and commercially available drug - Photofrin. The phototoxic efficacy of BMR102 on a human ovarian carcinoma cell line SKOV-3 were also studied. The effect of this photosensitizer was investigated by measuring SKOV3 cell viability by MTT assay, flow cytometric analysis and annexin V-FITC staining. The studies on efficacy of BMR102 in vivo using a SKOV3-xenografted nude mouse model have demonstrated a potent photodynamic anti-tumor effect of BMR102. In addition, it has also been observed negligible tumour regrowth post-treatment.

4.1.2 Genetic evidence for recent population mixture in India

CSIR-CCMB's recent study indicated that most of the ethno-linguistic groups in India descend from a mixture of two divergent ancestral populations: Ancestral North Indians (ANI) related to West Eurasians, and Ancestral South Indians (ASI) related (distantly) to indigenous Andaman Islanders. While genetic studies and other lines of evidence are consistent in pointing to mixture of distinct groups in Indian history, the dates are unknown. To estimate the date of admixture, the genome-wide analysis of 73 groups from the Indian subcontinent was performed and analyze linkage disequilibrium and estimated that the ANI-ASI mixture dates ranging from about 1900-4200 years ago. In a subset of groups, 100% of the mixture is consistent with having occurred during this period. These results

show that India experienced a demographic transformation several thousand years ago, from a region in which major population mixture was common, to one in which mixture even between closely related groups became rare because of a shift to endogamy.

4.1.3 Wnt Signaling Stimulates Phagocytosis

Phagocytosis is a primary defence program orchestrated by monocytes/ macrophages. But, unregulated phagocytosis can lead to pathological conditions. CSIR-IICB has shown that Wnt5a stimulates phagocytosis of bacteria and associated cell activation. Wnt5a mediated augmentation in phagocytosis may result in uncontrolled inflammation and sustained infection. The results have been published in Proceedings of National Academy of Sciences of the United States of America (PNAS).

4.1.4 Plant Derived Single Molecule (K058) from CSIR-CDRI as Rapid Fracture Healing Oral Drug

CSIR-CDRI has isolated a novel lead molecule K058 from a plant source and found rapid bone fracture healing anabolic activity that represents a new strategy in addressing primary and secondary osteoporosis.

CSIR-CDRI has signed a Research and licensing agreement on 28th September, 2012 with M/s Kemxtree LLC, USA (a Nostrum Group company) during 'CSIR 70 year celebrations' at CSIR-IGIB campus, New Delhi for further development of the molecule as a novel candidate drug for the treatment of osteoporosis and fracture healing.

4.1.5 Licensing of L-PAC, ephedrine and pseudoephedrine technology

L-PAC, ephedrine and pseudoephedrine technology developed earlier by CSIR-CDRI was licensed to M/s BVM Pharma Ltd., Bulandshahar, Uttar Pradesh on 11th March, 2013. An amount of Rs. 24,26,600.00 inclusive of service tax received towards licensing of the above technology on "As is Where is Basis".

4.1.6 Development of cosmaceutical products

- Herbal colour for cosmetics: Lipophilic strawberry red colour has been isolated from the plant NBR-R1 and standardized along with safety studies for application in lip balm. This technology has been licensed to M/s Himalaya Drug Company, Bengaluru.
- Natural Lip-Balm: CSIR-NBRI and CSIR-CIMAP jointly developed technology for natural lip balm. Herbal colour and natural ingredients used in lip balm protect the lips and leaves the lips hydrated and nourished by preventing moisture loss. Natural lip balm is non-toxic. Technology has been transferred to M/s Chiara Herbals Pvt. Ltd., New Delhi.
- Technology developed for yellow colour: Lipophilic yellow colour was also isolated from the plant NBR-Y for its application in lip butter/balm. Mango flavoured, vitamin-E enriched yellow lip balm developed jointly with CSIR-CIMAP. It keeps the lips healthy and colour is safe.

4.2 Chemical Sciences Cluster

4.2.1 Synthetic Aviation Lubricants

India is totally dependent on developed countries for its aviation lubricant requirements which are of immense strategic importance in the Defence-preparedness of our country necessitating self-reliance in this field. A Task Force involving CSIR-IICT as Nodal Agency, CSIR-NAL, Indian Oil Corporation Ltd (IOCL), Hindustan Aeronautics Limited (HAL), Gas Turbine Research Establishment (GTRE), and The Center for Military Airworthiness & Certification (CEMILAC) has

been formed for developing indigenous capabilities in aviation lubricants. The Task Force shortlisted lubricants OX-27, meeting MIL PRF-23699F and OX-38 meeting DEF STAN 91-98 specifications, for development. CSIR-IICT has developed two lubricants, SVS11 and SVS21. A specialized bench & pilot scale facility, and a sophisticated analytical testing facility were established at CSIR-IICT. The Rolling Element Bearing Test Facility, a first of its kind in India, was established at CSIR-NAL. The developed lubricants have passed all the mandatory tests. With this landmark development, India has joined the select group of countries having capabilities in aviation lubricant technologies. Provisional Certificates for Airworthiness Approval has been granted by CEMILAC for SVS11 and SVS21 lubricants, which is essential for their commercial exploitation.

4.2.2 Solvent De-oiling plant at Numaligarh Refinery Limited (NRL)

Numaligarh Refinery Limited (NRL) - a subsidiary of BPCL is setting up a wax deoiling plant using updated CSIR-IIP & Engineers India Ltd (EIL) process know-how at a capital outlay of Rs. 753.72 crores including a foreign component of Rs. 86.49 crores for specialized patented equipment like Scraped Surface DP Chillers and Rotary Vacuum Filters. This facility will produce 50,000 tons per annum of different grades of petroleum waxes by processing waxy streams available at NRL. The design of the unit is based on indigenous technology developed at CSIR-IIP.

4.2.3 High Energy Density Fuel Production

CSIR-IIP has developed a process for the production of high energy density fuel similar to the Russian origin T-6 fuel as per GOST 12308-89. Various blends of different kerosene range cuts were made and analysed for obtaining the desired characteristics and requirements. The optimized blend thus obtained was then dehydrogenated at high pressure and temperatures to obtain product similar to that of T-6 fuel specifications. The product has been characterized for GOST 12308-89 standard and then around 100 liters of fuel was supplied to DRDL, Hyderabad for testing performance at their facility. The fuel supplied by CSIR-IIP is found similar in performance to the T-6 fuel and also met the desired standards as per GOST 12308-89.

4.2.4 Indian Standards for North East Ginger

CSIR-NIIST has developed a database of oil content and physico-chemical composition of various fresh ginger cultivars grown in seven states of North East (NE) and to arrive at a revised IS specification for NE ginger and its value added products. Three sets of major cultivars of fresh ginger samples were collected at different stages of maturity from seven North East states and to determine the physico-chemical characteristics of all the cultivar samples. The variation in the essential oil composition and oleoresin and [6]-gingerol content in different fresh ginger cultivars harvested at 6 to 9-month maturity from five different states of NE has been investigated. Monoterpenes, sesquiterpenes, and citral composition in the essential oil isolated were evaluated to ascertain their variation during the stages of maturity. Except for Mizoram Thinglaidum, Mizoram Thingria, Nagaland Nadia, and Tripura I ginger cultivars, all other cultivars showed an increase in the citral content during the maturity. HPLC profiling of all the cultivars for screening major bioactives like gingerols and shoagols were also conducted. The database developed provide valuable information for farmers and entrepreneurs in identifying superior varieties of ginger for cultivation and processing which will yield higher volatile oil and oleoresin.

4.2.5 Economical utilization of solid wastes from tanning industry

CSIR-CSMCRI has developed a process for the preparation of a novel ketene oligomer. The process is patented. The process is simple and the raw materials for process can be sourced from solid wastes

generated by different processing industries including tanning industry. Due to its unique properties, it also has a potential for application in pharmaceutical industries as a delivery system through microencapsulation.

4.3 Engineering Sciences Cluster

4.3.1 Iron ore beneficiation

- Commercial plant of Brahmani River Pellets Ltd.

Iron ore beneficiation plant was set up by Brahmani River Pellets Ltd. (BRPL) at Barbil, Odisha on the process flowsheet developed at CSIR-IMMT, to operate 6 million tonnes of low grade iron ore to produce 4.5 million tonnes of iron ore concentrate. This concentrate is to be transported through pipeline to their pellet plant which is situated at a distance of 250 km. The plant has been commissioned after getting the environmental clearance.

- Commercial plant of Essar Steel India Ltd.

Iron ore beneficiation plant was set up by Essar Steel India Ltd. on the process flowsheet developed at CSIR-IMMT. The plant is located at Barbil, Odisha to process 16 million tonnes of low grade iron ore to produce 12 million tonnes of iron ore concentrate. This concentrate is to be transported through pipeline to their pellet plant which is situated on the coast at Paradeep at a distance of 260 km.

4.3.2 Treatment and safe disposal of effluent

CSIR-NEERI has provided a technological solution to M/s Mahindra Vehicle Manufactures Limited (MVML), Pune for treatment and safe disposal of its effluent using high rate transpiration system. The designed HRTS model was implemented in the field at M/s MVML, Pune. The HRTS design consists of filter media which provides more surface area for interaction of pollutants and also removes the suspended solids present in the wastewater was prepared.

4.3.3 CETP scale electro oxidation plant

The first ever CETP scale electro oxidation plant has been designed in India for treatment of highly recalcitrant chemical industry effluents, based on the technology developed by CSIR-NEERI. This technology helps to meet the effluent discharge norms (COD of 250 mg/l) with low foot print area (4m x 4 m per reactor) and is easy to install, operate and cost-effective.

4.3.4 Construction technologies and materials

CSIR-CBRI has developed construction technologies and materials like Concrete Masonry Blocks, Precast Roofing Components for Roofs and Under Reamed Pile Foundation in Black Cotton Soil are repeatedly being used in construction of thousands of houses by NGOs, Central and State Government Departments and private builders at various rural and urban locations of the country. Several Building Centres and Rural Building Centres are in regular production of precast concrete/ferro cement components by engaging local artisans and labour. CSIR-CBRI licensees at Yamuna Nagar and Ahmedabad are regularly manufacturing CSIR-CBRI designed clay brick extrusion machines of 2500 to 4000 bricks per hour. Fixed Chimney Brick Kilns and Gravity settlement chamber have been adopted by more than 30,000 brick manufactures to reduce consumption of fuel and environmental pollution. CSIR-CBRI is providing technical guidance in the design and construction of 1000 low cost houses in Bur-kina Faso, Africa.

4.3.5 Mine plan and EMP for Karwar project of Indian Navy

Indian Navy has constructed a naval base at Karwar in the western coast near Panaji. The mine plan and the EMP were provided by CSIR-CIMFR for the same. It was proposed to make available the various sized material for the construction purpose by mining the nearby hills.

4.3.6 Setting up an Industrial scale Column (2.5 m dia.) at Andhra Baryte Corpn. Pvt. Ltd, Cuddapah

CSIR-NML has developed and provided process, technological and engineering inputs in designing, fabrication, commissioning and stabilization of industrial flotation column to M/s Andhra Baryte Corporation Pvt Ltd. Chennai for the beneficiation of low-grade barytes of Mangampet, Cuddapah, Andhra Pradesh. A 2.5 m diameter flotation column has been fabricated and erected and related instruments have been installed.

4.4 Information Sciences Cluster

4.4.1 High Performance Supercomputing Facility

CSIR-4PI has established 360 Tera Flop (peak) High Performance Supercomputing facility which is the largest CPU based installation in the country and 82nd in the world as per the November 2012 list. The systems, riding over the National Knowledge Network, will provide the much needed boost to the computational scientists of CSIR in all the disciplines. It is a CSIR central facility catering to more than 200 computational scientists across all CSIR laboratories.

4.4.2 Increase in Impact Factor of CSIR Journals

CSIR-NISCAIR has been providing scholarly research communication links to the scientific community through its 19 journals of international repute, covering all major disciplines of science and technology. CSIR-NISCAIR journals notched up an increase of >41% in Impact Factor (IF) over that from the previous year, according to the Journal Citation Reports 2011. Two journals, viz. Indian Journal of Experimental Biology and Indian Journal of Biochemistry & Biophysics have even crossed an Impact Factor of 1.0 – a rarity for Indian Journals.

4.4.3 Popularization of Science

Building up on its aim of science popularization through its well-acclaimed popular science magazines (Science Reporter, Vigyan Pragati & Science ki Duniya), and promotion of Scientific Temper, CSIR-NISCAIR took up the cause further by organizing an international conference on 'Vaigyanik Drishtikon Tatha Chetna Jagane Mein Sanchar Madhyamon ki Bhumi par Antarrashtriya Sammelan' in May 2012 in New Delhi. This was on lines of the National Workshop and International Conference held earlier. CSIR-NISCAIR launched two new facilities during the year – Data Information Resource Facility (DIRF) and Video Recording Studio at Science Communication through Multi-Media Division.

4.5 Physical Sciences Cluster

4.5.1 First reporting of Native Gold Grains from the chromitites of Nuggihalli Schist Belt, South India

Occurrence of native gold in ultramafic (high magnesium rich) rocks is rare. CSIR-NGRI reported, to the best of knowledge of institute, for the first time, occurrence of native gold from the chromitite samples from the Mesoarchaean Tagadur Mines of the Nuggihalli Schist Belt (NSB), Southern India. The findings are based on Electron probe micro-analyser (EPMA) analysis of the thin sections of some rock samples. Distinct spectra of native gold grains, silver, copper, iron and tin as well as Fe-Ni-Cr-Cu alloys has been observed. These Tagadur Chromitites extend along a strike length ~ 1-2 km north of Tagadur Mines in a narrow zone of 50-90 m. The current findings warrant a re-evaluation of the economic potential of chromitite ores by mapping lateral and depth extent of this formation by detailed geophysical and geochemical exploration.

4.5.2 Scientific drilling near Koyna reveals the thickness of Deccan Traps and nature of underlying basement rocks

CSIR-NGRI has been carrying out scientific drilling at two sites, Rasati (near Koyna; borehole KBH-1) and Udgiri (south of Warna; borehole KBH-2), broadly marking the northern and southern limits of the seismic zone. Both the boreholes were targeted to go through the Deccan basalt pile and penetrate the underlying basement rocks for the first time in the region. Geological core logging, carried out by scientists from CSIR-NGRI, Atomic Minerals Directorate (AMD) and Mineral Exploration Corporation Limited (MECL) indicate that the flood basalt pile comprises multiple lava flows of varying thicknesses, with each flow consisting typically of a massive lower part and vesicular / amygdaloidal middle-upper part, occasionally flow top breccia and inter-trappean sediments. A number of sheared and/or crushed zones were observed in cores both from the basalt pile as well as the granitic basement. Geophysical logs obtained in the borehole column revealed the distribution of physical properties of the basalt pile as well as the granitic basement rocks. Drilling in borehole KBH-2 progressed amidst heavy water loss conditions and frequent occurrences of thick clay zones and/or fractured horizons at multiple depths that are prone to caving.

4.5.3 Integrated Geophysical Techniques and Numerical Modeling for mapping mineralization zones

Two dimensional electrical resistivity and Time Domain Induced Polarization datasets were collected by CSIR-NGRI along a 3.8 km line in Betul-Chindwara belt Madhya Pradesh, Central India. These data shows clear indication of sulphide mineralization, iron oxide, iron carbonate, oxidized sulphide (Gossan), volcanic massive sulphide deposits are preserved within the host rock. Models obtained from inversion clearly reflect presence of large sulphide (conducting) ore body. The integration of geological and geophysical methods helped in pinpointing the massive and disseminated sulphide mineralization leading to the delineation of base metals which are vital for industrial applications.

4.5.4 Study of estuarine systems

Extensive multidisciplinary measurements made at different time and spatial scales in Mandovi and Zuari estuarine systems in Goa, Gautami-Godavari system in Andhra Pradesh, and Backwaters of Kochi in Kerala by CSIR-NIO. The studies suggest that the monsoon driven estuaries of India do not reach steady state with respect to water and salt balances. The Indian estuarine systems experience very strong short-term and small-spatial scale variations that are driven by strong seasonality driven by monsoon regimes.

4.5.5 Extraction of Nano-diamonds from waste materials

Nano diamonds (NDs) are nontoxic materials and have potential applications in Bioimaging, drug delivery, biomedical sensing and lubrication. NDs were extracted from a novel source by CSIR-CSIO. These fluorescent nanomaterials were synthesized from waste material deposits of Indian villages. The raw material was purified by acid and thermal treatment. The purified material was characterized by various techniques like Raman spectroscopy, FTIR, TEM, SEM, Confocal, PL measurements etc.

4.5.6 Head-up displays for Aircraft variants: Tejas-Navy light combat aircraft

To meet the requirements of Tejas-Navy light combat aircraft, CSIR-CSIO in collaboration with Aeronautical Development Agency (ADA) has developed Head-up display (HUD) technology. The HUD for the naval version is a further development of the HUD produced earlier for the Air Force version of the Tejas. The Air Force version has already been integrated into the cockpit and several units have been installed in the Tejas aircraft. HUD for the naval version is technologically more advanced and has different technical specifications than the air force version and its operating parameters, cockpit configuration and the pilot's field of vision are different. After completion of qualification test as per MIL

STDs 704D, 461C and 810D, first two airworthy units are extensively being evaluated. The custom built bore sighting tool for harmonizing the HUD in the LCA-Navy Aircraft along with dedicated simulator-cum-test setup has also been approved by CEMILAC-RCMA for harmonizing, testing and formal evaluation of these HUD systems.

4.5.7 New developments in Carbon Nano Tubes

An invention relating to the development of light weight carbon nanotubes (CNT) reinforced polymer composites in the form of composite for electromagnetic interference (EMI) shielding applications has been filed by CSIR-NPL for securing IP. The technique enables up to 50 wt% of CNTs to be uniformly dispersed in the polymer. This makes these CNT-polymer composites more advantageous than metals and other carbon-based polymer composite materials as EMI shielding materials in range 8.2-18 GHz covering X and Ku band of the electromagnetic spectra.

4.6 CSIR 800

4.6.1 CSIR-CIMAP Vetiver (Khus) bio-village for rural income enhancement

The roots of Vetiver, commonly known as Khus, are the source of high value essential oil used in perfumery, cosmetics and flavour industries. Vetiver is normally cultivated as 18-20 months crop. CSIR-CIMAP has developed a new variety CIM-Vridhi with reduced growth cycle of 10-12 months as compared to 18-20 months. With a root yield of about 18 quintals/ha and oil content of 1.69%, the crop gives an yield of about 30 kg/ha of essential oil enabling a farmer to earn about Rs. 1,50,000 as net profit per hectare. Reduction in cropping duration has provided flexibility to CIM-Vridhi to be accommodated in various kinds of crop-rotations (rice-vetiver; rice-wheat and vetiver; maize-potato-vetiver) as well as its co- cultivation with food (wheat and lentil) and medicinal aromatic crops (mints and Ocimum) which ultimately led to increased profits/ unit area over a period of time. Thus, it has provided a new dimension to diversification in agriculture (suitable to agro-forestry too) as well income augmentation of the farming community.

The demand of the crop has increased so high that participating farmers also started getting additional benefits by the sale of planting material. A farmer from Barabanki district could sell around 5,00,000 slips of this variety to other farmers interested in cultivation of vetiver (khus). CSIR-CIMAP's technological interventions through development of short duration (annual-12 months) and high yielding cultivar CIM-Vridhi with quality oil and potential to grow over a vast varying agro-climatic conditions, has attracted large number of farmers and has become popular among the farmers of Uttar Pradesh, Bihar, Chhattisgarh, Jharkhand, Karnataka, Orissa state in last couple of years. Farmers of Vidarbha, Assam, Meghalaya and Nagaland have shown keen interest in cultivation of Khus and have started cultivating Khus for higher incomes.

Efforts are being made to popularize the cultivation technology of vetiver crop variety CIM-Vridhi through bio-village mode, extending to more than 10000 ha area of the country and about 22000 numbers of farmers are engaged in cultivation of this crop in U.P., Bihar, Karnataka etc. It is estimated that about 115000 kg good quality oil is being produced per annum based on the technology and variety developed by CSIR-CIMAP which is valued at about Rs.150 crore with an employment generation of about 15,00,000 mandays.

4.6.2 Cultivation of medicinal and aromatic plants in Jammu and Kashmir: S&T interventions by CSIR-IIIM

i. Srinagar

CSIR-IIIM has been responsible to introduce cultivation of medicinal and aromatic plants such as Rose, Lavender, Clarysage, Rosemary and Geranium in Kashmir region. Improved varieties of these plants have been developed which find use in pharma, aroma, flavor and fragrance industry. Seven

companies have come up in Kashmir region to cultivate aromatic plants as an industry and more than 40 farmers have been roped in as contract farmers of these plant varieties. The value added products isolated from these plant varieties find good market outside India that fetches them premium prices. The cultivation of these varieties has provided self-employment to many rural and underprivileged farmers.

ii. Gurez

Gurez valley remains snow bound for six months. Field demonstration centre have been established in the Gurez area for providing planting material to the farmers for medicinal and aromatic plants generating employment and revenue. Mint, lavender, Rosa demascena and Monarda citriodora are best suited crops for this area and were successfully introduced.

iii. Pahalgam

Lavender Park has been developed in Pahalgam in collaboration with Pahalgam Development Authority where it has shown profuse growth. The area which is thronged by a very large number of domestic and international tourists, Lavender park has resulted in popularizing Kashmir lavender as a brand in the International Market.

iv. Bhaderwah, Jammu

Medicinal and Aromatic plant garden was developed in village Dardu (Bhaderwah) in collaboration with Bhaderwah Development Authority and local farmers. Field demonstration and Training programmes and kisan melas were held in collaboration with KVK Bhaderwah. *Lavendula officinalis* and *Rosemarianus officinalis* crops which are alternative high income crops, are slowly replacing traditional low income crops in the area by rural farmers for their self-employment and additional revenue.

4.6.3 Setting up of RO desalination Plants in Rajasthan

CSIR-CSMCRI has set up many RO plants in Rajasthan for desalination of water and thus enhancing the potability of water. Based on the high order performance of the RO plants in Rajasthan and the quality of back-up support extended, CSIR-CSMCRI received from Department of Science & Technology, Govt. of Rajasthan, a request for setting up 50 RO plants. The distinguishing feature of the RO plants is the high recovery of product water and management of fluoride in reject stream.

CSIR... Resource Base



38 National Laboratories/Institute
with
39 Outreach Centres
3 Innovation Complex
5 Units

Rs. 2910 crore Government Budgetary Support
Rs. 1517 crore Plan Fund
Rs. 1393 crore Non-Plan Fund

Consisting 14559 permanent staff
(as on 31.03.2013)
Comprising
3867 Scientists
6534 Technical and Support Staff
4158 Administrative Staff

Rs. 728.81 crore External Earning

Key Statistics

Performance Indicators
2012-13



Utilization of CSIR's granted Patents 13.86% (as on 20.09.2012)

World rate patents Utilization 3-5%

Intellectual Property	National S&T Human Resource Development
Over 5000 Research Publications with highest impact factor 41.298 (Chemical Reviews)	Research Fellows/Associates supported 9110
2767 Patents in force (Abroad) (as on 31.03.2013) 381 Filed Abroad	Emeritus Scientists in position 180
	Senior Research Associates (SRAs) in position 169
1746 Patents in force (India) (as on 31.03.2013) 199 Filed in India	Research Schemes supported 1234

S&T Contributions



1.1 BIOLOGICAL SCIENCES CLUSTER

1.1.1 Scientific Excellence

New Gene Discovered for Early Onset Chronic Pancreatitis

Over last decade, CSIR-CCMB is working on the genetics of Tropical Calcific Pancreatitis (TCP), a common form of chronic pancreatitis in Indians. CSIR-CCMB led the multi-centric study involving 4 centres from India and sequenced carboxypeptidase 1 gene (CPA1) in ~ 300 TCP patients and normal subjects each. Interestingly, they identified one founder mutation in this gene only in the patients, which is different compared to Europeans and other Asians. The Indian mutation causes complete loss of function of this protein, which is involved in the degradation of trypsinogen. Identification of mutations in CPA1 gene drives the point that pathway of trypsinogen activation and deactivation is important overall and assume immense importance since Indian patients do not carry cationic trypsinogen mutations. Since this mutation is also predictive of early onset pancreatitis, early detection and modification of the course of the disease by appropriate counseling will be of tremendous help to these patients and their families. These observations have been recently published in the prestigious international journal "NATURE GENETICS".

Photo Dynamic Therapy (PDT)

In a joint effort with CSIR-NIIST, CSIR-CCMB has developed a photo dynamic therapy agent which is about two times more potent (in in vitro investigations) than the currently available FDA approved PDT drug. Considering the potential of this molecule a patent has been filed. Photodynamic therapy (PDT) in treating cancer where cells are first exposed to a photosensitizer molecule followed by exposure to near-infrared light, resulting in the release of ROS leading to sub-cellular damage and ultimately cell death. Scientists of CSIR-CCMB and CSIR-NIIST have evaluated several indigenously developed photosensitizers, including derivatives of porphyrins and chlorins as potential PDT molecules and found that two molecules, BMR102 and SJR103, showed a better photo-toxic effect on several cancer cell lines when compared to the US-FDA approved and commercially available drug - Photofrin. The phototoxic efficacy of BMR102 on a human ovarian carcinoma cell line SKOV-3 were also studied. The effect of this photosensitizer was investigated by measuring SKOV3 cell viability by MTT assay, flow cytometric analysis and annexin V-FITC staining. The studies on efficacy of BMR102 in vivo using a SKOV3-xenografted nude mouse model have demonstrated a potent photodynamic anti-tumor effect of BMR102. In addition, negligible tumour regrowth has been observed post-treatment. Researchers are presently standardizing drug dosage, route of administration, and irradiation parameters necessary for tumour regression.

Genetic evidence for recent population mixture in India

CSIR-CCMB's recent study indicated that most of the ethno-linguistic groups in India descend from a mixture of two divergent ancestral populations: Ancestral North Indians (ANI) related to West Eurasians, and Ancestral South Indians (ASI) related (distantly) to indigenous Andaman Islanders. While genetic studies and other lines of evidence are consistent in pointing to mixture of distinct groups in Indian history, the dates are unknown. To estimate the date of admixture, the genome-wide analysis of 73 groups from the Indian subcontinent was performed and analyzed linkage disequilibrium and estimated that the ANI-ASI mixture dates ranging from about 1,900-4,200 years ago. In a subset of groups, 100% of the mixture is consistent with having occurred during this period. These results show that India experienced a demographic transformation several thousand years ago, from a region in which major population mixture was common, to one in which mixture even between closely related groups became rare because of a shift to endogamy.

Indian origin of the European Romani populations

Roma populations are distributed widely within Europe including the Balkans and Scandinavia as well as throughout the Near East. Linguistic studies established that the various dialects spoken by the Roma derive

specifically from North India. The presence of Indian specific Y-chromosome haplogroup H1a1a-M82 and mt DNA haplogroups M5a1, M18 and M35b among Roma has corroborated that their South Asian origins and later admixture with Near Eastern and European populations. CSIR-CCMB has performed a detailed phylogeographical study of Y-chromosomal haplogroup H1a1a-M82 in a data set of more than 10,000 global samples to discern a more precise ancestral source of European Romani populations. The phylogeographical patterns and diversity estimates indicate an early origin of this haplogroup in the Indian subcontinent and its further expansion to other regions. The short tandem repeat (STR) based network of H1a1a-M82 lineages displayed the closest connection of Romani haplotypes with the traditional scheduled caste and scheduled tribe population groups of northwestern India.

Genetic variation increases the risk of leprosy in Indian population

Even though leprosy control has improved significantly due to effective multi-drug therapy, India ranks first in terms of both prevalence and new cases, which is about 58 per cent of global diseases burden. In the study published in Plos One journal, researchers from India including CSIR-CCMB and Germany have investigated the possible contribution of genetic variations in genes which are vital for immunological control of bacterial pathogen. A case control study design was employed with Indian leprosy patients either with few or more bacteria forms of leprosy along with infection-free individuals from the same ethnic population. The researchers found that mutations in three immune recognition genes—NOD2 (nucleotide oligomerization domain 2) RIPK2 (Receptor-interacting serine-threonine kinase 2) and LRRK2 (leucine rich reporter kinase 2) increase the risk of leprosy among Indians.

In a significant finding, scientists have identified molecular level mechanisms that lead to glaucoma, the fourth main cause of blindness in India

Glaucoma is a slow progressing disease and is more prevalent in the elderly. Unlike in cataract, which is the leading cause for blindness, loss of vision caused by glaucoma cannot be regained by therapeutic intervention. CSIR-CCMB has studied the molecular mechanism of glaucoma in collaboration with L.V. Prasad Eye Institute, Hyderabad. One of the mutated genes causing glaucoma was OPTN which codes for protein optineurin. An alteration in this gene (M98K) was earlier associated with glaucoma only in South Asian population. OPTN was one of the genes associated with glaucoma where intra-ocular pressure was not involved. The gene was studied in detail as the molecular mechanism of how it causes glaucoma was not known. Understanding the molecular mechanism would go a long way in devising strategies for treating and preventing further damage. The mechanism of how this alteration showed that the alteration induces cell death in retinal ganglion cells.

However, the mutation affected only the retinal ganglion cells and not other neuronal and non-neuronal cells. So by arresting ganglion cell death, further damage can be arrested and residual vision saved even after the onset of glaucoma. It was found that the cell death occurs due to enhanced autophagy (the process that removes damaged proteins and organelles in the cells by degradation). Any change in this — either increase or decrease — could lead to cell death. The work also enhanced the understanding of the process of autophagy, which was essential to maintain healthy cells. For instance, the scientists were able to stop cell death by blocking the enhanced activity of autophagy using chemical inhibitors. CSIR-CCMB is currently studying the role of optineurin in transporting materials like proteins and lipids from one cell compartment to another within the same cell (membrane vesicle trafficking) and in signalling involved in gene expression. The work showed that regulating one of the trafficking processes known as endocytic recycling was fundamental to the uptake of iron by the cell. A mutation in optineurin (E50K) causes a defect in endocytic recycling and leads to death of retinal ganglion cells.

Research program in Skin Biology Developed

CSIR-IGIB has initiated a new program in the area of skin biology research. Understanding skin homeostasis and pathological conditions affecting the homeostasis constitute an upcoming, important area of research both

in the international arena and in the Indian context. Starting with attempts to decipher the molecular basis of the crosstalk and dynamics between different cell types in skin, skin biology has now developed into a program which is addressing research problems both in the fundamental and application space under the CSIR mandate. New knowledge is being generated related to skin architecture in relation to molecular and cellular function, understanding the process of pigmentation, elucidating mechanisms of common skin diseases and building computational models. Application in the area of skin-microbe interaction and development of targeted therapeutics for the skin is being carried out. Eventually, this can also show potential for translational research avenues in the derma-care sector, an imminent area at the interface of clinic and cosmaceuticals.

A large number of collaborations have been established with different medical Institutes and other research organizations to fulfill the objectives. Under the 12th five-year plan, skin biology has arisen as one of the major network projects coordinated by CSIR-IGIB.

Novel results have been generated in the area of modulation of skin pigmentation. IFN- γ has been identified as a novel molecular factor responsible for hypopigmentation of melanocytes. This was achieved by the study of cyclical gene expression profile analysis of genes regulated during pigmentation change. Further, target genes have been identified that are involved in pigmentation response regulated by IFN- γ . This placed IFN- γ as a candidate factor that could signal for controlled physiological hypopigmentation of melanocytes observed under various physiological and pathological conditions. This also indicates wide applicability of this phenomenon for achieving controlled hypopigmentation. This has been published in a high impact journal drawing international visibility.

Diabetes Research @CSIR-IGIB

The competence developed over the years at CSIR-IGIB in the area of genomics and bioinformatics has translated into development of a large, multi-institutional program in the area of diabetes and metabolic disorders.

The first genome wide association study (GWAS) for T2D in Indian population was performed in more than 12,500 samples. Genome scan was performed for 2,498 Indo-European subjects from North India. The interesting findings of stage 1 were replicated in 10,167 subjects comprising of 7,370 Indo-Europeans and 2,797 Dravidians. The analysis revealed association of a novel locus on chromosome 2 with T2D. Forty nine of 56 previously reported signals showed consistency in direction with similar effect sizes in Indians and previous studies, 25 of them were also associated. The known loci and newly identified 2q21 locus altogether account for 7.65% variance in risk of T2D in Indians. This is an important finding in the context of diabetes in India.

A research programme has been developed involving several clinicians, scientists and young researchers in the analysis of the functional consequence of the genetic factors identified through the GWAS. A large repository of samples has been built and studies on genetic and epidemiological factors of the disease has led to many interesting leads. Studies in this area are ranging from epidemiological to determine risk factor for metabolic disorders in Indian population to in silico identification of Type2 diabetes candidate genes and their in vitro validation. In addition, the capacity built through the GWAS on Diabetes is now enabling similar studies on GWAS of various metabolic traits (related to obesity, lipid, glycemic, metabolic syndrome, inflammation and kidney function). Studies on several other diseases, dealing with smaller sample sizes appropriate to the respective diseases, also attempt to understand the interface of environmental and genetic factors and look for biomarkers to aid in the early detection of lifestyle disorders.

Nonprocessive [2 + 2] π -off-loading reductase domains from mycobacterial nonribosomal peptide synthetases

CSIR-IGIB scientists have made a novel discovery of a mechanism of metabolite reduction which provides a new paradigm in the biosynthesis of complex lipids. In mycobacteria, polyketide synthases and nonribosomal peptide synthetases (NRPSs) produce complex lipidic metabolites by using a thio-template mechanism of

catalysis. In this study, it was demonstrated that off-loading reductase (R) domain of mycobacterial NRPSs performs two consecutive $[2 + 2]e(-)$ reductions to release thioester-bound lipopeptides as corresponding alcohols, using a nonprocessive mechanism of catalysis. The first crystal structure of an R domain from *Mycobacterium tuberculosis* NRPS provides strong support to this mechanistic model and suggests that the displacement of intermediate would be required for cofactor recycling. Scientists at CSIR-IGIB have shown that $4e(-)$ reductases produce alcohols through a committed aldehyde intermediate, and the reduction of this intermediate is at least 10 times more efficient than the thioester-substrate. Structural and biochemical studies also provide evidence for the conformational changes associated with the reductive cycle. Further, it was shown that the large substrate-binding pocket with a hydrophobic platform accounts for the remarkable substrate promiscuity of these domains.

These studies present an elegant example of the recruitment of a canonical short-chain dehydrogenase/reductase family member as an off-loading domain in the context of assembly-line enzymology.

Highly efficient (R-X-R)-type carbamates as molecular transporters for cellular delivery

Design and development of novel molecular transporters for the delivery of a large variety of cargo molecules like nucleic acids, peptides, proteins and small molecules to the cells remains an important challenge in the international arena. Of the different classes of cargoes, arginine-rich peptides with cell penetrating properties seems to be an effective class of molecules. In collaboration with CSIR-NCL, scientists at CSIR-IGIB have shown that the replacement of amide linkages in the (R-X-R) motif by carbamate linkages as in (r-ahx-r) (4) or (r-ahx-r-r-apr-r)(2) increases the efficacy of such oligomers several-fold. A number of such molecules have been designed and synthesized and internalization of these oligomers in mammalian cell lines occurs by an energy-independent process. These oligomers show efficient delivery of biologically active plasmid DNA and siRNA into CHO-K1 cells. These are now being developed for in vivo cargo delivery to the skin.

Loss-of-function of inositol polyphosphate-4-phosphatase reversibly increases the severity of allergic airway inflammation

In a novel finding that was published in a high impact international journal, scientists at CSIR-IGIB have shown that modulation of inositol polyphosphate-4-phosphatase alters the severity of asthma. Inositol polyphosphate phosphatases regulate the magnitude of phosphoinositide-3 kinase signalling output. Although inositol polyphosphate-4-phosphatase is known to regulate phosphoinositide-3 kinase signalling, little is known regarding its role in asthma pathogenesis. Allergic airway inflammation in mice led to calpain-mediated degradation of inositol polyphosphate-4-phosphatase. In allergic airway inflammation models, preventing inositol polyphosphate-4-phosphatase degradation by inhibiting calpain activity, or overexpression of inositol polyphosphate-4-phosphatase in mouse lungs, led to attenuation of the asthma phenotype. Conversely, knockdown of inositol polyphosphate-4-phosphatase severely aggravated the allergic airway inflammation and the asthma phenotype. Interestingly, inositol polyphosphate-4-phosphatase knockdown in lungs of naive mice led to spontaneous airway hyper-responsiveness, suggesting that inositol polyphosphate-4-phosphatase could be vital in maintaining the lung homeostasis. It was suggested that inositol polyphosphate-4-phosphatase has an important role in modulating inflammatory response in asthma, and thus, this work uncovers a new understanding of the complex interplay between inositol signalling and asthma, which could provide alternative strategies in asthma management.

Complex patterns of genomic admixture within southern Africa

Applicability of Indian Genome Variation Consortium (IGVC) database for addressing human migration, evolutionary history and admixture in a different continental population (Africa) was demonstrated by CSIR-IGIB. The Southern African population was known to have admixtures from different parts of the world including Indian subcontinent through East Indian Slave Trade and intercontinental migrations. Integrative

analysis of genome –wide variation data from African populations, with IGV populations overlaid on the Dutch settlement regions in India during slave trade was carried out for this purpose. A substantial extent of admixture in African population with the Indo-European and Tibeto-Burman from Eastern India was observed. Since India harbors genetic diversity that encompass all the world population, many more similar studies with the IGV data can be carried out for understanding disease prevalence and identifying linked genetic variations.

Establishment of VADU Cohort for prospective studies

Under CSIR major Laboratory project scheme, a Ayugenomics Unit was established at CSIR-IGIB. Vadu Rural Health Program, a division of KEM Hospital Research Centre is an active collaborator under this project.

An exciting array of Translational Research (G2P studies) is ongoing at Vadu in collaboration with CSIR-IGIB from both Ayurvedic and disease perspective. Vadu has extensively contributed to Project Ayurgenomics: Integration of Ayurveda to Genomics for field based research. 10000 subjects from Vadu area participated in this study. Vadu has also developed a detailed phenotyping (DP) unit and molecular biology laboratory for primary investigations for this project. The DP unit includes State of the art labs for heart rate variability testing, spirometry, skin testing, anthropometry and gustatory testing.

Setting up CSIR- TRISUTRA @IGIB

In the last couple of years, CSIR-IGIB has been involved in the amalgamation of insights developed from high-end genomics research with the traditional knowledge about human health and disease as documented in Ayurveda. Having established "Ayurgenomics" as a unique approach towards understanding human health, CSIR-IGIB has now established a new center TRISUTRA with a focus on systems biology approach in predictive and personalized medicine. The centre will also aim to develop data and sample repositories for prospective research studies and co-ordinate translational research for developing affordable health care solutions. A major objective of the project is to develop measures for phenotypes like anthropometric features, skin types, autonomic nervous system, olfaction abilities, lung function etc for Ayurveda concept based phenotypic (Prakriti) assessment. By also defining the genome wide (expression, genetic, epigenetic and biochemical) differences in large number of individuals defined by specific Prakriti (Vata, Pitta Kapha) groups from a genetically homogeneous population, the researchers hope to identify the molecular basis of this classification. Clinical profiling of patients by using extensive questionnaires and classification based on "Prakriti" followed by genomic studies including genome-wide expression profiling and genome wide SNP profiling as well as biochemical measures on a subset of predominant Prakriti types has established clear correlations between the two. During this period a large number of National and International collaborations have been established with Ayurveda, Modern Medicine, Genomics and public health institutes and other organisations.

Setting up BSL3 facility @CSIR-IGIB

The BSL3 facility at CSIR-IGIB Mathura Road is a fully functional facility that ensures containment of the pathogenic strains of Mycobacterium tuberculosis (Mtb) under safe working conditions. Entry to the facility is restricted and users have to undergo training in order to obtain access to the facility. The facility access is restricted by a state of the art biometric access system.

The environmental conditions are maintained in the facility by an advanced BMS system that can be monitored without entering the facility. A complete power backup of the system ensures that the facility is kept working in the event of a power failure. A unique feature of the facility is the step wise decrease in pressure across the different working areas (from -20 psi in the changing rooms to ~ -60 psi inside the labs) in order to ensure safety in the event of a spill. The negative pressure facility is further equipped with three class I biosafety cabinets for pathogen handling.

The facility can cater to 3 or more research groups of the Institute working on several aspects of Mtb physiology and pathogenesis. Standard operating procedures and protocols have been established and strict compliance is being monitored at a regular basis. By ensuring that any waste from the facility undergoes multiple levels of decontamination before release (decontamination using antimycobacterial agents and finally autoclaving the facility conforms to environmental safety standards. The facility also encloses a state of the art animal BSL3 facility with individually ventilated cages for small animals like mice. For a sustained and controlled infection with virulent Mtb in animals, an advanced aerosol infection chamber is in place in the facility. The facility has been accredited by an external agency for maintenance of International safety standards.

Research on virulent strains of Mtb is being carried out in this facility with the aim of understanding mechanisms of drug resistance, tolerance, and survival within its host. These studies would provide useful insights and developments that would be crucial in our fight against TB.

eHealth center jointly developed by CSIR-IGIB and Hewlett Packard

There is a need for identifying the extent of respiratory diseases in rural areas and obtain quality assured data for discovery. However, the lack of health infrastructure limits such efforts. There has been an attempt to create an integrated solution that harnesses together the infrastructure-creation advantages of cargo containers; high-quality healthcare-access capability of telemedicine; operational transparency of cloud-based electronic workflow; and automated analysis of the data for various levels of decision-support.



Fig: 1.1 eHealth Centre

Salient features:

- Affordable, integrated, cloud-connected, telemedicine capable, and operationally transparent solution for expanding primary health coverage;
- Cuts cost by more than 50% compared to standard Primary Health Center (PHC) and uses open source design and components;
- 6 eHC's in place. More than 30,000 patients successfully seen;
- Supported by Asian Development Bank for Bhutan; and
- Adopted by Narayana Hrudyalaya, TATA and other prominent organizations.

Development of a Topoisomerase 1B Targeted Anti-leishmanial Agent

Niranthin, a lignan isolated from a plant *Phyllanthus amarus* is a potent anti leishmanial agent. CSIR-IICB has found that the compound induces topoisomerase 1- mediated DNA-Protein adduct formation inside *Leishmania* cells and triggers apoptosis by activation of cellular nucleases. Niranthin treatment in infected experimental mice favours a Th1-immune response. The results have been published in *EMBO Molecular Medicine*.

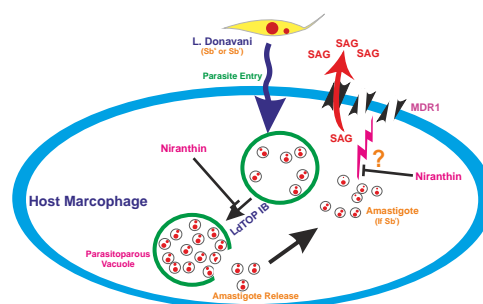


Fig: 1.2 Schematic diagram showing Niranthin act as a dual inhibitor. It stabilizes DNA – topoisomerase 1B adduct and abrogates essential life processes like replication, transcription etc. On the other hand niranthin inhibits P- glycoprotein (a transporter that is linked to clinical resistance Sodium Antimony Gluconate (SAG)

Wnt Signaling Stimulates Phagocytosis

Phagocytosis is a primary defense program orchestrated by monocytes/ macrophages. But, unregulated phagocytosis can lead to pathological conditions. CSIR-IICB has shown that Wnt5a stimulates phagocytosis of bacteria and associated cell activation. Wnt5a mediated augmentation in phagocytosis may result in uncontrolled inflammation and sustained infection. The results have been published in *Proceedings of National Academy of United States of America (PNAs)*.

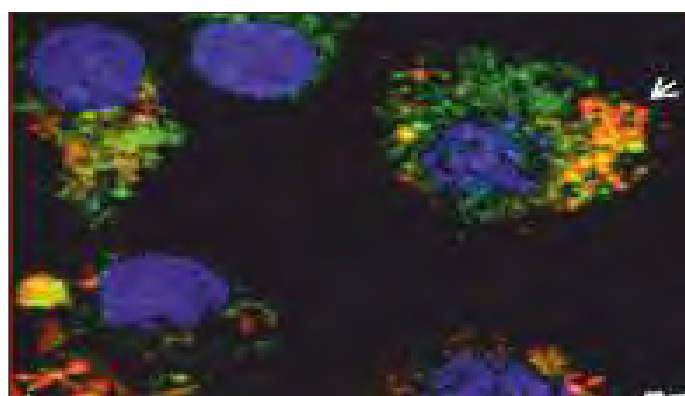


Fig: 1.3 Endosomal/lysosomal trafficking of GFP-*E.coli* depicting orange-yellow hue (green of GFP-*E.coli* and red of Lysotracker Red) in recombinant Wnt 5a after 4 hours bacterial internalization

An Improved Process for the Isolation of Organic Compounds Useful for the treatment of Cancer

Glioma cannot be cured. The prognosis for patients with high-grade gliomas is generally poor, and is especially so for older patients. Temozolomide is an orally active alkylating agent that is used for persons newly diagnosed with glioblastoma multiforme. Cervical cancer is the second most common malignancy among women worldwide. In India, cervical cancer ranks as the first most frequent cancer among women. The standards of treatment of cervical cancer include radiation therapy, chemotherapy and surgery. Chemotherapy uses either cisplatin alone or combination of two drugs, hycamtin and cisplatin. But all the available drugs are very cytotoxic and very costly for middle class family.

CSIR-IICB has isolated two main component molecules from an edible herb, abundantly available in India, for the treatment in glioblastoma and cervical carcinoma. The molecules induced apoptosis by activation of mitochondria-mediated death cascade both in glioma and cervical cancer cells. C-3 hydroxy group and NH group in the ring are two potential contributing groups for their cytotoxic effect. O-methyl derivative of one compound and N-methyl derivative of other compound are more or less inactive with respect to native molecules. The compound(s) reduced the effective doses of cisplatin and paclitaxel in cervical cancer showing better efficacy and therefore can be used as an adjunct chemotherapeutic agent to reduce toxicity of known toxic anti-cancer drugs. A new low cost process for the preparation of these two molecules was established. Both compounds are highly available in EtOAc extract and this extract is significantly active against glioma and cervical cancer cells.

The power of small RNA: Identification of mi-RNA as a potential therapeutic molecule against Kala-azar

Visceral Leishmaniasis (Kala-azar) caused by the pathogenic parasite *Leishmania donovani* is a deadly disease affecting a large portion of Bihar and adjoining areas. In patients, with progress of infection, down regulation of serum cholesterol was noted. Investigating the mechanism of this change, CSIR-IICB has discovered the role of a host micro-RNA regulating the infection process. This tiny RNA, miR-122 is a liver specific micro-RNA that gets reduced in the liver of infected animals. Restoration of miR-122 level in infected animals reverted serum cholesterol level and cleared parasite load from infected subjects. From this study, a therapeutic potential of miR-122-the tiny RNA wonder- in curing this parasitic diseases is evident. This is important particularly when other drugs are failing due to increased drug resistivity of the pathogen that has emerged recently.

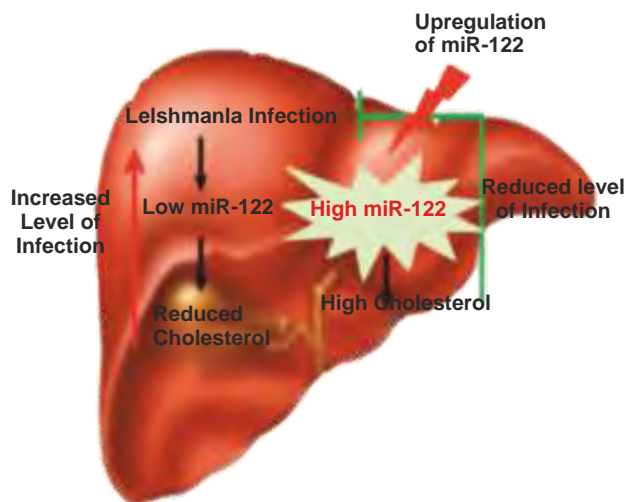


Fig: 1.4 Schematic diagram showing *Leishmania* parasites modulate liver miRNA for its survival

Games parasites play: how drug resistant *Leishmania donovani* evades the effect of antimonial drugs

Kala-azar or visceral leishmaniasis, caused by the protozoan parasite *Leishmania donovani*, has re-emerged and is spreading worldwide due to resistance to drugs such as pentavalent antimonials, which were introduced in the Indian subcontinent almost nine decades ago with dramatic clinical success. Despite their initial promise, antimonials were officially abandoned in 2005 because of toxicity issues, a progressively high (up to 65%) treatment failure rate, and the emergence of drug resistance.

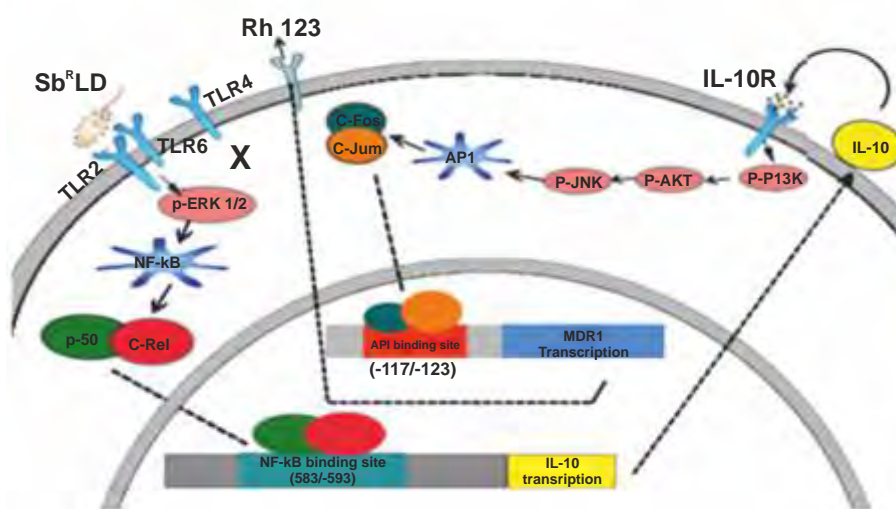


Fig: 1.5 Antimony resistant parasite (SbRLD) driven IL-10 overproduction and subsequent Multidrug resistant protein -1 (MDR1) upregulation in infected macrophage. Interaction of unique terminal sugar of SbRLD with host TLR2 results in the activation of ERK and NF-κB subunits, p50/c-Rel. Nuclear translocation and binding of these subunits to the specific IL-10 promoter site results in IL-10

The cell surface of *L. donovani* is covered with complex sugar molecules known as glycoconjugates or glycans. Here, CSIR-IICB has explored another domain of the parasite/host cell interaction and deciphered the complex interaction between antimony resistant parasite-specific parasite surface glycoconjugates, infectivity, IL-10 production, overexpression of Multidrug resistant protein 1 (MDR1) in the macrophage, and efflux of antimonial drugs from the host cell.

CSIR-IICB, after a systematic study, has revealed that antimony resistant *Leishmania donovani*-specific glycans induce IL-10 production from macrophages, which, in turn, upregulates expression of host MDR1 and might eventually contribute to drug resistance and increased pathogenicity. These findings broaden the view on the panel of molecular mechanisms involved in antimonial resistance. The findings suggest that further studies on drug resistance should not only focus on the parasite, but also explore its direct interface, the macrophage. Finally, CSIR-IICB study raises concern about the impact of major molecular adaptations on the outcome of the few available drugs that have been implemented to control kala azar in the Indian Subcontinent also.

Function of an Alba-family protein (PfAlba3) from human malaria parasite *Plasmodium falciparum*

CSIR-IICB has investigated the DNA-binding nature as well as the function of a putative Alba (Acetylation lowers binding affinity) family protein (PfAlba3) from *Plasmodium falciparum*. PfAlba3 binds to DNA sequence non-specifically and acetylation lowers its DNA-binding affinity. The protein is ubiquitously expressed in all the erythrocytic stages of *P. falciparum* and it exists predominantly in the acetylated form. *Plasmodium falciparum* Sir2 (PfSir2A), a nuclear localized deacetylase interacts with PfAlba3 and deacetylates the lysine residue of N-terminal peptide of PfAlba3 specific for DNA binding. PfAlba3 is localized with PfSir2A in the periphery of the nucleus. Fluorescence in situ hybridization studies revealed the presence of PfAlba3 in the telomeric and subtelomeric regions (Fig.1.6). PfAlba3 is involved in coordinated expression of Virulence Aggressive Resistance (Var) gene.

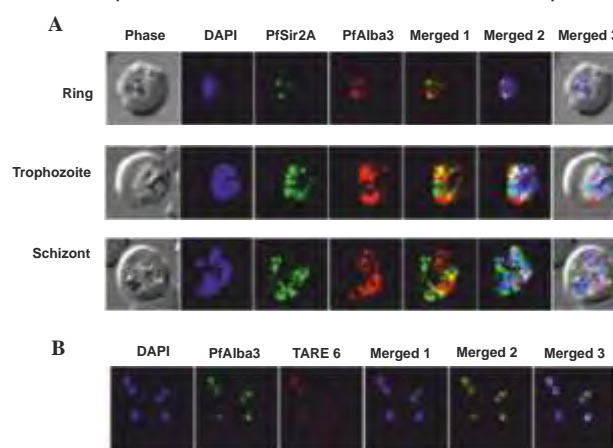


Fig: 1.6 PfAlba3 co-localize with PfSir2A (deacetylase) at the periphery of nucleus

Averting biodiversity collapse in tropical forest protected areas.

Tropical forests are biologically the richest ecosystems on Earth. Results of the CSIR-CCMB study showed that as anticipated in about half of the protected areas the diversity was protected, but in the rest an erosion of biodiversity that is often alarmingly widespread taxonomically (amphibians to primates) and functionally (ecological specialist to migratory species) was observed. Habitat disruption, hunting and forest-product exploitation were the strongest predictors of declining biodiversity. Crucially, environmental changes immediately outside the protected areas appeared nearly as important as those inside. These findings suggest that tropical protected areas are often intimately linked ecologically to their surrounding habitats, and that a failure to stem broad-scale loss and degradation of such habitats could sharply increase the likelihood of serious decline in biodiversity. The research work has been published in 'Nature'.

Investigations into an alternate approach to target mannose receptors on macrophages using 4-sulfated N-acetylgalactosamine more efficiently in comparison with mannose-decorated liposomes: An application in drug delivery

CSIR-CDRI has investigated the potential of 2 different ligands, i.e. palmitoyl mannose (Man-Lip) and 4-SO(4)GalNAc (Sulf-Lip) to target resident macrophages after surface decoration of Amphotericin B (AmB) loaded

liposomes. Flow cytometric data reveal enhanced uptake of Sulf-Lip in both J774 and RAW cell lines in comparison with the uptake of Man-Lip. Intracellular localization studies indicate that the fluorescence intensity of Sulf-Lip was much higher in comparison with that of Man-Lip and Lip formulations. Sulf-Lip and Man-Lip showed significantly higher localization of AmB at all time points in comparison with Lip ($P < 0.05$) after intravenous (IV) administration. The studies provide evidence that 4-SO(4)GalNAc possesses a promising feature for targeting resident macrophages and its application in the conditions of leishmaniasis is in the offing.

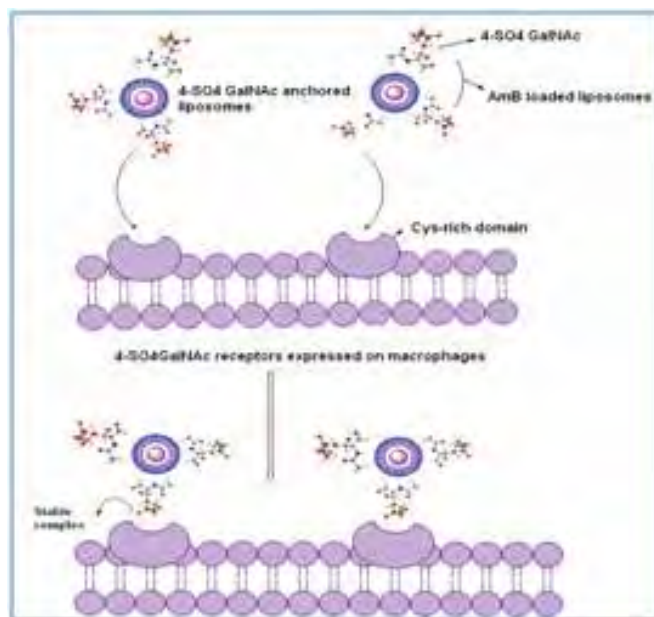


Fig: 1.7 Preferential targeting to resident macrophages through 4-SO(4) GalNAc anchored liposomes

Cascade [4 + 1] annulation via more environmentally friendly nitrogen ylides in water: Synthesis of bicyclic and tricyclic fused dihydrofurans

CSIR-CDRI has described a novel imidazolium ylide activated [4 + 1] annulation approach for the diastereoselective synthesis of bicyclic and tricyclic fused dihydrofurans in water. This cascade annulation presumably proceeds via a Michael reaction triggered zwitterion enolate followed by concomitant intramolecular cyclization. The methodology has distinction of being the first report on imidazolium ylide mediated [4 + 1] annulation in water as a unified greener approach involving an in situ base regeneration system and an alternative to pyridine ylide.

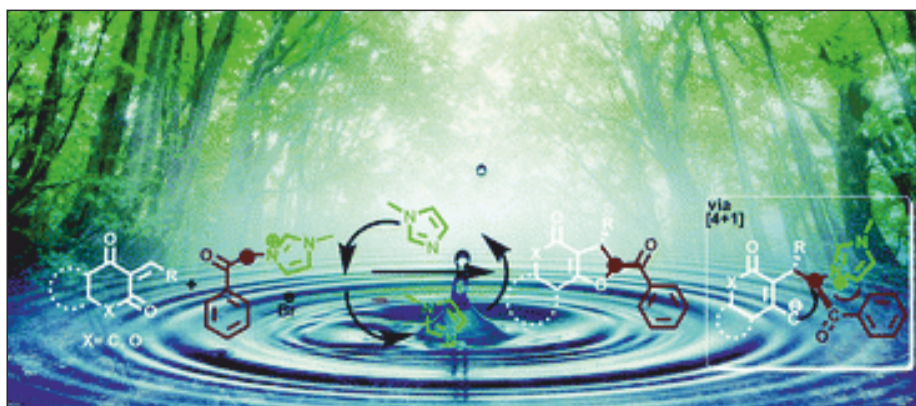


Fig: 1.8 Design and synthesis environmentally friendly nitrogen ylides and its application in Cascade annulation

Withaferin A: a proteasomal inhibitor promotes healing after injury and exerts anabolic effect on osteoporotic bone

CSIR-CDRI has demonstrated increased bone mass results from proteasome inhibition by Withaferin A. Withaferin A stimulates osteoblast growth and differentiation, accelerates bone healing following injury and exerts an anabolic effect on osteoporotic bone. Given the lack of uterine estrogenicity and intrinsic bioavailability of Withaferin A, these investigations provide important findings pertaining to Withaferin A-induced bone anabolic effect at 10. Data suggest that Withaferin A can reach an optimum therapeutic concentration in vivo that can be anabolic in nature. The present study supports the usefulness of natural proteasomal inhibitor Withaferin A, making it an attractive alternative anabolic candidate as a new treatment of post-menopausal osteoporosis.

Transcriptome of the omega 3 rich plant, chia (*Salvia hispanica*)

Chia is a Mexican plant, finding growing importance in every day diet of the West due to its high content of alpha linoleic acid (ALA), an essential fatty acid required by humans for the production of the other most important poly unsaturated fatty acids (PUFAs) like Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) that are associated with cognitive behavior and intelligence. Chia, although has found its way into bakery products and energy drinks and many other food products, not much has been done in terms of research.

For the first time CSIR-CFTRI has shown that Chia can be grown well in South Indian conditions and has also evolved agronomic practices for the same, apart from coming out with a high yielding variety. Considering the fact that this is probably the only plant source for such high content of ALA, CSIR-CFTRI has studied the seeds through the different developing stages to understand if there was a specific stage at which the unsaturation increased. Towards this, institute has also completed the de novo transcriptome of developing Chia seeds for the first time in the world and have deposited the data at <http://www.ncbi.nlm.nih.gov/bioproject/196477>. Analysis of the data revealed some important lipid genes; amplifying, cloning and characterization of which is underway.

Effect of extraction solvent on oil and bioactives composition of commercial Indian niger (*Guizotia abyssinica* (L.f.) Cass.) seed

Commercially available niger (*Guizotia abyssinica* (L.f.) Cass.) seed was investigated by CSIR-CFTRI to evaluate the effect of extraction solvent on oil and bioactives composition. For this purpose, niger seeds has subjected to solvent extraction using solvents of different polarity, viz. hexane, petroleum ether, chloroform, acetone, methanol and ethanol. Oil content of niger seeds obtained after extraction with solvents of different polarities was in the range of 31.8–41.3 g/100g. The extracted oil was characterized by the following parameters: color (40.0–95.0 Lovibond units), free fatty acids (3.6–12.3 g/100g), peroxide value (3.2–7.8 meqO₂/Kg), iodine value (137.6–140.3 cgl₂/g), saponification value (177.3–185.9 mg KOH/g) and unsaponifiable matter (1.3–4.3 g/100g). Among fatty acids, linoleic acid (69.4–73.2%) was the major fatty acid and trilinolein (31.2–33.4%) was the major triacylglycerol. The composition of bioactive molecules was 171.9–345.8 of total tocopherols ppm; 247.1–2647.7 ppm of total phenolics; 1249.6–6309.3 ppm of total sterols and 18.9–181.0 ppm of total carotenoids. Among the tocopherols, α -tocopherol was the major component with 154–276 ppm. Of the total phenolics, vanillic acid with 176–1709 ppm was the major phenolic compound in the oil extracted using different solvents. Ethanol-extracted oil showed 13.9 fold better oxidative stability and a higher radical scavenging activity (IC₅₀ value of 9.2 mg/mL) compared to hexane-extracted oil (IC₅₀ value of 40.3 mg/mL). This is probably the first report of its kind on solvent extractability of bioactives of niger seed.

Functionalized aptamers as nano-bioprobe for ultrasensitive detection of bisphenol-A in water samples

Bisphenol-A (BPA) is a food and environmental contaminant which causes various health problems to humans especially children, fetus and infants at a concentration as low as 0.23 ng/mL. A novel functionalized aptamer based 'turn-off' fluorescent biosensor for ultra-sensitive detection of small molecules like BPA in water samples. CSIR-CFTRI has proposed and performed a novel assay for detection of BPA using the 'turn-off' biosensor with a functionalized aptamer tagged with FAM (carboxyfluorescein) and BHQ (Black hole quencher) where the detection is based on the quenching of fluorescence emission upon binding of BPA with the functionalized aptamer. Institute has been able to detect up to 0.01 pg mL⁻¹ of BPA. This novel concept will be helpful in designing aptasensors for the ultrasensitive detection of various analytes with respective aptamers. Aptamer and gold nanoparticle based biosensing system can be used for affordable diagnostics with field applicability at economic cost.

Algae-mediated carbon dioxide sequestration for climate change mitigation and conversion to value-added products - food, feed and fuel grade

In the global effort to combat and mitigate climate change, several CO₂ capture and storage technologies are being deliberated. One of the most promising future-proof CO₂ sequestration technologies can be microalgal cultivation integrated with CO₂ sequestration and its conversion to value-added food and fuel-grade precursors/products.

CSIR-CFTRI has isolated five indigenous microalgal strains of *Scenedesmus*, *Chlorococcum*, *Coelastrum*, and *Ankistrodesmus* genera, from Indian fresh water habitats, were studied for carbon-dioxide tolerance and its effect on growth, lipid and fatty acid profile. *Scenedesmus dimorphus* strain showed maximum growth (1.5 g/L) and lipid content (17.83% w/w) under CO₂ supplementation, hence selected for detailed evaluation. The selected strain was alkaline adapted but tolerated (i) wide range of pH (5–11); (ii) elevated salinity levels (up to 100 mM, NaCl) with low biomass yields and increased carotenoids (19.34 mg/g biomass); (iii) elevated CO₂ levels up to 15% v/v with enhancement in specific growth rate (0.137 d⁻¹), biomass yield (1.57 g/L), lipid content (19.6% w/w) and CO₂ biofixation rate (0.174 g L⁻¹ d⁻¹). Unsaturated fatty acid content (alpha linolenic acid) increased with CO₂ supplementation in the strain.

Carbon Sequestration potential of Aromatic Plants

CSIR-CIMAP has studied carbon sequestration potential of aromatic grasses namely palmarosa, vetiver and lemongrass. It was found that palmarosa is far superior in respect to shoot biomass and vetiver for root biomass. These findings are of immense value in environment protection and maintenance of soil health besides adding extra income to rural masses and utilization of marginal to sub-marginal soils.

It has been shown that *articylopropylmether* and *artimisinin* derivative has therapeutic potential in reducing the *Helicobacter pylori* burden in chronic infection models. Recurrence of gastroduodenal ulcers, believed to be due to antibiotic resistance of the causal organism *Helicobacter pylori* possibly can be cured by *articylopropylmether*. Further, CSIR-CIMAP has synthesized Nineteen novel analogues of 2- methoxyestradiol of which two of the analogues showed potent anticancer activity against various human cancer cell lines. The best analogue of the series was found to be microtubule stabilizer. It was non-toxic up to 300 mg/kg dose in acute oral toxicity in Swiss-albino mice.

Enhanced bioavailability of estramustine (EM) and natural podophyllotoxin (PODO)

The synthetic estramustine (EM) and natural podophyllotoxin (PODO) anti-mitotic agents that inhibit tubulin polymerization are known anticancer agents. As low bioavailability limits their anticancer properties, CSIR-IHBT developed conjugation with PAMAM dendrimer (D) to enhance the activity of D-EM and D-PODO by altering their release pattern. Release kinetics indicated synthesized conjugates to be stable against hydrolytic cleavage and showed sustained release characteristics. However, release of D-EM was slow compared to D-PODO conjugate. Antitumor effect of these conjugates on glioma cells revealed (i) increased cell death and cell cycle arrest (ii) decreased migration and (iii) increased tubulin depolymerization as compared to free drug. Importantly, the effects of natural PODO conjugate on glioma cell survival and migration is more pronounced than D-EM.

Deciphering the molecular mechanism of survival of *Caragana jubata* in the harsh climate of high altitude

The harsh and hostile environment of the cold desert in Spiti valley of Himachal Pradesh (HP) is characterized by high radiation, temperature and extreme scarcity of water. CSIR-IHBT has deciphered the molecular mechanism that confers survival fitness to *C. jubata*, a perennial shrub of this region and found the dominance of genes encoding chaperones. Genes associated with growth and development and 11 late embryogenesis abundance protein genes (LEAs) belonging to six groups were observed at low temperature (LT). While some showed constitutive expression, others were over-expressed within 3 hours of exposure to LT. The sustenance of the species in the harsh environment of high altitude was attributed to the simultaneous up-regulation of six groups of LEAs. Genes associated with growth and development such as early light inducible protein, CjABA inducible,

CjCDPK, indole acetic acid inducible protein, auxin responsive factor 7, MYB transcription factor 133, rare cold inducible 2A (CJRCI2A), cold acclimation responsive, cold acclimation specific and mammalian cell entry family protein were also regulated in response to LT. Expression of all these genes was observed in the species growing in its natural habitat of Kibber-Gete area of Lahaul & Spiti district, HP.

Kinetics of gene expression suggested rapid adjustability of the *C. jubata* cellular machinery in less than an hour in its niche environment. This was rejected in LT mediated photosynthetic acclimatory response. Probably such molecular and physiological plasticity allowed *C. jubata* to survive the harsh environment of Himalayan cold desert.

Genome-wide expression profiling of NAC transcription factor family in potato (*Solanum tuberosum* L.)

NAC (NAM, ATAF1/2 and CUC2) proteins belong to one of the largest plant-specific transcription factor (TF) families. They play important roles in plant development processes, biotic and abiotic stress response and hormone signalling. On exploiting the available potato genome data and the genome-wide analysis by CSIR-IHBT, 110 StNAC genes encoding for 136 proteins were identified in potato. Phylogenetic analysis of StNACs and their arabidopsis and rice counterparts divided these proteins into 18 subgroups. Interestingly, 36 StNAC proteins clustered in NAC-q subgroup were potato-specific. In silico expression analysis using Illumina RNA-seq transcriptome data revealed biotic and abiotic stress as well as hormone-responsive expression profile of StNAC genes. Quantitative real-time PCR analysis also confirmed the expression profile of StNAC genes revealed by RNA-seq data. The data provides valuable leads towards putative functions of several StNAC TFs.

Over-expression of PaSOD in transgenic potato enhances photosynthetic performance under drought

Potato (*Solanum tuberosum*) is an important tuber crop, which is susceptible to drought stress. CSIR-IHBT has made an attempt to improve the plant performance under drought stress by modulating super oxide radical ($O_2^{\cdot-}$) content in potato cv. Kufri Sutelej by over-expressing super oxide dismutase (SOD), the enzyme involved in the scavenging of $O_2^{\cdot-}$. Over-expression of a cytosolic copper-zinc SOD, cloned from *Potentilla atrosanguinea* (PaSOD) resulted in enhanced net photosynthetic rates (PN) and stomatal conductance (gs) compared to that in the wild type (WT) plants under control (irrigated) as well as drought stress conditions. Decline in leaf water potential, PN, gs, photosystem II activity and chlorophyll content, but increased proline and $O_2^{\cdot-}$ content was more in WT than transgenic potato plants (SS5). Significantly lower proline and $O_2^{\cdot-}$ content but enhanced SOD activity in SS5 compared to WT under drought stress probably generated lower stress signal for stomata to close. This was indicated by significantly higher gs in SS5 as compared to the WT. Since gs also regulates substomatal concentration of CO_2 , SS5 plants exhibited significantly higher PN. Manipulation of $O_2^{\cdot-}$ content could be a new way of modulating drought stress tolerance in plants.

Groundwater contaminated with hexavalent chromium [Cr (VI)]: a health survey and clinical examination of community inhabitants

CSIR-IITR has assessed the health effects of hexavalent chromium groundwater contamination (from tanneries and chrome sulfate manufacturing) in Kanpur. The health status of residents living in areas with high Cr (VI) groundwater contamination (N=186) were compared to residents with similar social and demographic features living in communities having no elevated Cr (VI) levels (N=230). Subjects were recruited at health camps in both the areas. Health status was evaluated with health questionnaires, spirometry and blood hematology measures. Cr (VI) was measured in groundwater samples by diphenylcarbazide reagent method.

Residents from communities with known Cr (VI) contamination had more self-reports of digestive and dermatological disorders and hematological abnormalities. GI distress was reported in 39.2% vs. 17.2% males (AOR = 3.1) and 39.3% vs. 21% females (AOR = 2.44); skin abnormalities in 24.5% vs. 9.2% males (AOR =

3.48) and 25% vs. 4.9% females (AOR = 6.57). Residents from affected communities had greater RBCs (among 30.7% males and 46.1% females), lower MCVs (among 62.8% males) and less platelets (among 68% males and 72% females) than matched controls. There were no differences in leucocytes count and spirometry parameters. Living in communities with Cr (VI) groundwater is associated with gastrointestinal and dermatological complaints and abnormal hematological function. Limitations of this study include small sample size and the lack of long term follow-up. The research findings have been published in '[PLoS One](#).'

Analysis of imidacloprid residues in fruit, vegetables, cereals, fruit juices and baby foods and daily intake estimation in and around Lucknow

CSIR-IITR has collected and analysed a total of 250 samples-including fruits, fruit juices, and baby foods (50 samples each), vegetables (70 samples), and cereals (30 samples)- from Lucknow for the presence of imidacloprid residues. The QuEChERS (quick, easy, cheap, effective, rugged, and safe) method of extraction coupled with high-performance liquid chromatographic analysis were carried out, and imidacloprid residues were qualitatively confirmed by liquid chromatography- mass spectrometry. Imidacloprid was not detected in samples of fruit juices and baby foods. It was, however, detected in 38 samples of fruits, vegetables, and cereals, which is about 15.20% of the total samples. Of samples of fruits, 22% showed the presence of imidacloprid, and 2% of samples showed residues above the maximal residue limit. Although imidacloprid was detected in 24% of vegetable samples, only 5.71% showed the presence of imidacloprid above the maximal residue limit. However, 33% of cereal samples showed the presence of imidacloprid, and about 3% of samples were above the maximal residue limit. The calculated estimated daily intake ranged between 0.004 and 0.131 µg/kg body weight, and the hazard indices ranged from 0.007 to 0.218 for these food commodities. It is therefore indicated that lifetime consumption of vegetables, fruits, fruit juices, baby foods, wheat, rice, and pulses may not pose a health hazard for the population of Lucknow because the hazard indices for imidacloprid residues were below one.

Edible oil adulterants, argemone oil and butter yellow, as aetiological factors for gall bladder cancer

CSIR-IITR has investigated the potential aetiological factors of gall bladder carcinoma (GBC) in the Indo-Gangetic basin. Twice weekly intraperitoneal (ip) administration of AO (5 ml/kg body wt) and BY (25 mg/kg body wt) to Swiss albino male and female mice for 30 and 60 days indicated that females were more vulnerable to these adulterants in terms of responses to inflammatory markers. Subsequent experiments with dietary exposure of AO (1%) and BY (0.06%) for 6 months in female mice showed symptoms related to cachexia, jaundice and anaemia. High levels of total cholesterol, low density lipoprotein (LDL), TG, bilirubin and low level of high density lipoprotein (HDL) as well as gallstone formation was shown by AO exposure only, leading to the development of adenocarcinoma. BY exposure resulted in adenoma and hyperplasia without stone formation. The cyclooxygenase (COX-2) over expression was found to be related to prostaglandin E2 (PGE2) production in AO treated mice but not in BY exposed animals, thereby indicating a differential pathway specific carcinogenicity. PGE2 stimulates the secretion of secreted mucins (MUC5AC), which is involved in stone formation following AO exposure. Enhanced secretion of membrane bound mucins (MUC4) in BY and AO exposed mice resulted in the activation of ErbB2 and downstream signalling such as p-AKT, p-ERK and p-JNK, which ultimately affects the target proteins, p53 and p21 leading to adenoma and adenocarcinoma, respectively. The study suggests that AO and BY are responsible for producing GBC in mice along with stone formation in the AO exposed animals.

Particulate matter concentration in ambient air and its effects on lung functions among residents in the National Capital Region

The World Health Organization has estimated that air pollution is responsible for 1.4 % of all deaths and 0.8 % of disability-adjusted life years. NOIDA, located at the National Capital Region, India, was declared as one of the critically air-polluted areas by the Central Pollution Control Board of the Government of India.

Studies on the relationship of reduction in lung functions of residents living in areas with higher concentrations of particulate matter (PM) in ambient air were inconclusive since the subjects of most of the studies are hospital admission cases. Very few studies, including one from India, have shown the relationship of PM concentration and its effects of lung functions in the same location. CSIR-IITR has studied the effect of particulate matter on concentration in ambient air on the lung functions of residents living in a critically air-polluted area in India. PM concentrations in ambient air [PM(1,) PM(2.5)] were monitored at residential locations and identified locations with higher (NOIDA) and lower concentrations (Gurgaon). Lung function tests [FEV(1), PEFR] were conducted using a spiro meter in 757 residents. Both air monitoring and lung function tests were conducted on the same day. Significant negative linear relationship exists between higher concentrations of PM(1) with reduced FEV(1) and increased concentrations of PM(2.5) with reduced PEFR and FEV(1). The study shows that reductions in lung functions (PEFR and FEV(1)) can be attributed to higher particulate matter concentrations in ambient air. Decline in airflow obstruction in subjects exposed to high PM co-concentrations can be attributed to the fibrogenic response and associated airway wall remodeling. The study suggests the intervention of policy makers and stake holders to take necessary steps to reduce the emissions of PM concentrations, especially PM(1,) PM(2.5), which can lead to serious respiratory health concerns in residents.

Phenotypic characterization of *Streptomyces* strains

CSIR-IMTECH has observed antimicrobial positive *Streptomyces* strains under light microscope for acid-fastness and Gram-staining properties. Morphological characters on CSPY agar plate. Physiological criteria such as the ability to degrade casein and tyrosine as substrates by various *Streptomyces* strains were used for genus confirmation. The utilization of different carbon sources and production of melanin pigment and utilization of urea were studied so as to characterize species level classification.

Based on antimicrobial activity total 33 strains putatively *Streptomyces* spp. was selected from CSPY agar plates. Optimal growth temperature for the strains was recorded as 25°C, growth can occur below 6°C, no growth recording at 35°C or above. Most of these strains show typical morphology of *Streptomyces*, they had branched and non-fragmented substrate mycelia, abundant aerial hyphae and short or long spore chains with or without pigmentation. All the colonies of the strains were slow growing, aerobic, glabrous or chalky, heaped with substrate mycelia of colors and possessed an earthy smell. The strains were acid-fast negative and gram positive, degraded the substrates casein, however, degradation of tyrosine was variable according to each isolate. Microscopically, it was revealed that the spore chain morphology differed depending on the species, showing straight and flexuous forms, hooks, open loops and coils.

Based on the aerial mycelium colour, the strains could be grouped into - grey and white. Different colours of mycelia were also observed, the shades light brown and ivory colour being the predominant. Few of them had substrate mycelia in violet, purple or red-violet. Utilization of several carbohydrates varied according to each strain. Maximum, i.e. 11 nos. of strains had capacity to utilize L-arabinose, followed by (8 strains) sucrose, D-mannitol, raffinose and L-rhamnose. Only two strains were able to use D-fructose as carbon source. Majority of the strains (22 out of 33) could degrade urea, and 13 nos. of strains could produce diffusible pigments in the surrounding medium.

Silicon mediates arsenic tolerance in rice (*Oryza sativa* L.) through lowering of arsenic uptake and improved antioxidant defence system

CSIR-NBRI has grown two contrasting rice (*Oryza sativa* L.) cultivars i.e. Triguna (As tolerant) and IET-4786 (As sensitive) hydroponically to study the effect of silicon (Si) supplementation on As accumulation, growth, oxidative stress and antioxidative defence system in shoots during arsenite [As(III)] stress. Rice seedlings were exposed to three As(III) levels (0, 10 and 25 µM) and three silicic acid levels (0, 0.5 and 1 mM Si) in solution culture experiments. Addition of 1 mM Si during As(III) exposure significantly lowers shoot As accumulation in

both the cultivars, but more prominently in Triguna ($P = 0.01$) than IET-4786 ($P = 0.05$). However, addition of Si during As(III) stress had no significant effect on shoot length and dry weight ($P < 0.01$) of both the cultivars, compared to their As(III) treated plants. In contrast to IET-4786 ($P = 0.05$), Triguna tolerated As-induced oxidative stress through elevated level of cysteine, enhanced antioxidant enzyme activities and their isozymes. Upon Si supplementation lower 3 conglomeration of oxidative stress parameters viz., superoxide and peroxide radicals, lipid peroxidation and electrolyte leakage coincides with increased antioxidant activities and enhanced level of thiols, more effectively in shoots of Triguna than IET-4786 during As(III) stress ($P = 0.05$). In conclusion, 1 mM Si addition, significantly ameliorates As-induced oxidative stress in Triguna cultivar by lowering the As accumulation and improving antioxidant and thiolic system compared to IET-4786, implying genotypic differences with Triguna being less susceptible to stress dependent membrane lipid peroxidation.

Influence of arsenic-resistant bacteria on growth and arsenic uptake in Brassica juncea

CSIR-NBRI has isolated an arsenic hypertolerant bacterium from arsenic contaminated site of West Bengal. The bacterium was identified as *Staphylococcus arlettae* strain NBRIEAG-6, based on 16S rDNA analysis. It was able to remove arsenic from liquid media and possesses *arsC* gene, responsible for arsenate reductase activity. An experiment was conducted to test the effect of *S. arlettae* inoculation on concurrent plant growth promotion and arsenic uptake in Indian mustard plant [*Brassica juncea*(L.) Czern. Var.R-46] when grown in arsenic spiked (5, 10 and 15 mg Kg⁻¹) soil. The microbial inoculation significantly ($p < 0.05$) increased biomass, protein, chlorophyll and carotenoids contents in test plant. The plant growth promoting bacteria NBRIEAG-6 has the ability to help *Brassica juncea* to accumulate As maximally in plant root, and therefore it can be accounted as a new bacteria for As phytostabilization.

HMPR based genic enriched genomic sequencing

CSIR-NBRI has adopted a modified Hypo-Methylated Partial Restriction (HMPR) approach for the genic-enrichment in cotton genome, which employs complete digestion of genomic DNA with methylation sensitive restriction enzymes (ClaI and HpaII). The genic-enriched sequencing data was mined for various genomic resources like genes, transcription factors, promoters, non-coding RNAs, and molecular markers.

Six diverse genotypes of *G. hirsutum* (JKC703, JKC725, JKC737, JKC770, MCU5, and LRA5166) were selected on the basis of their genetic differences. Two individual genic-enriched libraries (using ClaI fragments and HpaII fragments) were made from genomic DNA of each of the genotypes. After the sequencing of all six genotypes, a total of 18,368,939 genomic reads representing 5,298,872,511 bases (approx. 5.29 Gb) were generated. A total of 717,694 mitochondrial reads, 3,680,762 plastid reads and 244,023 short reads (< 50 bp) were filtered out from the raw data. The quality filtered ClaI and HpaII reads (14,280,525) from all the genotypes were assembled using 454 gsAssembler v2.5.3 to generate 4,095,128 super-assembled sequences, including 533,271 contigs and 3,561,857 singletons (1.27 Gb).

A total of 422,617 SNPs in all 15 possible combinations of six genotypes were identified. Under-represented SNPs (in less than 3 reads from a genotype), paralogous SNPs and redundant SNPs were removed across all the 15 combinations and identified a total of 66,444 unique SNPs, which were distributed among 24,612 genic (15,648 exonic and 4518 intronic) and 41,832 non-genic SNPs. Further, 2,604 synonymous and 6,506 nonsynonymous SNPs were identified. In addition, 66,444 unique SNPs were checked for their novelty against all the 29,234 *Gossypium* SNPs submitted to NCBI dbSNP (<http://www.ncbi.nlm.nih.gov/snp/term/gossypiumhirsutum>) and identified 66,364 novel SNPs (80 redundant SNPs). A frequency of 1 SNP per 388 bases of sequence analyzed was observed. Most of the coding SNPs were enriched in protein kinase (292 SNPs), hydrolase (254 SNPs), Cytochrome P450 (234 SNPs), AAA domain (216 SNPs), AP endonuclease family (166 SNPs) and NB-ARC domain (108 SNPs). The study added significant number of resources for cotton community.

1.1.2 Technology Developed

Plant Derived Single Molecule (K058) from CSIR-CDRI as Rapid Fracture Healing Oral Drug

CSIR-CDRI has isolated a novel lead molecule K058 from a plant source and found rapid bone fracture healing anabolic activity that represents a new strategy in addressing primary and secondary osteoporosis. Fig: 1.9 Schematic diagram outlining the potential molecular targets and in vivo effect of WFA leading to bone anabolic effect in osteogenic cells and osteoclast precursor induced by proteasome inhibition

CSIR-CDRI has signed a Research and licensing agreement on 28th September 2012 with M/s Kemxtree LLC, USA (a Nostrum Group company) during 'CSIR-70' year celebration in New Delhi for further development of the molecule as a novel candidate drug for the treatment of osteoporosis and fracture healing.

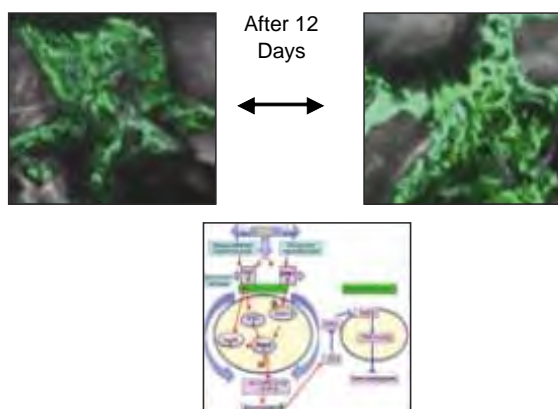


Fig: 1.9 Schematic diagram outlining the potential molecular targets and in vivo effect of WFA leading to bone anabolic effect in osteogenic cells and osteoclast precursor induced by proteasome inhibition

Licensing of L-PAC, ephedrine and pseudoephedrine technology

L-PAC, ephedrine and pseudoephedrine technology developed earlier by CSIR-CDRI was licensed to BVM Pharma Ltd., Bulandshahar, UP on 11th March, 2013. Full and final amount of Rs. 24,26,600.00 inclusive of service tax received towards licensing of the above technology on "As is Where is Basis".

Progress made in the further development of Candidate Drugs

Diseases / Disorders	Candidate Drugs	Clinical Status	Licensees & Collaborators
Malaria	97-78 Antimalarial	Phase-I clinical pharmacokinetic studies have been completed in 16 healthy male volunteers at PGIMER, Chandigarh in collaboration with IPCA Labs, Mumbai. Samples analyzed & report sent to IPCA.	IPCA Lab., Mumbai 2004
Diabetes & Dyslipidemia	CDR134D123 Anti-hyperglycemic	Detailed quality monograph on the Epicarp of the Dyslipidemia Anti-hyperglycemic plant <i>Xylocarpus sgranatum</i> as per the specifications of the Central Council for Research in Ayurvedic Sciences (CCRAS) has been submitted. DGCCRAS clearance is awaited for inclusion in the Extra Ayurvedic Pharmacopia	TVC Sky Shop Ltd., Mumbai 2008
	CDR134F194 Anti-hyperglycemic	The preparations for the drug formulation to be used in Phase-I Single Dose and Multiple Dose Clinical Good Trial studies from a certified company is in progress and the clinical trial would commence soon	

Progress made in the further development of potential leads

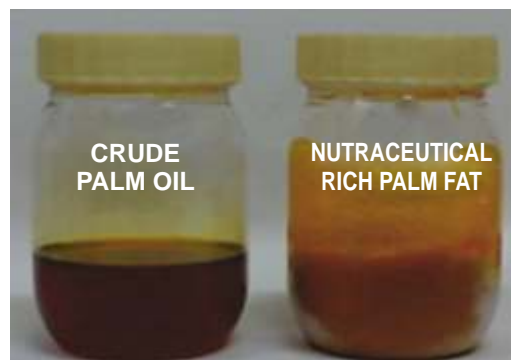
Diseases / Disorders	Lead & Efficacy	Current Status	Licensees & Collaborators
Osteoporosis	CDR914K058 Osteogenic	Synthetic process developed by CSIR-IICT. Licensed to Kemxtree, USA for further development and commercialization	Kemxtree, USA 2012
	S007-1500 Rapid fracture healing	Compound found safe in single dose toxicity study by oral route in rat and mice and by IM route in rat. Two year stability study completed	Under negotiation
	CDR4744F004 Osteoprotective & bone anabolic	Standardized fraction found to have bone anabolic effect in osteopenic rats; Principal component analysis of bioactiv markers completed. Further studies are under progress	
Cancer	S007-1235 Anti-leukemic	IC50 in K562, HL-60, U937, Kasumi1, Vero, & NIH3T3 respectively: 3.61 μ M, 5.99 μ M, 6.78 μ M, 8.12 μ M, >25 μ M, > 20 μ M. Activity is better than Imatinib (first gen) and Dasatinib (2nd gen). Possible mode of action established. Detailed mechanism, including identification of target and in vivo studies were planned.	Open for licensing
Thrombosis	S007-867 Antithrombotic	Compound found safe in single dose toxicity study by oral route in rat and mice and by IM route in rat; No adverse effect on Cardiovascular System (CVS) and Central Nervous System (CNS) and respiratory parameters.	Under negotiation
	S002-333 Antithrombotic	Compound found safe in single dose toxicity study by oral route in rat; Patent Granted. There was no significant effect on CNS, CVS and respiratory system up to 1000 mg/kg, po in rats.	
Diabetes & Dyslipidemia	CDR267F018 Antidyslipidemic	Compound found safe in 28 day repeat dose toxicity study in Rh monkey	Open for licensing
Tuberculosis	S006-830 Antituberculosis	Efficacy established in vivo in the mouse model of TB. Large scale synthesis completed. Pilot Pharmacokinetic Study of S006-830 in Male SD Rats completed and compound showed better bioavailability	Being developed under OSDD

Palm fat containing natural palm oil nutraceuticals and emulsifier property

Crude palm oil is fractionated into a liquid olein fraction and then refined, bleached, deodorized to get a colourless and odourless oil which is traded internationally. But, crude palm oil (CPO) is a source of unique natural antioxidants such as β -carotene (provitamin A), tocotrienols and coenzyme Q10. These antioxidants are lost during refining of crude RPO (CRPO). CSIR-CFTRI has deacidified CRPO containing 11.7% free fatty acids value

(FFA) using different methods for nutraceutical retention, solid consistency and emulsification property which was used for the preparation of food spreads. The food spread does not require colour addition and the product provides palm oil nutraceuticals to consumers and may provide health benefits.

The incorporation this palm fat in foods can provide the nutrients such as vitamin A, vitamin E, tocotrienols, coenzyme Q10, phytosterols present in palm oil to the malnourished children, aged patients and women and the general public to improve their health through consumption of such type of food. Food spreads are easy to prepare and can preserve the nutrients for a long time. This may be useful for national programmes dealing with health improvement.



1.10 A nutraceutical enriched palm fat prepared and used for the preparing of nutrient rich butter spread

Shelf stable dehydrated egg paneer/cubes and egg crunchy bites

CSIR-CFTRI has developed Egg paneer/cube which is a ready-to-use product for the preparation of curry, which provides convenience. The product can be made available in different flavours like onion, garlic, and pepper and is rich in high quality protein. The product can be stored at ambient temperature for six months. The product contains all natural food ingredients and does not contain any chemicals or synthetic preservative. The process can be adopted on a cottage scale also.



Fig: 1.11 Shelf stable egg albumin and yolk paneer

New Varieties of Medicinal and Aromatic Plants

Following high yielding varieties of medicinal and aromatic crops have been developed and released to farmers by CSIR-CIMAP:-

- **CIMAP Sii-9** is an improved variety of *Silybum marianum* having shorter plant height of (80-90cm), higher (>8%) silymarin content, and seed yield (10 quintal seeds/ha).
- **CIMAP Bio-G-171** is an improved variety of scented geranium (*Pelargonium graveolens*) which was released for the commercial cultivation having significantly higher oil content (0.24%) and oil yield (45kg/ha) against the checks Bourbon and CIM-Pawan.
- **CIMAP-Khus 22** of *Vetiverzanioides* which is an high essential oil yielding variety having higher oil yield (28kg/ha) and average oil content of 1.8%.

CIMAP-Khus15 of *Vetiverzanioides* is another high oil yielding variety having oil content of about 2.0% and oil yield of about 35 kg/ha with specific adaptation potential.

Herbichew (a tobacco and chemical free herbal mixture) developed jointly by CSIR-CIMAP and CSIR-NBRI is a tobacco and nicotine free herbal formulation, which give the feeling of Gutkha in taste and aroma but doesn't have any side effects. This herbal mixture is a good mouth freshener with anti-oxidants, anti-bacterials and digestive properties.

Inhibitors of IL-4 and IL-5 for the Treatment of Bronchial Asthma

The incidence of asthma and respiratory allergy is increasing in epidemic proportion throughout the world. It is one of the most critical, torturous diseases, which is threatening human civilization. Current studies shows that the loss due to asthma and other respiratory disorders is more that 30-34% of the total man-days. Even today there is no clear curative therapy for the disease. Moreover, currently available remedial drugs i.e. bronchodilators and steroids, are with undetermined responsiveness, and hazardous to health, with severe side effects.

CSIR-IICB, CSIR-IGIB and CSIR-IITR scientists have come up with pharmaceutical compositions including a compound of formula I or formula II (substituted catechols, as given herein below), for the treatment of bronchial asthma. These conditions may be treated by inhibition of IL-4 and IL-5.

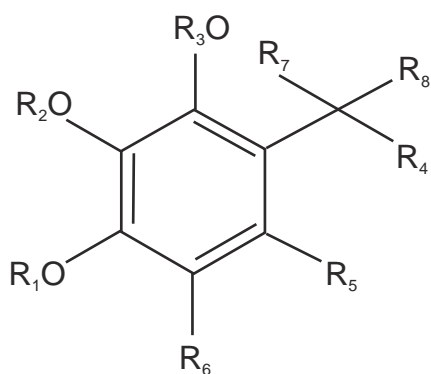


Fig: 1.12a Formula I

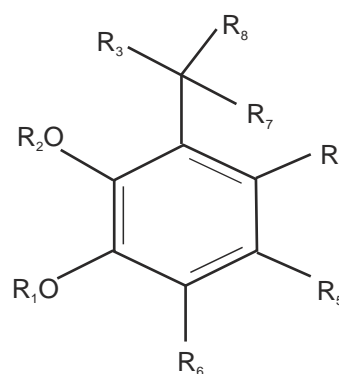


Fig: 1.12b Formula II

In this technology a method is provided for inhibition of IL-4 and IL-5 and for the treatment of bronchial asthma by administering an active compound of formula I or II or a composition containing such an active compound to a mammal in need thereof. The compounds of formula I or formula II are used in the manufacture of a medicament for the treatment of bronchial asthma. Development of therapeutics for the treatment of bronchial asthma has significant commercial importance in drugs and pharmaceutical sector. The present invention relates to inhibition of IL-4 and IL-5 by hydroxychavicol (purified from natural sources or prepared synthetically) and its analogues and shows anti-asthmatic efficacy in vivo in mouse model.

Improved Betelvine Production Technology

Betelvine (*Piper betle* L.) is a shade loving creeper, native of tropics and prevails best under humid conditions and mild temperature. In northern India, it is cultivated in closed structures, termed as 'Bareja, Bheet', constructed with the locally available materials like bamboo stems, jute sticks, paddy straw etc. Diffused light and humid conditions are conducive to pathogens viz. fungi and bacteria. These diseases sometimes lead to 100% damage to the crop and huge quantities of plant protection chemicals are used to save the crop. Mahoba district of Bundelkhand region of U.P. is known for excellent quality betel leaves, which are exported also. During recent years, the area and production of betel leaves have sharply declined as the cultivation is labour intensive, capital demanding and highly risky due to its sensitivity to vagaries of weather. To address these issues, CSIR-NBRI has initiated need based R&D and extension services for betelvine growers of U.P., considering it most important to educate the farmers intensively and advocate eco-friendly practices for pest and disease management. CSIR-NBRI has developed a "model barjeja", a modified shade net house, with raised, nutrient rich beds and fertigation system. This model is cost effective in terms of sustainability and production of betel leaves per unit area/year. This translational effort of CSIR-NBRI will benefit the farmers at large particularly poor betelvine growers and will play an important role in cultivation and conservation of betelvine.

Development of cosmaceutical products

Herbal colour for cosmetics: Lipophilic strawberry red colour has been isolated from the plant NBR-R1 and standardized along with safety studies for application in lip balm. This technology has been licensed to M/s Himalaya Drug Company, Bangalore.

- Natural Lip-Balm: CSIR-NBRI & CSIR-CIMAP jointly developed technology for natural lip balm. Herbal colour and natural ingredients used in lip balm protect the lips and leaves the lips hydrated and nourished by preventing moisture loss. Natural lip balm is non toxic. Technology transferred has been to M/s Chiara Herbals Pvt. Ltd., New Delhi.



Fig: 1.13a Strawberry red herbal colour for lip balm



Fig: 1.13b Natural Lip balm



Fig: 1.13c Lipophilic Yellow colour for cosmaceuticals

- Technology developed for yellow colour: Lipophilic yellow colour was also isolated from the plant NBR-Y for its application in lip butter/balm. Mango flavoured, vitamin-E enriched yellow lip balm developed jointly with CSIR-CIMAP. It keeps the lips healthy and colour is safe.

1.1.3 S&T Services Provided

DNA Profiling

CSIR-CCMB has continued to provide services to various Institutes / Universities for sequencing and genotyping. CSIR-CCMB also extends its service to the public for various purposes such as: organ transplantation, immigration, paternity / maternity testing, identifying victims of natural disasters and in wildlife forensics.

DNA profiling service has been rendered to many families. Other than the public, the DNA profiling reports also benefit the following organizations: Nizam's Institute of Medical Sciences, Apollo Hospitals, and AP Forensic Science Laboratory.

Laboratory for the Conservation of Endangered Species (LaCONES)

Novel universal technique to establish the identity of enormous number of animal species for forensic applications: This technology has led to establishment of first National Wildlife Forensic Cell in LaCONES of CSIR-CCMB to provide the wildlife forensic services to nation. LaCONES has continued to provide services pertaining to wildlife crime and solved a number of cases.

Diagnostic Services

CSIR-CCMB has provided services to various clinics/patients all over the country. During 2012-13, the CSIR-CCMB provided diagnostic services for the diseases like, Duchenne Muscular Dystrophy, Autosomal Dominant Cerebral Ataxia, Spinal Muscular Atrophy, Hemophilia, Fragile X Syndrome, Myotonic Dystrophy, Cystic Fibrosis, Thalassemia and others. CSIR-CCMB is also doing genetic analysis for such disorders which include haemoglobinopathies, musculopathies, bleeding and clotting disorders and neurodegenerative diseases. Using various techniques of molecular biology, genetic analysis has been performed to a number of families.

Also CSIR-CCMB has provided an efficient chromosome analysis for a gamut of reproductive disorders and other genetic disorders. A number of cases were taken up for chromosomal diagnostics and problems were detected.

CSIR-CCMB animal house facility catered to different strains of mice, rats, guinea, pigs, hamsters and rabbits to the scientific community of different research organizations.

1.2 CHEMICAL SCIENCES CLUSTER

1.2.1 Scientific Excellence

Electrochemical Resolution of Multiple Redox Events for Graphene Quantum Dots (GQDs)

Metallic and semiconducting nanoclusters stabilized by a variety of organic monolayers, such as thiols, amines, and carboxylic acids, have received considerable attention in the past decade because of their size- and shape-dependent electronic, chemical, and electrochemical properties, especially because of the ease with which they show discrete single-electron transfer behaviour. This intriguing behaviour is specially seen as a staircase in the current–voltage behavior even at room temperature, when prepared below a critical threshold size (about 1–3 nm), having a narrow size distribution. CSIR-CECRI has prepared green luminescent, GQDs with a uniform size of 3, 5, and 8. (± 0.3) nm in diameter through an electrochemical method from Multiwalled Carbon Nanotubes (MWCNT) using propylene carbonate and LiClO_4 at 90°C , at 30°C display this remarkable behavior below a critical threshold size.

Graphene Quantum Dots (GQDs) of tunable sizes of 2.2 ± 0.3 , 2.6 ± 0.2 , and 3 ± 0.3 nm can act as multivalent redox species presenting exciting opportunities for a variety of applications including single-electron transistors, molecular switches, and resonant tunneling diodes. This could also be important for biomimetic applications like artificial muscles, batteries, smart membranes, and smart drug-delivery devices. The research findings have been published in International journal 'Angewandte Chemie-International Edition'.

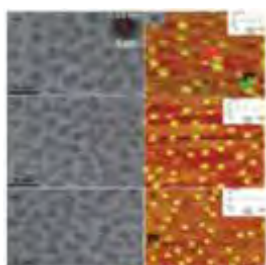


Fig: 1.14a Typical TEM images of dodecyl-amine-capped GQDs

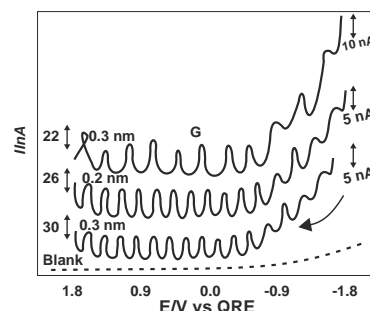


Fig: 1.14b Differential pulse voltammetric responses of GQDs in 0.5mmTBAHFP as supporting electrolyte in CH_2Cl_2 for particle sizes of 3 ± 0.3 , 2.6 ± 0.2 , and 2.2 ± 0.3 nm on a Pt ultra-microelectrode ($20\mu\text{m}$) at a typical scan rate of 25mV s^{-1} at 273K

High quality NMP exfoliated graphene nanosheet- SnO_2 composite anode material for lithium ion battery

CSIR-CECRI has prepared a graphene nanosheet- SnO_2 (GNS- SnO_2) composite using N-methylpyrrolidone (NMP) as a solvent to exfoliate graphene from graphite bar with the aid of Cetyl Trimethyl Ammonium Bromide (CTAB) by single phase co-precipitation method. NMP exfoliated GNS is made composite with GNS- SnO_2 and well characterised physically and electrochemically. The 'd' value obtained is in the range of 5.54 \AA and 2.37 \AA for the 002 plane of GNS and the formation of tetragonal SnO_2 in the composite is also confirmed by X-ray Diffraction (XRD). The Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) images give information about the sandwich type morphology of the GNS- SnO_2 . The capacity retentions at the end of the first 10 cycles is 57% (100 mA g^{-1} rate), the second 10 cycles is 77.83% (200 mA g^{-1}), and the final 10 cycles (300 mA g^{-1}) is 81.5%. Moreover the impedance analysis clearly explains the low resistance pathway for Li^+ insertion after 30 cycles when compared with the initial cycle. This superior characteristic of GNS- SnO_2 composite suggests that it is a promising candidate for lithium ion battery anode.

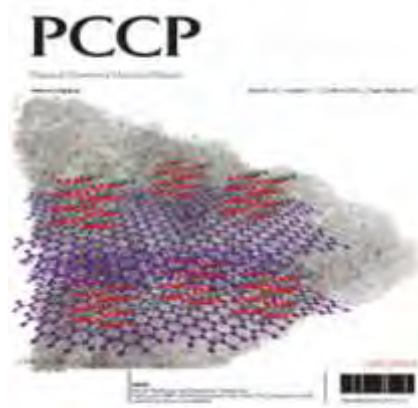


Fig: 1.15 The cover page of PCCP highlighting research work

The GNS–SnO₂ composite delivers a capacity of 1060 mA g⁻¹ and retains 57% of initial capacity after 10 cycles at a current density of 100 mA g⁻¹. Even at a high current density of 300 mA g⁻¹, the composite retains 81% of initial capacity (305.8 mA g⁻¹). This excellent performance is due to the sandwich morphology in between GNS layers which act as a building block and sustains volume expansion of SnO₂ during cycling, which assists for a better cycling performance. The research findings have been appeared on the cover page of an International journal 'Physical Chemistry Chemical Physics'.

Li-S batteries: simple approaches for superior performance

Although promising improvements have been made in the field of Li-S rechargeable batteries, they are still far from reaching the market place due to several drawbacks. To combat the solubility of polysulphides, confinement approaches aiming to trap sulphur within the cathode side have been pursued, but success has been limited. CSIR-CECRI drastically deviates from this approach and used a liquid cathode obtained either by dissolving polysulphides within the electrolyte or by placing sulphur powders in contact with the Li negative electrode. Such approaches are shown to result in greater performance than confinement approaches. Such a strategy eliminates the detrimental Li₂S formation inside a porous carbon matrix and moreover leads to the formation of a protective SEI layer at the Li electrode, as deduced by impedance spectroscopy and XPS, which seems beneficial to the cycling performance.

Targeting the origin of the rapid capacity decay in Li-S batteries is a must if one wants this system to become a reality for load leveling and transport. To address this issue two different approaches have been reported enlisting the use of either polysulphides as active materials or S deposited on Li, both aiming to eliminate the detrimental formation of Li₂S at the porous carbon matrix. Besides leading to performance improvements in terms of capacity retention, these approaches have also led to better insights regarding the impact of sulfur deposited on the Li surface. This SEI layer seems to combine attractive features, hence the crucial importance to understand both its nature and composition and to pursue more intensive chemical/physical analysis enlisting combined XPS-NMR surface analytical techniques. Although not fully understood, such a finding, which somewhat mimics what happens in Li-thionylchloride primary cells, holds some promises regarding the feasibility to build Li-S cells differently for sustainable performance. The research findings have been published in 'International Journal' Energy & Environmental Science.

Reversible anionic redox chemistry in high-capacity layered-oxide electrodes

Li-ion batteries have contributed enormously to the commercial success of portable electronics and may soon dominate the electric transportation market with possible major scientific advances including new materials and concepts. Classical positive electrodes for Li-ion technology operate mainly through an insertion–deinsertion redox process involving cationic species. However, this mechanism is insufficient to account for the high capacities exhibited by many new generation of Li-rich layered oxides that present unusual Li reactivity. In an attempt to overcome both the inherent composition and the structural complexity of this class of oxides, CSIR-CECRI has designed a structurally related Li₂Ru_{1-y}Sn_yO₃ material that exhibits sustainable reversible capacities as high as 230 mA h g⁻¹ along with good cycling behaviour with no signs of voltage decay.

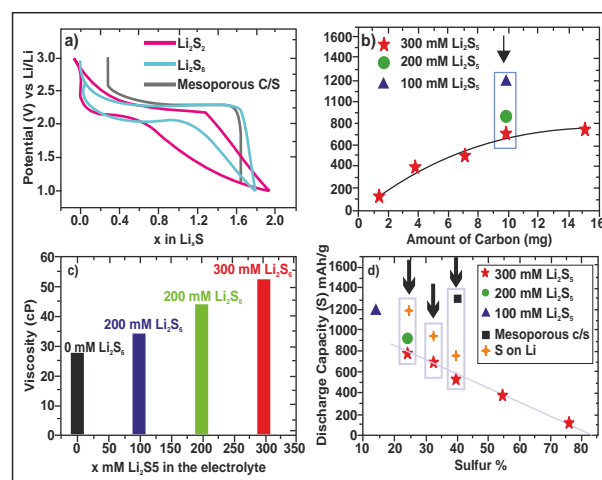


Fig: 1.16 (a) First discharge–charge profile of the chemically synthesized Li₂S₂ and Li₂S₈ as active materials and the mesoporous C–S composite. (b) the impact of the carbon amounts on the first discharge capacity, (c) the viscosity of the electrolyte/catholytes at different concentrations, (d) the impact of the sulphur content on the first discharge capacity

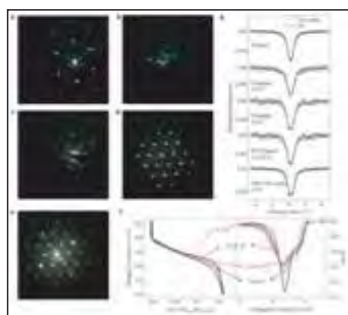


Fig: 1.17a Microscopy and Mössbauer measurements for spotting the evolution of $\text{Li}_2\text{Ru}_{1-x}\text{Sn}_x\text{O}_3$ electrodes on cycling

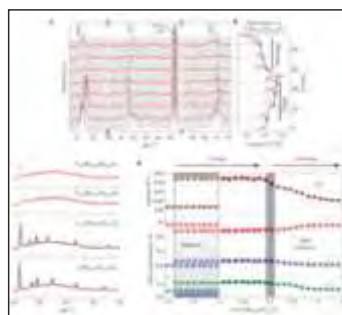


Fig: 1.17b Li-driven structural behaviour on cycling

In addition to unravelling the fundamental mechanisms of these high-capacity electrodes, the results are also important for practical applications despite the use of Ru for good cycle life and the elimination of the voltage decay on cycling make a significant impact on performance. It also provides a final answer to the long debate about the need for composite as opposed to single phases in high-capacity electrodes, as one single phase is sufficient to make it. Many other superior compounds can be made, including sodium-based ones, thereby opening a wide window within the periodic table from which it will be relevant to find the best combination having the proper elements in terms of sustainability. The research findings has been published in Nature Materials which has Impact factor of 35.705.

Lithium Economy

CSIR-CECRI has made a review on Lithium Economy. The dramatic explosion of the portable electronics market owes much to the ubiquitous batteries that power them. However, the days of the conventional battery systems seem numbered. The performance levels of conventional batteries are often found wanting for projected applications, be it in the burgeoning electronics industry or in the transportation sector. A shift in gears from the internal combustion engine vehicles (ICEVs) to electrically operated vehicles is in the cards. Much of the groundwork for this transformation is in the way that came through the U.S. government's Hybrid and Electric Vehicle Act of 1976. However, there is a lingering fear that battery technology has not lived up to the demands of the electric vehicle. An immediate choice, therefore, seems to be the plug-in hybrid electric vehicle (PHEV).

Ramifications of peak oil and the urgency to save the environment are driving a new course for transportation. The course being charted will give rise to a new energy order and is to be based on the economics and technologies of lithium, the gray gold. Although the metal is not scarce, deposits of its minerals are concentrated in politically turbulent regions such as Afghanistan and Bolivia. While countries such as Bolivia are trying to cash in on this bounty without interference from the developed world, they lack the technical expertise to exploit the resources. However, all of the heated projections on electric/hybrid electric vehicle production have cooled due to economic recession and high vehicle prices. While switching our addiction from the soon-to-be-drained out oil to lithium is projected to make way for technologies with low carbon footprints and, therefore, a cleaner environment, large-scale mining and exploitation of lithium is not without environmental fallouts. The grass always looks greener on the other side, but alternative technologies should be carefully examined for their long-term sustainability. The research findings have been published in an International Journal 'Journal of Physical Chemistry Letters'.



Fig: 1.18 A PHEV could be powered with batteries that can be charged conveniently by using electricity from the grid or a fuel such as gasoline, ethanol, and hydrogen or both

Giant Magnetoresistance in Electrodeposited Films

Electrodeposition of some alloys and multilayer exhibits the giant magneto resistance (GMR) effect with a great potential for technological applications, such as magneto resistive sensors and magnetic recording devices. GMR effect is more usually seen in multilayer and alloys structure, when two magnetic layers are closely separated by a thin non-magnetic spacer layer. CSIR-CECRI has studied effect of electrodeposition of alloys and multilayer for GMR applications. The effect of thickness of magnetic, non-magnetic layers, number of bilayers, electrolyte pH, electrolyte temperature, additives and annealing process on GMR properties has been analyzed. The impact of this work is obvious from the predictive ability since this is based on an overview on the current status of electrodeposited multilayer films exhibiting GMR. Although nearly 160 reports have been published on electrodeposition GMR multilayer films this is the first attempt to critically evaluate each multilayer system accessible for preparation by electrodeposition.

Agarose processing in protic and mixed protic-aprotic ionic liquids: Dissolution, regeneration and high conductivity, high strength ionogels

CSIR-CSMCRI has shown that low viscosity alkyl or hydroxyalkyl ammonium formate ionic liquids (ILs) can dissolve agarose, and higher dissolution can be achieved in the mixed, alkyl or hydroxyalkyl ammonium + imidazolium or pyridinium ILs. The polarity parameters: ϵ , μ , p^* , ET(30) and ETN of these IL systems were measured to explain their dissolution ability for agarose. Dissolved agarose was either regenerated using methanol as a precipitating solvent or ionogels were formed by cooling the agarose-ILs solutions to ambient temperature. Exceptionally high strength ionogels were obtained from the agarose solutions in the N-(2-hydroxy ethyl) ammonium formate or its mixture with 1-butyl-3-methylimidazolium chloride. Regenerated material and ionogels are characterized for their possible degradation/conformational changes and gel properties (thermal hysteresis, strength, viscoelasticity and conductivity) respectively. A high strength, high conducting ionogel was demonstrated to be able to build an electrochromic window. Such ionogels can also be utilized for other soft matter electronic devices and biomedical applications.

A rapid and green synthetic approach for hierarchically assembled porous ZnO nanoflakes with enhanced catalytic activity

Three dimensionally (3D) assembled hierarchical porous ZnO structures are of key importance for their applications in sensors, lithium-ion batteries, solar cells and in catalysis. CSIR-CSMCRI has reported a controlled synthesis of 3D hierarchically porous ZnO architectures constructed of two dimensional (2D) nano-sheets through the calcination of a hydrozincite $[Zn_5(CO_3)_2(OH)_6]$ intermediate. The intermediate 3D hierarchical hydrozincite has been synthesized by a novel organic surfactant and solvent free aqueous protocol at room temperature using an aqueous solution of ammonium carbonate and laboratory grade bulk ZnO in a short time (20–30 min). The amount of carbonate and the reaction temperature play a crucial role in the formation of the 3D hierarchical morphology and on the basis of the experimental results a probable reaction mechanism is proposed. On calcination, the synthesized 3D hierarchical hydrozincite resulted in ZnO with an almost identical morphology to the parental hydrozincite. On decomposition a porous structure having a surface area of $44 \text{ m}^2\text{g}^{-1}$ is obtained. The synthesized hierarchical ZnO morphology exhibits an improved catalytic activity for the synthesis of 5-substituted-1H-tetrazoles with different nitriles and sodium azide than that of nanocrystalline ZnO and bulk ZnO, as well as other developed solid catalysts. The catalyst is easily recyclable without a significant loss in catalytic activity.

Is dual morphology of rock-salt crystals possible with a single additive? The answer is yes, with barbituric acid

CSIR-CSMCRI has reported that barbituric acid is a new habit modifier for rock-salt crystals. It has also been demonstrated for the first time that a single additive can give dual morphology of rock-salt crystals. The computational studies predicted that the barbituric acid can yield rhombic dodecahedron crystals at lower

pH values and that with increasing pH value octahedron crystals are preferred, which has been corroborated by the experimental studies. Barbituric acid is one of the rare additives to induce the rhombic dodecahedron morphology of NaCl crystals.

The SbASR-1 gene cloned from an extreme halophyte *Salicornia brachiata* enhances salt tolerance in transgenic tobacco

Salinity severely affects plant growth and development. Plants evolved various mechanisms to cope up stress both at molecular and cellular levels. Halophytes have developed better mechanism to alleviate the salt stress than glycophytes, and therefore, it is advantageous to study the role of different genes from halophytes. *Salicornia brachiata* is an extreme halophyte, which grows luxuriantly in the salty marshes in the coastal areas. CSIR-CSMCRI has isolated SbASR-1 (abscisic acid stress ripening-1) gene from *S. brachiata* using cDNA subtractive hybridisation library. ASR-1 genes are abscisic acid (ABA) responsive, whose expression level increases under abiotic stresses, injury, during fruit ripening and in pollen grains. The SbASR-1 transcript showed upregulation under salt stress conditions. The SbASR-1 protein contains 202 amino acids of 21.01-kDa molecular mass and has 79 amino acid long signatures of ABA/WDS gene family. It has a maximum identity (73 %) with *Solanum chilense* ASR-1 protein. The SbASR-1 has a large number of disorder-promoting amino acids, which make it an intrinsically disordered protein. The SbASR-1 gene was over-expressed under CaMV 35S promoter in tobacco plant to study its physiological functions under salt stress. TO transgenic tobacco seeds showed better germination and seedling growth as compared to wild type (Wt) in a salt stress condition. In the leaf tissues of transgenic lines, Na⁺ and proline contents were significantly lower, as compared to Wt plant, under salt treatment, suggesting that transgenic plants are better adapted to salt stress.

Optical resolution of racemic lysine monohydrochloride by novel enantio-selective thin film composite membrane

CSIR-CSMCRI has prepared thin film composite membrane having chiral selective layer by the interfacial polymerization of trans-1,4-diaminocyclohexane, piperazine and trimesoyl chloride. The composition of chiral selective layer of composite membrane was elucidated by Fourier Transfer Infrared Spectroscopy (FTIS) in attenuated total reflectance (FTIR-ATR) mode. Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM) and Transmission Electron Microscopy (TEM) demonstrate the evolutionary transition of membrane surface morphology before and after the modification of membrane. This chiral separation method has been verified using the chiral separation results of racemic amino acid. The effect of membranes pore size on enantio-selectivity has also been investigated. The functional performance of membranes was determined by measuring volumetric flux, solute flux, rejection of solute and enantiomeric enrichment in cross flow closed loop mode of reverse osmosis process at 689.42 kPa pressure using aqueous solutions of racemic lysine monohydrochloride. The membranes permeated L-enantiomer preferentially resulting >78% enantiomeric excess of L-enantiomer in the permeated solution with good separation factor ($\alpha = 8$).

Transesterification of edible, non-edible and used cooking oils for biodiesel production using calcined layered double hydroxides as reusable base catalysts

CSIR-CSMCRI has produced fatty acid methyl esters (FAME) from edible, non-edible and used cooking oils with different fatty acid contents by transesterification with methanol using calcined layered double hydroxides (LDHs) as solid base catalysts. Among the catalysts, calcined CaAl₂-LDH (hydrocalumite) showed the highest activity with >90% yield of FAME using low methanol:oil molar ratio (<6:1) at 65 °C in 5 h. The activity of the catalyst was attributed to its high basicity as supported by Hammett studies and CO₂-TPD measurements. The catalyst was successfully reused in up to four cycles. Some of the properties such as density, viscosity, neutralization number and glycerol content of the obtained biodiesel matched well with the standard DIN values. It is concluded that a scalable heterogeneously catalyzed process for production of biodiesel in high yields from a wide variety of triglyceride oils including used oils is possible using optimized conditions.

Improved yield and quality by application of fertilizer sap from 2 seaweeds viz. *Kappaphycus alvarezii* and *Gracilaria edulis*

CSIR-CSMCRI is executing a multi-institutional project involving more than 43 Agricultural Institutes, Universities and its centres across 20 different states in India for experimental trials using seaweed sap derived from two macroalgae (*Kappaphycus alvarezii* and *Gracilaria edulis*) on 9 crops and also to understand the reasons behind beneficial effect of sap on different crops by studying different components of sap. The beneficial results of the sap on different agricultural crops have been validated through extensive testing by Agricultural Universities and Institutes in their farms and farmer's field. The key findings from 100 completed trials so far (on crops like rice, maize, blackgram, greengram, soybean, sesame and potato) reveal that in most of the cases average yield increases in excess of 20%. Similar increases have also been found using *Gracilaria* sap.

Collagen Composites for Tissue Engineering

Collagen is usually combined with other biopolymers to enhance its physico-chemical properties for tissue engineering applications. CSIR-CLRI has investigated guar gum, a non-ionic plant derived polysaccharide was mixed with collagen and the effect of the same on dielectric behaviour and pore size distribution of the composites. Circular dichroic studies show that guar gum does not bring any alteration in the conformation of the native protein. Thermoporometry result shows that by varying the concentration of guar gum, the pore size distribution of the biocomposite can be controlled. The thermal stability of biocomposite system increases as the concentration of guar gum increases and reaches a maximum of $40 \pm 0.5^\circ\text{C}$.

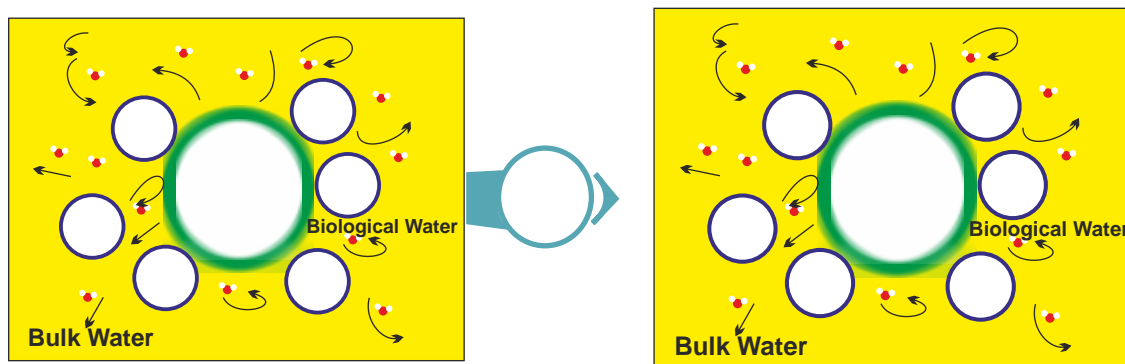


Fig: 1.19 Effect of Gaur Gum on the hydration dynamics of collagen

Polyurethane/Siloxane Cross-linked Films for Hydrophobic Surface (Leather) Coating Applications

Novel castor oil based polyurethane (PU)/siloxane cross-linked films were prepared by CSIR-CLRI using castor oil, isophorone diisocyanate and 3-aminopropyltrimethoxysilane by sol-gel process. FTIR spectra reveal the cross-linking interaction between PU and siloxane moieties. Si solid state NMR analyzing the Si environment presents in the PU/siloxane cross-linked films. It is observed that increasing siloxane cross-linking increased the hydrophobicity of the films. The optical transmittance obtained from UV-vis spectra indicated that the film samples are transparent in the region of 300-800 nm. Moisture isotherm curve shows a characteristic behavior of Type III isotherm corresponds to hydrophobic materials. The increase in E' reveals siloxane cross-linking gives rigidity to the films. AFM images show that the introduction of

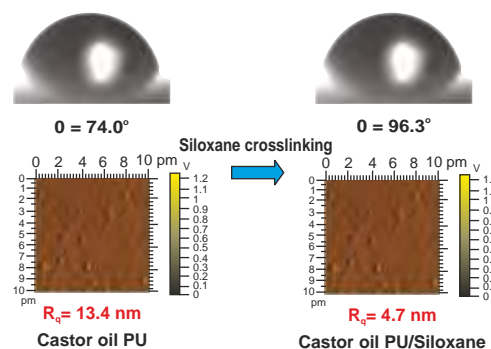


Fig: 1.20 Surface morphologies of castor oil PU and castor oil PU/Siloxane.

siloxane changes the surface roughness of the PU films. It is found that the siloxane cross-linking used to obtain hydrophobic surface films having good thermal stability and optical transmittance. These kinds of PU films may find potential application in the development of leather, lens coatings and optical fibre, etc.

Production of microbial enzyme cocktail from single organism for industrial applications

The enzyme consortia developed by CSIR-CLRI containing three potential enzymes, viz., protease, lipase and amylase was produced by *A. tamarii* MTCC 5152 through SSF (Solid state fermentation). The protease has been studied for its efficacy in removal of hair of hides/skins. Further, these enzymes demonstrated the fiber opening property, which is the most important property required to have more stabilized leather. Upon exploiting the cocktail enzyme in leather manufacturing processes exemplified that compared to the conventional process of dehairing (use of lime and sodium sulfide) use of enzyme offered a high quality leather with reduced pollutants in wastewater released. Furthermore, the cocktail enzyme establishes its potential for hide processing, which solves most of the problem associated with the transforming hides to leather.

Pectinases of *A. tamarii* MTCC 5152 showed interesting observations. The enzyme pectinase degrade the substrate pectin and release galacturonic acid. The presence of the degraded product identified by Thin layer chromatography. When this pectinase tested on scouring of cotton fibres in comparison with conventional alkali method, demonstrate the smooth surface and use of pectinase completely remove the pollution load in the wastewater generated during the process.

Functionalization of proteins for wet tissue approximation

Wet tissue approximation is a challenging task to surgeons. CSIR-CLRI has developed an adhesive product by conjugating the major proteins gelatin and keratin by phenolic moieties and insitu oxidation imparts adhesive property to the final product namely EGK - glue, which mimic the adhesive produced by mussels. The following schematic diagram emphasize the conjugation.

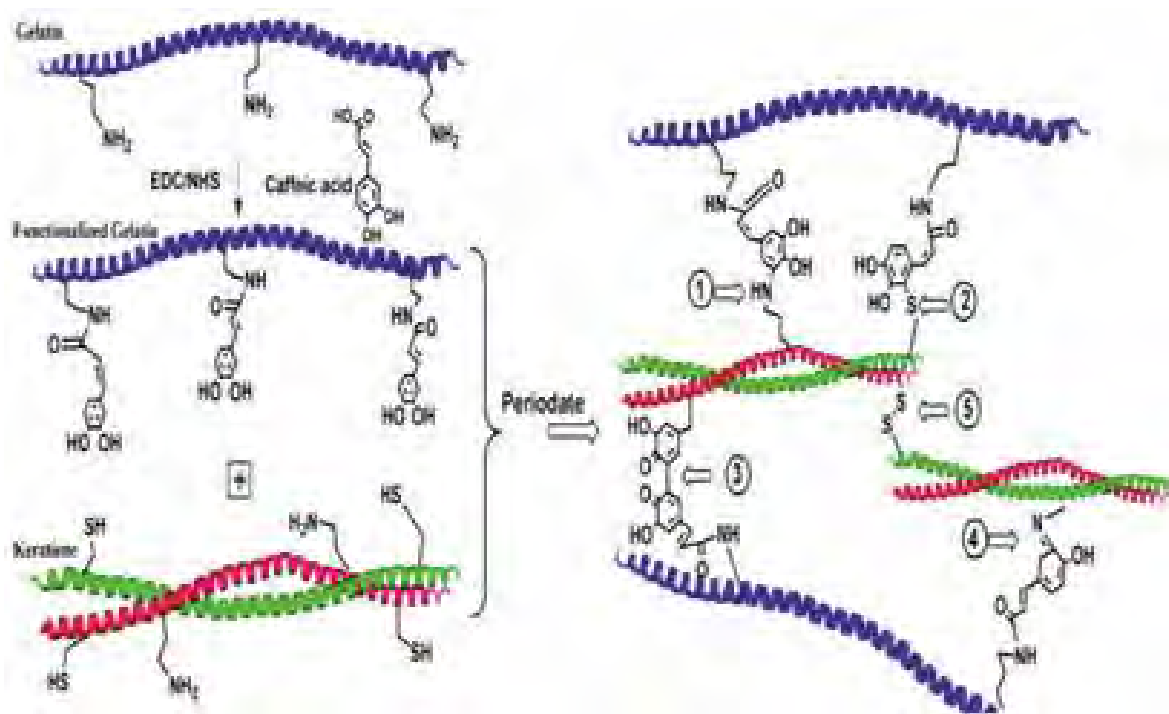


Fig: 1.21 Schematic of conjugation major proteins gelatin and keratin

An incisional wound healing efficacy of the adhesive product was studied in comparison with cyanoacrylate and fibrin glue. The following figure depicts the incisional wound healing pattern and the tensile strength of the skin after healing.

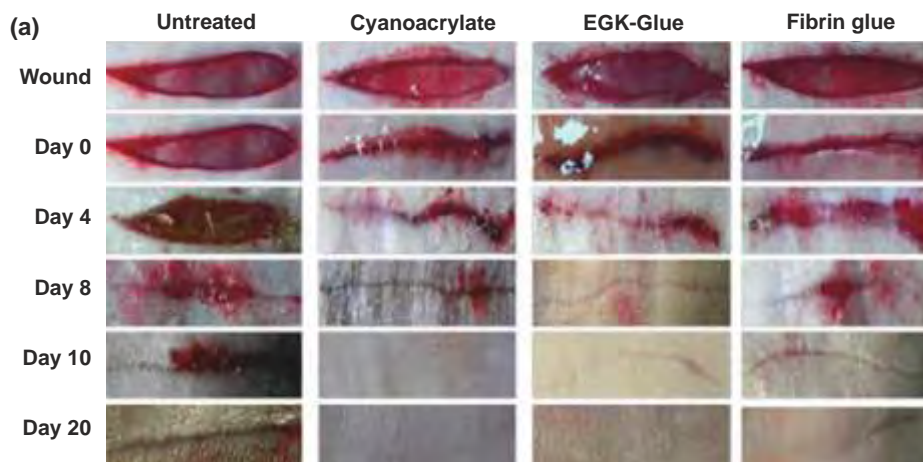


Fig: 1.22 Incisional wound healing efficacy of EGK-Glue in comparison with Cyanoacrylate and Fibrin Glue

Biosynthesis of metal oxide nanoparticles from effluents using probiotic microorganisms

The synthesis of Titanium dioxide nanoparticle (TiO_2 NP) has gained importance in the recent years owing to its wide range of potential biological applications. CSIR-CLRI has demonstrated the synthesis of TiO_2 NPs by a metal resistant bacterium isolated from the coal fly ash effluent. This bacterial strain was identified on the basis of morphology and 16s rDNA gene sequence [KC545833]. The physico-chemical characterization of the synthesized nanoparticles is completely elucidated by Energy Dispersive X-ray analysis (EDAX), Fourier transform infrared spectroscopy (FTIR) and Transmission and Scanning electron microscopy (TEM, SEM). The crystalline nature of the nanoparticles was confirmed by XRD pattern. Further, cell viability and haemolytic assays confirmed the biocompatible and non toxic nature of the NPs. The TiO_2 NPs was found to enhance the collagen stabilization and thereby enabling the preparation of collagen based biological wound dressing. The study essentially provides scope for an easy bioprocess for the synthesis of TiO_2 NPs from the metal oxide enriched effluent sample for future biological applications.

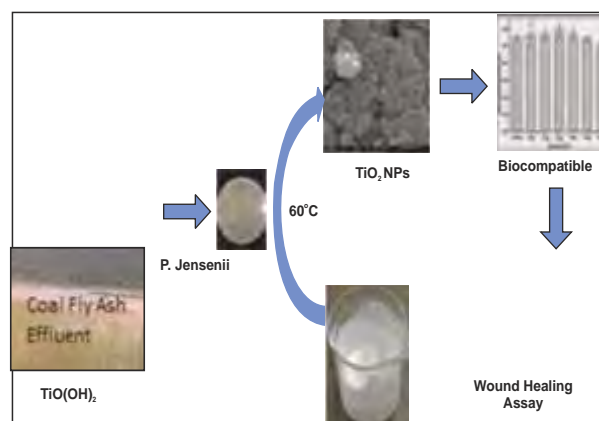


Fig: 1.23 Schematic representation depicting the role of probiotics from industrial effluent in biomedical applications

New Range of Chemicals for Smart Leathers

Making leather perform the functions it did as a skin on a live animal renders it as smart leather. CSIR-CLRI has made an attempt to incorporate thermo responsive function into leathers using smart materials such as phase changing materials (PCM). PCMs are capable of absorbing or releasing large amount of heat during phase transitions between two solid states and/or liquid and solid states.

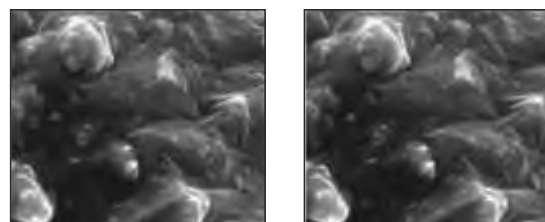


Fig: 1.24 SE micrographs of PCM incorporated retanning agent a) MF-SM; b) NSA-SM

Manufacture of syntans using PCM based on two different prepolymers viz, melamine formaldehyde and naphthalene sulfonic acid has been made by CSIR-CLRI. The retanning agents synthesized have been characterized and the leathers made using PCM incorporated agents exhibited the required properties.

Melamine based formaldehyde free syntan developed and the physico-chemical analysis, morphological studies and emission loads of the formaldehyde-free melamine syntan have been compared with conventional melamine formaldehyde syntan.

Up-grading of Low Quality Leathers

An attempt to improve the grade of the leathers by suitably modifying the post tanning operations without affecting the natural feel of the leathers. One of the major defects, thin substance, has been selected for up-grading. The post tanning auxiliaries have been selected so as to enhance the substance of the leather. Different types of leathers (upper, glove and lining) were made by CSIR-CLRI from thin substance raw material. The final leathers could be upgraded at least by 1 to 2 grades higher with improved physical and organoleptic properties.

Bacterial Strains for Cr(III) Removal

Bacterial strains belonging to the genus *Bacillus*, isolated from Cr- polluted soil (tannery sludge) by CSIR-CLRI were employed as consortium for Cr(III) removal from tannery effluents. Kaolin clay, a natural adsorbent, was used as supporting material for bacterial biofilm formation. The use of clay-supported bacterial biofilm on a commercial tannery effluent containing 1000 ppm of Chromium(III) was brought down to 2 ppm in 4 stages. The bacterial isolates were found to be *Bacillus subtilis* VITSCCr01 and *Bacillus cereus* VITSCCr02 by 16s rRNA gene sequencing.

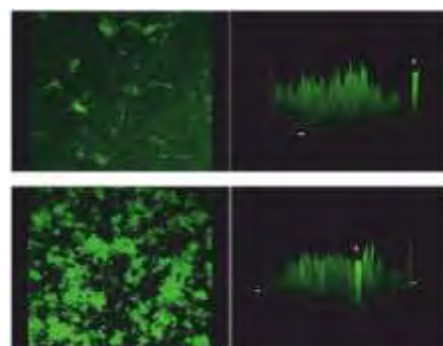


Fig: 1.25 Confocal images of bacterial isolates:
a) without kaolin
b) with kaolin in the presence of chromium

Cloisite-g-Methacrylic Acid Copolymer Nanocomposites by Graft from Method for Leather Processing

A series of novel facile water dispersible cloisite-g-methacrylic acid copolymers were prepared by graft from method by CSIR-CLRI. These graft copolymers were applied on goat skin before and after neutralization processes to produce lightweight, soft, grain tight, and water vapour permeable leather. All the graft copolymers and polymethacrylic acid (PMA) were thoroughly characterized by spectroscopic methods and thermal property changes. The intercalated cloisite-g-methacrylic acid copolymer nanocomposites exhibit a decreasing trend in viscosities with increase in the weight percentage of cloisite. The cloisite-g-methacrylic acid (C-g-MA) copolymers exhibit better thermal stability. All the nanocomposites showed a shear-thickening flow behavior. The stress- strain measurements of leather treated with nanocomposite samples reveal an increase in modulus property with the increase in cloisite content. The low weight percentage graft copolymers nanocomposite treated leathers are lightweight, have better smoothness, and show uniformity in feel, fullness, and load at grain crack.

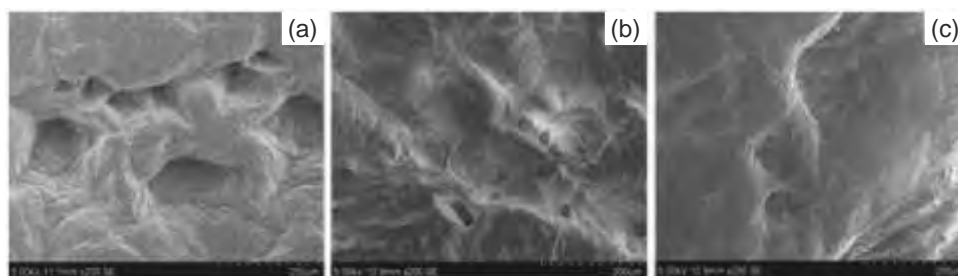


Fig: 1.26 SEM photomicrograph of (a) control sample (AN: after neutralisation), (b) PMA (AN), and (c) PMA+0.5% cloisite 10A (AN)

Design of smart leather: the thermo-responsive Behaviour

CSIR-CLRI has reported the non-covalent immobilization of pH and temperature responsive poly(N-isopropylacrylamide)-co-methacrylic acid to a protein collagen (type I) and leather surface. The polymer has N-isopropylacrylamide (NIPAM) functionality that is responsible for thermoresponsive characteristics and carboxylic acid/carboxylate functionality which facilitates the pH-responsive behaviour. The clouding behaviour of the polymer in water from 15 to 40 °C by changing the pH from 4.5 to 5.7. The binding of polymer with native collagen protein (type I) or leather is facilitated by carboxylate groups that form coordination complexes with chromium (III). The polymer was successfully used in retanning and coating of leather. The polymer coated leather as well as the polymer grafted collagen clearly shows thermo-responsive characteristics.

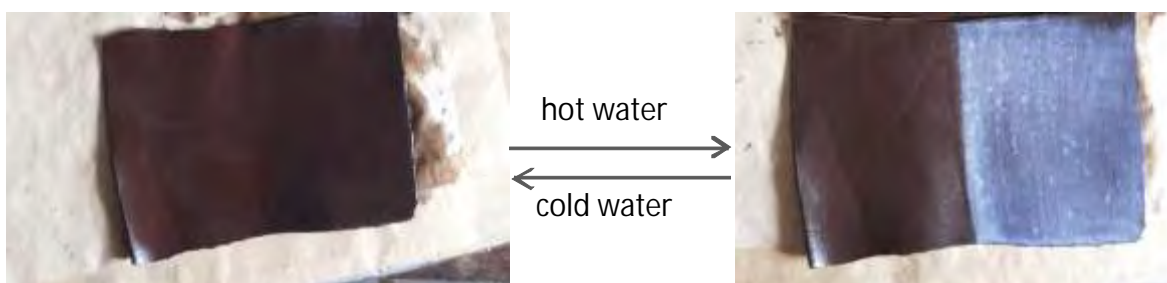


Fig: 1.27 Thermo responsive behaviour of the smart leather. Only right half of the leather was coated with thermo responsive polymer

Studies on the Development of Cleaner Leather Processing for Making Clean Products

In the area of cleaner leather processing, CSIR-CLRI has made an attempt to extract a crude bacterial protease from fish visceral wastes and to utilize the protease to dehair goatskins.

The bacterial species isolated has been identified by biochemical tests and microscopic examination as *Pseudomonas fluorescens*. It has been found that a combination of the extracted crude protease with a small amount of sodium sulfide allows for the complete dehairing of goatskins

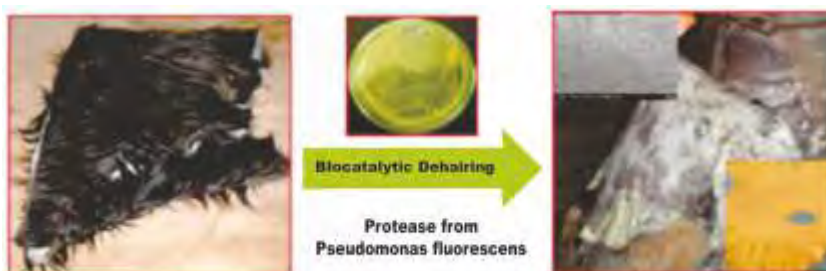


Fig: 1.28 Scheme Showing the Clean Dehairing Process

without the use of lime. In another study, Alkyl phenol ethoxylates (APEO) containing wetting agents and fatliquors have been chosen and treated with leather separately at various concentrations. The amount of APEO present in the treated leather was mapped based on their concentration of application. Results show that the APEO content in the leather increases with the increase in the concentration of fat liquor or wetting agent containing (APEO). An attempt has also been made to adopt some special treatment methods in post tanning process such as treating with formic acid at elevated temperature and use of specific enzymes to reduce APEO content in the final leather. Out of the different oxidizing enzymes employed, horseradish peroxidase treatment on APEO containing leathers resulted in 60% APEO removal.

Solid supported platinum(0) nanoparticles catalyzed green approach for n-arylhydroxylamine synthesis

CSIR-IHBT has developed Solid supported platinum(0) (SS-Pt) nanoparticles as a heterogeneous catalyst following a reduction-deposition method and characterized by SEM, TEM, EDX and XRD analysis. The SS-Pt catalyst was applied in the chemoselective reduction of nitroarenes to N-arylhydroxylamines using hydrazine

hydrate as a hydrogen source. A wide variety of reducible functional groups such as halides, carboxylic acids, esters, amides, nitriles, keto, alkenes, alkynes and N-benzyl were well tolerated under the reaction conditions. This process was further successfully employed in 10 g scale reactions. N-arylhydroxylamines were further applied for catalyst free synthesis of azoxybenzenes. Moreover, use of PEG-400 as cheap reaction medium, additive free methodology and the recyclability of SS-Pt catalyst up to ten times without significant loss of catalytic activity evidently follow the principles of green chemistry.

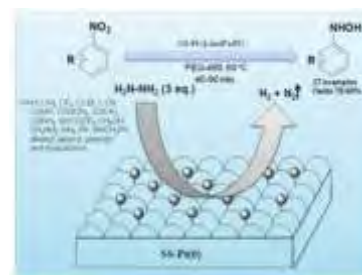


Fig: 1.29 Schematic of reduction-deposition method for Solid supported platinum(0)

Nanoparticle emissions and volatility of particles emitted by modern diesel and CNG transit buses

CSIR-IIP has tested two compressed natural gas (CNG) and two diesel transit buses on road to measure the particulate emissions and gas phase emissions under real world driving conditions. Both CNG buses as well as one diesel bus were tested in Calgary, Canada while the second diesel bus was tested in Dehradun, India. For the evaluated buses in Canada, the particle number concentration was measured using a condensation particle counter along with a dilution system in order to simulate the real world conditions. A thermodenuder was also employed to condition the sample to determine the non-volatile particles. The diesel bus evaluated in Canada was equipped with a diesel particulate filter (DPF) and an oxidation catalyst and the CNG buses were equipped with three-way catalyst. The particle size distribution and total number concentration were measured using a differential mobility spectrometer (DMS50) for the diesel bus without DPF which was equipped with an oxidation catalyst.

The results show that 72% and 7% of the particles from the diesel bus with the DPF are volatile particles in transient and steady state operating conditions, respectively. The CNG bus produces more volatile particles, and 84% of the particles were volatile in transient tests and 95% were volatile particles in the steady state tests. On average the CNG buses produce about 200 times less particles than the diesel bus without a DPF while they produce 35 times more particles than the diesel bus with a DPF.

Synthesis and catalytic applications of hierarchical mesoporous $\text{AlPO}_4/\text{ZnAlPO}_4$ for direct hydroxylation of benzene to phenol using hydrogen peroxide

CSIR-IIP has provided a simple and novel method for the synthesis of hierarchical mesoporous ZnAlPO_4 through a solvent-free, single organic template method. The material exhibited promising benzene conversion for the efficient production of phenol by the selective hydroxylation of benzene. Furthermore, the material shows its reusability with an excellent catalytic performance even after three reaction cycles. The subject opens up a new property of the metal AlPO_4 materials as suitable catalysts for selective oxidation reactions and has scope in the improvement of the catalytic activity through the optimization of the synthesis procedure of ZnAlPO_4 for expansion of its applications to other selective hydroxylation reactions and hence it is expected to find potential industrial applications.

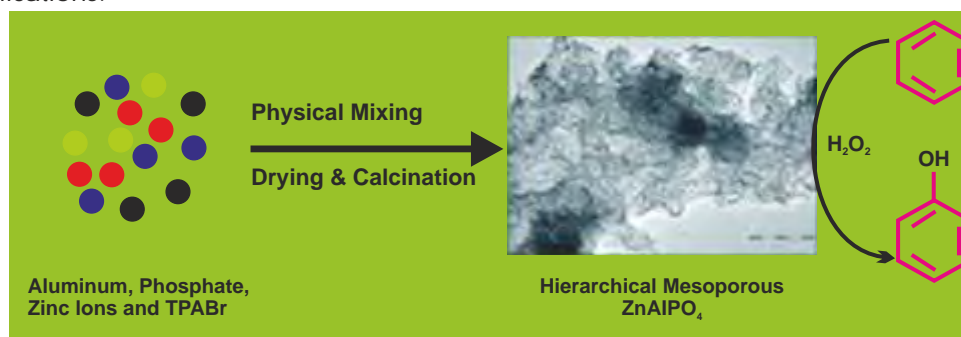


Fig: 1.30 Journal of Materials Chemistry cited this as Hot Article

Acid functionalized carbon-silica composite and its application for solketal production

CSIR-IIP has reported for the first time the synthesis of sulfonated carbon-silica-meso composite materials with tuneable acidity and porosity by adopting simple one step method of simultaneous carbonization and sulfonation. The simplicity involved in the material synthesis using low cost glucose as a carbon source as well as structure directing precursor makes the present method novel to those relevant works reported in the prior art. The materials exhibited excellent catalytic activity solketal production thus provides an efficient heterogeneous catalyst for the value addition of the undesired bi-product glycerol obtained in the biodiesel synthesis and hence it is expected to find potential industrial applications.

Synthesis of hierarchical ZSM-5 using glucose as templating precursor

CSIR-IIP has synthesized the hierarchical ZSM-5 zeolite samples by using the low-cost template precursor "glucose" in basic medium that can directly get converted to hard template during heat treatment of the gel to give glucose dependent porosity patterns in the samples. This method also provides scope in using other kinds of sugars as template precursors for the synthesis hierarchical materials. The synthesis method provides an economical path for the production of hierarchical aluminosilicates with tailored meso/macroporosity (controlled by glucose) for various industrial applications and could be extended for the synthesis of other types of zeolites and hence it is expected to find potential industrial applications.

Synthesis and catalytic applications of amine interacted $\text{Cu}_2(\text{OH})\text{PO}_4$ nano plates (copper NPs) and tubes (copper NTs)

CSIR-IIP has demonstrated a simple method for the selective synthesis of desired nano structure (Copper NTs/ Copper NPs) by controlling the concentration of structure directing amine, HDA, in the initial synthesis mixture. In other words, the present method provides a simple technique of variation of amine composition for the synthesis of a specific nano structure; Copper NTs at lower HAD concentrations and Copper NPs at higher HDA concentrations, which is a novel concept. The copper hydroxyl phosphate nanostructures were exploited for the first time in the present study for the direct oxidation of cyclohexane to adipic acid using hydrogen peroxide as an oxidizing agent. This theory may also be applicable for the synthesis of other metal/non-metal containing nano structures and hence it is expected to find potential industrial applications.

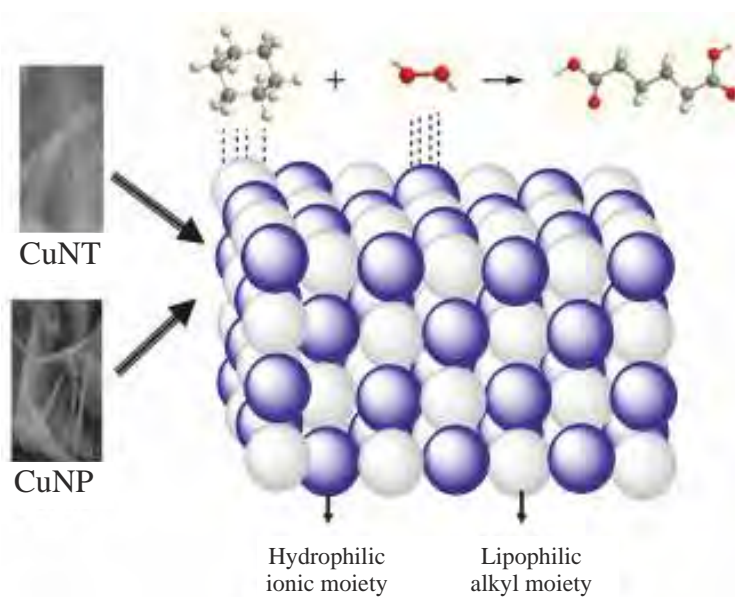


Fig:1.31 Schematic of Copper nanoparticles and nano tubes

Thermally assisted photonic inversion of supramolecular handedness

Symmetry breaking, leading to a specific handedness (either right or left) of biological structures is one of the most fascinating phenomena in nature. While several factors such as vortex motion, stirring, magnetic field and redox forces may be involved, natural light may have a key role in controlling the chirality and helical sense of biological helices. Light is undoubtedly a versatile external stimulus to control the chemical and physical properties of molecules, both natural and synthetic. CSIR-NIIST has demonstrated the role of light and heat on

helicity at a supramolecular level, with azobenzene linked phenyleneethynylene (PE) derivatives. It was found that the helicity of supramolecular assemblies associated with a specific chirality can be reversibly switched to the opposite helical sense through a chiral-center-controlled photoisomerization of the attached azobenzene moieties. The study strengthens the general perception that in combination with other forces, light may help to determine the parity violation in the symmetry of natural objects. Temperature-controlled photonic switching of macroscopic handedness of π -systems could be further used for the design of smart materials with switchable electronic properties, such as conductivity and charge carrier mobility. The research work has been highlighted on the cover page of the journal *Angew. Chem. Int. Ed.*



Fig:1.31 Cover page of the journal highlighting this research work of CSIR-NIIST

Photocleavable glycopolymer aggregates

CSIR-NIIST has synthesized a novel water soluble diblock glycopolymer, poly(spiropyran methacrylate) - block - poly (3-O-4-vinylbenzoyl - D-glucopyranose) (PSP-b-PBG), by the conventional atom transfer radical polymerization (ATRP) technique. Irradiation with UV light results in switching of the hydrophobic colourless spiropyran (SP) form to zwitterionic purple coloured merocyanine (MC) increasing the overall polarity of the glycopolymer, resulting in its enhanced affinity towards water. The MC form reverts back to the SP form in the dark or under visible light irradiation, restoring the amphiphilic nature of the polymer. Vesicular aggregates formed by this diblock copolymer in water could be dissociated and reconstructed by alternate UV and visible light irradiation. The ability of these polymersomes to efficiently encapsulate, release and re-encapsulate a hydrophobic dye was also explored.

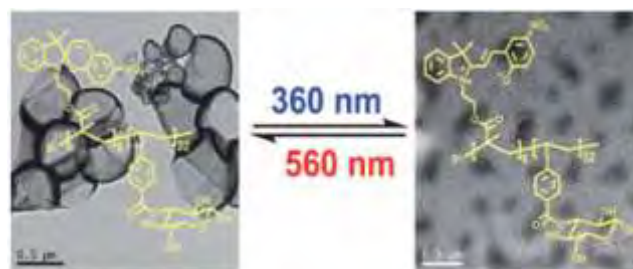


Fig: 1.32 Schematic of reaction

In vitro demonstration of apoptosis mediated photodynamic activity and NIR nucleus imaging through a novel porphyrin

Porphyrins have attracted much attention as sensitizers due to their higher cellular affinity and very low dark toxicity. CSIR-NIIST has synthesized novel water soluble neutral porphyrin derivatives and investigated their photophysical and in vitro photobiological properties. These systems exhibited high triplet excited state ($\tau = 0.66-0.94$) and singlet oxygen generation efficiency ($\phi_{\tau} = 0.590.92$). Investigation of the in vitro photodynamic activity indicated that these porphyrins exhibit high photocytotoxicity in cancer cell lines with negligible darktoxicity even at higher concentrations. Interestingly, the porphyrin derivative THPP showed about 2-3-fold higher in vitro photodynamic activity than the clinically used sensitizer Photofrin[®] under identical conditions. The mechanism of the biological activity of these systems was evaluated through DNA fragmentation, comet assay, PARP cleavage, CM-H2DCFDA assay, flow cytometric analysis, fluorescence and confocal microscopy, which confirmed the apoptotic cell death. Importantly, THPP showed rapid cellular uptake (< 10 min)



Fig: 1.33 Cover page of the journal highlighting this research work of CSIR-NIIST

and localized specifically in the nucleus of the cells. These derivatives can act as efficient sensitizers in photodynamic therapy and for nucleus imaging applications. The research work has been highlighted on the cover page of the journal 'ACS Chemical Biology'.

Brilliant yellow color and enhanced NIR reflectance of monoclinic BiVO_4 through distortion in VO_4^{3-} tetrahedra

CSIR-NIIST has been able to obtain bright yellow coloration and enhanced NIR reflectance of monoclinic bismuth vanadate by the substitution of Ta/P into the vanadium sites of BiVO_4 . Pentavalent metal ion substitution in bismuth vanadate blue shifted the absorption edge leading to bright yellow coloration and the color properties were comparable to that of commercially used praseodymium yellow. Lattice distortion and reduced crystallite size imposed by pentavalent metal ion substitution were responsible for the special optical properties. The synthesized pigments with improved yellow coloration exhibited good NIR reflectance making them potential candidates for cool colorants to reduce the heat build-up.

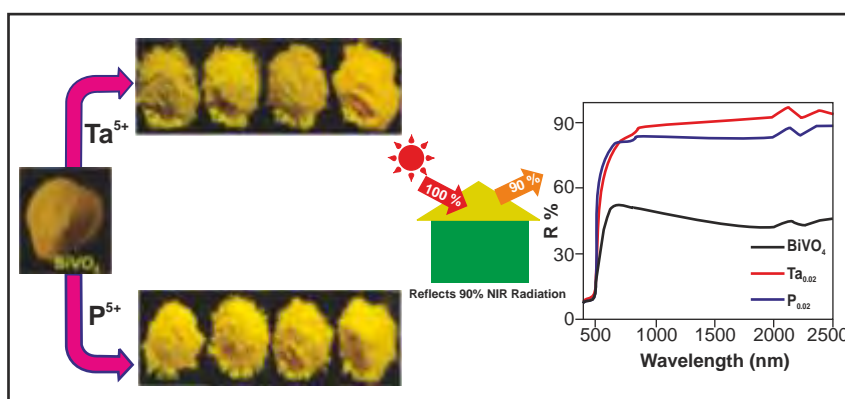


Fig: 1.34 NIR reflectance of (a) $\text{BiV}_{1-x}\text{Ta}_x\text{O}_4$ and (b) $\text{BiV}_{1-x}\text{P}_x\text{O}_4$. NIR reflectance is enhanced significantly from 46 % to 90 % for $\text{Ta}^{5+}/\text{P}^{5+}$ -substituted BiVO_4

Molecular cloning, expression, characterization and production of novel xylanases

CSIR-NIIST has isolated a novel *Streptomyces* strain producing cellulase-free xylanase from the soil samples collected from the mangrove forest of Kadalundi, Kerala, India. The culture produced cellulase-free xylanase, which was optimally active at pH 8.0 and temperature of 50°C . The enzyme was stable at high alkalinity (up to pH 12.0). The enzyme retained almost 85% activity up to 65°C . When the temperature was increased to 70°C , a decrease in activity was observed (65% of the activity retention). Partial gene amplification as well as partial purification of enzyme was carried out to characterize the enzyme (Figure 1.35a). Zymogram and protein staining of native PAGE gel showed four different isoforms of xylanase detected by congo red staining (Figure 1.35b).



Lane 1: The amplicon; Lane 2: 1Kb marker
Fig: 1.35a Partial gene amplification and purification

Lane 1 - 4: Partially purified protein
Fig: 1.35b Native gel zymogram showing isoforms of the xylanase

Oligo(p-phenylene-ethynylene)-derived super-p-gelators with tunable emission and self-assembled polymorphic structures

Linear π -conjugated oligomers are known to form organogels through noncovalent interactions. CSIR-NIIST has reported the effect of repeat units on the gelation and morphological properties of three different oligo(p-phenylene-ethynylene)s: OPE3, OPE5, and OPE7. All of these molecules form fluorescent gels in nonpolar solvents at low critical gel concentrations, thereby resulting in a blue gel for OPE3, a green gel for OPE5 and a greenish yellow gel for OPE7. The molecule–molecule and molecule–substrate interactions in these OPEs are strongly influenced by the conjugation length of the molecules. Silicon wafer suppresses substrate–molecule interactions whereas a mica surface facilitates such interactions. At lower concentrations, OPE3 formed vesicular assemblies and OPE5 gave entangled fibers, whereas OPE7 resulted in spiral assemblies on a mica surface. At higher concentrations, OPE3 and OPE5 resulted in super-bundles of fibers and flowerlike short-fiber agglomerates when different conditions were applied. The number of polymorphic structures increases on increasing the conjugation length, as seen in the case of OPE7, which resulted in a variety of exotic structures, the formation of which could be controlled by varying the substrate, concentration, and humidity.



Fig: 1.36 Cover page of the journal highlighting research work of CSIR-NIIST

Trigonal 1,3,4-oxadiazole-based blue emitting liquid crystals and gels.

CSIR-NIIST has synthesized star-shaped molecules consisting of a 1,3,4-oxadiazole core derivatized with alkoxy-substituted phenyl ethynylenes, FD12 (dodecyl) and FD16 (hexadecyl). These molecules exhibited enantiotropic columnar mesophases over a wide temperature range, with the liquid crystalline phases exhibiting strong blue fluorescence. On cooling, FD12 transformed into a transparent glass at room temperature and the liquid crystalline texture was retained. The glassy film remained stable over a period of one year and exhibited blue luminescence with an absolute quantum yield of 26%. The oxadiazole derivatives formed stable luminescent gels in decane and study of their morphology by scanning electron microscopy (SEM) and transmission electron microscopy (TEM) indicated formation of interlocked network of self-assembled fibers. X-ray diffraction (XRD) analysis of the xerogel of these derivatives indicated oblique columnar ordering of the molecules within the fibers. The length of the alkyl substituent was observed to have a significant effect on the absorption and fluorescence properties of the gels, which was attributable to the role of the alkyl substituents in controlling the nature of the molecular packing within the self-assembled fibers of the gels.

A photoresponsive fluorescent glycopolymer.

CSIR-NIIST has synthesized a new photoresponsive amphiphilic glycopolymer, poly (pyrenylmethyl methacrylate)-b-poly (3-O-4-vinylbenzoyl-D-glucopyranose) (PPy-b-PBG), via atom transfer radical polymerization (ATRP). The aggregation behaviour of PPy-b-PBG was investigated in dilute aqueous solutions by dynamic light scattering and fluorescence spectroscopy. Formation of spherical aggregates was observed in solutions under controlled conditions due to the amphiphilic nature of the polymer. The presence of strong pyrene excimer emission in aqueous solution indicated the aggregation of pyrene units. Irradiation of these glycosomes with UV light resulted in the photo-solvolysis of 1-pyrenylmethyl esters accompanied by the disruption of the polymer aggregates due to the hydrophilic nature of the residual polymer. The morphology of the polymer aggregates before and after UV irradiation was examined by AFM, SEM and TEM. Encapsulation of hydrophobic Nile Red molecules by the glycosomes resulted in successful fluorescence modulation and UV irradiation resulted in the controlled release of the entrapped dye into water.

1.2.2 Technology Developed

Condition survey and assessment of the different radial gate components for their suitability and structural integrity at Sardar Sarovar Dam Project, Gujarat

Sardar Sarovar Dam, shown in figure 1.38 is being constructed for a length of 1.21 km across the Narmada River, which is the fifth largest river in India.

The Sardar Sarovar Dam construction was commenced during 1977-78. Various grades of steel components amounting to thousands of tons were procured in phases for each stage of construction. The radial gate components, made of steel, weighing more than 15,000 tons were ordered during late 80s and were procured during early 90s. However, Dam construction came to a halt by the end of 80s due to protest from environmentalists.

Hence, even though more than 15,000 thousand tons of radial gate components were applied during early 90s, no further construction was possible. These components were being corroded during storage in the open atmosphere over the years. The exposure to atmosphere, rain and sun, damaged the coatings applied on their surface resulting in their corrosion. As these components are load-bearing members, their corrosion is a critical issue for their service and life.

The construction cost that was estimated to be about Rs. 6,406 crores during 1986-87 had escalated to Rs. 28,613 crores during 2000-01. The rise in cost of steel was also exorbitant during that period.

Subsequently, based on orders from the Supreme Court, further construction of the Dam was initiated during 2008-2010. By then considerable extent of corrosion had occurred on the radial gate components and the use of these components needed to be validated in order to save thousands of crores of Rupees that would be lost both due to re-purchase of these components and also due to ensuing delay in the construction of the Dam.



Fig: 1.37 Sardar Sarovar Dam across the river Namada



Fig: 1.38 Tie-flats of Sardar Sarovar Dam at storage site



Fig: 1.39 Trunnion for Sardar Sarovar Dam at storage site

Each component was assessed by a team of scientists from CSIR-CECRI, for its damage due to corrosion, dimensional details, structural stability etc. and based on the results, its usability was determined and recommended whether it can be utilized or not.

The major advantage is on economy in the fact that these components would cost more than thousand crores of rupees if they were to be again manufactured, which in turn would delay the further construction of the dam leading to another increase in cost of thousands of crores.

The analytical and assessment work executed by CSIR-CECRI has resulted in validating the re-use of more than 70% of the radial gate components that would lead to a huge economical savings as detailed above.

The use of these passed components has led to savings of more than thousand crore rupees. The time delay in raising the dam was also minimized, further reducing the costs due to delay (of the order of several thousand crores of rupees). Irrigation of about 1.9 million hectares is speeded-up. Water supply to the four states of Madhya Pradesh, Gujarat, Rajasthan and Maharashtra was more facilitated.

A Process of Treatment of Wastewater using Fluidised Immobilised Carbon Catalytic Oxidation Reactor (FICCO)

The process consists of mixing of the wastewater containing BOD, COD, Suspended Solids with bacteria immobilized activated carbon which acts as fluidized medium. The immobilized bacteria metabolises the organics present in the wastewater to safe end products without generation of sludge. The innovated design has the provision to destruct the organics released along with the unspent air into the atmosphere. The innovated design has the inbuilt settler unit for settling the sludge generated during the process of destruction of organics in wastewater. The innovated design employs hydroxyl radicals against molecular oxygen as in conventional biological treatment of wastewater. This technology has been commercialized for the treatment of wastewater discharged from domestic sector, pharmaceutical industry, chemical industry, municipal solid waste management facility centre. The FICCO technology developed by CSIR-CLRI is considered to be an alternate technology to membrane based technologies for the recovery of water. Technology has been transferred to two industries in Indonesia and Ghana.



Fig: 1.40 Glimpse of FICCO Plant

The technical know-how of FICCO technology has been transferred to treat the fish processing waste water in order to meet the standard required prior to membrane separation process.

Sustainable Immobilized Consortia to Treat Recalcitrant Pollutants under Microaerophilic Conditions

Biodegradation of recalcitrant chemicals generated from leather processing industries is yet to be solved in conventional treatment plants. Sustainable bacterial consortium was developed by CSIR-CLRI at microaerophilic condition for the biodegradation of recalcitrant pollutants generated from tannery wastewater. Isolated six microaerophilic bacterial strains which are highly motile, capsulated and sporulated were able to degrade the recalcitrant pollutants namely biocides, preservatives, surfactants, vegetable, synthetic tannins, dyes and synthetic fat liquors as sole carbon and energy under microaerophilic conditions. The bacterial strains were deposited in MTCC. The free cell state of the consortium developed is floc forming in nature and 97 % reduction in COD was observed within 24 hours and with minimum sludge production. A patent had been awarded on the invention titled 'A microaerophilic bacterial consortium and use thereof for the simultaneous biodegradation of mixture of recalcitrant's present in water' - Indian Patent application No.3437DEL2012.

An end to salinity concerns of tanning - Salt Free Chrome Tanning

CSIR-CLRI has developed a common salt free tanning technology adding economic & environmental benefits to leather making. The salt free tanning technology provides an enabling solution to address the issue of TDS through a change in the century old tanning process.

Technology Upgradation of Ethiopian Tanneries

Ministry of Trade and Industry (MoTI), Federal Democratic Republic of Ethiopia (FDRE) had enrolled the services of the CSIR-CLRI by invitation for the Bench Marking Program aimed at the Technology Upgradation of selected Ethiopian tanneries. With the technological interventions of CSIR-CLRI through two consultancy projects, the Ethiopian tanneries are emerging as reliable suppliers of quality finished leather in the International market.

Sector Specific Study and Report for Tannery and Chrome Chemical Sector

CSIR-CLRI has been awarded the Capacity Building for Industrial Pollution Management Project (CBIPMP) funded by World Bank entitled "Sector Specific Study and Report for Tannery and Chrome Chemical Sector in West Bengal" by West Bengal Pollution Control Board (WBPCB), Kolkata through tendering process. CSIR-CLRI has taken up the responsibility of preparation of a road map for management of chromium and other pollutants generated from tanneries and chrome chemical industries. There are 308 nos. of tanneries in Calcutta Leather Complex (CLC), Kolkata, 5 chemical industries are existing in Kolkata. At present the hazardous sludge generated from these industries is disposed in landfill facility located at Haldia. Collection of primary and secondary data on the current practices in tannery and chrome chemical industries has been completed. The data base on management of chromium from tanneries and chrome chemical industries are not available and it will be the first report in India with a comprehensive list of industries using chromium chemicals and management practices to be adopted for mitigation of pollution in West Bengal.

Advanced Soaker Visbreaking Technology

The CSIR-IIP developed advanced soaker visbreaking technology has been transferred to M/s Hindustan Petrochemicals Limited (HPCL) and M/s Indian Oil Corporation Limited (IOCL). Test run has successfully been carried out at HPCL and the one at IOCL is expected to be completed very soon. It is expected to increase the profit of HPCL by Rs. 935 lakh per annum and that of IOCL by Rs. 845 lakh per annum. CSIR has earned a fee of Rs. 270 lakh.

Seaweed sap trial as liquid fertilizer

Seaweed sap trial as liquid fertilizer was successfully tried on multiple crops at 45 agricultural Universities all across India with improved crop yield. The sap is being marketed as "PARAS" by Tata Chemicals produced by CSIR-CSMCRI's licensee.

Process for production of potassic fertiliser by selectively precipitating potassium from aqueous solutions

Earlier, technologies available in Indian context relied upon production of mixed salt from bittern through solar evaporation which is further processed to recover K-fertilizer or Magnesium of Potash (MOP). CSIR-CSMCRI has developed a process which is based on selectively precipitating potassium directly from bittern without taking recourse to solar evaporation for production of mixed salt and thereby eliminating the risk associated with unseasonal & unpredictable weather conditions frequently encountered in recent years. In this process K is precipitated from bittern in the form of K-bitartare & subsequently one can produce the desired K-salt for e.g. potassium sulfate, potassium nitrate and potassium chloride along with recycling of the tartaric acid for next cycle of potassium precipitation.

Economical utilization of solid wastes from tanning industry

CSIR-CSMCRI has developed a process for the preparation of a novel ketene oligomer. The process is patented. The process is simple and the raw materials for process can be sourced from solid wastes generated by different processing industries including tanning industry. Due to its unique properties, it also has a potential for application in pharmaceutical industries as a delivery system through microencapsulation.

Synthetic Aviation Lubricants

India is totally dependent on developed countries for its aviation lubricant requirements which are of immense strategic importance in the defence-preparedness necessitating self-reliance in this field. A Task Force involving CSIR-IICT as Nodal Agency, IOCL, CSIR-NAL, HAL, GTRE, CEMILAC was formed for developing indigenous capabilities in aviation lubricants. The Task Force shortlisted lubricants OX-27 meeting MIL PRF-23699F and OX-38 meeting DEF STAN 91-98 specifications for development.

CSIR-IICT has developed two lubricants, SVS11 and SVS21. A specialized bench & pilot scale facility, and a sophisticated analytical testing facility were established at CSIR-IICT. The Rolling Element Bearing Test Facility, a first of its kind in India, was established at CSIR-NAL. The developed lubricants have passed all the mandatory tests. With this landmark development, India has joined the select group of countries having capabilities in aviation lubricant technologies. Provisional Certificates for Airworthiness Approval has been granted by CEMILAC for SVS11 and SVS21 lubricants, which is essential for their commercial exploitation.

Process for the preparation of 4-tert-butyl toluene and 4-tert butyl benzoic acid for Vinati Organics Ltd, Mumbai

CSIR-IICT had developed two processes, (i) Process Development for Alkylation of Toluene to get 4-ter-butyl toluene (PTBT), (ii) Process Development for Oxidation of Para-tert-butyl toluene to Para-tert-Butyl benzoic Acid (PTBBA). In the first process, catalytic alkylation of toluene to 4-ter-butyl toluene (PTBT) was developed using isobutene and toluene under mild reaction conditions. The process involved selective formation of para isomer under continuous mode. In the later process, catalytic oxidation of Para-tert-butyl toluene to para-tert-Butyl benzoic Acid (PTBBA) was developed using cobalt catalyst and air as oxidizing agent in batch mode. In both the processes, the yields and purity of the product was obtained around 90% and < 99% respectively. The technologies were transferred to M/s Vinati Organic Limited, Mumbai. CSIR-IICT has entered into an agreement with M/s Vinati Organics Ltd, Mumbai for scale up and pilot plant studies for a contract value of Rs. 50 lakhs and a royalty of Rs. 50 lakhs.



Fig: 1.41a Reactor Assembly for Alkylation



Fig: 1.41b Reactor Assembly for Oxidation

Self Organizing Maps (SOM): A Novel Technology to Minimize Mosquito Borne Diseases

Self Organizing Map (SOM) an innovative clustering technique and first of its kind, has been developed by CSIR-IICT. This clustering technique enables the health officials to prioritize the diseases endemic zones and plan their control operations so as to minimize the mortality and morbidity occurring due to the onset of vector borne diseases. SOM can be used effectively for prioritization of the disease endemic regions which can be attained as per the severity of the parameters governing the disease in the respective villages. Once prioritization is done, the control operations can be launched effectively, with the knowledge gained by SOM and all the villages can

be mapped in a more precise way. Based on the effectiveness of the technique National Vector Borne Disease Control Program (NVBDCP), Ministry of Health, Govt. of India, has taken up the technology for its field application in phase wise manner. The preface action are being implemented in Gujarat, Arunachal Pradesh, Manipur, Assam and Mizoram.

Process know-how for preparation of Profenofos

Profenofos usage in India is listed for the following crops: Profenofos 50% EC: Tea (Red spider mite, Pink mite, Tea mosquito bug, Looper caterpillar Thrips, Jassid), Cotton (Bollworm, Jassids, Aphids, Thrips Whiteflies); Profenofos 40% + Cypermethrin 4% EC Cotton (Bollworm complex).

Profenofos is very effective in control of Lepidoptera insects and Mites in cotton, tobacco, sugar beet, soya beans, vegetables etc. Efficacy of profenofos is equivalent to monocrotophos but has higher degree of safety to mammals (LD50 in Rats 358 mg/kg for profenofos and 14 mg/kg for monocrotophos). It has low soil persistence and low solubility in water (20 mg/litre at 20°C compared to 1 Kg/litre at 20°C for monocrotophos). It is considered as the safe alternative to Monocrotophos and Endosulfan, which are being phased out in the country.

Realising the importance of this product, CSIR-IICT had developed an environment-friendly process to produce profenofos. The process was demonstrated and transferred to M/s India Pesticides Limited, Lucknow at half-a-kilogram level. Few other companies are also showing their interest in taking this technology.

Simultaneous Production of US Grade Gasoline and Pure Benzene from FCC C6 Heart Cut

CSIR-IIP has carried out substantial experimental and simulation studies with feedstock provided by M/s Reliance Industries Limited (RIL) and demonstrated that US grade gasoline and pure benzene can be simultaneously produced from a FCC C6 heart cut stream using extractive distillation (ED) route with aqueous NMP as the solvent. The gasoline thus produced has sulphur content <10ppm and benzene <0.3%. The technology has been transferred to RIL which is setting up 600,000 MTPA unit costing Rs. 160.00 crore. The annual gasoline production from this unit would equal to a prospective export monetary value of around 682 Million USD per annum with an additional profit of around 102 Million USD per annum from the sales of the recovered high purity benzene (Current market Value of Gasoline and Benzene ~ 1400 US \$/ MT).

Solvent De-oiling plant at Numaligarh Refinery Limited (NRL)

Numaligarh Refinery Limited (NRL) - a subsidiary of BPCL is setting up a wax deoiling plant using updated CSIR-IIP & Engineers India Ltd (EIL) process know-how at a capital outlay of Rs. 753.72 crores including a foreign component of Rs. 86.49 crores for specialized patent equipment like Scraped Surface DP Chillers and Rotary Vacuum Filters. This facility will produce 50,000 tons per annum of different grades of petroleum waxes by processing waxy streams available at NRL. The design of the unit is based on indigenous technology developed at CSIR-IIP. Design & engineering work is completed. All site contracts awarded and construction activities are in progress. Overall 80% physical progress of the project is achieved so far.

High Energy Density Fuel Production

CSIR-IIP has developed a process for the production of high energy density fuel similar to the Russian origin T-6 fuel as per GOST 12308-89. Various blends of different kerosene range cuts were made and analysed for obtaining the desired characteristics and requirements. The optimized blend thus obtained was then dehydrogenated at high pressure and temperatures to obtain product similar to that of T-6 fuel specifications. The product has been characterised for GOST 12308-89 standard and then around 100 liters of fuel was supplied to DRDL Hyderabad for testing performance at their facility. The fuel supplied by CSIR-IIP is found similar in performance to the T-6 fuel and also met the desired standards as per GOST 12308-89.

NCL BrahMos technology to save huge foreign exchange

The country will now be able to save huge amount of foreign exchange by developing the BrahMos supersonic missile system indigenously, thanks to a polyimide resin technology by CSIR-NCL. This technology is critical for ensuring highly durable airframes of BrahMos missile system in high temperature Indian conditions. The BrahMos supersonic missile technology is a joint venture projects between India and Russia. The key, critical non-metallic components, polymerisable monomeric reactant (PMR) type polyimide resin, and 14 other chemicals were successfully developed by CSIR-NCL. These are critical for ensuring highly durable airframes of BrahMos missile system in high temperature conditions. The non-metallic components to be used in the BrahMos system are from 200 different materials. The key composites were successfully prepared and cleared all the tests. For this endeavours CSIR-NCL has been adjudged 'Best Laboratory Award' by DRDO.

Commercialization of compact anaerobic digester cum biogas plant

An improved anaerobic digestion system has been developed by CSIR-NIIST for the stabilization of household organic wastes. The major advantages of ANEROBIC DIGESTER include:

- (i) works as a complete treatment system for household biodegradable wastes;
- (ii) compact and versatile;
- (iii) yields higher quantity of methane in the biogas;
- (iv) composted wastes requires no further processing to use as organic fertilizer; and
- (v) operation of the system requires no electricity.

The Technology was licensed to M/s Carries and Pipes Pvt. Ltd., Ernakulam, Kerala and M/s. B.M. Industries, Moovattupuzha, Kerala for mass production and marketing of the biogas plant.



Fig:1.42 The commercial anaerobic treatment system cum biogas plant for household biodegradable wastes

Commercial release of AutoCAST-X1 with Virtual Casting Technology

Virtual Casting is a software package developed by CSIR-NIIST for the simulation of solidification process of industrial castings. The Virtual Casting Solver technology was transferred to M/s 3D Foundry Tech Pvt. Ltd., (3DFT) a company which maintains and markets AutoCAST-X, an integrated easy-to-use environment for casting method design, solid modeling, and simulation. The teams from CSIR-NIIST and 3D Foundry Tech worked closely in integrating these two software codes in NET environment with new GUIs and visualization tools to release AutoCAST X1 which couples the quick fluid flow simulation, heat transfer and solidification simulation of Virtual casting into the AUTOCAS-T-X environment. With the addition of Virtual Casting, AutoCAST X1 has the capability to predict both flow related and solidification defects like misruns, cold shuts and shrinkage porosity. The integrated code was benchmarked with the experimental results generated by IIT-Mumbai. It was further validated with industrial scale castings. After testing, this module was launched during IFEX -2013 at Kolkata. Virtual Casting won the second place in the Computer Society of India IT Excellence Awards for 2012 at Kolkata in the Engineering Solutions and Product Manufacturing Category.

Demonstration plants for bioextraction of coir fibre, banana fibres and pineapple leaf fibre

The potential of coir fibre, banana fibres and pineapple leaf fibres are well known. However, the current methods of extraction of these fibres are inappropriate to produce quality fibres in reasonable scale. CSIR-NIIST has developed an anaerobic extraction (A Method for anaerobic process coupled separation and refining of Plant Materials, for plant fibres, which facilitates to make good quality fibres without pollution and enables

process water recycle. The process was taken up to demonstrate in the field for the production of coir fibre, banana fibres and pineapple leaf fibres. NGOs and self-help groups are involved in this programme for developing skills to utilize such resources through this technology and building up livelihood opportunities.



Fig: 1.43 Agreement signed with Kudumbashree of Kerala State in presence of the Honourable Minister Dr M.K. Muneer, Panchayat and Social Welfare for setting up demonstration plants for the bioextraction of banana fibre and pineapple leaf fibre

Coir fibre composite for furniture

“Polycoir”, the composite of coir fibre is one of the products developed by CSIR-NIIST. This thermoset mouldable natural fibre polymer composite has enormous potential as substitute for wood-based or alternative products. The properties of the material can be engineered as per requirement and several unique properties like fire resistance, termite resistance and water resistance. One such product has been made with coir fibre and phenol-formaldehyde resin where the coir is initially prepared as needle felt.

In view of the developments made by the institute in the area including facilities created and expertise built up efforts were made to transform the generated knowledge into products. Works were carried out in the laboratory to make commercial samples by improving the surface finish and properties for market acceptability. This technology was transferred to M/s. Kerala Furniture Consortium Pvt. Ltd, Ernakulam.

1.2.3 Unique Major Facilities

Centre For Biofuels

A Centre for Biofuels has been set-up at CSIR-NIIST. The pilot plant is the first public sector initiative of its kind in India and has been installed on the CSIR-NIIST campus to produce bioethanol from biomass. This facility comes up jointly with Technology Information, Forecasting and Analysis (TIFAC), Department of Science and Technology for the development of technology for production of bioethanol as an alternative fuel for transportation. The plant set up has 80-kg/batch capacity for ethanol production from lignocellulosic biomass including agro-residues and forestry by-products and has an efficiency of 70 per cent in the conversion of biomass to ethanol. The process of production goes through three basic stages - pre-treatment, enzymatic hydrolysis to produce free sugars, and fermentation of sugars to ethanol. Centre for Biofuels has also initiated activities on biomass-based butanol production and on algal biofuels. The Centre is initiating collaborations with international universities and institutions for advanced studies on biomass-based fuels and energy and on the life cycle and on techno-economic analyses. The Centre would also serve to impart knowledge and training for skilled manpower development in the field of biofuels and bioenergy.

Technology Business Incubation Centre in Agroprocessing (TBIC-A)

CSIR-NIIST in collaboration with the Department of Agriculture, Govt. of Kerala has launched a programme to develop and transfer technologies for value addition of the agricultural produce of the state. Sharing of specialized infrastructure facilities, offering technical expertise to prospective entrepreneurs for product development, scale up, test marketing etc. and providing consultancy services to industries, form part of the venture, named as Technology Business Incubator in Agroprocessing (TBIC-A). The institute is currently involved in the development of certain processes for clients under TBIC platform. Development of process to enhance the colour of the turmeric powder and to facilitate the modernization of the existing unit in Haryana are being taken up as major programmes of TBIC-A.

Centre for Lipid Research

CSIR-IICT, which has been serving the vegetable oil industry for over six decades, has established a Centre for Lipid Research. The Centre focuses on developing efficient processing methods for the Indian vegetable oil sector, which has an annual turnover more than Rs. 1 lakh crores. In addition, the Centre aims to develop vegetable oil based novel organic intermediates that substitute petrochemicals and specialty chemicals. The Centre has developed eco-friendly processes for producing biodiesel from multifeedstock, and a variety of biolubricants, including aviation lubricants for the first time in the country.



Fig: 1.44 His excellency Shri. E S L Narasimhan, Governor of Andhra Pradesh inaugurating the Centre for Lipid Research

1.3. ENGINEERING SCIENCES CLUSTER

1.3.1 Scientific Excellence

Development of Si-nano-particles doped silica glass based optical fibre by MCVD process for use as light source near IR

CSIR-CGCRI has developed a new-type of silicon nano-particles (Si-n/p) doped silica fibre, through the MCVD process, with no solution-doping technique. The formation of Si-n/p in the fibre was confirmed by the TEM, EPMA, Raman, optical absorption, and fluorescence spectral measurements. Si-n/p doped fibres were formed basically due to the excess of Si phase in the fibre's core region. Among the other features, the Si-n/p fibre demonstrated a nonlinearity, much higher in magnitude than the conventional Si-free fibres. Generation of super-continuum in the Si-n/p fibre at 1.6 microns excitation showed distinguished results.

Mine plan and Environmental Management Plan for Karwar project of Indian Navy

Indian Navy has constructed a naval base at Karwar in the western coast near Panaji. The mine plan and the Environmental Management Plan were provided by CSIR-CIMFR for the same. It was proposed to make available the various sized material for the construction purpose by mining the nearby hills.

A study of factors influencing the severity of road crashes involving drunk drivers and non drunk drivers

CSIR-CRRI has made an attempt to develop Multinomial Logit (MNL) model to understand the influence of various factors on severity of road crashes involving both drunk as well as non drunk drivers on Indian highways. Certain facts that drunken drivers involved in rear end collisions or road crashes occurring between 10:00 pm and 1 am influences the serious injuries more than the non injury related road crashes has been established through the modelling exercise in this paper. Further, it has been found from the analysis that the rear end collisions involving non drunk drivers also influence severe injury crashes more in comparison to the non injury crashes.

Moreover it becomes evident that road crashes of rear end collision tend to influence the serious injuries irrespective of the fact that the driver is under the influence of alcohol or not. It can also be further concluded that many of the factors which have in significant influence on the type of severity for crashes involving non drunk drivers have been eliminated as in significant variables as compared to road crashes involving drunken drivers. It has been found that the nature of collision and the time of road crashes are the influencing factors in the case of drunken drivers. The above findings are consistent with the fact that the injuries involving drunken drivers are influenced lesser by the geometric and environmental factors than by the nature of collision and time of occurrence of accident. Hence it is essential to bring in strict enforcement measures and strategies to curb drunken driving during late night hours which can pave the way for stronger enforcement measures against drunken driving. In addition, the economic costs of different types of drunken and non-drunken drivers involved in road crashes have been determined based on the economic cost of each types of road crashes presented in Manual on Economic Evaluation of Highway Projects in India IRC: SP-30 (2009) Q7.

Infrastructure Information System in GIS Environment for Maintenance of Bridges on National & State Highways.

As the allocated funds for the maintenance of the bridges are generally limited, so it is essential that the allocated funds for the bridge maintenance shall be used in such a way that they yield the highest possible benefit to society at the lowest possible cost.

Like many other developing nations, in India too, there is a strong need for introducing bridge management programs, which provide for a long range bridge evaluation process that covers bridge condition, site traffic, maintenance and inspection cost. CSIR-CRRI has developed an interactive software Indo-BMMS using VISUAL Studio 2008 for Front end, MS-SQL Server 2008 for Data base management and CRYSTAL Report for report generation. For the development of bridge/culvert inventory in GIS environment, commercially available software (ARC- GIS, ARC-IMS and ERDAS) have been used.



Fig: 1.45 Flow chart of bridge maintenance management system in GIS environment

Flow chart of the work of development of BMMS in GIS Environment for Maintenance of Bridges is given in Fig. 1.45. In developing this system, a comprehensive methodology has been adopted on the basis of the actual condition of the different components of a bridge and possible cost effective solutions for maintenance/rehabilitation/strengthening for allocation of budget on priority basis. The methodology and software Indo-BMMS is validated with respect to the data collected from district Ghaziabad in U.P., India.

Bridge maintenance management system consists of various components viz. inventory of bridges, inspection and assessment of condition of bridges, bridge maintenance/repair schemes, assessment of requirement of funds for each bridge and prioritization of rehabilitation/maintenance of bridges on the basis of safety, cost and socio-economic benefits. The developed bridge maintenance management system Indo-BMMS provides information on possible scheme of maintenance and helps to allocate the budget to a particular bridge in a road network for its maintenance in a scientific manner.

Evaluating Bus Rapid Transit (BRT) Corridor Performance from Ambedkar Nagar to Mool Chand Intersection

Bus Rapid Transit System (BRTS), was introduced as a pilot project (spanning for 5.8 Km) on April 20th 2008, starting from the junction of signal-controlled Mehrauli - Badarpur Road (near Ambedkar Nagar) and running through J. B. Tito Marg terminating before Mool Chand Hospital intersection on the inner ring road.

Complying a court order, and request from Government of NCT, New Delhi, CSIR-CRRI carried out an exhaustive list of surveys / studies on the BRT corridor and also selected traffic studies on other adjoining Non-BRTS road sections in Delhi. The studies conducted include intersection traffic volume counts, Mid-block counts, speed and delay studies, Spot Speed studies, Queue length and saturation flow studies, pedestrian volume counts at strategic locations, parking studies, users perception on the BRTS corridor, fuel consumption studies using probe vehicle and bus passenger boarding / alighting studies etc.

The efficacy analysis of allowing other vehicles to ply on the BRT corridor on experimental basis has also been carried out which presents detailed account of the performance measures derived under 'normal BRT operations' and 'experimental trial run' operations.

Following two recommendation were made:

- (i) Measures on traffic engineering and bus-route rationalization to enhance safety of the road users in the event of continued operation of the road under normal BRT mode; and
- (ii) Traffic impact evaluation of different scenarios like 'with' and 'without' BRT.

Evaluation of the Old Railway Bridges for Increase in the Axle Loads due to Freight Wagons

CSIR-CRRI has monitored two of the bridges of West Central Railways under axle loading at current operating conditions, forces in primary members under operating conditions. The monitoring was done through theoretical analysis of bridge, planning of the instrumentation scheme, installation of sensors & instruments and related activities at the sites, continuous monitoring of sensors/instruments data during passage of test trains and prevailing trains after installation, and studies related to the behaviour and performance of the bridge based on several field studies. Specially designed strain gauges called Intelliducers have been mounted on the surfaces of the structural members of the instrumented span. Vibrating wire (VW) type of strain sensors were employed to measure ambient temperature and resulting structural response in terms of strains were collected on the surface of the bridge at an interval of half an hour during the day-night cycle for a period of three days using an automatic data acquisition system. The LVDTs and dynamic deflection transducers (DDT) were installed at the upstream as well as at the downstream girders. At mid span, deflections were monitored in the vertical as well as in the lateral directions. The span of the bridge was instrumented for recording the free-vibration parameters by placing accelerometers at the centre and at quarter points. The location of the strain gauges to monitor the stresses on the surface of the pier was near its base. For measuring the tilt of the piers (in two orthogonal directions viz. in the longitudinal axis of the bridge and in the transverse direction), tilt plates were installed on the head of the pier.

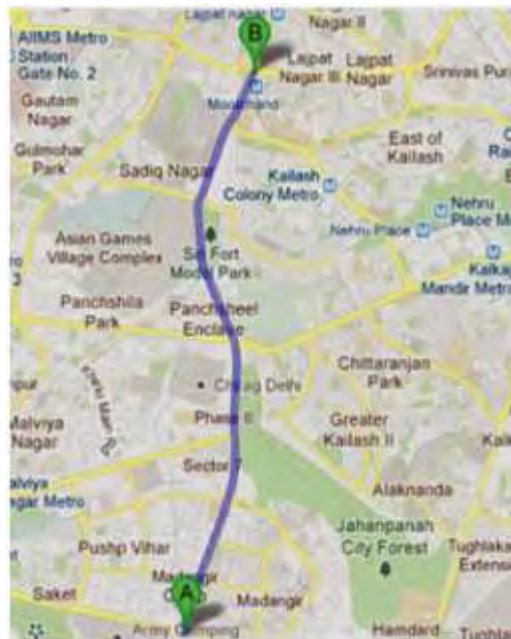


Fig:1.46 Location of Delhi BRT Corridor on J.B.Tito Marg from Mool Chand to Ambedkar Nagar

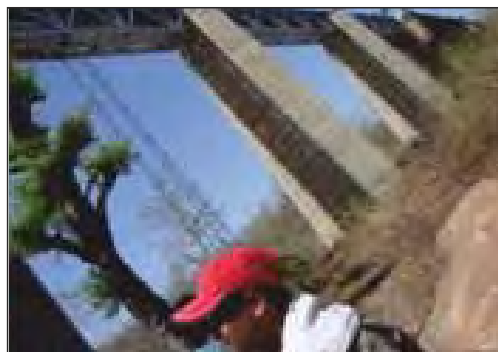


Fig: 1.47a View of the bridge near the mid span



Fig: 1.47b Location of VW strain-sensors

The first fundamental frequency was observed to be in the lateral direction while the second mode was in the vertical directions which are close to the numerically obtained values. Strains were obtained on the representative members of the truss. The maximum measured vertical deflection at the mid span of the under slung bridge due to the passage of the test train was matching that of the numerically obtained value. Based on the measurements made during the passage of the trains no opening of joints or presence of crack in parts of the bridge was observed. The deflection curve is consistent and suggests the overall response behaviour of the bridge to be within elastic range. It has been concluded that this bridge can carry a load of CC + 8 + 2 and even MBGL loading.

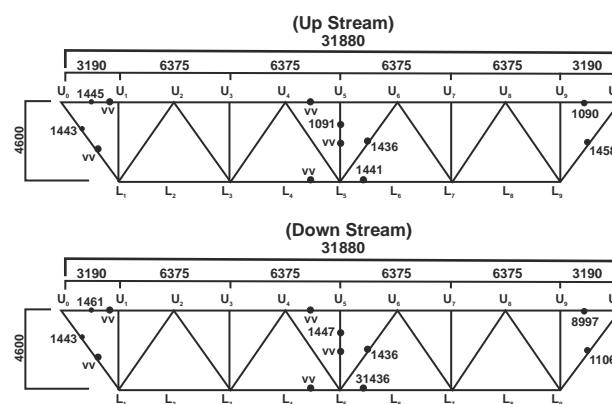


Fig: 1.47c Scheme of placement of intelligiducers on the span

Investigation of Causes of Longitudinal Cracking in Concrete Pavements on National Highways

Under National Highway Development Programme (NHDP) of NHAI Concrete pavements have been constructed at many locations during the last 8 to 10 years. These concrete pavements have been designed and constructed for a design life of 25 to 30 years. The structural failure has been observed at some of these concrete highways, for examples Indore bypass road, Kanpur-Allahabad, Balasore-Odisha, Chittorgarh – Mangalwar, due to full depth longitudinal cracking. CSIR-CRRI has investigated causes of longitudinal cracking. Initial investigations have revealed that in a two lane carriageway with tied shoulder, no crack is developed under the saw cut between outer lane and shoulder (Fig. 1.48). When the whole width of one carriageway is laid with paver in one go and then longitudinal saw cuts of one-fourth to one-third of the pavement thickness are made between inner and outer lane as well as between outer lane and tied concrete shoulder, cracks are expected to develop under these saw cuts to separate the lanes and shoulder from each other. It helps in reducing the size of the slabs and hence reducing the curling and corresponding stresses. In case tied shoulder and outer lane are not separated from each other then the size of slab in outer lane becomes more than the designed size of the slab. This leads to the development of excessive stresses under traffic loads and gradually a crack is developed in longitudinal direction.



Fig: 1.48 Longitudinal crack in outer lane

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Development of a Suitable Methodology in Terms of Repair Treatment of Defence Runway in Emergency

Emergent repairs of Air Force airfields are required to be carried out essentially after damage has been caused to these pavements due to bombing during the war. These damages are in the form of craters which are of different magnitude in terms of shape and dimensions. Therefore, the repair essentially must be completed immediately and rapidly after the attack so as to allow the launching and recovery of combat aircrafts. New developments in the weapon technology with deep strikes and increased

demands in aircraft operations make existing crater repair procedures complex, inadequate and unsuitable. CSIR-CRRI has developed the cold mixes of bituminous concrete characterization of the cold mix for better load dissipation. The cold Bituminous concrete (BC) and semi dense bituminous concrete (SDBC) may be used as wearing course on emergency repair of bomb crater on runway. Stabilisation of base course in emergency repair will enhance the structural strength of pavement compatible to aircraft (more than 15 PCN value) in lieu of conventional pavement. The use of Geogrid / glass grid will enhance the air field pavement strength.



Fig. 1.49 Emergency Repair of Kolkata Runway

State of Art Report for Development of Warm Mixes for Road Construction

Hot mix asphalt (HMA) is used as the primary paving material for road construction. About 95 per cent of the paved roads in the India are made of HMA, which consists of aggregate and asphalt binder which are heated and mixed together at elevated temperature of about 160°C.

CSIR-CRRI has also carried out the study on emulsion based Warm Mix Asphalt or Half warm mixes, which consists of slightly heated bitumen emulsion at 70°C and moderately heated aggregates upto 110°C. WMA is produced at 90°C lower than typical hot mix asphalt (HMA). Apart from low fuel costs and reduced emissions compared to HMA, Warm mix asphalt (WMA) is a technology that produces mixes with almost the quality of hot mix asphalt with 60 per cent less energy. Warm mixes can also be used in remote areas with rainfall or snowfall. Warm mix asphalt (WMA) is a technology that allows reduction in the temperatures at which asphalt mixes produced and placed. These technologies tend to reduce the viscosity of the asphalt and provide for the complete coating of aggregate at lower temperatures. WMA is produced at 90°C lower than typical hot mix asphalt (HMA). In this study Institute has SS-2 grade emulsion in designing cold mixes and warm mixes. The Marshall specimens of both warm and cold mixes meeting the gradation requirements for Dense Bituminous Macadam and Semi Dense Bituminous Concrete, are prepared and tested for different properties like Marshall Stability, Creep value, Indirect Tensile Strength, and Retained stability. A State of Art-Report on warm mixes has been prepared.

Feasibility Study of 'Cinder Waste Material' for Road Construction

Cinder is waste material of coal burning residue produced by steel industries. Slag is another waste material generated as a by-product during the production of molten iron. It is generated due to the fusion of limestone and other fluxes with the ash from coke and siliceous & aluminous components of the ferrous ore. Recycling of slag is carried out as a part of manufacturing process. Reject material obtained from waste recycling plant, which is also a form of slag is termed as 'SWRP'. At TATA Steel plant in Jamshedpur, huge deposits (mounds) of cinder material mixed with slag exists (Fig. 1.50). Height of these mounds varies from 10 to 45 m and they block the use of valuable land area. To study the potential for using cinder and SWRP for construction of road embankment, subgrade, sub-base, base and bituminous layers of road, detailed laboratory investigations were carried out by CSIR-CRRI to assess its physical and engineering properties. Different waste materials viz., Cinder (100 per cent), SWRP-Local Soil mixes (25 to 75 per cent), and Cinder-SWRP mixes (25 to 75 per cent) were evaluated for their physical and engineering properties. Feasibility of using cinder as a partial replacement of fine aggregate in sub base, base and bituminous layers was investigated. Cinder was also stabilised using cement in the range 2 to 8 per-cent to investigate its feasibility for use in sub base and base layers of road pavement. Following are some specific conclusions:

- Cinder and SWRP were observed to be coarse grained and non-plastic materials. According to Bureau of Indian Standards (IS) classification, Cinder and SWRP were classified as GP i.e., poorly graded gravel as SP i.e., poorly graded sand respectively;
- Cinder and SWRP slag samples were observed to be non cohesive with angle of internal friction (ϕ) equal to 450 and 410 respectively. It indicates that they can be used for embankment construction; and
- Laboratory tests showed that about 38 and 60 per-cent cinder material can be used as a replacement of fine aggregate in Granular sub base and Wet Mix Macadam mixes respectively. However, due to their crushable nature, field trials are required. It was also concluded that cement-stabilized cinder is not feasible for the construction of sub base and base layers of road pavement.



Fig: 1.50 View of cinder dump at TATA plant, Jamshedpur

Cold Mix Technology Developed at CRRI to M/s Bitchem Asphalt Technologies, Guwahati for North East Region and Eastern Part of India

The heating leads to emission of solvents used as cutter stock, which create environmental problems. The use of bitumen emulsion eliminates the heating of binder and aggregate and thus prevents the degradation of environment and conserves the energy. The advantages of cold mix technology conventional hot mix technology are:

Cold application at ambient temperature as heating is eliminated; Environment friendly technology; Energy conservation; Coats damp aggregates; Non polluting process; Repair feasibility in all weathers; Resistant to water damages; Less manpower and machinery requirements; Binder Economy; Uniform Quality; 15 to 20 per cent cheaper in cost

The demonstrations for cold mix technology for road construction was successfully carried out for Assam PWD Engineers at following locations

- Guwahati for SDBC;
- Bhogpur village near Guwahati for MSS and PMC for PMGSY Roads;
- Mirza near Guwahati for BM + SDBC; and
- Rani Kamrup Guwahati for SDBC with Hot mix plant (with out heating arrangement) for cold mix manufacturing and Paver (Fig.1.51a & Fig. 1.51b).



Fig.: 1.51a Production of emulsion based cold mix by Hot Mix Plant (Switching Off Heating Arrangement) in Guwahati



Fig: 1.51b Laying of cold SDBC in Guwahati as demo for Assam PWD

Tailor made process flow sheets

CSIR-IMMT has released tailor made process flowsheets to over 20 industrial clients. Extensive studies carried out to enrich the ore quality and obtain valued added products from industrial wastes involving the processing of iron ore, manganese ore, copper, rock phosphate, zircon, bauxite and limestone. The effort has a direct bearing in strengthening industrial rupee.

High temperature diffusion preventing ceramic coatings on steel/high strength steel by Electrophoretic deposition (EPD) for active corrosion protection

Ceramic coating on metal is generally non-adherent, resulting into delamination of the deposits during drying and sintering. This is because of the large difference in their thermal expansion coefficients. CSIR-IMMT has developed a novel strategy based on EPD (at 100 V for 30 sec from a stable TiO_2 suspension of 0.5 wt% in ethanol, in presence of methyl hydrogen silicon fluid KF-99) to obtain thin, well adhered and crack-free coating of TiO_2 on steel which withstand a temperature of 500°C while exhibiting high resistance to corrosion. The KF-99 bridged the micro-cracks, developed during drying and sintering, leading to increased adhesion. Adhesion was tested using scotch adhesion test. The corrosion test was performed using salt spray test in 3.5 wt% NaCl solution as well as by electrochemical measurements. Adhesion and corrosion resistance was improved further by dipping the coated sample in KF-99 immediately after deposition followed by drying and sintering. The time to initiate pitting increased from 24h for coating in absence of KF-99 to 1200h in presence of KF-99. Improvement in corrosion resistance was due to increase in hydrophobicity of the coating (observed contact angle: $100 - 105^\circ$) in presence of KF-99 which prevented wetting by the corrosive liquid. The coating delaminated above a temperature of 500°C because of removal of organic component KF-99.

The coating service temperature could be improved to 750°C with Al_2O_3 phosphate coating on steel substrates using aluminium phosphate. Further experiments are taken up to establish the mechanism of improved adhesion in this case with the help of FTIR analysis.



Fig: 1.52 TiO_2 coating on steel developed- 1200 hrs. salt spray test, explore to 500°C and 90 degree bend test

Coatings for Solar Selective Absorber Surfaces

CSIR-NAL has developed Carbon Nanotube-based solar absorber coatings on $\text{Co}/\text{Al}_2\text{O}_3/\text{Ti}$ coated SS substrates by atmospheric pressure chemical vapor deposition technique. The transition of carbon nanotube forest from near perfect blackbody absorber to solar selective absorber was achieved by varying the thickness of CNTs. For thickness greater than $10\ \mu\text{m}$, the CNT forest acts as near perfect blackbody absorber ($\alpha = 0.99$; $\tau = 0.99$), whereas, for thickness less than $500\ \text{nm}$, the infrared reflectance of the coating decreased drastically ($\alpha = 0.20$) with slight decrease in the absorptance ($\tau = 0.95$). These coatings can be used for solar thermal power generation.

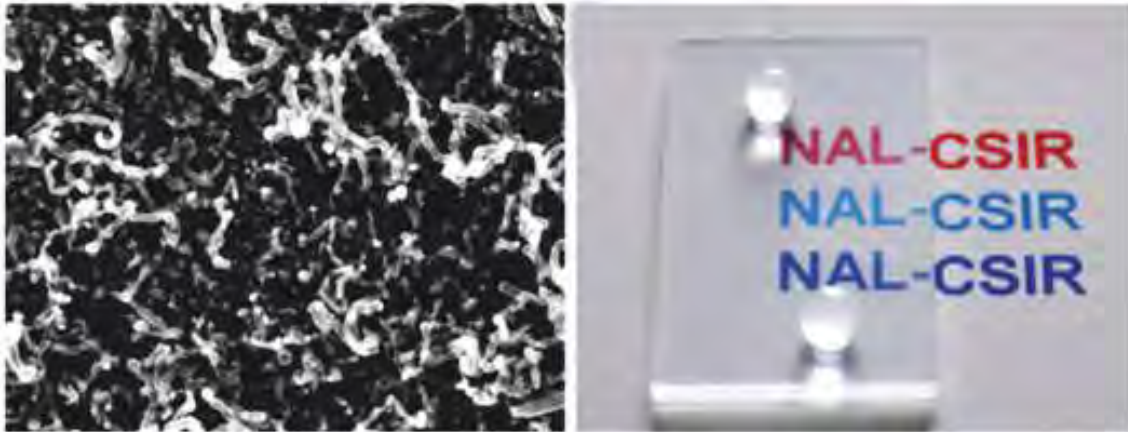


Fig: 1.53 FESEM image of CNT and (b) ZnO multifunctional coating on glass substrate.

Studies on the non-linear behaviour of shear walls

CSIR-SERC has evaluated the seismic performance of shear walls of medium aspect ratios. The experimental program includes: Monotonic load test on shear wall, Cyclic load tests on shear walls and Shake table test on shear wall. Analytical models based on the axial-force dependent moment curvature relationship of the section are developed to verify the experimental results. Elastic and plastic rotational capacities of shear wall structures as stated by codes such as ATC-40 and other documents are correlated with the results of the experiments and subsequently suitable improvements are suggested. Comparison between the ductilities exhibited by the shear wall specimen during monotonic, cyclic and seismic motions have been carried out. A guideline towards seismic design of shear wall structures is established. A programme has been developed for the design of shear wall.

It concluded through a study that addition of shear wall throughout the height of the structure is found to be the most effective as a retrofit option for open ground storey structures. Enforcement of diaphragm wise displacement compatibility due to rigid in-plane stiffness of diaphragm ensures majority load sharing by shear wall element even after formation of hinges in the shear wall. This makes the soft storey mechanism totally untenable. A guideline towards seismic retrofit of open ground storey structures with shear walls is documented.

A bio-inspired control algorithm based on emotional learning is studied and implemented for semi active control. This algorithm is called "BELBIC-Brain Emotional Learning Based Intelligent Controller". This algorithm is widely used in automation and aerospace applications. The performance of BELBIC algorithm in structural control application is investigated with the help of numerical simulations.

Development of distributed damage diagnostic techniques for sustainable Structural Health Monitoring using Wireless Smart Sensor Network (WSSN) and Laboratory level demonstration of the SHM scheme

Though the smart wireless sensor technology has been rapidly improving, there still remain serious limitations in hardware, software, and energy supply technology. Hardware issues to be improved may be wireless communication range, data transmission rate, and high frequency sampling capability. However, it is expected that hardware problems may be solved relatively faster owing to the speedy advancement of electronics technology. Software technology for the full utilization of the hardware and for the complete assessment of structural health has been progressing slower than the hardware technology. CSIR-SERC has developed, a comprehensive distributed software technology based on Imotes and Tiny OS environment for sustainable SHM using smart sensor networks. The development mainly comprises of various distributed strategies for damage diagnostics and decentralization schemes for structural health monitoring. Since the structural health monitoring schemes are heavily based on the measurement data recorded during a long period, the sensor faults if goes undetected, may misrepresent as a structural fault. Hence thorough investigation is required

for the long-term reliability, robustness, and calibration of these sensors, and develop robust algorithms that can provide a reliable damage detection capability even under malfunction of some sensing nodes of the global SHM system. A sensor fault diagnostic scheme based on AR-ARX models has been developed. The development has led to a new research domain of sustainable remote health monitoring of civil engineering structures like bridges using WSSN, reduce the off chip computation and communication weight. WSSN, increases the robustness and speed of the damage detection algorithms and takes care of environmental variabilities and measurement noises in the signal to provide the robust detection.

Development of a rail defect detection technique

Conventional rail defect detection systems use contact type sensors for detecting the defects in the rail in which the inspection rate is lower. Development of non contact ultrasonics detector is in the primitive stages. CSIR-SERC has made an attempt to implement non contact type ultrasonic sensors for detecting any defects in the rail. Algorithm has been developed for identifying the defects in the rail using ultrasonic sensors. The research pursued was a step towards building up of a new research domain. From the research carried out, it was found that the non contact type ultrasonic sensors were unable to create ultrasonic surface waves of higher frequencies (2Mhz). The waves produced were attenuating and it is difficult to capture these waves. Hence further research would be focused towards getting a better external source of excitation for creating such higher frequency ultrasonic surface waves so that these waves can be detected by the non contact ultrasonic sensors for detection of defects in railway tracks.

Experimental investigation on strengthening of Reinforced Concrete beam with Carbon Fibre Reinforced Polymer(CFRP) plate bonding

The repair and rehabilitation of concrete structures has become a necessary measure for deficient structures. The deficiency of structure is generally due to the unexpected loads, corrosion and upgradation of load standards. The visual damages can be observed during visual inspection, but the damages occurred internally needs examination through experimental and / or analytical investigation. These methods also have their own limitations. CSIR-SERC has made an attempt to evaluate percentage of damage in reinforced concrete beam from its stiffness degradation. A repair mechanism for concrete beam with a particular percentage of damage has been attempted. CFRP which is a well accepted and efficient material for repair and rehabilitation is used in this study. The reinforced concrete beam has been tested and the performance under cyclic load has been observed. The stiffness degradation in each cycle has been observed for an equivalent damage assessment. The information on damage level from the results is used to predict the loading required to simulate the required percentage of damage. In a set of experiments, beams were subjected to different levels of loading to create damage and then the damaged beams were repaired with CFRP. The undamaged control beam has also been strengthened with CFRP laminates. The repaired as well as strengthened beams were tested under monotonic load for comparison. The study has confirmed the applicability of cyclic loading method to evolve the stiffness degradation and damage assessment. The bonding strength of CFRP governs the strength of the repaired beams in most cases. The bonding of CFRP is better in the cracked beams than in the un-cracked beam. The results have also shown that the repaired damaged beams outperformed than the undamaged control beam strengthened with CFRP. The above method can be used to assess the damages in RC beams and repair the damaged reinforced concrete beam with CFRP plate bonding to restore the strength and enhance the performance utilising the reserve strength.

1.3.2 Technology Developed

Aluminum foam core Sandwich Panels

The recent development of aluminium foam with density ranges from 0.42 g/cc to 0.70 g/cc shows potential applications in the areas of crashworthiness, noise and vibration attenuation and thermal management.



Fig: 1.54a Aluminium foam Sandwich Panels



Fig: 1.54b Cross section of the panel

CSIR-AMPRI has evolved a process to synthesise aluminium alloy foam core sandwich panels with epoxy resin filled flyash and cenosphere as face sheet. Aluminium foam core of thicknesses ranging from 10 mm to 30 mm was used for making the panels. The polymer sheet thickness varies from 1.5 mm to 2.5mm. The sandwich panels were tested in terms of three point bending and the stress-strain diagram shows the ultimate flexural failure stress around 2.5 MPa, 7 MPa, and 170 MPa and elastic deflection was noted around 0.14 mm, 0.43 mm and 0.50mm for epoxy resin, flyash and cenosphere sandwich panels respectively. The young modulus was measured using sonic modulus unit and found 7.26 GPa for flyash filled polymer panel, 3.30 GPa for cenosphere filled polymer panel and 0.43 GPa for epoxy resin sheet panels. The collapse mechanism map was generated using non-dimensional axes c/l (c =core thickness, l =span length) and t/c (t =sheet thickness). The calculated non-dimensional collapse load of panels was in the range of 3.5×10^{-2} - 4.2×10^{-2} , which falls under the region of indentation failure in the contour map. These panels could be used as an integral part of the doors in the automobile and other similar applications to reduce the noise and vibrations to a great extent.

Process for making Advanced Ligno – Silico – Aluminous (LSA) Materials

A novel process for making advanced Ligno – Silico – Aluminous (LSA) materials with broad applications spectrum ranging from cementitious materials to advanced functional materials has been developed. A cement free reinforced green concrete structure has been demonstrated successfully in CSIR-AMPRI campus.

Anti-termite barrier for new buildings

CSIR-CBRI has developed anti-termite barrier material to support structural units or foundations and to protect structure from termites. Some of the specifications of desirable material calculated so far are raw material- any suitable hard material or stone type, desirable particle size- 1.4 to 2.36 mm (60% approx.), 1.0 to 1.4 mm (30% approx.), and 0.7-1.0 mm (10% approx.), particle shape-irregular and sharp edged, fineness modulus-3.5 to 4.5, desirable thickness of anti-termite layer 100 to 150 mm specific gravity of material 2.5 to 3.5. This termite barrier may be used to resist, prevent, delay, inhibit or otherwise obstruct entry of termite into variety of structures including house, shed, patio, pergola, garage or any other building structure that are directly in contact with ground or otherwise potentially prone to entry, infestation and / or damage by subterranean termites.

Construction technologies and materials

CSIR-CBRI has developed construction technologies and materials like concrete masonry blocks, precast roofing components for roofs and under reamed pile foundation in black cotton soil are repeatedly being used in construction of thousands of houses by NGOs, Central and State Government Departments and private builders at various rural and urban locations of the country. Several building centres and rural building centres

are in regular production of precast concrete/ferro cement components by engaging local artisans and labour. CSIR-CBRI licensees at Yamuna Nagar & Ahmedabad are regularly manufacturing CSIR-CBRI designed clay brick extrusion machines of 2500 to 4000 bricks per hour. Fixed chimney brick kilns and gravity settlement chamber have been adopted by more than 30,000 brick manufactures to reduce consumption of fuel and environmental pollution. CSIR-CBRI is providing technical guidance in the design and construction of 1000 low cost houses in Bur-kina Faso, Africa to be funded by Govt. of India.

Development of 100% Biofuelled Tractor

Shortage of petroleum products and their rising international prices has drawn interest towards the exploration of alternate fuels. Moreover, there is renewed attention on controlling vehicular and other emissions. Among different alternate fuels, Biodiesel has proven to be the best candidate. In India, tractors comprise a versatile prime mover in farm as well as on the road; the only problem with their proliferation is the fact that they run on diesel and contribute significantly to vehicular emissions. As of now, no tractor is available indigenously to run fully on biodiesel. CSIR-CMERI has tested a 35 hp, 3 cylinder, Direct Ignition Sonalika tractor (engine) on B100 on a test bed to assess its performance. The engine has run on B100 on the test bed with the modified engine for 800 hrs without any complications. The trials have further exhibited equally comparable performance in terms of power developed, thermal efficiency, bsfc, etc. as compared to diesel. The biodiesel required for the long duration test has been produced from the semi-continuous Biodiesel plant (600l/day capacity) designed and developed by CSIR-CMERI and all the fuel properties have been tested to meet BIS/ASTM standards. Presently the tractor with modified engine is being run in field condition to assess its performance.

Design & Development of Biomimetic Frog Robot for Multimode Locomotion

Many locomotion principles adapted in robotics have been inspired by nature. Frogs constitute one species where multimode locomotion comprising walking, swimming and flying are all utilised. Mimicking locomotion of frogs can thus be adapted for robots working in unknown environments, particularly for tasks demanding locomotion in land, semi aquatic hazardous environment and in water.

CSIR-CMERI has studied different aspects of a live swimming Indus Valley Bullfrog. It was observed that jumping/crawling movements involves motion of the legs primarily on the sagittal plane whereas swimming locomotion involves motion of the legs in the frontal plane. Frogs utilise drag-based propulsion for swimming. Propulsive forces are further generated by the hindlegs terminating in webbed feet. Kinematic and morphological data pertaining to a swimming frog were obtained with the help of cine-film records.

Joint trajectories for one complete swimming cycle was extracted, which helped in the design of the robotic frog and modeling of the thrust force characterization. Different limbs of the robotic frog was also designed from the morphological data. The design of the hind and forelegs was inspired by the musculoskeletal system of a frog. For the movement of hindlegs, two coupled motions were introduced for the four joints by means of tendon-pulley arrangement. Webbed feet for the robot for supporting locomotion in water was also designed. An additional degree of freedom was incorporated for changing the configuration of hindlimbs when the mode of locomotion changed from an aquatic one to a terrestrial one. For the design of the forelegs, two simple segments with two DOF was used. Prototype of the robotic form is being fabricated on the basis of the design.



Fig: 1.55 Extracted frames of frog for one swimming cycle

Basic engineering and technical support for commercial beneficiation of low grade iron ore

Beneficiation of low grade iron ore fines with 55% Fe has been taken for Bhushan Steel Ltd, New Delhi, for their proposed plants having the feed capacity in the range of 4-15 MTA. Basic engineering package along with material balance, particle size distribution and other related physical data for each stream has been provided. CSIR-IMMT will provide necessary technical support for the proposed beneficiation plants.

Tungsten carbide cast composites for neutron shielding of tokamak type fusion reactor walls

CSIR-IMMT in association with Board of Research in Fusion Science and Technology (BRFST), and Institute for Plasma Research, Gandhinagar has designed and commissioned a down draft plasma reactor to produce good quality tungsten carbide cast ingots. An arc plasma melting process is utilized in this reactor to melt-cast tungsten carbide for application in the walls of tokamak type fusion power reactor. Tungsten carbide is a good neutron absorbing material at higher energy level (2-14 MeV, fast neutron). The high Z value of tungsten and its association with light element like carbon, brings down fast neutron energy to thermal energy level by a combination of inelastic and resonance scattering of tungsten nucleus and elastic scattering of carbon nucleus. Due to the high melting point of tungsten carbide ($>2750^{\circ}\text{C}$), its melt casting to produce porosity free substrate/ingot is a difficult task.

In the developed process, composite mixtures of WC and W_2C were produced with carbon variation in the range of 30-50%. TiC and B_4C were also added to WC to produce WC + TiC and WC + WB composites which exhibited up to 26% neutron absorption per cm of thickness. The process has been developed at kg scale with a reactor capacity of 50 kW.



Fig: 1.56 a 50 kW arc plasma reactor



Fig: 1.56 b Tungsten carbide cast composite products

Production of ferro-nickel from chromite overburden/nickel laterite ore by thermal plasma process

CSIR-IMMT has developed a state-of-the-art technology for complete utilization of nickel bearing lateritic ore/ chromite over burden (COB) containing nickel for commercial production of ferro-nickel, which can be used for manufacture of stainless steel. The nickel bearing lateritic ore/ COB is in a complex state that cannot be beneficiated only by physical means. The physical beneficiation process does not provide any up-gradation of nickel or elimination of iron present therein due to its complex and finely disseminated nature. To overcome this inherent problem, an eco-friendly and zero waste innovative process know-how has been developed by

CSIR-IMMT to convert goethite phase present in ore bodies into magnetite phase so that iron and nickel present therein can be easily separated from other gangue materials, viz. silica, alumina etc. by employing the reduction roasting technique followed by magnetic separation. The magnetic concentrate, which is rich in nickel, can be smelted to produce Fe-Ni containing 6-10% Ni. This process is well comparable with any of the processes available elsewhere in the world for commercial Fe-Ni production.

Magnesia galaxite/hercynite bricks for cement rotary kiln

Magnesia chrome bricks are used in the burning and transition zone of rotary kiln, the main equipment for the production of Portland cement. Here, chromite poses a great environmental problem due to its carcinogenic nature. Development of alternate refractory materials is the key to overcome this problem.

Magnesia-galaxite and magnesia-hercynite bricks can replace magnesia chrome brick due to their thermo-elasticity property and compatibility with molten cement clinker. Galaxite and hercynite are spinel group of minerals which are not available in nature and have to be synthetically prepared by sintering as well as fusion route in electric arc furnace (EAF). Magnesia-galaxite and -hercynite bricks have been produced by CSIR-IMMT by using synthetically prepared fused galaxite/hercynite through plasma fusion route to replace magnesia chrome bricks in cement rotary kiln.

The chrome free bricks can be used in the burning zone of cement rotary kiln in place of conventional magnesia chrome bricks. The product showed high spalling resistance, excellent coating formation and better chemical resistance to alkalis.

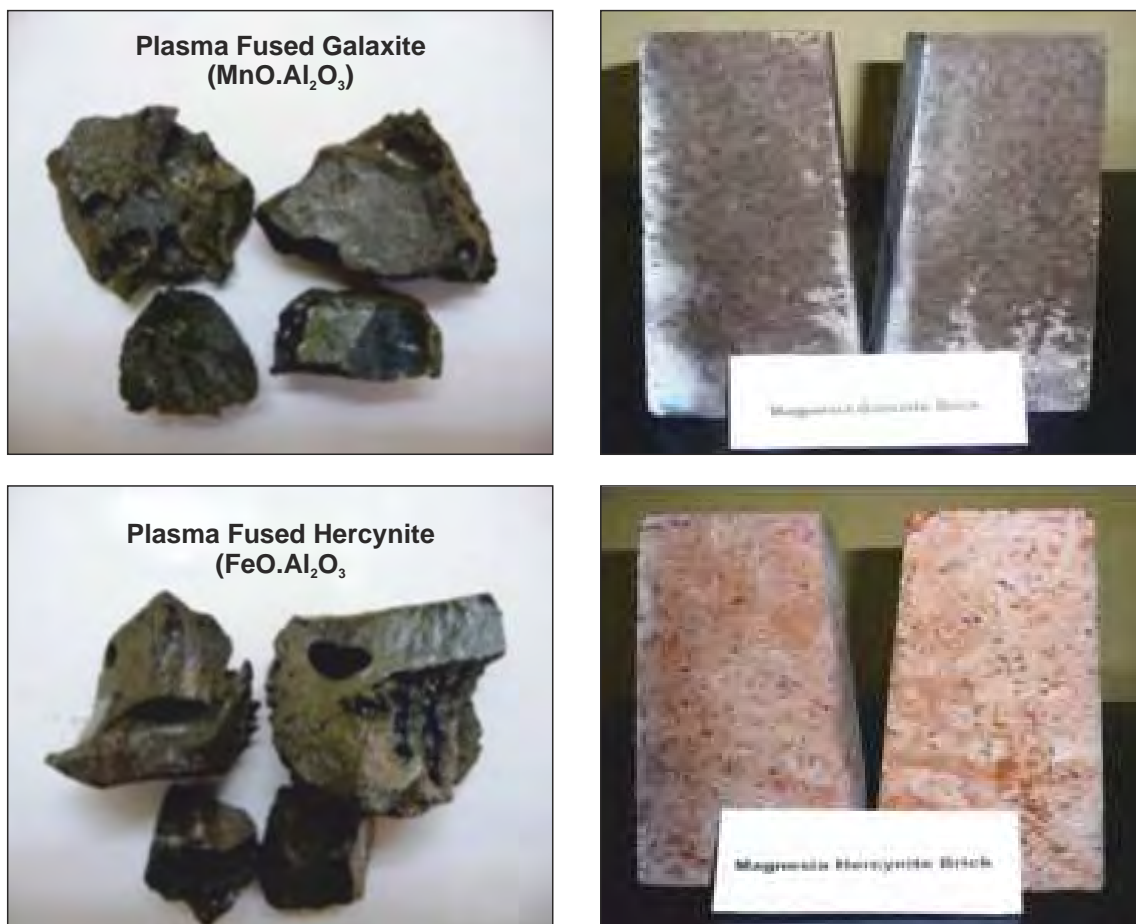


Fig: 1.57 Chrome free bricks

The Engine Bay Door for LCA

As a part of Light Combat Aircraft (LCA) series production, CSIR-NAL has new production standard tools were designed and fabricated through private partner M/s Tata Advanced Materials Ltd. One set of centre fuselage parts (7 nos.) were delivered to the production group of LCA for series production (SP1) assembly. This contribution is a major step in taking LCA from limited series production phase to series production phase. In another achievement, the Engine Bay door (middle) of LCA using high temperature Carbon/Bismaliemide prepreg system, with a service temperature of 200°C, has been developed using a novel vacuum bag technique which is currently undergoing testing.

DHVANI - An indigenous advanced target training system for the Indian Army

CSIR-NAL has developed a system for detection and hit visualization using Acoustic N-wave Identification (DHVANI) for locating bullet hits on targets. This involves the deployment of an array of acoustic sensors at pre-specified location under the general flight path of such projectiles, acquiring and analyzing the signal in real-time and instantaneous display of results in a graphical form at the shooter's end. Detection of the N-wave is carried out

by an in-house algorithm which was inspired by approaches to detecting irregular heartbeats (which are also like N-wave shapes). It is further recognized that the intersection of the shock wave with the ground results in a hyperbola, the center of which can be realized by the solution of a pair of simultaneous equations which essentially capture the time-delay of arrival of the wave at each

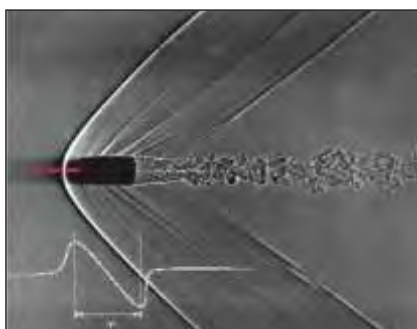


Fig: 1.58a N-wave' associated with passage of bullet



Fig: 1.58b The 'DHVANI' system

sensor. This is accomplished by a multitude of sensors (six) in two rows to also obtain the velocity of the projectile. The results of field trials using INSAS rifle and 5.56 caliber bullets at Iblur firing range showed an accuracy of better than 7mm. Typical processing times per shot are lesser than 50ms which allows a fire rate of up to 900 rounds per minute implying that tracking can also be done for a light machine guns.

The system is now being ruggedized to withstand all environmental conditions and acceptance trials at the Infantry School.

Drishti Systems at Main Runway 28-10 of IGI Airport

Based on the excellent performance of Drishti installed at IGI Airport (New Delhi) in December 2011, Indian Meteorological Department requested CSIR-NAL to install three more systems on a priority basis at the main Runway 28 of IGI Airport. The systems were needed to handle the urgent requirement of the winter season of 2012-13. In a record time of three weeks, three systems were fabricated and installed at the touch-down, mid & take-off points of runway 28 in the first week of January 2013. Presently there are five Drishti systems at IGI airport, the only Cat III B airport in the country wherein aircrafts have to land under conditions of lowest visibility of 50 meters. Drishti system is capable of measuring visibility down to 5 meters and meets all the stipulations of International Civil Aviation Organisation (ICAO) & World Meteorological Organisation (WMO).



Fig: 1.59 Drishti at Main Runway 28-10 of IGI Airport

One more system was installed in Netaji Subhash Chandra Bose International Airport, Kolkata in December 2012. The systems have been awarded international Class I certification. Presently seven latest state of the art Drishti systems are working in three international airports viz., Lucknow, IGI, New Delhi and NSCBI, Kolkata.

Certificate for Limited Series Production of a Wankel Engine

The second flight test of the indigenous 55 hp Wankel Rotary Combustion Engine (WRCE) was carried out on 20th June 2012 on the Aeronautical Development Establishment's (ADE), at Kolar airfield. This engine was the second flight worthy prototype delivered to ADE by CSIR-NAL. Two out of three engines produced by DRDO based on the CSIR-NAL design, through a private partner, were also flight tested and shown to meet the requirements of the mission. Based on the performance, CEMILAC accorded the certificate for 'Limited Series Production' on 7th February 2013.

DWR for ISRO at Cherrapunji

CSIR-NAL has successfully installed 12.88m diameter composite spherical Doppler Weather Radome (DWR) protecting the weather radar belonging to BEL/ISRO at IMD campus Cherrapunji within a record time. The IMD campus is at a distance of just 30kms from the Indo-Bangla border.

The radome will protect the Rs.12 Crores worth antenna installed by ISRO from the rains and other harsh environments that are impending. It is a matter of great pride for CSIR-NAL as the indigenously developed ground based DWR Radome has for the first time reached the country.

The fructification of the efforts in the development of the radome manufacturing technology has been all the more satisfying as it caters to the societal needs of N-E India. CSIR-NAL has received a technology fee of Rs. 2 crore.



Fig: 1.60 Glimpse of DWR at Cherapunji

High Speed Permanent Magnet Alternator

CSIR-NAL has developed a high speed permanent magnet alternator with a power rating of 4.5 kW at 30,000 rpm and this remote part rated speed for Gas Turbine Research Establishment (GTRE), DRDO. An integrated test set-up with alternator and air turbine drive was designed, fabricated and used for the performance testing of the alternator.

The alternator mainly consisted of a rotor and a stator. The rotor was constructed with a main cylindrical iron core, several magnets arranged circumferentially over the core and sleeve containment over the magnets in a concentric manner. The containment sleeve is the most critical component in the rotor assembly as it experiences very high circumferential stress resulting from the centrifugal loads of the magnets and its inertia due to high speed of rotation. A high degree of interference is required in the rotor assembly between the core, magnets and the sleeve in order to avoid slippage at high speed. A novel concept introduced relaxes the interference requirement leading to easier assembly. Moderate interference was achieved using temperature differential during assembly with rotor cooled in liquid Nitrogen and the sleeve with induction heating. Special fixtures were developed to keep the 24 magnets together into the rotor.



Fig: 1.61 High speed permanent magnet alternator rotor

CETP scale electro oxidation plant

The first ever CETP scale electro oxidation plant has been designed in India for treatment of highly recalcitrant chemical industry effluents, based on the technology developed by CSIR-NEERI. This technology helps to meet the effluent discharge norms (COD of 250 mg/l) with low foot print area (4m x4m per reactor) and is easy to install, operate and cost-effective.

Setting up an Industrial scale Column (2.5m dia.) at Andhra Baryte Corpn. Pvt. Ltd, Cuddapah

CSIR-NML has developed and provided process, technological and engineering inputs in designing, fabrication, commissioning and stabilziation of industrial flotation column to M/s Andhra Baryte Corporation Pvt Ltd. Chennai for the beneficiation of low-grade barytes of Mangampet, Kadapa, Andhra Pradesh. A 2.5m diameter flotation column has been fabricated and erected and related instruments have been installed. Commissioning of the plant is in advanced stage.



Fig: 1.62 Flotation Column (2.5m dia) erection work in progress at Andhra Baryte Corporation Pvt Ltd, Mangampeta, A.P. for the beneficiation of low grade barytes

Development of a process and design of a closed cell for production of sodium metal by fused salt electrolysis of sodium chloride

Sodium metal is used as a coolant in fast breeder reactors. Being a strategic metal with no indigenous production facility presently available in India, it is imperative to be self-sufficient in the production of Na in view of India's fast breeder reactor programme. CSIR-NML, in association with Heavy Water Board (DAE), Mumbai, has developed indigenous technology for production of sodium metal through molten salt electrolysis of sodium chloride. CSIR-NML has successfully designed, and fabricated a 500A closed cell, which was operated continuously for three weeks at CSIR-NML and produced about 20Kg of sodium metal. The purity of the metal was between 98 to 99%. Scaling up activity for operation of 2000A cell is under progress.



Fig: 1.63a Operational view of 500A closed cell



Fig: 1.63b Storage of Sodium Metal in Kerosene

Recovery of metallic alloys and slags as valuable product from spent catalyst residue

The hydro processing catalysts used in the petroleum refining process deactivate with time and become spent when the activity of the catalyst declines below the acceptable level. The waste catalyst is required to be processed not only to prevent environmental pollution but also to obtain economic advantage by recovering the valuable metals. The hydrometallurgical recovery process at M/s Rubamine Ltd. generate a leach residue containing about 3.5% Ni, 1.0% Co, 3.0% Mo, 1.5% W, 1.5% P in alumina matrix. CSIR-NML has developed a process for treatment of waste catalyst to recover metal values in the form of alloy and high grade alumina as slag. Various smelting parameters were optimized on a 3kg scale to maximize the metal recovery and to get the desired alumina grade. More than 96% of different metals such as Mo, Ni, W, V were recovered in the alloy. The result was validated at a 10 kg scale with repeat smelting experiments.



Fig: 1.64 Molybdenum, tungsten and nickel rich alloy and alumina rich slag obtained from catalyst residue by smelting

Technology for production of tellurium metal powder from copper refinery anode slime.

The application of tellurium includes cadmium telluride solar panels, free machining additives in metallurgy, catalysts, colour ceramics, etc. Massive commercial production of cadmium telluride solar panels and bismuth telluride in refrigeration technologies in recent years has significantly increased tellurium demand. The selling price of tellurium is ~US\$ 200/kg. Average world production of tellurium is estimated at 450-500 tonnes per year. The world reserve of tellurium is around 24,000 tonnes contained mostly in copper resources.

Worldwide, more than 90% of tellurium is produced from anode slimes collected from electrolytic copper refining, and the remainder is derived from skimmings at lead refineries and from flue dust and gases generated during the smelting of bismuth, copper and lead ores. The anode slimes of copper and lead refineries normally contain about 3% tellurium. Hindalco Ind. Ltd. at their Birla copper unit produces ~ 2600 tpa anode slime. Presently a fraction of the tellurium resource is utilized for production of copper telluride. The present process developed by CSIR-IMMT utilizes the secondary material-anode slime, from copper refinery plant of Hindalco Industries Ltd. - A Birla copper unit, located at Dahej, Gujarat, for production of tellurium powder.

At present, there is no plant producing tellurium in the country. Process know-how and basic engineering is provided by CSIR-IMMT for a plant capacity of 60 tpa tellurium (~13% of world tellurium production). By-products of 300 tpa copper cathode and 600 tpa lead sulphide will be produced. The process is a close loop process and hence will not produce any solid/liquid effluents. The residue after recovery of tellurium will be used for recovery of precious metals using existing process. Plant construction approval has been obtained. The plant is expected to be commissioned soon.

Iron ore beneficiation

- **Commercial plant of Brahmani River Pellets Ltd.**

Iron ore beneficiation plant has been set up by Brahmani River Pellets Ltd. (BRPL) at Barbil (Odisha) on the process flowsheet developed CSIR-IMMT, to operate 6 million tonnes of low grade iron ore for producing 4.5 million tonnes of iron ore concentrate. This concentrate is to be transported through pipeline to their pellet plant which is situated at a distance of 250 km. The plant has been commissioned after getting the environmental clearance.

- **Commercial plant of Essar Steel India Ltd.**

Iron ore beneficiation plant has been set up by Essar Steel India Ltd. on the process flowsheet developed CSIR-IMMT. The plant is located at Barbil (Odisha) to process 16 million tonnes of low grade iron ore to produce 12 million tonnes of iron ore concentrate. This concentrate is to be transported through pipeline to their pellet plant which is situated on the coast at Paradeep at a distance of 260 km. The plant is under erection and commissioning after getting the environmental clearance from Ministry of & Environment & Forest.

1.3.3 Unique Major Facilities

Lab Scale Autoclave for Academics

CSIR-NAL has conceived, designed and an affordable lab scale autoclave developed to meet the requirements of academic and research Institutions working in the area of polymer composites. Orders for this autoclave have been received from premier educational and research institutes such as IIT Kanpur, MIT, Manipal and VSSC.

Integrated Global Bus Avionics Processing System & Advanced Display System

The Integrated Global bus Avionics Processing System (IGAPS) with features like avionics full duplex ethernet, ARINC 653 compliance and wide bandwidth for communication has been successfully designed, developed and integrated for the first time in India by CSIR-NAL. It has been integrated with sophisticated real time automated test station for simulation, debugging and application integration. Further, the widescreen high resolution AMLCD and Advanced Display System (ADS) has been successfully realized and integrated with state of the art avionics suite for regional transport category aircraft. A memorandum of cooperation has been signed with Astronautics, USA for worldwide commercial exploitation.

The National Trisonic Aerodynamic Facility (NTAF)

Like previous years, NTAF provided S&T support to the major national aerospace projects including in-house projects and that of Departments of Space, ADA, and Defense using the 1.2m Trisonic wind tunnel. Another notable achievement was

an all-time record productivity of 2015 blow-downs. The tunnel time was utilized for projects by VSSC, DRDO, ADA and NAL (43). Apart from contributing to the National security, during the year 2012-13 the NTAF carried out blow-downs worth Rs.18.55 crore.

Acoustic Test Facility

The Acoustic Test Facility (ATF) continues to play a crucial role in environmental qualification of satellites, launch vehicle inter-stages and their subsystems for the Indian Space Programme. During the year, ATF successfully completed acoustic test programmes on the GSLV as well as GSLVM3. The new state-of-the-art, nitrogen-based, acoustic test facility built by NAL at ISRO's ISITE Complex was fully commissioned and completed the acoustic test on GSAT 7, GSAT 10, GSAT 14 and SARAL spacecraft. An amount of Rs. 4.15 crore during 2012-13 for utilization of the facility.

Failure Analysis and Accident Investigations

CSIR-NAL is recognized as India's premier organization for carrying out failure analysis and accident investigations. It has been doing this with distinction for more than 40 years. During the year 2012-13, fifty seven investigations were taken up and completed. Majority of these investigations were undertaken for Indian Air Force, India Navy, HAL, ADA, DGCA etc. The laboratory contributed significantly in identifying the causes of failures and suggesting recommendations for prevention of similar failures in future. The recommendations suggested encompassed design modification, selection of appropriate material and fabrication methodology, maintenance and inspection schedule as applicable depending on the nature of failure.

Static Structural Strength Testing of Active Antenna Array Unit (AAAU)

CSIR-NAL has completed full scale static structural strength testing of active antenna array unit (AAAU) for demonstration of compliance with the strength and deformation requirements for airworthiness certification (RBHA/FAR 25) for selected critical flight and ground load cases (limit and ultimate). There were 6 limit load cases and 7 Ultimate load cases for which the AAAU was tested and qualified. The complete test set-up is shown in Fig. 1.65. The test article was mounted and the test fixtures for applying the loads were designed and developed in-house. Displacement sensors at various locations were identified by Finite Element Analysis (FEA) results. The SST of AAAU for all the 13 test load cases was successfully completed and measurements made. The static strength tests were witnessed by ANAC certifying agency, Brazil, for the FAR 25 certification.



Fig: 1.65 Static structural strength test setup for AAAU

1.4. INFORMATION SCIENCES CLUSTER

1.4.1 Scientific Excellence

High Performance Supercomputing Facility

CSIR-4PI has established 360 Tera Flop (peak) High Performance Supercomputing facility at which is the largest CPU based installation in the country and 82nd in the world as per the November 2012 list. The systems, riding over the National Knowledge Network, will provide the much needed boost to the computational scientists of CSIR in all disciplines. It is a CSIR central facility catering to more than 200 computational scientists across all CSIR laboratories.

CO₂ and Ocean Modules

CSIR-4PI has commissioned continuous measurement stations at Pondicherry and Port Blair. In addition to a Picarro instrument measuring CH₄ and CO₂ at very high precision, Port Blair has a LGR instrument which measures NO₂ and CO. A new Picarro instrument has been installed in Hanle. The robust inversion of CO₂ fluxes from Temperate Asia by CSIR-4PI, perhaps the first paper from India on this topic, has been published in Current Science recently. Climatological and inter-annual simulations of the biogeochemistry of the global oceans has been completed using the TOPAZ model embedded within the Modular Ocean Model. Analysis of these simulations have revealed interesting insights into the interannual variability of chlorophyll, primary production, pCO₂ etc in the Indian Ocean.

Increase in Impact Factor of CSIR Journals

CSIR-NISCAIR has been providing scholarly research communication links to the scientific community through its 19 journals of international repute, covering all major disciplines of science and technology. CSIR-NISCAIR journals notched up an increase of >41% in Impact Factor (IF) over that from the previous year, according to the Journal Citation Reports 2011. Two journals, viz. Indian Journal of Experimental Biology and Indian Journal of Biochemistry & Biophysics have even crossed an Impact Factor of 1.0 – a rarity for Indian Journals.

CSIR-NISCAIR Tube

CSIR-NISCAIR Tube has been launched to serve as a repository of science videos, photographs, presentations, etc which could serve as an important information and archival resource for CSIR scientists. The site has recorded more than 25000 hits. About 75 photographs and more than 100 videos have been uploaded by various members/agencies. The participating members are from various viz. CSIR laboratories like CSIR-CLRI, CSIR-IICT, CSIR-CECRI, CSIR-NAL and CSIR-NML. Efforts are on to popularise the CSIR-NISCAIR Tube within the wider scientific community as well.

CSIR Outreach

The two newsletters brought out by CSIR-NISCAIR – 'CSIR News' (in English) and 'CSIR Samachar' (in Hindi) – serve as effective links between various CSIR constituents and purveyor of information regarding CSIR's S&T achievements for other R&D organizations, university departments, industry and other users. Both the monthly newsletters have been given a new look and their contents reorganized in keeping with CSIR's corporate ambitions.

Video Recording Studio

Video Recording Studio has been established at CSIR-NISCAIR which is equipped with latest HD technology, working shooting floor with HD recording facility and editing bays for film quality HD editing capability. The Studio will promote the objective of science communication through multimedia taken up recently by the Institute. Three documentary films have already been made on CSIR-NPL, CSIR-IHBT and CSIR-NISCAIR and proposals from about 10 labs have been received.

Indian ISSN Centre

The Indian ISSN Centre at NSL is one of the networks of over 80 national centers worldwide. It is responsible for assigning ISSNs free of charge to serials published in India. To date, over 23,500 Indian periodicals have been assigned ISSNs. The Centre is also responsible for contributing Indian records to the world database of ISSN numbers, known as the ISSN Register, maintained by the ISSN International Centre in Paris. Around 3000 ISSNs have been assigned during 2012-13.

Popularization of Science

Building up on its aim of science popularization through its well-acclaimed popular science magazines (Science Reporter, Vigyan Pragati & Science ki Duniya), and promotion of Scientific Temper, CSIR-NISCAIR took up the

cause further by organizing an international conference on 'Vaigyanik Drishtikon Tatha Chetna Jagane Mein Sanchar Madhyamon ki Bhumika par Antarrashtriya Sammelan' in May 2012 in New Delhi. This was on lines of the National Workshop and International Conference held earlier.

CSIR-NISCAIR launched two new facilities during the year – Data Information Resource Facility (DIRF) and Video Recording Studio at Science Communication through Multi-Media Division.

National Science Library (NSL)

National Science Library was set up in 1964 at CSIR-NISCAIR to provide a wide range of S&T documentation and information services. NSL subscribes to almost all Indian S&T periodicals and 200 foreign S&T periodicals. The library has more than 2, 51,670 monographs and bound volumes of periodicals. It continues to subscribe to PCT (Patent Cooperation Treaty) Minimum journals. It has also started providing e-access to more than 5000 foreign periodicals to its patrons.

Library Acquisitions

During the year 2012-13, 875 books were acquired and catalogued. NSL has access to a number of e-resources including: Essential Science Indicators; Journal Citation Reports (JCR); Web of Science–Expanded; Indian Journals.com: Access is extended to all CSIR labs; Emerald database; Ulrich online; Library and Information Science Abstracts; Springer; and Sage.

Library Automation

E-Granthalaya, a web-enabled library automation software from National Informatic Centre (NIC), was successfully installed and data transferred from 'GRANTHALAYA TO E-GRANTHALAYA' and new books/Journals were entered in 'E-GRANTHALAYA'.

Information Retrieval Service

With the rich collection of S&T information resources and online access to a large number of international databases, CSIR-NISCAIR provides comprehensive bibliographies on any topic in any discipline of science and technology, by searching periodicals, patents, standards, technical reports. During the year, preliminary searches were carried out and information in terms of references in databases was supplied to a large number of customers. The orders registered from academic, scientific, business and industry communities were executed.

Contents, Abstracts and Photocopy Service (CAPS)

The main objective of CAPS is to fill the gap created by sharp decline in the availability of foreign periodicals to the Indian S&T community. This service is of great help to scientists who do not have access to foreign periodicals. On a yearly subscription, one can get contents of journals (15 for individual subscribers and 30 for institutional subscribers) (12 monthly dispatches) of one's choice from about 7300 Indian and foreign periodicals pertaining to different disciplines on paper, diskette or through e-mail. On browsing the contents, one can place order for abstracts and/or photocopies of full articles.

'India S&T'

CSIR-NISTADS published 'India S&T (Volume II)' through Cambridge Foundation. The book was released by the Minisetr of S&T and the first copy was presented to the President of India on Technology Day 2013.

CSIR – Traditional Knowledge Digital Library (TKDL) Unit

TKDL database has been created in five international languages i.e. English, French, German, Spanish and Japanese from the codified traditional knowledge texts to prevent misappropriation of India's Traditional Knowledge at International Patent Offices. During the period from April 2012 to March 2013, 20,854 numbers of medicinal formulations of Ayurveda, Unani, Siddha and Yoga have been added to the TKDL database. 250 Yoga techniques videographed, have been incorporated in the TKDL database along with the details of the prior art.

Status for the Period : 2012-13		
S. No.	Stream	Transcription
1.	Ayurveda	1,330
2.	Unani	16,657
3.	Siddha	2,862
4.	Yoga	5
	Total	20,854

Unit for Research and Development of Information Products

CSIR-URDIP has provided IP search and analysis were provided to number of clients in public and private sector including research institutions, Indian private sector companies, MNCs, SMEs and academic institutions.

The Unit also assisted few of the CSIR laboratories to set up Institutional Repositories. CSIR-CENTRAL – the open archives harvester also harvested the repositories in to the Central Harvester System.

1.5 PHYSICAL SCIENCES CLUSTER

1.5.1 Scientific Excellence

Spectroscopic Diagnostic of Volume Discharge Arrangement of a DBD Source and Comparison with PIC Simulation Code

CSIR-CEERI has reported the spectroscopic analysis in volume discharge arrangement of a dielectric barrier discharge source in parallel plate geometry of a width of 2 mm. Helium is used as working gas. The investigations are carrier out using sinusoidal supply for the generation of discharges where two current pulses have been observed with different polarities in one period. The electron plasma density and temperature during the discharge have been estimated using the line-ratio technique from the observed visible neutral helium lines. To validate the results, a commercial particle-in-cell simulation code, OOPIC-Pro, has been used, which confirms filamentary as well as diffused discharges observed in the experiment. This code analysis also validates the estimated electron plasma density and temperature measurement at two different working pressures and at a fixed operating frequency.

In Dielectric Barrier Discharge (DBD) CSIR-CEERI has estimated the electron plasma density and electron plasma temperature during the discharge through spectroscopic diagnostic technique and resistive method because in-situ diagnostics are not possible due to small geometries of DBD sources. It has established for these results by comparing them with the particle-in-cell (PIC) simulation. It is further proposed multi-switch equivalent electric circuit model for DBDs which has provided an opportunity to explain first time the multi-peak phenomena observed in the discharge current. This model understanding enabled to obtain the internal discharge parameters including discharge impedance which is not measurable during the experimental process.

Large volume double ring penning plasma discharge source for efficient light emissions

CSIR-CEERI has developed a large volume penning plasma discharge (LVPPD) device with a facility to insert a Langmuir probe in the main plasma and also to observe the effect of opacity and diffusion on the observed spectral lines by means of spectroscopic analysis. The main task was to make the PPD volume larger for VUV spectrometer-detector system calibration study, i.e., novel technique we proposed, and is to get the brighter emissions of both VUV and visible light simultaneously without any obstacles. For this, a simple large dimension double ring penning discharge device has been developed. When stayed with the single anode ring configuration, worse confinement resulted and also spectral emission saturated at higher pressures. In recent past some efforts have been made to avoid saturation at higher gas pressures in PPD sources. These approaches are more complex. Moreover, in some geometries confinement was much more important. Confinement was so good that they contained non-neutral

plasmas at substantial densities. In such cases, the geometries were having much larger and precision-shaped anodes, nearly closing the gap between the cathodes. Therefore this approach with double anode ring is an unique arrangement and is a compromise between optical confinement and anode transparency for effective spectroscopic and Langmuir probe measurements inside the LVPPD source.

Detailed Slope Stability Analysis of Jhakri (Bari Village) Landslide Site & Developing Early Warning System

Landslides are one of the critical natural hazards affecting the mankind. The incidences of landslides have increased tremendously in recent times mainly due to large scale unplanned construction activities and other geo-physical factors. It is important to monitor potentially unstable slopes based on time dependent deformation to understand the nature and pattern of slope movements. The systematic monitoring of the slope provides valuable information, which is utilized for the design of control measures as well as developing an early warning system for forecasting the major failure which may occur in that area.



Fig: 1.66 View of instrumented landslide site from Rampur side hill

CSIR-CSIO has carried out a detailed analysis of an active landslide in Jhakri Distt Shimla (Himachal Pradesh). The data acquisition system installed at site is monitored & controlled from CSIR-CSIO through GSM/GPRS interface. Recorded data is analyzed for finding causative landslide trigger parameters.

As per the field investigations carried out at the selected site along with results of various index tests carried out on strata samples collected during borehole drilling, it is observed that strata is overburden slipped mass which is predominantly comprised of quartz mica schist big slipped boulders, mica schist broken rock pieces set in matrix of sand, silty sand and mica schist fines.

A movement at 7.5 m depth along EW axis has also been observed in inclinometer casing. Further, the sub soil water level in the drill holes viz DH-01 & DH-02 have not been encountered up to the drilled depths of 50.10m & 50.20m in DH-01 & DH-02 respectively. No significant change in pore pressure is observed by piezometer installed at 50 meter depth throughout the monsoon season.

Aqueous Synthesis of L-Cysteine Stabilized Water-Dispersible CdS:Mn Quantum Dots for Biosensing Applications

A protocol for the aqueous synthesis of L-cysteine (2-amino 3-mercaptopropionic acid) capped manganese-doped cadmium sulphide quantum dots (QDs) has been developed by CSIR-CSIO. Nanoparticles of the average size of 3 ± 0.5 nm are synthesized. Depending upon the size, the QDs exhibit emissions such as 585, 610, 660 nm. The proposed L-cysteine capped CdS:Mn QDs can be termed as multi-functional crystals, which are useful for the assembly of fluorescent molecular probes for clinical analysis and disease diagnosis. The proposed nano-crystals can also be potentially used as contrast agents in the magnetic resonance imaging due to the presence of manganese.

Extraction of Nano-diamonds from waste materials

Nano diamonds (NDs) are nontoxic materials and have potential applications in Bioimaging, drug delivery, biomedical sensing and lubrication. NDs were extracted from a novel source by CSIR-CSIO. These fluorescent nanomaterials were synthesized from waste material deposits of Indian villages. The raw material was purified by acid and thermal treatment. The purified material was characterized by various techniques like Raman spectroscopy, FTIR, TEM, SEM, Confocal, PL measurements etc.

Scientific drilling near Koyna reveals the thickness of Deccan Traps and nature of underlying basement rocks

CSIR-NGRI has been carrying out scientific drilling at two sites, Rasati (near Koyna; borehole KBH-1) and Udgiri (south of Warna; borehole KBH-2), broadly marking the northern and southern limits of the seismic zone (Fig:1.67a&b). Both the boreholes were targeted to go through the Deccan basalt pile and penetrate the underlying basement rocks for the first time in the region. Geological core logging, carried out by scientists from CSIR-NGRI, Atomic Minerals Directorate (AMD) and Mineral Exploration Corporation Limited (MECL) indicate that the flood basalt pile comprises multiple lava flows of varying thicknesses, with each flow consisting typically of a massive lower part and vesicular / amygdaloidal middle-upper part, occasionally flow top breccia and inter-trappean sediments. A number of sheared and/or crushed zones were observed in cores both from the basalt pile as well as the granitic basement. Geophysical logs obtained in the borehole column revealed the distribution of physical properties of the basalt pile as well as the granitic basement rocks. Drilling in borehole KBH-2 progressed amidst heavy water loss conditions and frequent occurrences of thick clay zones and/or fractured horizons at multiple depths that are prone to caving.

The boreholes revealed a 933 m – thick pile of basaltic flows, underlain directly by the granite-gneiss basement. No sediments were found between the basaltic pile and the granitic basement. The thickness of the Deccan Traps, revealed by drilling, is consistent with the inference made earlier from the conspicuous absence of earthquakes in the top ~ 1 km in the area.

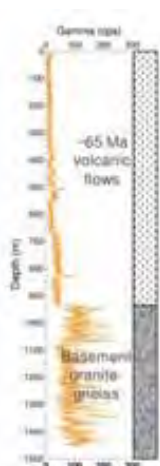


Fig: 1.67a Gamma log in borehole KBH-1 showing the sharp transition from basalt to granite-gneiss basement rocks at a depth of 933 m

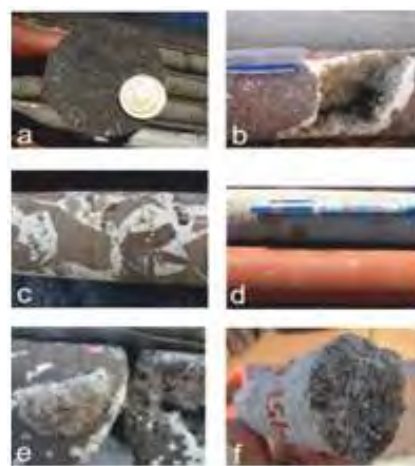


Fig: 1.67b Core samples from borehole KBH-1 showing (a) massive basalt, (b) vesicular and amygdaloidal basalt with large vugs filled with quartz and/or calcite, (c) flow-top breccia, (d) red bole bed and overlying massive basalt, (e) vugs filled with zeolite, and (f) basement granite at 951 m depth.

Near Surface Shear Velocities in Diverse Geological Segments of India

CSIR-NGRI has estimated the near-surface shear velocities beneath 144 broadband seismic stations of India that span diverse geological terrains, using 37,635 good quality three-component waveforms from 3849 earthquakes. The estimation suggests lower shear velocities beneath regions of large sedimentation, with the lowest in the range of ~1 km/s observed for the Indo-Gangetic plains. These low velocity estimates show a dependence on frequency, implying velocity changes with depth. Segments that represent the Precambrian shield reveal high shear velocities in the range of 3.2 to 3.4 km/s, akin to global observations. The mountain ranges that constitute the Himalaya and southern Tibet have intermediate velocities primarily ranging from 2.8 to 3.0 km/s. Shear velocities can be used as first order diagnostics for the nature of geological terrane all over the country.

First Finding of Native Gold from the Chromitites of the Nuggihalli Schist Belt, Dharwar Craton, South India

Occurrence of native gold in ultramafic rocks is rather rare. For the first time, CSIR-NGRI has reported occurrence of native gold grains and flakes from the chromitites of the Mesoarchean Tagadur Mines of the Nuggihalli Schist Belt (NSB), Dharwar Cratons, Southern India. Broadly, the gold grains (Fig: 1.68) occur in three distinct forms: anhedral and dendritic flakes in the matrix (~1 to 480 μm); spherical and subspherical grains (~1 to 25 μm) and as inclusions in chromite grains (~5 to 35 μm). The gold grains included in the chromite grains are nearly pure with a very minor component of copper. The spherical and subspherical grains in the ultramafic matrix have significant contents of Ag and Co. The anhedral and dendritic gold flakes in the matrix have significant Co content. The petrographic character and the compositions indicate that the gold grains are syngenetic in nature and indicate the processes involved in the progressive crystallisation of the magma from which the minerals are crystallising. It further indicates that the gold in the native form is due to highly reducing conditions in the initial stages of crystallisation of the komatiitic melts from which the chromitites are alleged to have formed. Occurrence of gold provides direct bearing on the understanding of the geological evolution of the region. Gold being precious, this discovery once established will have long varying economic implications.

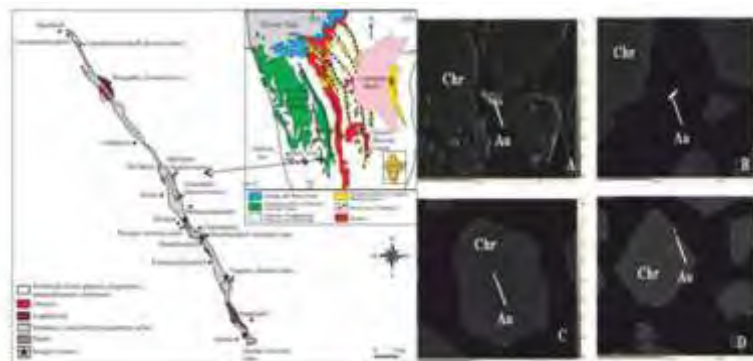


Fig : 1.68 Location map of the Nuggihalli Schist Belt, Karnataka and the BSE images of the Chromite grains with native gold inclusions

Low shear velocities in the sub-lithospheric mantle beneath the Indian shield

CSIR-NGRI has obtained the mantle transition zone structure of the Indian shield obtained by analyzing ~14,000 teleseismic receiver functions from 77 broadband stations reveals variations among geological provinces. Regions like the northwestern Deccan volcanic province and the Southern granulite terrain which are acknowledged to be under the influence of mantle plumes show delays (~1.5 s) in the Ps conversion times from the 410 and 660 km discontinuities with respect to the stable Archean segments of India. Incidentally, the 410 km conversions at most stations sited on Archean Indian cratons contrast with similar settings globally (Fig: 1.69) where the P410s and P660s conversion times are advanced by ~2 s. These delays for the Indian shield suggest elevated temperatures in the sub-lithospheric mantle coupled with a thin lithosphere that is uncharacteristic of cratons. A thin transition zone beneath most of the cratonic stations lends support to the enhanced temperatures within the TZ itself. The study provides evidence for imprints of plume lithosphere interactions, which is vital for understanding geodynamic processes in the region.

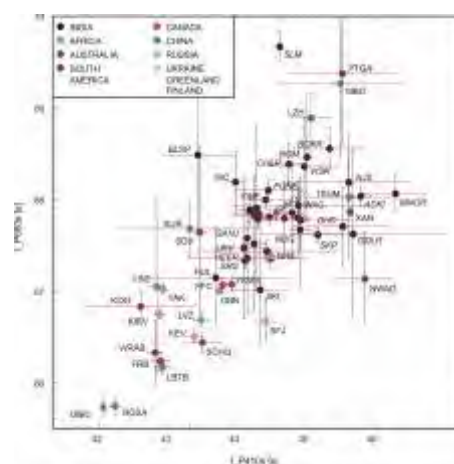


Fig: 1.69 Comparison of the Ps conversion times from the 410 and 660 km discontinuities for stations (labeled in italics) sited on the Archean Indian cratons, with those from the other cratonic regions. One sigma error bars of the times estimated from bootstrap analysis are also indicated.

Insights into interaction between Mantle Processes and Crustal Tectonics: Gravity Perspective

2-D lithospheric density modelling along three geotranssects of more than 1000 km each crossing the southern Indian shield has been based on the assumption of local isostatic equilibrium and is constrained by the topography, gravity and geoid anomalies, by geothermal data, and where available by seismic data. CSIR-NGRI's integrated modelling approach reveals a crustal configuration with the Moho depth varying from about 40 km beneath the Dharwar Craton, and about 39 km beneath the Southern Granulite Terrane to about 15–20 km beneath the adjoining oceans. The lithospheric thickness varies significantly along the three profiles from about 70–100 km under the adjoining oceans to about 130–135 km under the southern block of Southern Granulite Terrane including Sri Lanka and increasing gradually to about 165–180 km beneath the northern block of Southern Granulite Terrane and the Dharwar Craton. The thin lithosphere below the southern block of Southern Granulite Terrane including Sri Lanka is, however, atypical considering its age. Results suggest that the southern Indian shield as a whole cannot be supported isostatically only by thickened crust; a thin and hot lithosphere beneath the southern block of Southern Granulite Terrane including Sri Lanka is required to explain the high topography, gravity, geoid and crustal temperatures.

An integrated 2-D lithospheric density model of southern Indian shield, south of 16°N, reveals a significantly thin lithosphere below the southern block of Southern Granulite Terrane including Sri Lanka, which is typical considering its age. The widespread thermal perturbation during Pan-African (550 Ma) metamorphism and the breakup of Gondwana during late Cretaceous are proposed as twin cause mechanism for the stretching and/or convective removal of the lower part of lithospheric mantle and its replacement by hotter and lighter asthenosphere in the southern block of Southern Granulite Terrane including Sri Lanka.

Fracture zone induced seismic anisotropy in the Mahanadi offshore basin

The ocean bottom seismic (OBS) data acquired in the Mahanadi offshore by CSIR-NGRI in the year 2010 reveals shear wave splitting patterns in the azimuthal gathers of OBS data, clearly isolating the fast (S1) and slow (S2) axes of propagation in the radial azimuthal gathers. Further, amplitude nulls and amplitude maxima are observed in the transverse azimuthal gathers. These two features are diagnostic for the existence and orientation of anisotropy, which is modeled by generating full waveform synthetic seismograms. Based on an

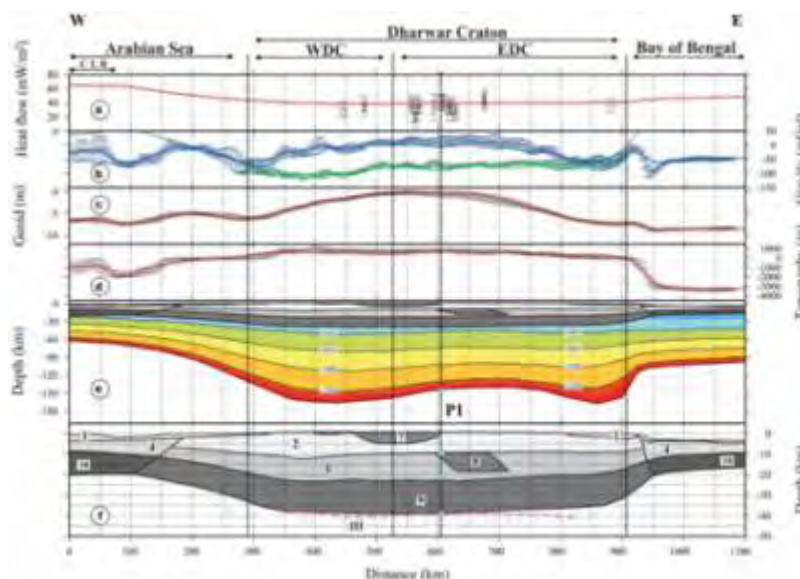


Fig: 1.70 Lithospheric model and observed and calculated response along W-E across Dharwar craton. Figs (a–d), continuous lines correspond to calculated response of the initial model and dots with uncertainty bars correspond to measured data. blue line and symbols corresponds to free-air gravity anomalies, green ones to Bouguer anomalies.

analysis of the 2-D multi-channel seismic (MCS) and the OBS data, it is suggested that this splitting could be due to dominant fractures present in this region. The strike of this fracture set is inferred to be 130° from the S1 and S2 orientation and variation in the P-wave amplitude with azimuth. A good match between the synthetic and observed data is noticed for a near vertical fracture (dip angle of $\sim 85^\circ$). The seismic image obtained from 2D high-resolution MCS data correlate reasonably with the OBS results. Based on these analyses, we are able to delineate the fracture zone, which is linked to near vertical fracture in gas hydrate reservoir. The study determines fracture angle and orientation which are vital for selection of final drilling targets for hydrocarbon exploration.

Integrated Geophysical Techniques and Numerical Modelling for mapping mineralization zones

Two dimensional electrical resistivity and Time Domain Induced Polarization (TDIP) datasets were collected by CSIR-NGRI along a 3.8 km line in Betul-Chindwara belt (BCB) Madhya Pradesh, Central India. These data shows clear indication of sulphide mineralization, iron oxide, iron carbonate, oxidized sulphide (Gossan), volcanic massive sulphide deposits are preserved within the host rock. Models obtained from inversion clearly reflect presence of large sulphide (conducting) ore body.

The integration of geological and geophysical methods helped in pinpointing the massive and disseminated sulphide mineralization leading to the delineation of base metals which are vital for industrial applications.

Prognostic Anomalies of Induced Seismicity observed In Koyna-Warna Region

In order to study the preparatory processes in the sources of the induced earthquakes, CSIR-NGRI has analyzed q , d and b -values and the RTL parameters in the earthquake catalogue for Koyna–Warna region from 1964 to 2006. The induced seismicity is found to exhibit prognostic variations in these parameters, which are typical of preparation of tectonic earthquakes and indicative of the formation of metastable source zones of future earthquakes. Based on the obtained results, it is suggested that initiation of failure in these metastable zones within the region of induced seismicity could have been caused by the external impacts associated with water level variations in the reservoirs and by the internal processes of avalanche unstable crack propagation.

Understanding proxies associated with a medium undergoing stress perturbations prior to failure during an earthquake is an important research area, globally. The studies in the Koyna region have an advantage as the region is seismically active for the past more than five decades and provides a well documented catalog from which several prognostic anomalies have been deciphered in the present study. The results obtained can be applied to other case studies for understanding earthquake generation processes.

Assessment of Seismic Hazard in the Himalayan foreland basin

CSIR-NGRI has installed a network of 24 strong motion velocity meters in the foothills of Himalaya during October–November 2012 covering areas in the western Indo-Gangetic plains in addition to the earlier array of broadband seismic stations operated in this region. Using recordings of four shallow focus earthquakes ($M < 5.0$) which, occurred in the Himalaya and near Delhi at soft sites and hard reference sites, institute computed standard spectral ratios (SSRs). SSRs at sites near the Himalayan foothills, where the sediment thickness is ~ 4 km, reveal a broadband amplification with a fundamental frequency of 0.13 Hz. The amplification at this frequency varies between 20 and 60. The fundamental frequency increases to the south as the thickness of the sediments decreases, becoming ~ 0.8 Hz at the southernmost site. The amplification at the fundamental frequencies exceeds 10 at all eight soft sites. Calculations based on reasonable earthquake source and attenuation models and application of random vibration theory suggest that peak ground acceleration and peak ground velocity at soft sites near the foothills, located 100 km from the epicenter, would be amplified by a factor of 2–4 and 6–12, respectively.

This study will be very useful in developing prediction models for amplification of seismic waves in case of a large earthquake in the Himalaya, thus enabling estimation of meaningful earthquake hazard in the foot hills of Himalaya comprising major cities.

Hydrology and water resources from space over the Indian continent

CSIR-NGRI has analyzed Gravity Recovery and Climate experiment (GRACE) satellite gravity data over the main Indian river basins (Ganga, Krishna, Godavari, Brahmaputra and Indus) and time series of integrated vertical water content have been produced over these basins. To understand spatio-temporal variation of water storage over these basins, an empirical Orthogonal Function (EOF) has been also applied to the GRACE time series and results are interpreted in terms of natural and anthropogenic causes. The water level time series over the various major Indian rivers (Ganga, Krishna, Indus, Godavari, Brahmaputra) and their main tributaries are computed using the various satellite missions such as T/P, Envisat, Jason-1/2. Precise information of geoid undulations is essential for determining orthometric heights from GPS and also offers information of subsurface density heterogeneities. CSIR-NGRI has computed geoid undulations over southern Indian region from terrestrial gravity and elevation data using remove-restore technique that involves computation of Stokes's coefficients through a spherical Fast Fourier Transform. It has been noticed that the gravimetric geoid shows an improvement in precision and reliability, fitting the geoidal heights measured for the validation points better than EGM2008 and EIGEN-GRACE02S in the south Indian Region.

In view of the long term decrease in the water storage found in the northern India encompassing Ganga and Indus basins (in contrast to the southern India) where inter-annual variability is dominant, the water level time series over the various major Indian rivers (Ganga, Krishna, Indus, Godavari, Brahmaputra) and their main tributaries are computed using the different satellite missions such as T/P, Envisat, Jason-1/2. It is noticed that river levels at various places are in agreement to river gauge records indicating the potential of utilizing satellite altimetry data for monitoring of river levels of wide rivers which provides important clues for water management.

Structure and dynamics of groundwater systems in northwestern India under past, present and future climates

Electrical Resistivity Tomography (ERT) carried out by CSIR-NGRI across the Ghaggar river system of northwestern India is inverted using least squares inverse approach with a smoothness constrained standard Gauss-Newton optimization technique using 'Res2DINV software'. The results of the 2D resistivity sections in and around Punjab

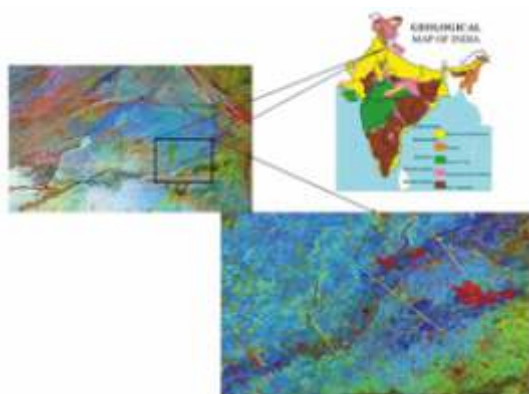


Fig: 1.71a Figure showing the landsat imagery showing near surface palaeochannel in alluvium aquifer of the Ghaggar river system in Northwestern India : Yellow lines are the 2D resistivity tomography profiles across the palaeochannel

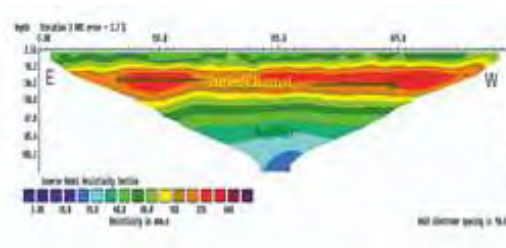


Fig: 1.71b Shows the 2D inverted resistivity section along Kasaur Site (KA -2) delineating the buried channel anomaly with variable thickness and its lateral extension along with the aquifer zone

and Haryana, in northwest India revealed that the subsurface consists of sedimentary formations underlain by 6 to 7 major stratified layers but at a few sites the layers are highly disturbed and are quite heterogeneous in nature signifying the palaeochannel signature and meandering nature. The present day near surface younger

sediments showing moisture variation underlain by major and clear cut buried palaeochannel (hard sand layer) and followed by the aquifer are clearly delineated as revealed from the resistivity models in terms of resistivity values and their contrast. The alternate bands of sand and silty layers are delineated based on the geological interpretation of the 2D inverted resistivity models. The thickness of the buried channel varies from place to place, which relates to the depositional history of the sand at different times and stratigraphy of the region.

The buried channels are possibly the indicators of groundwater reserves and serve as a precious resource on demand. The presence of buried channel (dry and hard sand formation) and the discontinuity within the buried channel are very well resolved from the present 2D resistivity tomography at different sites.

Imaging mantle lithosphere for diamond prospecting

CSIR-NGRI has studied a wide area in southeast India, parts of which are bestowed with both diamondiferous and non-diamondiferous kimberlite/lamproite occurrences. Using Ps (SV and SH) and Sp receiver function techniques, depth images of the lithospheric mantle beneath southeast India encompassing the Eastern Dharwar-Bastar cratons and the adjoining Eastern Ghats Mobile belt were recovered. These images reveal presence of two significant velocity anomalies of contrasting nature at different depths beneath the study region. High velocity features are observed between 160 and 220 km depth (Lehmann discontinuity depth or L-depth) while a complex low velocity contrast layer (LVZ) is delineated at ~ 80-100 km depth. Analyses of results from several other studies that include regional geology, geophysics, geochemistry, and geochronology allow us to infer that the positive velocity contrasts at L-depth represent preserved oceanic remnants of a ~ 1.6 Ga old paleosubduction event in southeast India. Computations on selected geothermobarometry data in conjunction with multiple evidences presented in this study argue that the craton beneath southeast India is underlain by a thick lithospheric root/keel in excess of 200 km. This suggests an environment conducive for diamond stability. Consequently, the delineated complex LVZ feature is favored as a mid-lithospheric discontinuity (MLD) and not the shallow lithosphere-asthenosphere boundary (LAB) as inferred earlier in the study region. Our transverse component receiver functions bear remarkable similarity in shallow mantle stratification with that of the kimberlite bearing Slave craton in Canada that has confirmed presence of diamonds accompanied by a thick lithospheric keel.

It is encouraging that the three regions within the Bastar and Eastern Dharwar cratons in this study are laden with a vast hidden potential for more future discoveries of kimberlite/ lamproite intrusions. Search for new indicator minerals that are stable within the stability field of diamond and dominantly defined by subduction related process that possibly operated over an area in excess of $2 \times 10^5 \text{ km}^2$ holds the key to realize the unrealized potential of the study region in terms of diamond exploration.

Xenon as Internal Standard for the Accurate Determination of Trace Elements in Water Samples by ICP-MS

The utility of ^{129}Xe as an internal standard has been validated by CSIR-NEIST using standard reference materials NIST National Institute of Standards (USA) 1640d, NIST 1643e, and NIST 1640a. The accuracies and precisions achieved were markedly better when internal standardization was applied. In general, trace element data in a variety of water samples were obtained with < 5% RSD with comparable accuracy in each case, suggesting that this method can be applied routinely for the determination of trace elements in water.

The approach of using xenon (^{129}Xe) as an internal standard for the precise and accurate determination of several trace elements in different kinds of water samples by ICP-MS is novel since no external addition of any reagent is involved. As a result, the possibility of introducing any type of elemental impurities through the addition of an internal standard will be completely avoided. Therefore, this feature will be of great value when determinations are carried out for elements present at nanogram/ml and further smaller levels.

Study on influence of water saturation on rock thermal conductivity Measurements

The effect of water saturation on thermal conductivity measurements using a set of 67 rock samples (covering igneous, sedimentary and metamorphic rocks) ranging in porosity from 0 to 8 %. CSIR-NEIST has carried out thermal conductivity measurements in the laboratory both in dry as well as water-saturated states using a steady state thermal conductivity meter. Thermal conductivities of rocks measured under both states are plotted for comparison. The present data reveal that for rocks with porosity > 1%, the thermal conductivity measured on dry rock is appreciably lower (generally up to 25%) than the value measured under saturated state. For rocks with porosity < 1%, the differences in measured thermal conductivities in the dry state and saturated state are within the measurement uncertainty. It is therefore recommended that the thermal conductivity on all rocks should be measured after saturating the rock samples with water to reflect near in-situ thermal conductivity.

An accurate assessment of thermal conductivity constitutes a key piece of information in all geothermal modelling studies for geodynamics as well as a wide spectrum of geothermal and geo-engineering applications including geothermal energy resource assessment, reservoir modelling, construction of underground tunnels for transportation and for hydropower projects, and planning for geological repositories for nuclear waste disposal.

Active Tectonics & Paleoseismic studies, using Geophysical Parameters, along the mountain frontal part of Eastern Syntaxial Bend, Lower Dibang Valley and Lohit Districts, Arunachal Pradesh

CSIR-NEIST has juxtaposed northwestern trending lithotectonic units of the Mishmi block with the almost N-S trending eastern Himalayan lithotectonic units along the Siang fracture. Earthquakes occurring on the Indian peninsula are the outcome of the Indian plate under thrust towards the Eurasian continent. A large window in the Siang river section exposes Paleocene rocks interbedded with Abhor volcanic as the subthrust package and MBT as the roof thrust. Mishmi block, tectonically separates the eastern Himalayan and the Indo-Myanmar mobile belts and form 'a linkage' in between. Active faulting along the Himalayan Front is observed. Left-lateral strike slip faults displacing Mishmi Thrust Zone had been observed. Morphological and sedimentary records at Siang, Dibang and Lohit rivers at Pasighat, Dambuk, Roing, Tezu and Parsuramkund areas in the NE Himalaya were studied with the help of terraces, for the evidences of the climate-tectonic interplay. Drainage maps were prepared and structurally controlled drainages were observed in the study area. Mishmi Thrust zone is found to be tectonically active with the uplifting of the Quaternary fluvial sediments for a height of about 40m from the present day river channel.

Aza-BODIPY derivatives: enhanced quantum yields of triplet excited state and singlet oxygen generation and their role as facile green photooxygenation catalyst

Singlet oxygen can mediate a wide range of reactions such as photooxygenation of organic substrates, in addition to PDT applications. CSIR-NEIST has developed a new series of aza-BODIPY dyes and tuned their triplet excited state as well as the yield of singlet oxygen generation, by substituting with heavy atoms such as bromine and iodine. The effect of substitution was studied by varying the position of halogenation. The core-substituted dyes showed high yields of the triplet excited state and high efficiencies of singlet-oxygen generation when compared to the peripheral-substituted systems. The aza-BODIPY dye having six iodine atoms on the core and peripheral phenyl ring, showed the highest quantum yields of triplet excited state ($\Phi_T = 0.86$) and singlet-oxygen generation ($\Phi_{^1O_2} = 0.80$). Interestingly, these dyes were found to be highly efficient as photooxygenation catalysts under normal sunlight conditions. These aza-BODIPY systems exhibit high yields of singlet-oxygen generation, and can act as efficient and sustainable catalysts for photooxygenation reactions.

Seismic Vulnerability Assessment of Shillong city

CSIR-NEIST has analyzed Microearthquakes spectra from Shillong region to observe the effect of attenuation and site on these spectra. The spectral ratio method is utilized in order to estimate the Q values for both P and S-wave in subsurface layer wherein the ratio of spectral amplitudes at lower and higher frequencies are taken into consideration for three stations at varying epicentral distances. Average estimates of QP and QS are 178 and 195. The ratio of QS to QP was estimated to be greater than one in major parts of Shillong area which can be related to the dry crust prevailing in Shillong region. The variation in corner frequencies for these spectra is inferred to be characteristics of the site. Simultaneously, observation from spectral content of local earthquakes recorded at two stations with respect to reference site yields greater amplification of incoming seismic signal in the frequency range of 2 to 5 Hz which is found to be well supported by the existing local lithology pertinent to that region.

Signatures of Indian Ocean dipole and El Nino-Southern Oscillation events in sea level variations in the Bay of Bengal

CSIR-NIO has investigated the impact of the Indian Ocean Dipole (IOD) and El Nino Southern Oscillation (ENSO) on sea level variations in the North Indian Ocean during 1957-2007. Using tide-gauge and altimeter data, it was shown that IOD and ENSO leave characteristic signatures in the sea level anomalies (SLAs) in the Bay of Bengal. During a positive IOD event, negative SLAs were observed during April-December, with the SLAs decreasing continuously to a peak during September-November. During El Nino, negative SLAs were observed twice (April-December and November-July), with a relaxation between the two peaks. SLA signatures during negative IOD and La Nina events are much weaker. A linear, continuously stratified model of the Indian Ocean to simulate their sea level patterns of IOD and ENSO events was used. Later solutions were separated into parts that correspond to specific processes: coastal alongshore winds, remote forcing from the equator via reflected Rossby waves, and direct forcing by interior winds within the bay. During pure IOD events, the SLAs are forced both from the equator and by direct wind forcing. During ENSO events, they are primarily equatorially forced, with only a minor contribution from direct wind forcing. Using a lead/lag covariance analysis between the Nino-3.4 SST index and Indian Ocean wind stress, we derive a composite wind field for a typical El Nino event: the resulting solution has two negative SLA peaks. The IOD and ENSO signatures are not evident off the west coast of India.

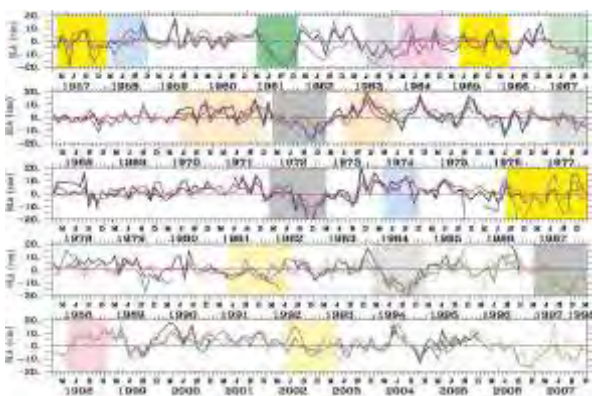


Fig: 1.72 Monthly SLAs at Visakhapatnam (black) and Chennai (blue) during 1957–2007; the model SLA is shown only for Visakhapatnam (red) because the SLAs at Chennai were almost the same (unlike in the climatology). Altimeter SLAs (green) at Visakhapatnam are shown for 1993–2007. The strong (dark color) and moderate (light color) positive IOD and El Niño events are shown in back- ground shades. Pure positive IOD events are in green shade, pure El Niño in yellow shade, and combined events (positive IOD and El Niño events) in grey shade. Pure negative IOD events are in light blue shade and pure La Niña events in ivory (cream) shade and combined events (negative IOD and La Niña events) are in pink shade. The correlation coefficients at Visakhapatnam and Chennai are 0.6 and 0.5, respectively. The regression coefficients a (intercept) and b (slope) at Visakhapatnam (Chennai) are 0.47 (A0.1) and 0.85 (0.7), respectively.

Study of estuarine systems

Extensive multidisciplinary measurements made at different time and spatial scales in Mandovi and Zuari estuarine systems in Goa, Gautami-Godavari system in Andhra Pradesh, and Backwaters of Kochi in Kerala by CSIR-NIO. The studies suggest that the monsoon driven estuaries of India do not reach steady state with respect to water and salt balances. The Indian estuarine systems experience very strong short-term and small-spatial scale variations that are driven by strong seasonality driven by monsoon regimes.

CSIR-NIO survey revealed large remnant of a grounded vessel off Candolim Beach, Goa

CSIR-NIO has carried out geophysical survey off Candolim Beach, Goa from 25 to 31 October 2012 where the then MV River Princess was grounded. The survey comprised of bathymetric, magnetic, sonographic and sub-bottom profiling. This was further backed up by underwater diving operations. Integrated interpretation of geophysical data supported by visual observations clearly showed the presence of large remnants of a grounded ship at water depths approx. between 3 to 10 meters located off Candolim Beach. While the penetration of the wreck into seabed could not be ascertained, a large part of the metallic structure was found to be exposed to water, protruding several feet above the sea bed.

1.5.2 Technology Developed

42 GHz, 200 kW CW/long pulse Gyrotron

CSIR-CEERI has indigenously developed the design technology of high power Gyro-devices and implemented in the fabrication of high power Gyrotron.

Microwave occupies a glorious position in the electromagnetic spectrum and in that there are a number of devices in this frequency regime which are capable of high power operations. Among them, Gyrotron has proven to be an efficient source for radio frequency (RF) generation at high power level and up to very high frequency. The Gyrotron consists of several components like electron beam source, interaction structure, quasi-optical launcher, collector, RF window, magnet system, etc. All the components have their distinct role in the function of the device. Among them, electron beam source also called magnetron injection gun (MIG) is the generator of electron beam and it is very essential that MIG should produce and provide electron beam suitable for the beam-wave interaction at the interaction structure for the effective power growth. The paper presents the introduction of a microwave tube, Gyrotron and its components along with review of the previous work, the background and the applications.

The functions of various components of a Gyrotron are discussed with particular highlighting on the electron beam emission from the electron beam source and the beam-wave interaction for power growth in the device. A review on different types of Gyrotron electron beam sources is also presented.

Importance of the contribution typically as an input to applied R&D/technology development, new insight into understanding of a phenomenon etc.

With the help of indigenous design technology, components of 42 GHz Gyrotron were developed. Some of the important tasks are also summarized as follows.

Fabrication of Nonlinear taper: The fabrication of non-linear taper (NLT) section is itself a challenging task due to its parabolic structure. For gaining expertise in NLT fabrication, first dummy NLTs were fabricated, initially with brass and subsequently with aluminum. Various measurements like dimensional measurement and surface finish measurement were carried out on the dummy NLTs. Based on the measurements, gradual slope and the overall slope of the NLT was found and it matched satisfactorily (up to three decimal points) with the design.



Fig. 1.73 Nonlinear taper of 42 GHz Gyrotron



1.74 Collector of 42 GHz Gyrotron

Capacitive Micromachined Ultrasonic Transducer (cMUT)

CSIR-CEERI has developed a capacitive micromachined ultrasonic transducer which is useful for Non Destructive Testing (NDT) applications of the materials. Developed fabrication technique of the device is simple and requires less number of masks.

A new fabrication process is developed for realizing cMUT devices. The developed technology is based on the anodic bonding technique using Silicon-on-Insulator (SOI) wafers. The device is easy to fabricate and the fabrication requires less number of processing steps.

A schematic diagram illustrating the basic components of the cMUT is shown in Figure 1.75. It is basically a parallel plate capacitive structure with bottom electrode fixed on the substrate and top electrode on a suspended membrane, which can vibrate at ultrasonic frequency. DC bias is applied for polarization and to ensure deflection in the desired mode of operation, which is out-of-plane. A small-amplitude AC signal of ultrasonic frequency is applied with the DC bias for excitation in the desired mode.

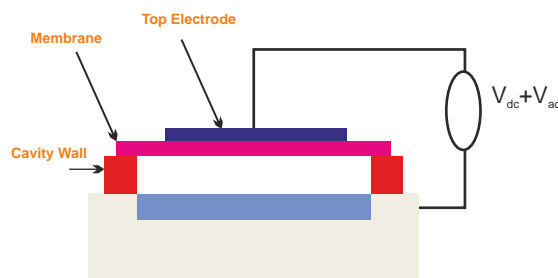


Fig:1.75 Schematic diagram of cMUT

The cMUT devices are fabricated using anodic bonding technique. Fabricated devices on 4" wafer are shown in Figure 1.76. A device under test is shown in Figure 1.77. The frequency response of a single circular cell is shown in Figure 1.78. The resonance frequency of the circular cell is found to be ~ 1.7 MHz.

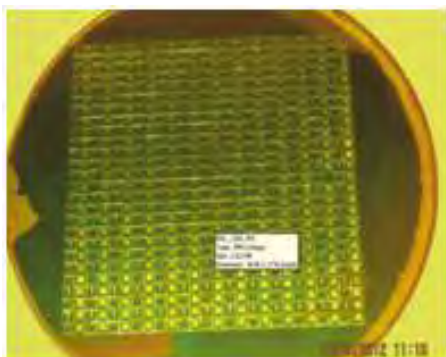


Fig: 1.76 Wafer with fabricated devices.

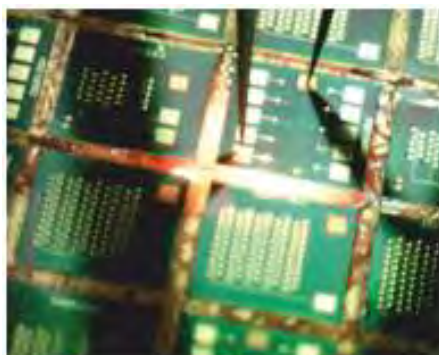


Fig:1.77 Device under test (DUT)

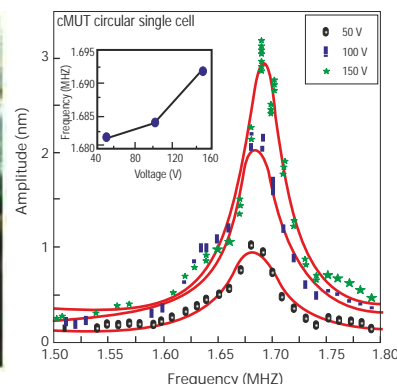


Fig:1.78 Frequency response of fabricated device

Symmetrical and Decoupled MEMS Vibratory Gyroscope

The gyroscope has a wide range of application spectrum that includes automotive applications for ride stabilization and rollover detection; some consumer electronic applications such as video-camera stabilization, virtual reality, and inertial mouse for computers; robotics applications; and a wide range of military applications.

Keeping in view the wide applicability of MEMS vibratory gyroscope, CSIR-CEERI has developed such device and has taken the lead in country. The present one is the second generation gyroscope which utilizes symmetrical structure and is free from mechanical cross talk. A SEM image of MEMS vibratory gyroscope recently developed by CSIR-CEERI is shown in Fig. 1.79. The device has been fabricated using UV-LIGA process having $10 \mu\text{m}$ thick nickel as structural layer. The device chip is $5 \text{ mm} \times 5 \text{ mm}$ in dimension and minimum feature size of the device is $5 \mu\text{m}$. Also, the prototype device has been characterized for frequency response using Polytec MSA-500 Micro System Analyzer. The results are shown in Fig. 1.80. The resonance frequency has been observed at 7.3 kHz against the design value of 7.5 kHz . The excitation voltage for this device is $40 V_{ac}$ with polarization voltage of $50 V_{dc}$.

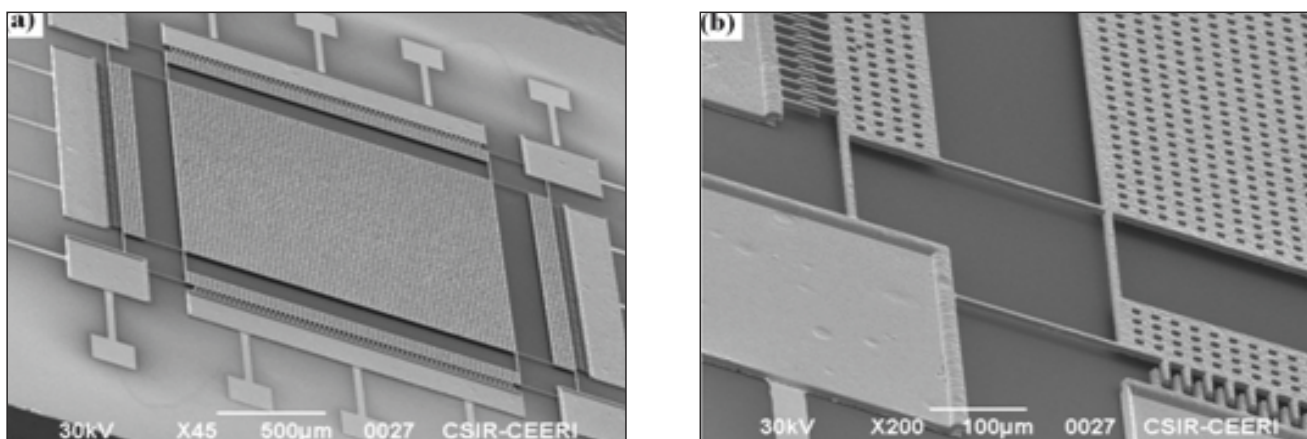


Fig. 1.79 (a) SEM image of the fabricated device. (b) Closer SEM image of the fabricated device

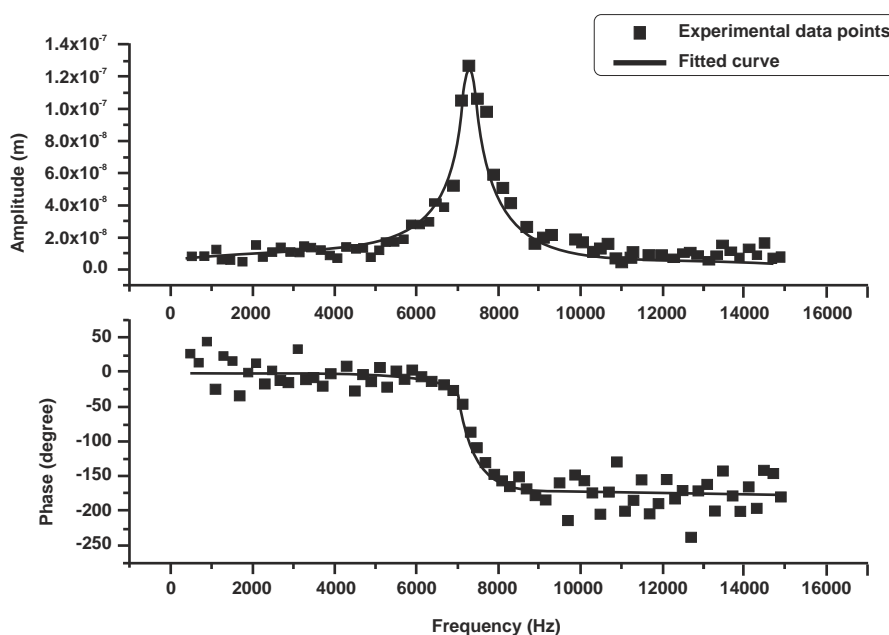


Fig. 1.80. Frequency response of fabricated device

VUV/UV Excimer Sources for Water Purification

The sterilization effects of ultraviolet (UV) radiation are well known, and low-pressure mercury vapor lamps are commonly used at the industrial level. More portable versions of utilizing small UV bulbs suspended in water bottles are currently on the market as well. Plasma based VUV/UV excimer devices developed by CSIR-CEERI will have long lifetime, environment friendliness, requiring less replacement and maintenance than their conventionally used bulb counterparts.

25kV/5kA Sealed-off PSS and 40 kV/3 kA Thyatron

The high power plasma switches specially PSS and thyatron are extremely useful for industrial and strategic applications, such as, radars, pulse fields, sterilizations, plasma processing, beam deflection, etc. In view of the strategic importance, this research is kept closely guarded calling for lesser dependence on the other countries and self-reliance in their development within India. Therefore, the development of the high-power plasma switches and related technologies are safeguard for required control and sovereignty of our country in this area of considerable strategic relevance.

The indigenous development of the new technology related to the plasma switches will enable Indian manufacturers, taking the know-how, to produce and market these devices without or less foreign dependence at a reduced cost. Consequently, this will motivate users to get attracted by Indian market. The competitive cost may also attract the abroad users.



Fig: 1.81 Discharge view of mercury free plasma based water purification system



Fig: 1.82 Developed 25kV/5kA Sealed-off PSS



Fig: 1.83 Test setup for 40 kV/3 kA deuterium thyatron at BARC, Mumabi



Fig: 1.84 A self-breakdown based single gap plasma cathode electron (PCE) gun

Electrodes for Milk Analyzer

Multisensor systems such as electronic tongue exhibit natural capability to measure sample attributes: quality, condition changes in time. Now-a-days great interest is shown in the concept of an electronic-tongue. CSIR-CEERI is involved in the fabrication of sensor for e-tongue electrodes. Sensor detects the adulteration in the milk and display appears on machine whether milk is adulterated or pure. Cost of investment is less. The technology is suitable for small and medium enterprise.

LTCC Microhotplates

LTCC Microhotplates are fabricated using LTCC technology and these hotplates are used for detecting leakage of gases e.g. LPG etc. LTCC microhotplates are rugged and reliable.

A number of electrodes were supplied to various agencies like: REIL Jaipur—100 nos. of sensors; DRDO-SSPL Delhi-25 nos. of via butterfly microhotplates; CSIR-CSIO-10 nos. of hotplates; CSIR-CGCRI - 05 nos. via butterfly microhotplates

Electrostatic Sprayer for Agricultural Applications

Pesticides are applied in fields as per recommended doses for healthy crop growth. It is one of the common methods to protect crops and trees against diseases and insects in agriculture/horticulture. Pesticides include insecticides, fungicides, herbicides and various other microbes. More than 90% of these pesticides are applied as sprayers mostly using hydraulic and conventional spray nozzle systems. Due to non-uniformity of droplet size and off-target drift, target deposition efficiency of less than 30% is quite common in agricultural pesticide spraying.

CSIR-CSIO has conducted experiment in an air atmosphere at ambient conditions ($T = 16 \pm 2^\circ\text{C}$, $\text{RH} = 57 \pm 3\%$), with air feed rate of 140 l/min with pressure variation range of 50-70 psi, liquid feed rate of 110 ml/min with liquid pressure variation in the range of 5-10 psi.

Charge-to-mass ratio is a term which measures the performance of the sprayer. Higher charge-to-mass ratio is required and the developed sprayer covers almost all the liquid based pesticides with full efficiency of the sprayer. The unit is ready for field level deployment by the users.

Head-up displays for Aircraft variants: Tejas-Navy light combat aircraft

To meet the requirements of Tejas-Navy light combat aircraft, CSIR-CSIO in collaboration with Aeronautical Development Agency (ADA) has developed Head-up display (HUD) technology. The HUD for the naval version is a further development of the HUD produced earlier for the Air Force version of the Tejas. The Air Force version has already been integrated into the cockpit and several units have been installed in the Tejas aircraft. HUD for the naval version is technologically more advanced and has different technical specifications than the air force version and its operating parameters, cockpit configuration and the pilot's field of vision are different. This includes advanced features customized for Naval requirements like enhanced instantaneous field of view in the vertical direction, additional electrical specifications like RS03 compliance for electric field of 200V/m, additional environmental compliance etc customized for the cockpit of LCA-Navy Aircraft. The developed system has been designed to withstand the impact of arrestor landing process on the aircraft carrier deck. The designed system is at par with the contemporary systems available all over world with its display brightness performance being the best in the world.

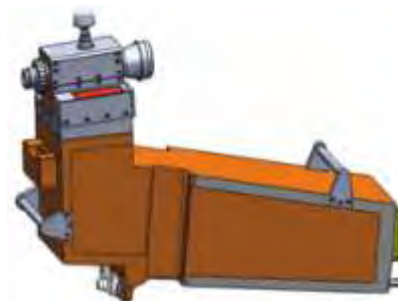


Fig: 1.85a Bore Sighting Tool



Fig: 1.85b HUD Flight Symbology

After completion of qualification test as per MIL STDs 704D, 461C and 810D, first two airworthy units are extensively being evaluated. The custom built bore sighting tool for harmonizing the HUD in the LCA-Navy Aircraft along with dedicated simulator-cum-test setup has also been approved by CEMILAC-RCMA for harmonizing, testing and formal evaluation of these HUD systems.

Head-up display for Hindustan Jet Trainer Aircraft

Head-up display CSIR-CSIO has custom built for Hindustan Jet Trainer - 36 Aircraft with new opto-mechanical layout, size, and electrical requirements of HJT-36 Aircraft Cockpit. Its salient features include low weight, lower power consumption, compact size, customized optical and photometric characteristics. The Real Data Entry Panel (RDEP) meant for interface with HUD Repeater has been upgraded as per the pilot's new recommendations.

Successful completion of 1st Phase of flight trials with indigenous HUD involved day and night flight trials and it resulted in valuable feedback to meet the pilot's final expectations.



Fig: 1.86a Head-up Display System for HJT-36 Aircraft



Fig: 1.86b Snapshot of HUD Display captured during 1st phase of flight trials

Autonomous Vertical Profiler

The AVP (Autonomous Vertical Profiler) technology (US Patent #6,786,087) developed by CSIR-NIO has been transferred to M/s CT Control Technology India Pvt. Ltd., Bengaluru, Karnataka. Weighing about 15 kg, made of aluminium alloy and having a speed upto 1m/s, the AVP offers a fast, cost effective, optimized approach to profiling in coastal waters. It consists of hands-free, motor driven in-situ robot profiler that requires no operator skill or deployment gear, while fulfilling the requirement of repetitive sampling. It uses standard oceanographic sensors to measure parameters such as chlorophyll, conductivity, temperature, radiance, dissolved oxygen at high resolution in water depths ranging from 5-200 m. It can also be used for surveying in dams, lake and estuaries.



Fig: 1.87a AVP under sea

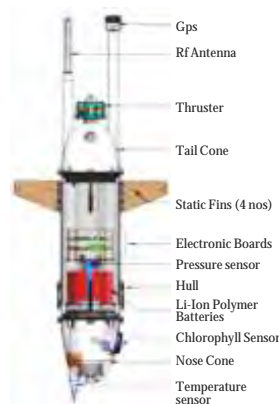


Fig: 1.87b Schematic of AVP

Launch of RV Sindhu Sadhana

With the launching of new multi-disciplinary Oceanographic Research Vessel RV Sindhu Sadhana, on 31st July 2012, at ABG Shipyard, Surat, the CSIR-NIO achieved an important milestone in the history of CSIR. This is one of the ambitious and prestigious projects of the CSIR taken up at a cost of Rs. 226.51 crores.

The new Oceanographic Research Vessel will greatly enhance the capabilities of Indian oceanographers to make multi-disciplinary observations, with adequate spatial and temporal resolution, enabling them to understand the oceanographic process in the seas around India and to translate this knowledge to benefit the nation.



Fig: 1.88 Prof. Samir K Brahmachari, Seretary, DSIR and Director General, CSIR (third from right), Dr. S R Shetye, Director, CSIR-NIO with others posing in front of RV Sindhu Sadhana

New developments in Carbon Nano Tubes

An invention relating to the development of light weight carbon nanotubes (CNT) reinforced polymer composites in the form of composite for electromagnetic interference (EMI) shielding applications has been filed by CSIR-NPL for securing IP. The technique enables up to 50 wt% of CNTs to be uniformly dispersed in the polymer. This makes these CNT-polymer composites more advantageous than metals and other carbon-based polymer composite materials as EMI shielding materials in range 8.2-18 GHz covering X and Ku band of the electromagnetic spectra.

Development of Fuel cell components

Two important carbon components of the fuel cell has been developed by CSIR-NPL viz. Porous conducting carbon paper and composite bipolar plate matching the performance of commercially available components.

Technology for porous conducting carbon paper has been commercialized and is being used in the fuel cells. The development of carbon based anodes for Li-ion batteries is also being used at CSIR-NPL.

1.6 CSIR 800

1.6.1 Scientific Excellence

Eco-friendly non-cyanide electroplating process

CSIR-CECRI has developed an eco-friendly non-cyanide electroplating process. It is useful for Moradabad brass cluster. The overall process cost is expected to be reduced by approximately 3 to 4 times. More than 400 small scale industries of Moradabad brass cluster are expected to be benefited.

Rehabilitation of Affected School Buildings during Kedarnath Disaster, Uttarakhand

CSIR-CBRI has played a major role in rehabilitation of affected school buildings during Kedarnath Disaster, Uttarakhand by organizing Workshop cum Demonstration Programme for Engineering Staff of SSA, Uttarakhand, providing Technological Options for School Buildings, Whole School Development Planning, Site Selection, Foundation & Slope Protection for Hilly Terrains, Vulnerability, Repair & Retrofitting of School Buildings, Quality in Construction of School Buildings; Demonstrating Stone Block Masonry, Rat Trap Bond, EQ Resistant Measures etc.

Training video on rural housing 'Unnat Gramin Awas'

A training video on rural housing 'Unnat Gramin Awas' has been developed and distributed by CSIR-CBRI to about 70 agencies working in the area. Ministry of Rural Development has posted the video on their Website. It is also available on U-tube.

CSIR-CIMAP Vetiver (Khus) bio-village for rural income enhancement

The roots of Vetiver, commonly known as Khus, are the source of high value essential oil used in perfumery, cosmetics and flavour industries. Vetiver is normally cultivated as 18-20 months crop. CSIR-CIMAP has developed a new variety CIM-Vridhi with reduced growth cycle of 10-12 months as compared to 18-20 months. With a root yield of about 18 quintals/ha and oil content of 1.69%, the crop gives an yield of about 30 kg/ha of essential oil enabling a farmer to earn about Rs.1,50,000 as net profit per hectare. Reduction in cropping duration has provided flexibility to 'CIM-Vridhi' to be accommodated in various kinds of crop-rotations (rice-vetiver; rice-wheat and vetiver; maize-potato-vetiver) as well as its co-cultivation with food (wheat and lentil) and medicinal aromatic crops (mints and Ocimum) which ultimately led to increased profits/ unit area over a period of time. Thus, it has provided a new dimension to diversification in agriculture (suitable to agro-forestry too) as well income augmentation of the farming community.

The demand of the crop has increased so high that participating farmers also started getting additional benefits by the sale of planting material. A farmer from Barabanki district could sell around 5,00,000 slips of this variety to other farmers interested in cultivation of vetiver (khus). CSIR-CIMAP's technological interventions through development of short duration (annual-12 months) and high yielding cultivar CIM-Vridhi with quality oil and potential to grow over a vast varying agro-climatic conditions, has attracted large number of farmers and has become popular among the farmers of U.P., Bihar, Chhattisgarh, Jharkhand, Karnataka, Orissa state in last couple of years. Farmers of Vidarbha, Assam, Meghalaya and Nagaland have shown keen interest in cultivation of Khus and have started cultivating Khus for higher incomes.

Efforts are being made to popularize the cultivation technology of vetiver crop variety CIM-Vridhi through bio-village mode, extending to more than 10000 ha area of the country and about 22000 numbers of farmers are engaged in cultivation of this crop in U.P., Bihar, and Karnataka etc. It is estimated that about 115000 kg good quality oil is being produced per annum based on the technology and variety developed by CSIR-CIMAP which is valued at about Rs. 150 crore with an employment generation of about 15,00,000 mandays.

High purity steviol glycosides (SG) from *Stevia rebaudiana*

CSIR-IHBT in its continuous endeavor has earlier developed and patented a simple, eco friendly, green process for extracting total SGs with a purity of 75% in the final product. In view of recent European Union approval of total SGs purity >95%, the process has been further improved and purity of total SGs in the final product has been achieved > 90 % on lab scale. Further improvement and optimization of the various process parameters are being carried out.

SGs powder developed with the improved process was further used to develop formulations namely table top sweetener 'HIM Stevia' and as a sweetener alternative to sugar in Tea product developed by the institute named 'READY TO DRINK TEA'.

'Him Sphurti' (CSIR-IHBT-T-01) a high yielding cultivar of China hybrid tea

CSIR-IHBT has developed a tea cultivar 'Him Sphurti' through selection approach from the century old Kangra tea plantations. The cultivar has excellent nursery performance both in rooting and early establishment. It is an early flushing clone by (8-12 days), vigorous in growth and has wide adaptability. It recorded over 1,500 kg made tea/ha yield (4-year cycle average) which was 50 % higher than the recommended cultivars for this region. It has a yield potential of 2,500 kg/ha in the second cycle, 25 % higher than its counterparts. In quality, it has better aroma than recommended cultivars i.e. Kangra Asha, Kangra Jat and UPASI-09, but astringency, brightness and briskness are at par.



Fig. 1.89 Tea cultivar Him Sphurti

This cultivar is moderately resistant to blister blight (10-20 % disease severity). HimSphurti has captured moderate to high level of genetic diversity. An additional net income of Rs. 20,000/ha through the sale of green leaf to the tea factories can be achieved by getting 25% high yield with this cultivar over the existing plantation.

Thornless Rose

CSIR-IHBT has developed novel rose cultivars namely 'Himalayan Wonder' and 'Himalayan Glory'. 'Himalayan Wonder' is thornless and the fully open flower is 10.23 cm, it has a vase life of 7 days. While in Himalayan Glory, the outer petals are of Tyrian purple coloured. The fully open flower is 10.65 cm and has a vase life of 8 days. Both these varieties are genetically distinct. Being unique in colour and feature both would fetch good returns at farmer level.



Fig: 1.90a Himalayan Wonder



Fig: 1.90b Himalayan Glory

Nutritionally enriched food products to combat malnutrition

CSIR-IHBT has identified certain bioresources with nutritional value having potential to be incorporated into food products. Calcium and iron rich products such as Mango Bar and Puffed Rice Bar were developed using low cost affordable technology.



Fig: 1.91a Mango Bar



Fig: 1.91b Puffed Rice Bar

Mango Bar and Puffed Rice Bar meets 40 and 60% of RDA requirement of iron and calcium, respectively. These products will be disseminated in a single serve pack under national mission programme of S&T intervention to combat malnutrition with the help of NGOs and other organizations closely link.

Cultivation of medicinal and aromatic plants in Jammu and Kashmir: S&T interventions by CSIR-IIIM

i. Srinagar

CSIR-IIIM is responsible to introduce cultivation of medicinal and aromatic plants such as Rose, Lavender, Clarysage, Rosemary and Geranium in Kashmir region. Improved varieties of these plants have been developed which find use in pharma, aroma, flavor and fragrance industry. Seven companies have come up in Kashmir region to cultivate aromatic plants as an industry and more than 40 farmers have been roped in as contract farmers of these plant varieties. The value added products, isolated from these plant varieties, find good market outside India that fetches premium prices. The cultivation of these varieties has provided self employment to many rural and underprivileged farmers.

ii. Gurez

Gurez valley remains snow bound for six months. Field demonstration centre have been established in the Gurez area for providing planting material to the farmers for medicinal and aromatic plants generating employment and revenue. Mint, lavender, Rosa damascena and Monarda citriodora are best suited crops for this area and were successfully introduced.

iii. Pahalgam

Lavender Park has been developed in Pahalgam in collaboration with Pahalgam Development Authority (PDA) where it has shown profuse growth. The area which is thronged by a very large number of domestic and international tourists, Lavender park has resulted in popularizing Kashmir lavender as a brand in the International Market.

iv. Baderwah, Jammu

Medicinal and aromatic plant garden has been developed in village Dardu (Baderwah) in collaboration with Baderwah Development Authority and local farmers. Field demonstration and Training programmes and

kissan melas were held in collaboration with KVK Bhaderwah. *Lavendula officinalis* and *Rosemarianus officinalis* crops which are alternative high income crops, are slowly replacing traditional low income crops in the area by rural farmers for their self employment and additional revenue.

Fresh ginger processing unit at Wyanad

CSIR-NIIST is setting up a fresh Ginger processing facility on behalf of the Department of Agriculture, Government of Kerala. The facility is for processing farm fresh ginger and makes value added products like cleaned/waxed ginger, ginger powder. Conventional artificial drying of ginger powder results in loss of aroma and the new facility employ state of the art refrigeration dehumidification drying. The unit will have a capacity to process 7.5 tonnes per day fresh ginger at a project cost of Rs.193.00 Lakhs. Institute is offering detailed engineering, technical consultancy, vetting the specifications for plant machinery, identification of machineries, erection, commissioning, training of plant personnel etc.

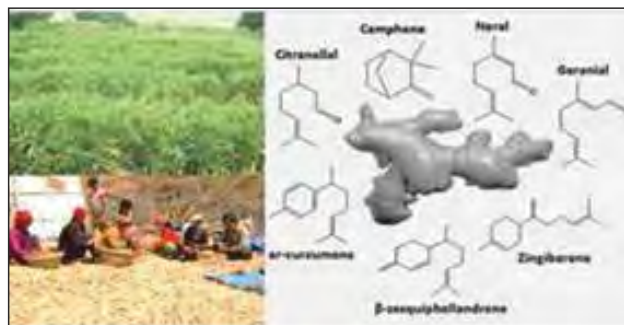


Fig: 1.92 Ginger cultivation in NE and compounds from ginger extracts

Development of Indian Standards for North East Ginger

CSIR-NIIST is developing a database on oil content and physico-chemical composition of various fresh ginger cultivars grown in seven states of North East (NE) and to arrive at a revised IS specification for NE ginger and its value added products. 3 sets of major cultivars of fresh ginger samples collected at different stages of maturity from seven North East states to determine the physico chemical characteristics of all the cultivar samples for Bureau of Indian Standards. The variation in the essential oil composition has been investigated for oleoresin and [6]-gingerol content in different fresh ginger cultivars harvested at 6- and 9-month maturity from five different states of NE. Monoterpenes, sesquiterpenes, and citral composition in the essential oil isolated were evaluated to ascertain their variation during the stages of maturity.

CSIR-NML's Contribution for the artisans of Moradabad

CSIR-NML has developed Improved coke based Energy Efficient Brass Melting Furnace for the artisans of Moradabad; The furnace of capacity is 150 kg for casting ingots and 3-10 kg for casting artifacts. It has reduced coke consumption (about 20%); less pollution, less effect on Zn vapour on human body; reduced melting cycle per batch (20%); minimum alteration of traditional furnace.

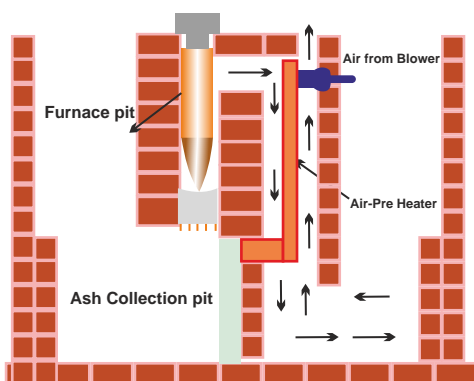


Fig: 1.93a Schematic diagram of Coke-based Energy Efficient Brass Melting Furnace



Fig: 1.93b Brass melting furnace in operation



Fig: 1.93c Artisans of Moradabad engaged in artifacts casting at CSIR-NML

Formulation of an anti-tarnishing lacquer for copper and its alloys

Metal work and handicrafts made from copper and its alloys (brass, bronze) tarnish (surface becomes black) when exposed to the environment resulting in the loss of aesthetic appeal. This has led to a decrease in the sale of brass/bronze handicrafts made in India in the international and domestic markets. The livelihood of the brass artisans of India and the survival of the age old profession of brass artifacts production are threatened. Lacquers can be used to prevent tarnishing of the brass, bronze or copper handicrafts for long durations. A novel polymeric corrosion inhibitor based lacquer has been developed at CSIR-NML which can be used as a coating to prevent tarnishing of copper and its alloys for several years. The lacquer is more efficient, cost effective and user



Fig: 1.94 Effect of lacquer

friendly compared to those available in the market. The advantages of the developed lacquer over the existing lacquers available in the market are: the lacquer takes 2 to 4 times less time to dry; no baking is needed; has 5times more storage life; provides low gloss (natural metal) finish rather than high gloss finish (plastic like); can be applied as dip, brush and spray coating. The lacquer was implemented at CSIR-NML. Field trial of the lacquer was successfully carried out at the brass cluster, Moradabad, Uttar Pradesh in collaboration with National Innovation Council of India. The target is to commercially produce the lacquer so that the brass artisans of India are able to produce better quality brass handicrafts in terms of surface finish and longevity. Also, these products of aesthetic appeal are available at a cheaper price and are able to compete internationally.

Fabrication and installation of RO plant

RO plant of 6000 litres per hour capacity which can treat seawater was installed at Erwadi Village in Ramnathpuram district of Tamilnadu. It has established our competency and ability to develop large scale seawater RO Plants using indigenous technology. The main distinguishing feature of the unit is the incorporation of an energy recovery system which reduced power consumption from 55 kW to 35 kW in first stage of the process.

The CSIR-CSMCRI mobile RO desalination bus provided 5000 litres per hour pure drinking water to the affected people of Jagatsinghpur and Ganjam districts of Odisha in the aftermath of the Cyclone Phailin. The hollow fibre-based water purification eliminated turbidity and pathogens from contaminated surface water. RO desalination unit of 4000 LPH capacity was deployed in H N Bahuguna Hospital, Srinagar, Uttarakhand after the Himalayan Tsunami. The unit was able to cater to the need of the people in the hospital as well in the vicinity of the hospital.



Fig: 1.95 Dr. T.Ramasami, Secretary, DST, New Delhi is inaugurating the plant

Water Purification through Membrane Technology for Societal Welfare by CSIR-IICT

Fluorosis is a dreaded disease which has affected several lakhs of people in India, especially growing children, who are suffering from dental and skeletal deformities. Nalgonda in Andhra Pradesh is the worst affected district due to its high ground water fluoride concentration which has reached a maximum level of even 20 ppm at certain locations. CSIR-IICT has put in significant efforts in research and application of reverse osmosis (RO) process for defluoridation of ground water in affected areas of A.P. Major advantages of RO technology include removal of all impurities in a single step, low operating cost which is less than six paise per liter of purified water and high production capacity. CSIR-IICT designed and commissioned the first plant of 600 L/h capacity at Mylaram village of Nalgonda District in July, 2005, which proved to be a model for replication by other organizations, and widely appreciated by the press and the masses. Recently one such unit has been installed.

Fresh Orders for Setting up of RO desalination Plants in Rajasthan

Based on the proven performance of the RO desalination units in Rajasthan and the quality of service rendered, CSIR-CSMCRI received order from DST, Govt. of Rajasthan for setting up 50 indigenously designed RO plants. The distinguishing feature is the high recovery of product water and management of fluoride in reject stream.

Establishment of a Model Salt Farm at Marakanam

In continuation the efforts to disseminate high purity solar salt technologies to grass root level at across the country CSIR-CSMCRI undertook an assignment from Salt Department, Govt. of India for setting up of a Model Salt Farm at Marakanam of Vellupuram District in Tamil Nadu. The area covered under this model salt farm is ca 10 acre and utilize the sub-soil brine for the recovery of salt & marine chemicals. The model salt farm has been fully established and "golden scrapping of salt" has started in the year 2012-2013.



Fig: 1.96 Model Salt Farm at Marakanam in Tamil Nadu

"NIIST NEER" - project inaugurated

CSIR-NIIST installed a fully automated drinking water plant on 24th August 2012. The plant provides purified drinking water which is christened "NIIST NEER". It uses the reverse osmosis and UV treatment technology. The quality of drinking water provided adheres to WHO standards. The plant has a capacity of 500 liter per hour with an efficiency of 50%. With the addition of this facility the Institute now makes substantial savings on public exchequer by getting rid of the external agency for drinking water supply.



Fig: 1.97 Dr. Suresh Das, Director, CSIR-NIIST, inaugurating the Drinking Water Plant

Central Management Activities



2.1 CSIR SOCIETY

[Highlights of the Meeting]

The meeting of CSIR Society was held on 7th June, 2012 under the Chairmanship of the Hon'ble Prime Minister of India and President, CSIR, Dr. Manmohan Singh.

The proceedings of the meeting started with the welcome address by the then Hon'ble Minister of Science & Technology and Vice President, CSIR, Shri Vilasrao Deshmukh. He appreciated the efforts of CSIR in domain of affordable healthcare which has developed a significant knowledgebase. He specifically mentioned about streptokinase portfolio of CSIR due to which the price of this injection fallen down by approximately one-sixth (i.e. Rs. 1000). He also applauded the concerted endeavor of CSIR for developing anti-dementia, anti-cancer, anti-hypertensive and fracture healing drugs. Hon'ble MoST and VP, CSIR made special mention to CSIR's Open Source Drug Discovery programme which has emerged as a globally recognized paradigm for innovation in drug discovery. Further, he commented on the partnership between CSIR and National Innovation Council to enhance the technology base of MSME. He applauded the setting up of Academy of Scientific and Innovative Research (AcSIR) which would secure India's leadership in tomorrow's science. He profoundly thanked Hon'ble Prime Minister, his Cabinet Colleagues and fellow Parliamentarians to help in setting up of AcSIR. Based on CAG report on autonomous bodies, he informed that plan support to CSIR, in comparison to the other Scientific Departments is on decline. He requested that in order to boost the pace of innovation in the country, enhanced funding to be provided to CSIR.

Hon'ble VP, CSIR put on record that CSIR has been striving hard to maintain its leadership position in research publications, patents, technology development and its commercialization. He assured Hon'ble PM that "CSIR will not only maintain its leadership position but would meet your expectation and expectation of this great Nation and create the technological niches, which would be globally recognized".

Prof. Samir K. Brahmachari, DG, CSIR made a detailed presentation on achievements of CSIR. He emphasized that, CSIR has translated the CSIR Vision document 2022 into effective strategies and programmes for implementation in XII Plan and beyond. Major achievements of CSIR, as projected by DG, CSIR included: highest ever published papers in SCI journals with highest ever impact, measured by citation; building up of its drug discovery portfolio; novel lacquer to help artisans of Moradabad brass cluster; and Fly-by-Wire Flight control Laws for TEJAS-Air Force and Naval Aircraft Variants. He also touched upon the assistance rendered to some State Governments through CSIR's knowledgebase.

On the invitation from Hon'ble Prime Minister and President, CSIR, members of the CSIR Society expressed their views. All the members appreciated overall accomplishments of CSIR.

Hon'ble Prime Minister requested his Cabinet colleagues also to offer their comments. Shri Pranab Mukherjee, the Hon'ble Minister of Finance assured all the necessary support from his Ministry regarding amending tax laws to enable CSIR to take equity in spin offs. Hon'ble Minister of Human Resource Development, Shri Kapil Sibal appreciated CSIR for its overall knowledgebase. Hon'ble Minister of State for Science & Technology, Shri Ashwani Kumar emphasized that S&T has to be promoted for the cause of innovation and its benefits must reach to the people who live at the bottom of the economic pyramid.

CSIR Society considered and adopted the CSIR Annual Report for the year 2010-11 and Annual Accounts for the year 2010-11.

Hon'ble Prime Minister and President, CSIR gave directions to CSIR.

He congratulated CSIR on its 70th Birthday for remaining relevant and contemporary. He expressed happiness to see CSIR initiate extensive interaction with various sectors of economy and work out strategies and programmes for the XII Five Year Plan to translate its Vision Document 2022. He urged CSIR scientists to be even more innovative in prevailing economic conditions and trade scenarios. He also said "CSIR has had a glorious

past and is going through an extraordinary present. I have no doubt that it has a bright future".

He reaffirmed his faith in CSIR for providing leadership to the nation and empowering young people and the people at the bottom of the economic pyramid.

2.2 GOVERNING BODY

During the year CSIR Governing Body met twice i.e. on 4th September, 2012 and 6th February, 2013.

2.2.1 181st Meeting of the Governing Body held on 4th September, 2012

Prof. Samir K. Brahmachari, DG, CSIR and Chairman, CSIR Governing Body appraised the members of deliberations of CSIR Society meeting which was held on 7th June, 2012 under the Chairmanship of Hon'ble Prime Minister of India and President, CSIR, Dr. Manmohan Singh. He also informed the members about the appreciation and acknowledgement CSIR received for the achievements.

The Governing Body accorded following approvals:

- (i) Amendment of Rule 8.3 of CSIR Service Rules, 1994 for Recruitment of Technical and Support Staff;
- (ii) Ratification of Amendment in Rule 7.6.3 (v) of CSRAP Rules, 2001;
- (iii) Proposal for demolition of old 8 Nos. Type-I Staff Quarters located at side colony of CSIR-CSMCRI, Bhavnagar;
- (iv) Proposal for demolition of old dilapidated buildings and structures in CSIR-CGCRI campus;
- (v) Demolition of existing Dispensary Building for construction of new Dispensary Building in CSIR-CSIO, Chandigarh; and
- (vi) Demolition of old Administrative Building in CSIR Madras Complex, Chennai for construction of Innovation Complex, Chennai.

2.2.2 182nd Meeting of CSIR Governing Body held on 6th February, 2013

The 182nd meeting of CSIR Governing Body (GB) was held on 6th February, 2013 under the Chairmanship of Prof. Samir K. Brahmachari. Significant contributions made by CSIR were appreciated by GB. Following decisions were taken by GB:

- (i) Consideration and adoption of CSIR Annual Report for the year 2011-12;
- (ii) Consideration and adoption of CSIR Annual Accounts for the year 2011-12, the Audit Reports and CSIR's comments thereon;
- (iii) Ratification of Award of CSIR Young Scientists Awards for the years 2011 and 2012;
- (iv) Ratification of Award Shanti Swarup Bhatnagar Prizes for Science & Technology for the years 2011 and 2012;
- (v) Ratification of Award of GN Ramachandran Gold Medal for Excellence in Biological Sciences & Technology for the years 2011 and 2012;
- (vi) Ratification of CSIR Technology Awards 2011 and 2012;
- (vii) CSIR Award for S&T Innovations for Rural Development (CAIRD)-for information;
- (viii) CSIR Diamond Jubilee Technology Award (CDJTA)-for information;
- (ix) Ratification of Enhancement of function of the Committee mentioned in Rule 7 of the Recruitment Rules 2008 to the post of Distinguished Scientist of CSIR; and
- (x) Adoption of Model Recruitment Rules for Multi-Tasking Staff (erstwhile Group 'D' Non-Technical i.e. re-designated as Group C Non-Technical under 6th CPC) - approval thereof.

2.3 70TH FOUNDATION DAY CELEBRATIONS OF CSIR

On 26th September, 2012, CSIR completed 70 years of dedicated service to the nation. The entire CSIR family, dotted across the country celebrated this day with much zeal and fervour. On one hand CSIR celebrated its host of achievements marked during the year gone by and on the other it was the moment to reaffirm its commitment to serve the nation with greater dedication.



Fig: 2.1 L to R Shri Vylar Ravi, Dr. Manmohan Singh and Prof. Samir K. Brahmachari on the dias during CSIR Foundation Day celebrations at VigyanBhawan, New Delhi

The entire scientific fraternity of the country look forward to this day as CSIR accords recognition to excellence in scientific research through presentation of various awards like CSIR Young Scientist Awards, CSIR Technology Awards, CSIR Award for S&T Innovations for Rural Development (CAIRD), CSIR Diamond Jubilee Technology Award, and CSIR Innovation Awards for School Children. It announces the most coveted Awards of Science in India i.e. Shanti Swarup Bhatnagar Prize. The main function of the CSIR Foundation Day was organized at Vigyan Bhawan, New Delhi, which was attended by the august ensemble of Scientists and Technologists. The function was graced by the Honourable Prime Minister and President, CSIR, Dr. Manmohan Singh and Hon'ble Minister of Science & Technology and Earth Sciences and Vice President, CSIR Shri Vayalar Ravi.

70th Foundation Day was commemorated with an exhibition highlighting CSIR's 70 best papers, 70 best patents, 70 best wealth creating technologies, 70 best Societal interventions and 70 Scientific Leaders. The exhibition was well attended by dignitaries and other guests.

The function at Vigyan Bhawan was started with the Welcome address by Prof. Samir K. Brahmachari, Director General, CSIR, followed by speech of Hon'ble Minister of Science & Technology, Shri Vayalar Ravi and address by Hon'ble Prime Minister, Dr. Manmohan Singh. 70th Foundation Day Lecture was delivered by Prof. C.N.R. Rao, Chairman, Scientific Advisory Council to the Prime Minister, National Research Professor, and Honorary President and Linus Pauling Research Professor at the Jawaharlal Nehru Centre for Advanced Scientific Research. Another noteworthy event of the occasion was the felicitation of former Director Generals of CSIR and some Eminent Scientists. Hon'ble Prime Minister gave away Shanti Swarup Bhatnagar Prizes for the year 2011.

Prof. Brahmachari has a firm belief that Scientific zeal is not blocked by age. Setting an example of walk the talk he announced a new award 'Science@70'.

2.3.1 Excerpts of Welcome Address by Director General, CSIR, Prof. Samir K. Brahmachari

Full text of the address is at Annexure-VI]

Prof. Samir K. Brahmachari, Director General, CSIR felt a rare honour and privilege in welcoming the august gathering including: Hon'ble Prime Minister and President, CSIR, Dr. Manmohan Singh; Hon'ble Minister of Science & Technology and Vice President, CSIR, Shri Vayalar Ravi; Foundation Day speaker Dr. C.N.R Rao; Chancellor of AcSIR and Former DG, CSIR, Dr. R.A. Mashelkar; Awardees and their families; members of CSIR family and others. For the day 26th September, 1942, when CSIR was born, he appreciated the group of Indian scientists who dared to have this dream of creating CSIR as R&D hub of India. He shared "I am of the belief that to craft a masterpiece there has to be a dream, courage to stand by it, passion and determination to realize it".

He, further, narrated that the visionaries and foot soldiers of CSIR worked tirelessly to create institutions founded on science and technology which were ahead of its time in birth, withstood the vagaries of time through the seven decades and continue to flourish and be relevant even today. Thanking Hon'ble Prime Minister for his gracious presence, Prof. Brahmachari mentioned that PM's presence, infact, testified his (PM's), not only commitment to science and technology but also his attachment to the scientific excellence. He also commented that the legacy of giving away Shanti Swarup Bhatnagar awards by Pandit Nehru still continues.

Prof. Brahmachari, applauded the support and confidence rendered by Hon'ble Minister of Science & Technology, Shri Vayalar Ravi.

He emphasized that the day was to mark a long journey of seven decades, to thank past leaders, distinguished champions, visionaries and scientific leaders. He also stated that an infusion of young and bright scientists was imperative if India has to forge ahead in global S&T arena. He remarked that on the advice of Hon'ble PM, CSIR leveraged its infrastructure and scientific strengths by forming the 'Academy of Scientific and Innovative Research (AcSIR).

Recognizing 'Innovation' as an ability to see change as an opportunity, he apprised that CSIR has fostered a major strategic partnership with the setting up Cluster Innovation Centers to promote innovation at the grass root level particularly in Micro, Small & Medium Enterprises (MSMEs) sector. He mentioned Krisnagiri cluster of Tamil Nadu (largest producer of mangoes) and Brass cluster of Moradabad, UP as example where CSIR is providing innovative S&T solutions. He also dwelt upon the concept of CSIR TECHVILs which CSIR would be implementing during the current plan. 24 such locations across the country for setting up TECHVILs were identified, he stated.

Mentioning about the transformation of 'Centre for Biochemical Technology' to 'Institute of Genomics and Integrative Biology', he emphasized that CSIR is changing. He meant to convey that CSIR is transforming itself to embrace all sections of the Society while at the same time exploring the unexplored frontiers of Science.

He proudly mentioned that as an organization, CSIR is moving from creating to collaborating, from isolated laboratories to Innovations complexes, from creating wealth for a few large industries to creating wealth for many.



Fig: 2.2 DG CSIR, Prof. Samir K. Brahmachari delivering the Welcome Address

While concluding his welcome address, Prof. Samir. K. Brahmachari, DG, CSIR, has given birthday gift' a new CSIR' to the Hon'ble Prime Minister and President, CSIR.

2.3.2 Excerpts of Speech by Shri Vayalar Ravi, Hon'ble Minister of Science & Technology and Vice President of CSIR

[Full text of the address is at Annexure-VII]

Shri Vayalar Ravi, Hon'ble Minister of Science & Technology and Earth Sciences and Vice President, CSIR extended birth day wishes to the Hon'ble Prime Minister and President, CSIR, Dr. Manmohan Singh.

He congratulated CSIR family on the occasion of CSIR's 70th birth anniversary.

He also congratulated all the awardees and their families. He commented that the awards they have received, would motivate them, to enhance their R&D efforts, so as to create newer and newer innovations, benefiting society. He deliberated upon how CSIR is performing its assigned mandate that is promotion of scientific and industrial research, award of fellowships, transfer of technologies etc. He ventured into history of CSIR by remembering Dr. Bhatnagar whose dynamic leadership gave the new nation its first eleven laboratories in the years spanning 1950-1953. He appreciated that in spite of lack of resources, CSIR kept on scaling newer heights as was evident from its presence in sectors from Chemicals to Glass and Ceramics, from Physics to Metallurgy, from Tractors and Food products to Fuel research etc.

Hon'ble Minister applauded CSIR for building up a pool of trained human resource, which is the deciding factor transcending every other resource. He recalled the great visionary Pt. Nehru who alongwith Dr. Bhatnagar nurtured CSIR in its formative years and put it on a well thought out path which CSIR traverses dedicatedly even today. CSIR followed it in letter and spirit and has challenged itself to do better and better and thus it moved further and higher, he mentioned. He also praised roles of subsequent Director Generals of CSIR in enhancing CSIR's S&T prowess.

Addressing the Hon'ble Prime Minister and President, CSIR, Hon'ble Minister expressed that CSIR was fortunate for his (PM's) continuous guidance and directions. It has challenged and motivated CSIR to achieve the unachievable, he mentioned. He, on behalf of CSIR, assured Hon'ble Prime Minister that CSIR system has fully committed to achieve the performance targets as enunciated in 'CSIR@80: Vision & Strategy 2022'.

Hon'ble Minister quoted Pandit Jawarlal Nehru's comments on 'Wealth of India'- the encyclopedia brought out by CSIR as "I have no doubt that this book will be of great value to the builders of new India. It should be of value also in educating the average citizen, who should take interest in this fascinating land and its enormous potentialities". He emphasized that the publication is still relevant in 21st century.

He lauded CSIR for securing 90% of US patents granted to any Indian publicly funded R&D organization. Amongst its peers in publicly funded research organisations. CSIR is a leader in terms of filing and securing patents world-wide, he mentioned. He also appreciated the fact that major industry houses and large number of MSMEs are getting benefited from CSIR. He further mentioned about CSIR's significant contributions towards the development of North East Region, its scientific excellence (CSIR's research papers constitute 11% of India's scientific outputs) etc.



Fig: 2.3 The Hon'ble Minister of Science & Technology and Earth Sciences and Vice President, CSIR, Shri Vayalar Ravi addressing the gathering

The Hon'ble Minister of S&T directed CSIR to connect to International Innovation Systems more and more for the benefit of the Society. He expected CSIR to achieve all what it has planned through its Vision document much before 2022. While concluding his speech he urged CSIR scientists and staff to take pledge to that effort.

2.3.3 Excerpts of address by Hon'ble Prime Minister and President, CSIR, Dr. Manmohan Singh

[Full Address is at Annexure-VIII]

Dr. Manmohan Singh, Hon'ble Prime Minister of India and President, CSIR expressed his delight over joining the 70th Foundation Day Celebrations as well as sharing the occasion with his birthday. He mentioned that he could not have thought any better company than the illustrious gathering of people of science as this was the first public engagement of the day.

He traveled down the memory lane by associating himself with Council fraternity. He remembered Dr. Shanti Swarup Bhatnagar, the founder of CSIR, who came to Delhi from Lahore with a dream to build chain of CSIR laboratories. Dr. Singh followed him with a more modest dream of his own to start new beginning in free India.

He narrated the horror of partition marking it as a national tragedy. He also told that the country, at that time, could have been written off with its inherent problems like, deep rooted poverty, frequent epidemics, stagnant economics etc. But India has leader like Pandit Nehru who visioned S&T a route for India's development and scientist like Dr. Bhatnagar who had extraordinary organizational ability to realize Pandit Nehru's vision.

He lauded Pandit Nehru's recognition of potential of scientific research as a result the Council was in his charge. That sets in a tradition of successive Prime Ministers leading the Council. Dr. Singh considered it as a privilege to preside over the council in the seventh decade of its service to the nation.

He applauded CSIR's professional worth in every phase of India's growth, in line with the national policies and priorities be it import substitution, technology denial etc. He appreciated CSIR's association with strategic sector in developing some key components like radiation shielding glasses, components for aerospace and satellites etc.

After India joined WTO, CSIR emerged as flag bearer of Intellectual Property movement in the country and became single largest holder of US and European patents, he lauded. He also referred CSIR's leadership role in domains of biotechnology and recombinant DNA products. He further appreciated CSIR's efforts to make healthcare by exploiting the power of Open Source Drug Discovery.



Fig: 2.4 The Hon'ble Prime Minister of India and President CSIR, Dr. Manmohan Singh addressing the gathering



Fig: 2.5 A view of the audience

He commented that while aiming for global excellence of country in science, CSIR must not lose sight of mandate of science in the country as envisioned by Pandit Nehru which was “science must think in terms of 400 million persons in India”. Hon'ble Prime Minister expressed his satisfaction over council's CSIR 800 programme which aims at affordable scientific interventions to improve the quality of life of the people at the base of economic pyramid.

Moving further he marked AcSIR as a good initiative which would train young scientists and researchers in trans disciplinary domains of scientific dispense as the conventional approaches finding it difficult to address complex developmental challenges. He hoped to have early results. He also appreciated the power of public private partnership in scientific research, and mentioned about CSIR's partnership with National Innovation Council to provide focused technology assistance to small and medium enterprises.

Dr. Singh cautioned that in spite all the laurels it is not the time to rest. He mentioned that the country could not mobilize enough private investment into science to raise investment in scientific research to 2% of GDP. Country has not been able to make an impact on a world scale commensurating with large scientific manpower pool. He asked CSIR to devote itself to national challenges in the years to come. He desired CSIR to take up national leadership in science, engineering and technology.

He concluded his address by identifying young people of the country as nation's hope and future.

2.3.4 Felicitation of Former Director Generals of CSIR and Eminent Scientists

One of the highlights of the 70th Foundation Day Celebrations at Vigyan Bhawan on 26th September, 2012 was the felicitation of former Director Generals of CSIR and other eminent Scientists. CSIR has always had far-seeing and gifted leaders at its helm who have steered it not only through the turbulent times immediately after Independence of India, but also through changing times, and in the face of challenges that appeared almost insurmountable. The 70th Foundation Day of CSIR was thus the most appropriate time to acknowledge the huge debt of gratitude CSIR owes to these leaders and to publicly acknowledge the appreciation and esteem in which they are held.

Former Director Generals of CSIR

Dr. S.S. Bhatnagar (Director), (1942 - 1954)	Dr. G.S. Sidhu, (5.5.1981 - 4.5.1984)
Prof. M.S. Thacker, (3.8.1955 - 1.8.1962)	Prof. P .K. Jena, (5.5.1984 - 21.6.1984) and, (28.1.1986-25.2.1986)
Dr. S. Husain Zaheer, (1.9.1962 - 21.8.1966)	Dr. S. Vardarajan, (22.6.1984 - 27.1.1986)
Prof. S.R. Mehra, (Officiated during deputation abroad of DG.)	Dr. G. Thyagarajan (Officiated for 7 days in 1986)
Dr. Atma Ram, (22.8.1966 - 21.8.1971)	Dr. A.P. Mitra, (26.2.1986 - 16.4.1991)
Dr. Y. Nayudamma, (27.8.1971 - 27.7.1977)	Prof. S.K. Joshi, (18.4.1991 - 30.6.1995)
Dr. A. Ramachandran, (27.7.1977 - 9.10.1978)	Dr. R.A. Mashelkar, (1.7.1995 - 31.12.2006)
Prof. M.G.K. Menon, (9.10.1978 - 4.5.1981)	Dr. Maharaj Kishan Bhan,(Additional Charge), (5.1.2007 - 6.3.2007)
Dr. T.Ramasami (Additional, Charge) (7.3.2007-11.11.2007)	



Fig: 2.6 Champions of CSIR

To the sound of thunderous applause from the audience Prof. M.G.K. Menon, Dr. S. Vardarajan and Dr. R.A. Mashelkar were honoured with shawls and mementoes by the Hon'ble Minister Shri Vayalar Ravi.

It was a rare, emotional and evocative moment in time, when the present embraced the past to be frozen as golden memory in the minds of all who were present on the occasion. Among the distinguished Scientists to be honoured were Prof. R. Kumar, Prof. M. M. Sharma (in absentia), Dr. P. Rama Rao (in absentia), Dr. V. S. Ramamurthy, Prof. M. Vijayan, Prof. Asis Datta and Dr. N. K. Ganguly.

Each 'Champion of CSIR' was presented with a shawl and a citation printed on special parchment-like leather created by CSIR-CLRI, Chennai, as a token of CSIR's deep appreciation for their sustained contribution to Champions of CSIR.

2.3.5 Foundation day Lecture by Prof. C N R Rao

The 2012 CSIR Foundation Day Lecture entitled '*Celebration of Science: Glorious Past and Challenging Future*' was delivered by Prof. C.N. R. Rao, Chairman, Scientific Advisory Committee (SAC) to PM, and Member of the Atomic Energy Commission of India. Prof. Rao provided an astonishingly personal account of doing science against the global backdrop of the work done by scientists through the centuries. It was an amazing blend of personal experiences, which in Prof. Rao's case are formidable indeed, with the trend in science through the ages. Against the backdrop of the scientific and technological developments of the last century, Prof. Rao led the audience on an enthralling tour of the advances of science. He began by highlighting just what a wonderful period of time this is.



Fig: 2.7 Prof. C.N.R. Rao delivering the CSIR Foundation Day Lecture

The year 2011 was the centenary of the discovery of atomic structure by Nobel laureate Ernest Rutherford. Although the Rutherford atomic model proposed in 1911 turned out to be not quite correct, the image of electrons forming ellipses around a central nucleus is used across the globe as a symbol for atomic and nuclear items and institutions.

2011 was also the centenary of the discovery of superconductivity by Kamerlingh Onnes, whose mentor was the celebrated scientist Van der Waal. Thus science is not only linked by the continuum of time but also by an unbroken chain of guru-shishya parampara. Prof. Rao illustrated this point by showing archival photographs of the Solvay Conferences of 1901 and 1927. As is well known, the 1911 Conseil Solvay is considered a turning point in the world of physics and a century has passed since then. The Solvay Conference marks the passage of classical physics to quantum mechanics; the passage of old science to new science. Showing a close-up of the scientists who had participated in the two conferences, he said that students of science must know the faces of scientists. It was important to know how ideas are born and how science happens, he said.

2011 was also the centenary of the second Nobel Prize of Madame Marie Curie, who despite all her contributions to science, had to fight prejudices, sexism and chauvinism all her life. It is beyond belief, said Prof. Rao, that she was never admitted into the French Academy of Science. 2011 was the International Year of Chemistry and huge developments have taken place in the last century. Prof. Rao pointed out that in 1911, X-rays had just been discovered; as had radioactivity, noble gases and atomic structure. At around this time, scientists had worked out the secrets behind chemical bonds (1916) and quantum chemistry (1930). Today, chemistry has advanced tremendously.

Prof. Rao elaborated on the contributions of Antoine Laurent Lavoisier, Michael Faraday, G. N. Lewis, and Sir William Lawrence Bragg to name a few. Thanks to the efforts of Lavoisier, the science of Chemistry progressed by leaps and bounds. Sadly, he was beheaded during the French revolution. Michael Faraday was multi-faceted and multi-talented scientist who, using the most simple and almost primitive instruments, designed elegant experiments that have stood the test of time. He did not belong to an elite family; rather he had to start earning quite young when he was apprenticed to a book binder at the age of fourteen. Faraday educated himself by reading books on a wide range of scientific subjects. In 1812, he had the good luck of being given tickets to attend the lectures given by the chemist Humphry Davy at the Royal Institution. Faraday subsequently wrote to Davy asking for a job as his assistant. Although initially Davy turned him down but finally, he did get a job with Davy and science gained a master Scientist. To the amusement of the audience Prof. Rao revealed that Faraday's first job in the laboratory had been as "Chief Bottle Washer." Then, this young boy, with just three years of formal schooling, went on to author 451 research papers and carve his name in Science's Hall of Fame. He is "...the hero of every thinking person," said Prof. Rao.

Prof. Rao further spoke about the contributions of Sir William Lawrence Bragg, the youngest ever Nobel laureate who shared the Nobel Prize with his father, Sir William Henry Bragg. Laurence Bragg was only 25 when he got the Nobel Prize. Prof. Rao said that "Modern chemistry is only about two hundred years old but Chemistry is an old subject." He substantiated this statement by analyzing Dmitri Mendeleev's seminal contributions to Chemistry; the Periodic Table. In the 1st century only about seven elements were known; the number reached a double figure (ten) in the 16th century, and by the 18th century this figure doubled to reach twenty known elements. By the 20th century, 114 elements were known to us. Prof. Rao said that modern chemistry began when chemical bonds began to be understood. It was the contribution of Gilbert Newton Lewis that made this possible when he elucidated the structure of the covalent bond. Prof. Rao said that Dr. Lewis was nominated 23 times for the Nobel Prize but did not get it although he was perhaps the greatest chemist of the 20th century. Lewis died in 1946 and interestingly, the years spanning 1930 to 1970 were dominated by chemical bonds.

In 1951, Linus Pauling discovered the structure of the alpha helix in proteins. He won the Nobel prize in chemistry for this in 1954. After the structure of the alpha helix was deduced, so was the structure of the DNA double helix in 1953. James Watson and Francis Crick shared the Nobel Prize in Physiology or Medicine with Maurice Wilkins in 1962 for this feat. However, no less an achievement was the deduction of the triple helix or the structure of collagen by Gopalasamudram Narayana Ramachandran (GNR) who published his findings in Nature in 1956. Unfortunately no Nobel Prize was forthcoming for this discovery.

Science progressed through the eighties and nineties and now, the progress (particularly in organic chemistry) is so swift that if one does not read research journals for two or three years one will find it impossible not just to keep up but even to understand what has been written, said Prof. Rao. We in India are slow and find it difficult to keep up but we have to learn to progress faster, he cautioned the young scientists in the audience. He elaborated on the shared legacy of science when the mantle passes from one scientist to another as they carry forward the work. He compared the science spending in the USA and the nationalistic pride that characterizes Chinese citizens and implored the audience to be "Proud to be Indians and to choose the right problem to work upon."

Why do science he queried. Because science gives you generosity and makes you fearless and makes you forget trivialities and become unselfish, he answered. To the young scientists his advice was simple. "Be determined to succeed. Give your best to India." In a lighter vein he said, "If you become famous, your institute becomes famous. Your country becomes famous."

Prof. Rao's lecture ended with an invocation that reminded the audience that science is a stream that flows ever onwards; and the mantle of the teacher descends on the disciple's who carry the work forward.

Prof. Rao quoted Rabindranath Tagore: "I have got my leave. Bid me farewell, my brothers! I bow to you all and take my departure. Here I give back the keys of my door —and I give up all claims to my house. I only ask for last kind words from you. We were neighbors for long, but I received more than I could give. Now the day has dawned and the lamp that lit my dark corner is out. A summons has come and I am ready for my journey."

2.4 SHANTI SWARUP BHATNAGAR PRIZES FOR SCIENCE & TECHNOLOGY

Shanti Swarup Bhatnagar Prize for Science & Technology was instituted in the year 1957, in the memory of late Dr. (Sir) Shanti Swarup Bhatnagar, FRS, the Founder Director of the Council of Scientific and Industrial Research (CSIR). The SSB Prize is awarded each year on the basis of conspicuously important and outstanding contributions to human knowledge and progress, made through work done primarily in India during the five years, preceding the year of the prize. Any citizen of India engaged in research in any field of science and technology up to the age of 45 years is eligible to be nominated for the SSB Prize. Overseas Citizen of India (OCI) and Persons of Indian Origin (PIO) working in India are also eligible to be considered.

The SSB Prize, comprising a citation, a cash award of Rs. 5,00,000/- (Rupees five lakh only) and a plaque, is given to each person selected for the award in the following disciplines:

- Biological Sciences;
- Chemical Sciences;
- Earth, Atmosphere, Ocean and Planetary Sciences;
- Engineering Sciences;
- Mathematical Sciences;
- Medical Sciences; and
- Physical Sciences.

Till 2011, 474 scientists have received the prestigious Shanti Swarup Bhatnagar Prize for Science and Technology. Majority of SSB Awardees have remained in the country and contributed immensely to Indian Science and Technology.

2.4.1 Shanti Swarup Bhatnagar Prizes 2011-Presentation

The Hon'ble Prime Minister of India presented the Shanti Swarup Bhatnagar Prizes to 11 awardees for the year 2011. The awardees are:

Biological Sciences



Dr. Amit Prakash Sharma
International Centre for Genetic Engineering
and Biotechnology, New Delhi



Dr. Rajan Sankaranarayanan
CSIR-Centre for Cellular and
Molecular Biology (CSIR-CCMB), Hyderabad

Chemical Sciences



Dr. Balasubramanian Sundaram
Jawaharlal Nehru Centre for
Advanced Scientific Research, Bengaluru



Dr. Garikapati Narahari Sastry
CSIR-Indian Institute of Chemical Technology
(CSIR-IICT), Hyderabad

Earth, Atmosphere, Ocean and Planetary Sciences



Dr. Shankar Doraiswamy
CSIR-National Institute of Oceanography (CSIR-NIO), Goa

Engineering Sciences



Dr Sirshendu De
Indian Institute of Technology, Kharagpur



Dr Upadrasta Ramamurty
Indian Institute of Science, Bengaluru

Mathematical Sciences



Dr. Mahan Mj
Ramakrishna Mission Vivekananda University,
Howrah



Dr. Palash Sarkar
Indian Statistical Institute, Kolkata

Medical Sciences



Dr. Kithiganahalli Narayanaswamy Balaji
Indian Institute of Science, Bengaluru

Physical Sciences



Dr. Shiraz Minwalla
Tata Institute of Fundamental
Research, Mumbai



Fig: 2.8 Hon'ble Prime Minister, Hon'ble Minister of Science & Technology and Earth Sciences and DG, CSIR with the recipients of the Shanti Swarup Bhatnagar Prizes 2011

2.4.2 Shanti Swarup Bhatnagar Prize for Science & Technology 2012 - Announcement

Eleven scientists, listed below, have been selected for the Shanti Swarup Bhatnagar Prizes announced for the year 2012.

Biological Sciences

Dr. Shantanu Chowdhury,
CSIR-Institute of Genomics and
Integrative Biology (CSIR-IGIB), Delhi

Dr. Suman Kumar Dhar,
Special Centre for Molecular Medicine,
Jawaharlal Nehru University, New Delhi

Chemical Sciences

Dr. Govindasamy Mugesh,
Indian Institute of Science, Bengaluru

Dr. Gangadhar J Sanjayan,
CSIR-National Chemical Laboratory,
(CSIR-NCL), Pune

Engineering Sciences

Dr. Ravishankar Narayanan,
Indian Institute of Science, Bengaluru

Dr. Y Shanthi Pavan,
Indian Institute of Technology Madras, Chennai

Mathematical Sciences

Dr. Siva Ramachandran Athreya,
Indian Statistical Institute, Bengaluru

Dr. Debashish Goswami,
Indian Statistical Institute, Kolkata

Medical Sciences

Dr. Sandip Basu,
Bhabha Atomic Research Centre
Tata Memorial Center Annexe, Mumbai

Physical Sciences

Dr. Arindam Ghosh,
Indian Institute of Science, Bengaluru

Dr. Krishnendu Sengupta,
Indian Association for the Cultivation of Science,
Kolkata

2.5 CSIR Young Scientist Award 2012

Instituted in 1987, CSIR Young Scientist Awards seek to promote in-house excellence in various fields of science and technology. CSIR scientists upto 35 years of age, as reckoned on 26 September (CSIR Foundation Day) of the preceding year, are eligible for the award. These awards are given annually in the following fields:

- Biological Sciences;
- Chemical Sciences;

- Earth, Atmosphere, Ocean and Planetary Sciences;
- Engineering Sciences; and
- Physical Sciences (including instrumentation).

Each award consists of a citation, a cash prize of Rs. 50,000/- and a plaque. CSIR Young Scientist Awardees are also entitled to a research grant of Rs. 5 lakhs per annum for a period of five years.

Biological Sciences	
Dr. Avinash Mishra, CSIR-CSMCRI	Dr. Vinod Scaria, CSIR-IGIB
Chemical Sciences	
Dr. Dipti Prakasini Das, CSIR-IMMT	Dr. N Lakshminarasimhan, CSIR-CECRI
Earth, Atmosphere, Ocean and Planetary Sciences	
Dr. Pawan Dewangan, CSIR-NIO	Dr. R Ebhin Masto, CSIR-CIMFR
Engineering Sciences	
Dr. Mugdha Chetan Gadgil, CSIR-NCL	Dr. Priyanka Heda Maheshwari, CSIR-NPL
Physical Sciences including Instrumentation	
Dr. Poonam Arora, CSIR-NPL	Shri Umesh Tiwari, CSIR-CSIO



Fig: 2.9 Hon'ble Prime Minister, Hon'ble Minister of Science & Technology and Earth Sciences and DG, CSIR with the Young Scientist Awardees

2.6 CSIR TECHNOLOGY AWARDS 2012

Instituted in 1990, CSIR Technology Awards seek to foster and encourage multidisciplinary in-house team efforts and external interaction for technology development, transfer and commercialization. These awards include: (i) Life Sciences; (ii) Physical Sciences including Engineering; (iii) Innovation; (iv) Business Development and Technology Marketing; and (v) Most Significant CSIR Technology of the Five-Year Plan Period (awarded once in five years, coinciding with the plan period, to such technology which has proven in the market place atleast for five years). Each Technology Award comprises of a cash prize of Rs. 2 lakh, except the award for the Most Significant CSIR Technology of the Five-Year Plan Period, which has a cash prize of Rs. 5 lakh. Besides, a plaque and a citation is also given to the awardees. Hon'ble Minister of Science and Technology and Earth Sciences and Vice President, CSIR, Shri Vayalar Ravi, on the occasion of CSIR Foundation Day, gave away CSIR Technology Awards 2012.



Fig: 2.10 Hon'ble Minister of Science & Technology and Earth Sciences and DG, CSIR with the CSIR Technology Award 2012 winners

CSIR-Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP)

CSIR-CIMAP has won the award for development and commercialization of anti-malarial drug plant *Artemisia annua* technology package facilitating industrial growth, societal health and rural prosperity. A unique Pharma-Farm value chain linkage in Public-Private Partnership (PPP) mode through CSIR-CIMAP Biovillage approach was established resulting in not only enhancement and self reliance of drug production for the deadly malaria but also enhancement of the farmers income.

CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR)

CSIR-CIMFR has won the award for developing non-nitroglycerine based explosive-cord system suitable for use in blasting gallery method in underground coal mines. The explosive system developed is first of its kind. So far the only non nitro- glycerine based explosive-cord system recommended for use in Blasting Gallery method in underground coal mines by the Directorate General of Mines Safety (DGMS).

CSIR-Institute of Genomics and Integrative Biology (CSIR-IGIB)

CSIR-IGIB has won the award for developing Biochemical Oxygen Demand (BOD) Biosensor. The developed BOD Biosensor provides quick and precise estimation of pollution load of waste water. It helps in conducting

desired study in just two hours as against three to five days in conventional methods. The developed technology has been transferred to M/s Forbes Marshall Pvt. Ltd, Pune for commercialization.

CSIR-North-East Institute of Science and Technology (CSIR-NEIST)

CSIR-NEIST has won the award for significantly enhancing the business and markets for their knowledge base by reaching out to people in the rural and tribal areas of North East Region.

CSIR-Central Glass and Ceramic Research Institute (CSIR-CGCRI)

CSIR-CGCRI has won the award for developing completely packaged commercial grade C-Band Erbium-Doped Fiber Amplifier (EDFA) for CATV and Telecom Networks. The developed product has found place in India and US markets.

2.7 ANTI-ARTHRITIS HERBAL DRUG DEVELOPED BY CSIR-NEIST LAUNCHED

A safe and efficient Herbal Drug for Arthritis Treatment "Anti-Arthritis" which is pharmacologically and clinically assured for arthritis treatment with proven relief developed in collaboration with Visva Bharati University was released under CSIR-NEIST affordable healthcare by Hon'ble Minister of Science & Technology and Earth Sciences Shri Vayalar Ravi in presence of Prof. Samir K. Brahmachari, DG, CSIR. Most of the inventors from CSIR-NEIST viz., Dr. Mantu Bhuyan, Scientist, Dr. P. R. Bhattacharyya, Chief Scientist, Dr. P. K. Baruah, Medical Officer, Dr. N. C. Barua, Chief Scientist and Dr. P.G. Rao, Director, CSIR-NEIST were present at the function.



Fig: 2.11 Shri Vayalar Ravi, Hon'ble Minister of Science & Technology and Earth Sciences, releasing 'Anti-Arthritis' in presence and DG, CSIR and Dr. P.G. Rao, Director NEIST (Left)

2.8 CSIR AWARD FOR S&T INNOVATIONS FOR RURAL DEVELOPMENT (CAIRD)

CSIR instituted CSIR Award for S&T Innovations for Rural Development (CAIRD) in 2006 to recognize the honour those outstanding S&T innovations that have helped transform the lives of rural people or alleviated the drudgery of the rural people. The award is given to an innovation that has created a paradigm shift in standards of quality of life of the rural people or demonstrated competitive advantage and positive user response or helped in generation of rural employment in the country and shown a new way of conducting business to achieve social and economic transformation in the domain of rural development. The award consists of a cash prize of Rs. 10 lakh, a citation and a shield.

2.8.1 CAIRD-2010

CSIR Award for S&T Innovations for Rural Development (CAIRD) for the year 2010 was conferred on Defence Institute of High Altitude Research (DIHAR), Leh Ladakh for the 'Development of cold arid agro-animal technologies for rural development in Ladakh region (J&K)'. Through its multidimensional R&D efforts, DIHAR has brought about qualitative and quantitative changes in agriculture, animal husbandry and cold desert flora of Ladakh. It has identified suitable varieties and developed agro-practices of 78 types of vegetables and 30 types of high altitude medicinal and aromatic plants to boost local production in cold desert region of Ladakh. DIHAR has developed and successfully commercialized sea buck-thorn products. The sea buck-thorn berries had no commercial value in Ladakh region till the year 2001. However, after setting



Fig: 2.12 Hon'ble Prime Minister, Hon'ble Minister of Science & Technology and Earth Sciences and DG, CSIR with the awardees of CSIR awards S&T Innovations for Rural Development (CAIRD) 2010

up the first seabuck- thorn processing unit in Leh, seabuck-thorn collection has been taken up as an important activity and additional source of income for farmers. The contributions of DIHAR has helped enhance the availability of fresh foods such as vegetables, fruits, milk, meat, eggs, supplementary herbal products and medicinal and aromatic plants to troops through local farmers in Ladakh, which has helped Ladakh to achieve self-sufficiency.

2.8.2 CAIRD-2011

CSIR Award for S&T Innovations for Rural Development (CAIRD) for the year 2011 was conferred on Directorate of Agriculture, Government of Uttar Pradesh and CSIR-NBRI for the Plant Growth Promoting Microbial Bioinoculants for Enhanced Crop Productivity. This innovation relates to the development of environment-friendly bioinoculants, which have been gainfully used for enhancing the crop yield. These have been used successfully for several economic crops like Urad, Arhar, Mung, Soybean, Groundnut, Gram, Pea, Lentil etc. Promising results have also been obtained in trees, floricultural crops, spices, medicinal and aromatic crops through employment of these products. The bioinoculants developed by CSIR-NBRI and produced by Biofertiliser manufacturing units of the UP Govt. have been used in approximately 26 lakh hectares of agricultural land in UP during the last six years. This innovation has resulted in total fertilizer savings up to the tune of 31,997 MT for nitrogenous and 52,708 MT for phosphatic fertilizers during these years in U.P. The synergistic efforts of Directorate of Agriculture and CSIR-NBRI have helped transform the agricultural scenario of UP in terms of economic and ecological benefits.



Fig: 2.13 Hon'ble Prime Minister, Hon'ble Minister of Science & Technology and Earth Sciences and DG CSIR with the awardees CSIR awards S&T Innovations for Rural Development (CAIRD) 2011

2.9 CSIR DIAMOND JUBILEE TECHNOLOGY AWARD, CDJTA-2011

CSIR instituted the 'CSIR Diamond Jubilee Technology Award (CDJTA)' in commemoration of its Diamond Jubilee from the year 2003. The award acknowledges the most outstanding technological innovation that has brought prestige to the nation. The award is given to a technology that is developed in the country by Indian innovators and meets the highest global standards. Technologies leading to commercially successful products, processes and services, which give India a sustainable competitive advantage, are considered for the award. The award consists of a cash prize of Rs. 10 lakh, a citation and a shield.

CSIR Diamond Jubilee Technology Award for the year 2011 was conferred on Tejas Networks Ltd., Bengaluru for developing and commercialising the TJ1600, a high density core optical transport platform. TJ1600 is ideal for the core network location where large amounts of data and voice traffic from different sources have to be groomed and switched at wire speed. Designed for optical backbone, highspeed point-to-point links and high-density digital cross-connects, TJ1600 accommodates a wide range of traffic modules, PDH tributary protection, Carrier Ethernet functionalities and support for DWD Minter faces. The platform is suitable for metro aggregation locations.



Fig: 2.14 Hon'ble Prime Minister, and DG, CSIR with the recipients of CSIR Diamond Jubilee Technology Award

The TJ1600 enables several traffic interfaces and supports ASON which facilitates dynamic control of transmission networks through an automated management of network resources. Successfully deploying its transport solutions, such as TJ1600, in the key telecom networks in India and across the world, Tejas have emerged as a leading Indian technology company. The success of Tejas has demonstrated the redoubtable technological and engineering capabilities of India and the competitive spirit of the nation. CSIR recognises and honours Tejas Networks Ltd. for the outstanding innovation TJ1600.

2.10 CSIR INNOVATION AWARDS FOR SCHOOL CHILDREN 2011

In order to enhance creativity amongst school children, CSIR announced Diamond Jubilee Invention Award for School Children on 26 April 2002, the day celebrated as World Intellectual Property Day, for the first time. The objectives of this competition are to capture creativity and innovativeness amongst school children and create awareness about IPR. The competition in the year 2011 was renamed as 'CSIR Innovation Award for School Children'. On 26th September 2012, 22 children were awarded CSIR Innovation Award for School Children 2011. In the year 2011, no first prize was given.

The winner gets a cash prize, trophy and a certificate. The prizes are as follows:

Second prize: Master Sanat Anand

Third Prize (Three): Master Aditya Arun, Master Sailesh Patra, Master G. Brahadees.,

Fourth Prize (Four): Master Yash Kothari, Master Gulshan Sahu, Master Ayush Sharma and Master Saransh Tiwari.

Master Monawwer Mahfuz, Anjaney Kumar, Abhishek Anand and Master Rahul Kumar

Master Abhijit Pal, Master Pallavi Sharma,

Fifth Prize (Three): Master Amit Kumar, Miss Aditi Raj, Miss B.J. Sadhana, Master C Shrijanand, Master Kartik Mathur, Master T Sai Praneet and Master Vaghul K V, Master Rohit Patel



Fig: 2.15 Hon'ble Minister of Science & Technology and Earth Sciences and DG, CSIR with the winners of CSIR Innovation Award for School Children 2011

2.11 AcSIR CONVOCATION CEREMONY

Established in 2011 as an 'Institution of National Importance', the Academy of Scientific & Innovative Research (AcSIR) is committed to creating and training some of the best of tomorrow's S&T leaders through a combination of innovative and novel curricula, pedagogy and evaluation. On 26th September 2012, and coinciding with the 70th Foundation Day of CSIR, AcSIR held its Second Convocation. Incidentally, the first Convocation of AcSIR had been held on 15th September 2011 (during interim mode) for 52 Students of PGRPE-2009 batch. Prof. Gautam Biswas, Acting Director, AcSIR and Chairman of the Senate and Director, CSIR-CMERI delivered the Welcome Address. Prof. Gautam Biswas and Dr. Nagesh Iyer, Acting Associate Director AcSIR and Member-Secretary of the Senate and Director CSIR-SERC conducted the degree awarding ceremony and admitted the

successful candidates to the M.Tech degree of AcSIR. In his Convocation address to those graduating, Prof. Samir K. Brahmachari, Vice Chairman, AcSIR and Director General, CSIR said, "You have done well since 94 per cent have got distinction, therefore all the graduates with distinction are eligible to participate in CSIR's PhD programme." In a lighter vein he said that the students graduating today held the passport to enter the world of science and that the young scientists would create a new CSIR with new aspirations. He exhorted them to develop sensitivity to the needs of others, who are less fortunate. He said that there was a need for those with high intellectual ability coupled with high sensitivity in the new CSIR. He said, "You will make a difference and then you will have inner happiness." Speaking on the occasion Dr. R. A. Mashelkar, Chairperson, AcSIR said that what was needed was innovation, passion and compassion. Innovation is associated with the brain, passion is the fire in the belly and compassion lies in the realm of the heart. Acknowledging the role that Late Shri Vilasrao Deshmukh had played in steering the AcSIR Bill through the Parliament, he said that a special AcSIR Fellowship would be created to commemorate his name. He said that the creation of AcSIR had taken seven long years and that it owed a lot to the conviction and vision of Prof. Brahmachari. Today with its distributed campuses spanning the distance from Kashmir to Kanyakumari, AcSIR is emerging not only as a centre of distributed learning, but also integrated learning. His inspirational message was that AcSIR was a new institute and it carried no "baggage". Whatever AcSIR did was novel. It was free from the need to conform to hidebound traditions; free to experiment with new pedagogy of learning. "We are in the business not just setting up best practices but NEXT practices," he said.

2.12 G N Ramachandran Gold Medal for Excellence in Biological Sciences & Technology 2012

CSIR instituted a Gold Medal in 2004 in the fond memory of Prof. G N Ramachandran, a pioneer of protein chemistry and the founding father of structural biology in India, for recognising excellence in the interdisciplinary field of Biological Sciences and Technology.

Till the year 2011, eight scientists have been bestowed with this prestigious award: Prof. M. Vijayan (2004), Prof. P. Balaram (2005), Prof. T. P. Singh (2006), Prof. C. Ramakrishnan (2007), Prof. M. R. N. Murthy (2008), Prof. R. V. Hosur (2009), Dr Dinakar M. Salunke (2010), Prof. Jayant B. Udgaonkar (2011).

For the year 2012, the Advisory Committee recommended Prof. Dulal Panda of Indian Institute of Technology, Bombay for G N Ramachandran Gold Medal.

Prof. Dulal Panda of Indian Institute of Technology Bombay has pioneered in the mechanism of bacterial cell division which has led to the development of promising antibacterial agents. Additionally, his studies on cancer cell division have led to identification of anti-cancer agents that act by destabilising microtubules.



Headquarters Activities

3.1 PLANNING AND PERFORMANCE DIVISION (PPD)

The Division is nucleus of the CSIR Headquarters, which is mandated to assist the activities of laboratories, interactions with Government agencies, conceptualizing Five Year Plans and Annual Plans, dealing with the issues related to Department-related Parliamentary Standing Committee on Science & Technology and Environment and Forests, preparing Outcome Budget, driving New Millennium Indian Technology Leadership Initiative (NMITLI), supporting business development activities, bringing out Annual Reports of CSIR, managing awards such as CSIR Technology Awards; CSIR Diamond Jubilee Technology Awards; and CSIR Award for S&T Innovations for Rural Development, Managing Plan projects etc.

The following paragraphs encapsulate some significant activities of the Division:

3.1.1 Twelfth Five Year Plan

The 12th Plan is focused upon achieving global leadership in identified domains that would cover parameters in terms of: Science; Technology; Human Resources; and Inclusive Development.

In the Twelfth Five Year Plan, there are ten schemes in total. Out of these ten schemes, four schemes viz. 'CSIR-800 Scheme', CSIR Scheme for Open Innovation', 'CSIR Initiative for Inclusive', 'Participative and Collaborating Research & Development; and 'National Programme on National Civil Aircraft Development Programme (NCAD)' are new and introduced in the current plan. CSIR is pursuing R&D activities in cluster mode. Each of the cluster has evolved a mission for itself to be followed in the 12th Five Year Plan. The R&D efforts under various verticals of cluster are being pursued in a dynamic mode.

3.1.2 Department-related Parliamentary Standing Committee on Science & Technology, Environment and Forests

The Department-related Parliamentary Standing Committee on Science & Technology, Environment and Forests considers and recommends for grants of DSIR including CSIR to the Government of India. It also looks into specific topics/subjects on national S&T interests for deliberation from time to time.

Demands for Grants for the year 2012-13

The Demands for grants for CSIR (as a part of DSIR's Demands for Grants) was prepared and submitted to the Rajya Sabha Secretariat during 2011-12. The Committee raised certain queries related to Total Budgetary allocation during XII Five Year Plan, Major Thrust areas, etc. The division prepared suitable replies and submitted to the Rajya Sabha Secretariat for the consideration of the Committee.

PPD facilitated meeting of the Committee in the Parliament House depicting salient achievements of CSIR for the consideration of the Demands for Grants of DSIR including CSIR. The power point presentation of DG,CSIR, made before the Committee, was prepared by the division.

Two Hundred Twenty Seventh Report

The Committee made certain recommendation through its Two Hundred twenty Seventh Report which was presented to both the Houses of the Parliament on 18th May, 2012. Excerpts of some of the significant recommendations of the Committee are as follows:

- On awards won by CSIR Scientists- While the Committee lauds CSIR winning a number of prestigious awards at the national level, the Committee desires that CSIR scientists should strive hard to make their presence felt even at the international level by winning prestigious international awards as well. The Committee further desires that with a good number of patents, CSIR should make efforts to help Indian Industry develop more and more globally competitive products, for that alone will determine usefulness of patents developed by CSIR scientists;

- On National S&T Human Resource Development- The Committee feels that institution of greater number of scholarship for higher studies in science shall to certain extent help in arresting the recent trend of large number of bright students not opting science subjects for higher studies in view of attractive opportunities that have emerged in other disciplines and which in turn is leading to shortage of scientific personnel in the country. The Committee, therefore, recommends that there is a need for further increasing the number of scholarships as also for making scholarship more attractive. The Committee, further, recommends that a very transparent, fair and objective criteria be devised for awarding these scholarships so that meritorious students alone get it;
- On Intellectual Property- The Committee is happy to know that CSIR's rate of licensing/commercialization of Intellectual Property as about 9% is much better as compared to the global average of 3-4% and compliments CSIR for it. The Committee, however, feels that there is a need for wider and more effective dissemination of products/technologies developed by CSIR and patents registered by it so that common man could be benefited from this knowledge. The Department may consider making details of all products/technologies developed by it available on its website and organizing seminars and exhibitions in different parts of the Country to make people aware of them. Advisements/handbills and poster campaigns can also be deployed appropriately to create awareness;
- On NMITLI- the Committee hopes that the Department would effectively leverage the funds allocated to obtain desired outcome under the scheme. The Committee is of the view that the Department should take necessary steps to dispel the apprehensions about PPP mode and make sincere efforts to ensure success of this model; and
- On Interaction between industry and CSIR-The Committee is happy to learn that CSIR has implemented all the recommendations of Abid Hussain Committee. The Committee notes that share of public funding for R&D at 2-3 per cent of Gross Domestic Product (GDP) is at par with international norms. However, the share of private funds for R&D at only 3 per cent of GDP in our country is very low as compared to international norms of 1.3-1.4 of GDP. In France, Industry performs over 63 per cent (of all R&D) and funds around 54 per cent projects while this figure is 69 per cent in Japan. In India contribution of industries is estimated at around 25 percent of national R&D expenditure which needs to be enhanced to at least 50 percent in the Twelfth Plan. The Committee feels that the Department should give more and more incentive and form more partnerships with the private sector companies of India in order to infuse more funds in R&D sector. In this regard, the Committee fully supports the recommendations of the Planning Commission in its 'approach paper on Twelfth Five Year Plan-Faster, Sustainable and more Inclusive Growth' wherein it has suggested on interaction of Public S&T Institutions with CSIR at large.

PPD, with the help of inputs received from the concerned divisions of Headquarters, prepared the requisite 'Action Taken Report'. After obtaining necessary approvals it was submitted to the Rajya Sabha Secretariat within the prescribed timeframe for the consideration of the Committee.

Statement by the Hon'ble Minister of S&T on the Implementation of the recommendations of the Committee

Hon'ble Minister of Science & Technology has to make a statement in both the Houses of the Parliament twice in a year. PPD prepared the requisite statement on the implementation on the recommendations as contained in the 227th Report of the Committee. Hon'ble Minister made the statement in both the Houses of the Parliament on 26th November, 2012 in Rajya Sabha and on 5th December, 2012 in Lok Sabha, during the Winter Session, 2012.

Two Hundred Thirty Seventh Report

The Committee made further recommendations on the 'Action Taken Report' on the recommendations contained in 227th Report of the Committee. Some of the significant ones (corresponding to the recommendations of 227th Report as cited above) are:

- On awards won by CSIR Scientists-The Committee notes the reply but would like CSIR scientists to win prestigious international awards and help Indian Industry to develop globally competitive products on a Regular basis. The Committee further observes that steps being taken in this regard should have been spelt out in its Action Taken Note;
- On National S&T Human Resource Development- The Committee is pleased to note that the Department has agreed to the proposal of the Committee to widen the ambit of its 250 CSIR handholding scholarships to the students suffering from other serious physical disabilities;
- On Intellectual Property- The Committee notes the reply of the Department;
- On NMITLI- The Committee notes the reply and hopes that as assured, the Department would further strengthen NMITLI Scheme; and
- On Interaction between industry and CSIR-The Committee notes the reply of the Department and hopes that CSIR would soon be able to work in partnership with other big industrial players in its endeavour to increase the share of private funds for Research & Development activities.

As per the practice, PPD, with the help of inputs received from the concerned divisions of Headquarters, prepared the requisite 'Action Taken Report'. After obtaining necessary approvals it was submitted to the Rajya Sabha Secretariat within the prescribed timeframe for the consideration of the Committee

Demands for Grants for the year 2013-14

The Division prepared a background note on Demand for Grants for the year 2013-14 for CSIR highlighting activities, programmes and financial summary. The note was submitted to the Committee through Rajya Sabha Secretariat.

3.1.3 Outcome Budget 2013-14

It is imperative for all Ministries/ Departments to submit its Outcome Budget to the Ministry of Finance. The Outcome Budget is a mechanism to measure the development outcomes of all major programmes run by Ministries. It is envisaged to improve the quality of implementation of developmental programmes. In short, the 'Outcome Budget' is a pre-expenditure instrument to help realize the Department's vision through clearly defined outputs/outcomes, as a supplement to the current system built around post-expenditure scrutiny.

With this tenet as a guiding beacon, division prepared the requisite material (pertaining to CSIR), for the year 2013-14, as per the format provided by Ministry of Finance and submitted to DSIR, duly approved by DG, CSIR both in Hindi and English. The same was consolidated into 'Outcome Budget of Ministry of Science & Technology' for the year 2013-14.

3.1.4 Strategic Planning of 12th FYP Plan Projects for Implementation

During the FY 2012-13, the Division initiated the colossal task of implementation of the 12th FYP projects by strategically planning the end-to-end process. With the formulation of the 12th FYP document by PPD the broad framework of 12th FYP implementation was developed. During the year the implementation strategy for the projects and programmes was taken up that includes: financial planning; technical review and approval of projects for implementation; initiation of projects etc. PPD undertook financial planning, followed by technical review of the proposals for implementation, sought concurrence and approval of the projects by Competent Authority, and finally communicate the approval for implementation of the projects to nodal laboratories.

For the financial planning, PPD developed various scenarios of CSIR for 12th FYP implementation based on the past plan performances of CSIR, national economic developments, possible future requirements and envisaged outcomes of CSIR etc. The scenarios were developed since the Planning Commission was still finalizing the

12th Five Year Plan and the final allocation was not communicated till December 2012. The scenarios paved the way for strategizing 10 schemes of CSIR for implementation during the 12th FYP. The scenarios developed were inclusive based on bottom-up approach with allocation been made right from sub-schemes to finally arriving at the allocation of the schemes. The schemes were individually allocated followed by cluster level allocation, then further allocation within the laboratories of a cluster and finally to the projects. The holistic mechanism adopted at PPD, in consultation with Cluster Directors, included review of the performance of the laboratory during the 11th Five Year Plan along with the proposed projects of the laboratories during the 12th FYP. Once the allocations to projects were made, the allocation was communicated to the laboratories for submission of the projects.

Projects under the National Laboratories scheme of CSIR was received under five clusters namely Biological Sciences, Chemical Sciences, Engineering Sciences, Information Sciences, and Physical Sciences clusters. More than 160 proposals were received.

The proposals were critically reviewed at PPD which was followed by presentation to a approving or appraising committee for final approval. The projects went through the entire process of review before final approval by Competent Authority.

During the FY 2012-13, 134 projects were approved for implementation under the National Laboratories scheme.

It is pertinent to note that the final approved allocation made to CSIR is Rs.17400 crore in which various projects of CSIR under National Laboratories scheme were approved.

3.1.5 Annual Plan 2013-14

Preparation and submission of Annual Plan of CSIR to the Planning Commission is one of major activities of the Division. Annual Plan 2013-14 was prepared on the basis of the inputs received from the national laboratories/institutes on the progress of the plan projects of the 12th Five Year Plan along with future targets. The information was analysed and compiled by keeping in view the priorities under consideration, into Annual Plan document 2013-14 and sent to the Planning Commission for consideration.

The Annual Plan document for the year 2013-14 consists of the overall achievements of the CSIR during the preceding year, details of schemes and progress of the plan projects during the 12th Five Year Plan period and project-wise budgetary support for the year 2013-14. A chapter is dedicated to financial requirements which covers project-wise, scheme-wise, and consolidated financial requirement of CSIR.

3.1.6 CSIR Annual Report 2011-12

The Division prepares Annual Report of CSIR every year which is a statutory requirement. The Report for the year 2011-12 was prepared on the basis of the inputs received from laboratories/institutes and divisions of the Headquarters. The inputs were analysed, significant achievements selected and edited and got consolidated in the form of the Report. The Report was put up to CSIR Governing Body (GB) in its 182nd meeting held on 6th February, 2013 for recommendation. The GB recommended the report for adoption by the CSIR Society without any modification.

3.1.7 New Millennium Indian technology Leadership Initiative (NMITLI)

CSIR is implementing New Millennium Indian Technology Leadership Initiative (NMITLI) which is the largest public-private-partnership effort within the R&D domain in the country. The programme looks beyond today's technology and thus seeks to build, capture and retain for India a leadership position by synergising the best competencies of publicly funded R&D institutions, academia and private industry. The Government finances plays a catalytic role. It is based on the premise of consciously and deliberately identifying, selecting and supporting potential winners. NMITLI has carved out a unique niche in the innovation space and enjoys an

excellent reputation. NMITLI has so far evolved 75 networked projects in diverse areas viz. Agriculture & Plant Biotechnology, General Biotechnology, Bio-informatics, Drugs & Pharmaceuticals, Chemicals, Materials, Information and Communication Technology and Energy. These projects involve 100 industry partners & 300 R&D groups from different institutions. All 75 projects cumulatively have had an outlay of approximately ` 600 crore.

Brief details of some significant achievements in the year are presented below:

Design, development and demonstration of high performance Parabolic Trough based 300 kW Solar Thermal Power Plant

In the pursuit of alternative energy sources, Concentrating Solar Power (CSP) technologies hold significant promise and are considered to be an important and efficient renewable energy route. Generation of electricity by alternate / non conventional sources is of strategic importance to India viz. for Rural Electrification which is not possible by conventional resources and infrastructure. Out of primarily 6 CSP Technologies [(i) Concentrating Parabolic Trough; (ii) Concentrating Linear Fresnel Reflector; (iii) Solar Power Tower; (iv) Dish Stirling; (v) Solar Chimney; and (vi) Concentrating Photovoltaic] under development for power generation, the most cost effective and potentially viable is the Concentrating Parabolic Trough based Solar Thermal Power Generation Technology.

In the Concentrating Parabolic Trough based Solar Thermal Power Generation technology, the key sub-system is the Heat Collection Element (HCE). Its performance decides the efficiency and cost of conversion, total solar field requirement and therefore investment. It is also one of the important factors which governs breakeven or payback period of the project. HCE is strategically important aspect of the technology, as globally there are only two suppliers. The development of a solar selective coating with high absorption together with low emission and high quality rugged anti-reflection coating on outer glass envelope are core requirements for high performance HCE. A high performance multilayer cermet based solar selective coating with high absorptivity in the solar irradiation spectrum [α -0.96] and low emissivity [ϵ - 0.1] with stability at high temperature [$> 400^\circ\text{C}$] will be developed in the project using Magnetron Sputtering Technology.

The project envisaged the development of (a) High Performance Heat Collection Element (HCE); (b) Engineered Parabolic Trough; and (c) Prototype 300 kW Solar Thermal Power Plant. The project is primarily being executed by M/s Milman Thin Film Systems Ltd, Pune and 3 publicly funded institutes viz., CSIR-National Chemical Laboratory (CSIR-NCL), Pune, Indian Institute of Technology Madras (IITM), Chennai, and Raja Ramanna Centre for Advanced Technology (RRCAT), Indore are supporting the technical developments.

In half of the project duration, the following have been developed and demonstrated:

- A new Magnetron Sputtering Pilot Plant System with multi-chambers capable of co-deposition and as well sequential deposition of six different types of coatings to address the need for various functionality of (a) IR reflection, (b) Diffusion barrier, (c) Multilayer cermets, (d) Multilayer antireflection coating etc;
- Tracking System with features: (i) Hydraulic System coupled with Advance Controller (ii) Inclinometer for absolute measurement of position (iii) Drives 6 modules of three Troughs on each side (iv) Accuracy 1.7 mrad (v) Validation at DLR, Germany is underway;
- Photo-receiver Tube (Heat Collection Element) for 1 m size with measurement of : (i) Thermal loss (ii) Assess performance in outfield natural Solar Radiation (iii) Vacuum leak test (iv) Vacuum integrity with time and (v) Optical efficiency test on through; validation to be done at DLR, Germany;

- New design of a highly engineered Concentrating Parabolic Trough Collector assembly with unique features has been frozen; and
- A high precision Glass to Metal Seal with High Temperature stability for Heat Collection Element developed and integrated into the HCE as per the satisfaction industry.

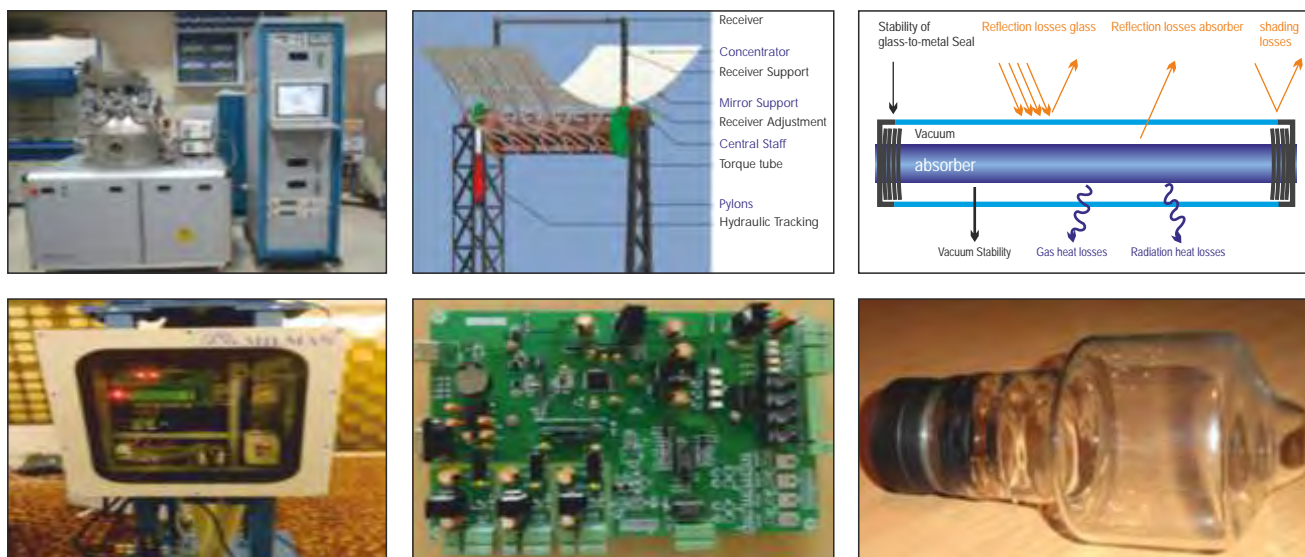


Fig: 3.1 Various components of Parabolic Trough based 300 kW Solar Thermal Power Plant

It is projected that the Solar Thermal Power Plants built on the above technology will provide power to a large number of villages where electric power through National Grid is not viable.

Design and fabrication of All-Fiber Supercontinuum Light Source with application demonstration on spectroscopic signature detection

Lasers have high spatial coherence and very high brightness, which enables optimum coupling to a fiber and outstanding single-mode beam quality. On the other hand, Supercontinuum light generation is the process of generation of white light by focusing intense laser pulse on to a nonlinear medium. Incandescent and fluorescent lamps, such as those made from tungsten halogens or xenon, provide spectrum of limited width, typically 400 nm to 1,700 nm and the intensity is limited to the filament or the gas excitation. CSIR put in together expertise in combination with of M/s Vinvish Technology Ltd., Thiruvananthapuram capabilities and CSIR-CGCRI competence to design, develop and fabricate a product of supercontinuum source with wide range of applications in the fields of industrial, medical, bio-photonics, nano-photonics, imaging etc. to name a few. Unlike the normal wide band sources like tungsten, xenon, halogen and SLED, with limited power and spectral width, the developed source's wavelength span ranges from 390 nm to over 2450 nm, with orders of magnitude higher spectral power density of the order of 0.1mW/nm to 1mW/nm. Coupling an ultrafast laser pulse directly out of an oscillator into a few meters of photonic crystal fiber (PCF) produced more than an octave broad supercontinuum. The developed supercontinuum source with PCF fibers is reliable, affordable and relatively simple to operate. By varying the design parameters, the PCF can be fabricated to have zero dispersion at a given wavelength, thus enabling soliton formation and dispersive wave generation in a specific length of PCF resulting in generation of supercontinuum light. Widest spectra are obtained when the pump pulses are launched close to the zero-dispersion of the non-linear PCF.



Fig: 3.2a Developed Product with Tablet User Interface in the future with upgraded design

The developed system consists of excitation pump laser, laser drivers, power stabilization circuits, Photonics Crystal Fiber, collimating optics and power Supply. The supercontinuum light source is packaged inside a module with dimension of 210 x 160 x 120 mm. This light source is powered by +24VDC power supply. It has RS232 communication interface which allows the user to control the light source with a computer.

This module would be made as an OEM module, or integrated inside a 3U rack mount. The maximum optical output power of such light source can reach 2W in the future with upgraded design.

The developed product could have multiple applications in the field of bio-photonics where broadband sources as the supercontinuum are used for spectral and illumination sources. Joint collaborations between supercontinuum manufacturers and spectrometer manufacturers are happening / announced regularly. There are only two competitors in the world - NKT Photonics and Fianium, USA for the Vinvish Ltd.



Fig: 3.2b Output of developed Supercontinuum Laser (White laser covering broad wavelength)

Development and production of a therapeutic monoclonal antibody against eNAMPT, a novel inflammatory target

Under the project, scientists at UDSC, New Delhi has constructed a naive human antibody library of scFv fragments displayed on the gIIIp of the bacteriophage M13. This large library (comprising of nearly 7.2×10^8 independent clones) has been constructed using a unique restriction enzyme free cloning techniques in a manner that after the selection of the binder scFv as displayed on the phage, the same can be easily transferred to an E.coli hyperexpression vector, where scFv can be produced as periplasmic protein with c-terminal poly histidine Tag.

This library is being characterized for diversity using recently acquired Next Generation Sequencing system, Illumina Miseq. In this, data from nearly 10 million clones for VK and VH sequences has been obtained. Preliminary analysis using online software from IMGT shows that the distribution of germline families is as reported in the literature with CDRs of varying length and composition. Further, no duplicate clone has been found within the initial 1 million clones of VK indicating that every clone in the library is likely to be unique. The detailed analysis of VH sequences is under progress.

The above description reveals that the Phage-displayed Naive Human antibody fragment (scFv) library constructed at UDSC, New Delhi would be a great resource for selecting human scFv anti fragments against any antigen.

Production of full length Nicotinamide phosphoribosyl transferase (NAMPRase or NAMPT) Protein

Nicotinamide phosphoribosyl transferase (NAMPRase or Nampt) also known as pre-B-cell colony-enhancing factor 1 (PBEF1) or visfatin is an enzyme that in humans is encoded by the PBEF1 gene. This protein has also been reported to be a cytokine (PBEF) that promotes B cell maturation and inhibits neutrophilapoptosis Industrial partner of the project-Gennova Biopharmaceuticals Limited, Pune has developed recombinant technology based production process for full length NAMPT. Full length NAMPT has an average market price of US\$ 10,084 (range \$5800-25,900) per mg. Gennova has produced this protein at 5L scale with an average yield of 250 mg of 6X His tagged protein, of which 50 mg was made free of the 6X His tag for panning . experiments. Under optimized conditions, it is estimated that cost of production to be US\$68.25/mg. It is therefore possible for Gennova to commercialize this product at a considerable profit. Based on the Monitoring Committee's recommendations, Gennova is currently trying to estimate annual sales volume across the world, and look for a global marketing partner.

Evaluation of RNAi based constructs for conferring resistance on transgenic rice against the blast fungus *Magnaporthe grisea*

Rice blast caused by fungus *Magnaporthe grisea* is one of the most widespread and devastating diseases affecting grain yield. The disease is highly adaptable to environmental conditions and can be found in irrigated lowland, rain-fed upland or deep water rice fields. Integrated disease management programs including use of resistant varieties, cultured practices and chemical control is required for successful control of the blast. Breeding efforts are limited in their success. The use of fungicides is hazardous for human health of the environment and further if used intensively they place enormous selection pressure on the blast and the pathogen rapidly develops resistance.

The complete genome sequence of *Magnaporthe grisea* and the functions of some of its genes responsible for pathogenesis are available. This knowledge was utilized by the industry, Metahelix Life Sciences Ltd, Bengaluru in the project to achieve RNAi silencing of fungal genes that are essential for survival/pathogenesis and over expression of antifungal genes in the rice plants. RNAi constructs based on pathogen derived genes were developed and introduced in the rice plants which expressed these genes. Four pathogenesis related genes were over expressed and 25 *Magnaporthe* genes were targeted for gene silencing. Out of the four over expressed targets- e lysozyme is the best expressing and showing a high degree of tolerance to blast infection in whole plant bioassay. Whole plant bioassay showed that fungal growth inhibition was higher in single gene silencing constructs as compared to multi-gene constructs. Fungal growth inhibition was the maximum by silencing of NTH1, serine threonine phosphatase and Con7 genes.

Extensive field trials are now required to confirm the better control of the disease by these constructs and their feasibility. This now awaits proper approvals by Indian regulatory bodies for transgenic research. Thus the necessary platform technology (transformation of plants by customized RNAi constructs) is developed under NMITLI. Once the technology matures and the supporting regulation are in place at Government level, it would lead to development of better yielding plant variety resistant to pathogen, for the use of mankind in future.



Whole Plant Bioassay (at DRR and Metahelix)



Non transgenic control Co39 and 25B



Con7-Disease score 3



Lysozyme-Disease score 4



Fig: 3.3 NTH1-Disease Score 5-6

3.1.8 Business Development and Marketing of Knowledgebase

PPD maintains interaction with Indian as well as international institutions and companies. The Division continued to render proactive assistance to laboratories for business development and marketing of knowledgebase. During the period it examined and facilitated for approval over 90 agreements received from CSIR laboratories. PPD continued to maintain organic linkage with national level industry associations and other stakeholders. Some of the major agreements modified and facilitated by PPD are given below:

CSIR-NAL's collaborative work with De Montfort University (DMU), Leicester, UK and De Montfort Expertise Limited (DMEL), Leicester, UK

CSIR-NAL has signed a Memorandum of Understanding (MoU) with De Montfort University (DMU), Leicester, UK and De Montfort Expertise Limited (DMEL), Leicester, UK (wholly owned company of De Montfort University, UK through which the project(s) is/are being executed). The MoU is for a possible collaborative interaction and work of mutual interest, particularly on the work related to 'Research on nonlinear flight dynamics and control'. CSIR-NAL attaches considerable significance to this potential collaboration which has so far proved beneficial both ways. Further, the expertise of Dr. Mikhail Goman of DMU (a recognized expert in the area of non-linear flight dynamics and controls) has been valuable to train the existing team of flight dynamics and controls experts at CSIR-NAL on aspects of high angle of attack flight dynamics. His association has also benefited the younger generation of scientists working in flight dynamics at CSIR-NAL to develop their analytical skills in this area.

CSIR-NAL jointly with DMEL and DMU has successfully executed 2 research projects entitled "Aerodynamic model extension and validation beyond normal envelope" and "Development of a synthetic reconfigurable aerodynamic model" with the support of DMEL, UK. Work on the 3rd project (extension of the scope of the work contract) entitled the "Investigation of Generic Tailless Aircraft (GTA) nonlinear Dynamics and Control in extended Flight Envelope" is under progress.

The entire project work has been assigned to CSIR-NAL by the Aeronautical Development Agency, (ADA) Bengaluru under Ministry of Defence (Govt. of India) with a total cost of the Rs. 1,91,02,500/-. CSIR-NAL, Bengaluru with the help of DMU and DMEL, UK is executing the projects.

Licensing of 'Bone healing anabolic agents' from CSIR-CDRI to KEMXTREE, a subsidiary of Nostrum, USA

CSIR-CDRI has licensed bone healing anabolic agents K058, K012, K068, and K100 to Kemxtree for further development and commercialization. Kemxtree will pay CSIR-CDRI US\$ 1 Million in milestones payment. They will also pay 2% of net sales royalty in those countries where patents are in force and 0.5% of net sales in remaining countries. The agreement was modified, improved and facilitated by PPD.

3.1.9 Security and Sensitivity Clearance

The R&D proposals involving foreign scientists/ agencies were examined and assessed in the Division from security and sensitivity angle. The proposals covered basically contract R&D. During the year, around 70 such proposals were processed. Some of the clientele covering these proposals included Farabi Petrochemical Company, Kingdom of Saudi Arabia; Sherwin Williams Company, USA; PT, NALCO, Indonesia; DIISR, Australia, Rtec-Instruments, USA; Arkema, France; Nippon Steel & Sunitomo Metal Corporation, Japan; Essilor Inc., France; Mayo Clinic, USA; SwereaMefors Lulea, Sweden; Tioxide, Malaysia; General Cable Corporation, USA; LSRI, Vietnam; Sabic Ventures, Netherland etc.

3.1.10 Repositioning of CSIR-CMMACS as nucleus of CSIR-Fourth Paradigm Institute (CSIR-4PI)

Recognising the vast potential of computational science, CSIR established its Centre for Mathematical Modelling and Computational Simulation (C-MMACS) nearly 25 years ago. C-MMACS has contributed significantly towards developing CSIR core competence in the areas of simulation and modelling particularly in the areas of climate science. Many CSIR laboratories have deep research engagement with areas ranging from high end computational research to informatics. While C-MMACS working in network mode with other laboratories has been reasonably successful in carrying out computational science research, it is being

increasingly felt that a dedicated set-up to address the concept of Fourth Paradigm in totality would be instrumental for CSIR to attain global leadership in this emerging domain. Thus Governing Body, CSIR has approved the repositioning of CSIR-CMMACS as the nucleus of CSIR-Fourth Paradigm Institute (CSIR-4PI), as it would provide the country a unique positioning in the domain of computational data intensive research and discovery.

3.1.11 CSIR Technology Awards

Instituted in 1990 and given annually, 'CSIR Technology Awards' seek to foster and encourage multi-disciplinary in-house team efforts and external interaction for technology development, transfer and commercialization. These Awards include one each for: (i) Life Sciences; (ii) Physical Sciences including Engineering; (iii) Innovation; (iv) Business Development and Technology Marketing; and (v) Most Significant CSIR Technology of the Five-Year Plan Period (awarded once in five years, coinciding with the plan period, to such technology which has proven in the market place at least for five years). Each Technology Award comprises of a cash prize of Rs. 2 lakh except the award for the "Most Significant CSIR Technology of the Five-Year Plan Period" which has a cash prize of Rs. 5 lakh. Besides, a plaque and a citation is also given to the awardees.

The Hon'ble Minister Science & Technology and Earth Sciences and Vice President, CSIR, Shri Vayalar Ravi on the occasion of CSIR Foundation Day, gave away CSIR Technology Award 2012. These awards were in the categories of: Life Sciences (to CSIR- CIMAP) for development and commercialization of anti-malarial drug plant *Artemisia annua* technology package facilitating industrial growth, societal health and rural prosperity; Physical Sciences including Engineering (to CSIR-CIMFR) for developing non-nitroglycerine based explosive-cord system suitable for use in blasting gallery method in underground coal mines; Innovation (to CSIR-IGIB) for developing Biochemical Oxygen Demand (BOD) Biosensor; Business Development & Technology Marketing (to CSIR-NEIST) for significantly enhancing the business and markets for their knowledge base by reaching out to people in the rural and tribal areas of North East Region; and Most Significant CSIR Technology of the Five Year Plan Period (to CSIR-CGCRI) for developing completely packaged commercial grade C-Band Erbium-Doped Fiber Amplifier (EDFA) for CATV and Telecom Networks.

3.1.12 CSIR Diamond Jubilee Technology Award 2011

CSIR had instituted CSIR-CDJTA in commemoration of its Diamond Jubilee from the year 2003. The award acknowledges the most outstanding technological innovation that has brought prestige to the nation. The award is given to a technology that is developed in the country by Indian innovators and meets the highest global standards. Technologies leading to commercially successful products, processes and services, which give India a sustainable competitive advantage, are considered for the award. The award consists of a cash prize of Rs. 10 lakh, a citation and a shield.

The Hon'ble Prime Minister of India and President, CSIR, Dr. Manmohan Singh gave away the CSIR Diamond Jubilee Technology Award (CDJTA) for the year 2011 to M/s Tejas Networks Ltd., Bengaluru for developing and commercialising the TJ1600, a highdensity core optical transport platform.

TJ1600 is ideal for the core network locations where large amounts of data and voice traffic from different sources have to be groomed and switched at wire speed. Successfully deploying its transport solutions, such as TJ1600, in the key telecom networks in India and across the world, Tejas have emerged as a leading Indian technology company. Designed for optical backbone, high-speed point-to-point links and high-density digital cross-connects, TJ1600 accommodates a wide range of traffic modules, PDH tributary protection, Carrier Ethernet functionalities and support for DWDM interfaces. The platform is suitable for Metro aggregation locations where complete equipment protection as well as tributary protection is needed.

3.1.13 CSIR Award for S&T Innovations for Rural Development

CSIR had instituted, in 2006, the "CSIR Award for S&T Innovations for Rural Development" to recognize and honour S&T innovations that have helped transform the lives of rural people. The effort through this award, in a

way, is also to give a boost to rural development through intrinsic innovation and its implementation at ground level. The award, which has emerged as a very prestigious one, carries a cash prize of Rs. 10 lakh, a citation and a shield.

Hon'ble Prime Minister of India, and President, CSIR, Dr. Manmohan Singh gave away the CSIR Award for S&T Innovations for Rural Development (CAIRD) - 2010 to 'Defence Institute of High Altitude Research (DIHAR), Leh' for "Development of cold arid agro-animal technologies for rural development in Ladakh region (J&K)" and CAIRD-2011 to Directorate of Agriculture, Govt. of Uttar Pradesh and CSIR-NBRI, for "Plant Growth Promoting Microbial Bioinoculants for Enhanced Crop Productivity".

3.1.14 Technologies and Product for Solar Energy Utilisation through Networks (TAP-SUN)

TAPSUN program was conceived soon after the release of 'National Action Plan on Climate Change', Govt. of India, by Prime Minister of India on 30th June 2008 mentioning 'Solar Energy' as one of the eight missions identified to address the issues concerning climate change. Later, on January 10, 2010, Government of India launched Jawaharlal Nehru National Solar Mission (JNNSM) having the objective to develop and promote use of solar energy including off-grid uses keeping in mind the needs of rural and remote areas of the country. MNRE was identified as the Nodal Ministry to steer the mission program.

TAPSUN program is a joint initiative of CSIR and MNRE which envisages to create a network of research institutes within CSIR in the first instance and subsequently a broader network which would include academia, other research institutions and industry. The purpose is to have a virtual institute called CSIR- Network of Institutes for Solar Energy (CSIR-NISE) which would conduct research, development and deployment of solar energy technologies, products and systems. TAPSUN program is aligned to the objectives of JNNSM and is mainly oriented towards developing off-grid applications of solar energy.

Because of its very nature, the program required central intervention for mapping of CSIR capabilities in the area, identifying themes, human resources and infrastructure while creating Pan CSIR networks for efficient and effective delivery of results. Planning & Performance Division has been involved at all stages of program formulation to now implementation of projects under the identified themes.

CSIR has identified following 12 themes under the TAPSUN program which are to be vigorously pursued through R&D interventions for providing next generation solar energy systems and devices:

- Efficient Silicon Photovoltaics (EffiSOLAR);
- Organic and flexible photovoltaics including solar Paints (FlexiSOLAR);
- Dye Sensitized and Quantum Dot Sensitized Solar Cells (DyeCELL);
- Thin Film Solar Cells including CIGS (ThinCELL);
- Organic-Inorganic Hybrid Solar Cells;
- Solar Thermal system/ Power generation;
- Energy Storage Materials/ Batteries (StoreSOLAR);
- Efficient Lighting Systems / Devices including LED and OLED (LightSOLAR);
- Conversion of Solar Energy to Chemical Energy and storage (ChemSOLAR);
- Thermoelectric materials based devices/ power generation (ThermoelectricSOLAR);
- Inverters and power electronics for grid and off-grid applications (PowerSOLAR); and
- Solar metrology.

The 9 themes having acronyms have been initiated thus far. The projects are funded both by CSIR and MNRE under this program. More than 150 scientists from 14 CSIR laboratories are engaged on these 9 themes.

Under TAPSUN Programme, first TAPSUN Conference was organized on 4-5 December 2012 at CSIR-NPL, New Delhi. Dr Farooq Abdullah, Hon'ble Minister for New & Renewable Energy and Shri S. Jaipal Reddy, Hon'ble Minister for Science & Technology and Earth Sciences were the Guest of honours. Highly acclaimed researcher and inventor of the Dye Sensitized Solar Cells, Prof. M. Graetzel from Federal Institute of Technology, Switzerland was the Chief Guest. Participants from 14 CSIR Laboratories, IITs, Universities and industries attended the Conference. About 130 research scholars/ students attended the Conference proceedings. There were 8 invited lectures besides oral presentations about the developments. Research scholars/ students involved in the TAPSUN Programme presented their work through 109 posters.



Fig: 3.4 Hon'ble Minister of New & Renewable Energy and others during the first TAPSUN Conference

3.2 HUMAN RESOURCE DEVELOPMENT GROUP (HRDG)

The Human Resource Development (HRD) Group has a mandate to develop and nurture S&T manpower at the national level. It also promotes, guides and co-ordinates scientific & industrial research through research grants to scientists/professors working in universities/R&D institutes. The activities of the HRD Group include: Selection of Junior Research Fellows (JRF) through National Eligibility Test (NET); Selection of Senior Research Fellows (SRF), SRF Extended, Research Associates (RA), Senior Research Associates (SRA) and Shyama Prasad Mukherjee Fellows (SPMF); Award of Shanti Swarup Bhatnagar Prizes (SSB), CSIR Young Scientist Awards (YSA) and GN Ramachandran Gold Medal; Funding of Extra Mural Research (EMR) Schemes at universities/R&D organizations; and Travel /Conference/ Symposium grants.

Following are the significant achievements:

3.2.1 National S & T Manpower Development

3.2.1.1 CSIR-UGC National Eligibility Test (NET) for JRF and LS

'CSIR-UGC National Eligibility Test (NET) June 2012' for Junior Research Fellowship (JRF) and Lectureship was conducted on 17th June 2012 at 26 centres throughout the country. 2,00,932 candidates registered & 1,44,516 appeared for the examination. A total number of 2,491 candidates qualified for CSIR/UGC JRF and 3,274 qualified for lectureship only. Out of 2,491 candidates qualified for JRF, 1,191 are to be supported by CSIR and rest by UGC.

The CSIR-UGC NET December 2012 was conducted on 23rd December 2012. 2,55,820 candidates registered and 1,85,080 appeared for the examination. Out of these, 40,390 candidates registered and 27,216 appeared for Engineering sciences which was introduced as sixth subject in NET examination for the first time in December 2012. A total number of 2,477 candidates qualified for CSIR/UGC Junior Research Fellowship & lectureship and 3,176 qualified for lectureship only. Out of 2477 candidates qualified for JRF, 1277 are to be supported by CSIR and rest by UGC.

3.2.1.2 Shyama Prasad Mukherji Fellowship (SPMF)

The objective of the SPM Fellowship Scheme is to identify and nurture budding scientific talent towards pursuit of scientific research. The fellowship is given to top certain number of JRF-NET scholars in five disciplines of basic sciences. During the year, SPM Fellowship was awarded to 59 students from five disciplines- 18 from Life Sciences, 16 from Chemical Sciences, 9 from Mathematical Sciences and 8 each from Earth and Physical Sciences.

3.2.1.3 Senior Research Fellowship (SRF), SRF Extended and Research Associateship (RA)

The expert committee meetings for the selections of SRFs, SRF (Extended) and RAs in 16 disciplines were held during November 2012 to March 2013. Out of total 2,521 candidates called for interview, the candidates selected for SRF, SRF (Extended) and RA were 576, 42 and 131 respectively.

3.2.1.4 Senior Research Associateship (SRA)/ Scientist's Pool Scheme

The Senior Research Associateship (SRAShip) is primarily meant to provide temporary placement to highly qualified Indian scientists, engineers, technologists, and medical personnel who are not in regular employment in the country and including those returning from foreign countries. During the year 2012-13, 73 Senior Research Associates were selected and their total number as on 31st March 2013 was 169.

3.2.1.5 Junior Research Fellowship for GATE qualified engineering and pharmacy graduates (JRF-GATE)

CSIR introduced a research fellowship known as the Junior Research Fellowship (JRF)-GATE in 2002 for the GATE qualified candidates with B.E./B.Tech./B.Arch./ B. Pharm degree to pursue research leading to Ph.D. in engineering and pharmaceutical sciences. JRFs selected under this scheme get an excellent opportunity to work with CSIR scientists with state-of-the-art R&D facility. During the year, twenty four (24) JRF-GATE fellowships were awarded and around 136 JRF-GATE Fellows are working at present in different CSIR laboratories.

3.2.1.6 CSIR Nehru Science Postdoctoral Research Fellowship Scheme

CSIR Nehru Science Postdoctoral Research Fellowship scheme was instituted in the year 2008 to identify & nurture promising young researchers in niche areas of basic science, engineering, medicine and agriculture. The scheme aims at facilitating their transition from mentored to independent research career. Fifteen candidates were selected out of 44 called for interview during 2012-13.

3.2.2 Promotion and Recognition of Excellence

3.2.2.1 CSIR Young Scientist Awards

The Young Scientist Awards (YSA) are given to scientists below the age of 35 years, in 5 disciplines of Science & Technology to recognize in-house excellence. During 2012, ten scientists were selected for Young Scientist Awards, two each from Biological Sciences, Chemical Sciences, Engineering Sciences, Physical (including Instrumentation) and Earth Sciences, Atmosphere Sciences, Ocean & Planetary Sciences. These Awards were presented by Dr. Manmohan Singh, Hon'ble Prime Minister of India and President, CSIR at the 70th CSIR Foundation Day Function held on 26th September 2012 at Vigyan Bhavan.

3.2.2.2 Shanti Swarup Bhatnagar Prize for Science & Technology

The Shanti Swarup Bhatnagar Prize for Science & Technology is given every year to Indian scientists below 45 years of age for their notable & outstanding contributions, applied or fundamental, in seven disciplines of Science & Technology. The names of eleven scientists selected for the Shanti Swarup Bhatnagar Prizes for the year 2012 were announced by Prof. Samir K. Brahmachari; DG, CSIR at the 70th CSIR Foundation Day Function held on 26th September 2012 at Vigyan Bhavan.

3.2.2.3 GN Ramachandran Gold Medal for Excellence in Biological Sciences & Technology

GN Ramachandran Gold Medal for Excellence in Biological Sciences & Technology is given every year for notable and outstanding research, applied or fundamental, in the interdisciplinary subject/field of Biological

Sciences and Technology. For the year 2012, GN Ramachandran Gold Medal was presented to Prof. Dulal Panda of Indian Institute of Technology, Bombay by Shri Vayalar Ravi, Hon'ble Minister of Science & Technology and Earth Sciences and Vice President, CSIR at the CSIR Foundation Day Function held on 26th September 2012 at Vigyan Bhawan, New Delhi.

3.2.2.4 Funding of Extra Mural Research Schemes to promote R & D

CSIR provides financial assistance to promote research in the field of Science and Technology including Agriculture, Engineering and Medicine. It is given in the form of research grants to Professors/ Scientists working in Universities/ Academic Institutes/ IIT's etc. The number of research schemes recommended during 2012-2013 are as given below:

Schemes	No. of Proposals Considered	Proposals Recommended	Proposals Renewed
General	911	385	817
Emeritus Scientist	83	31	149
Sponsored	11	5	27
One Time Grant	4	4	-

3.2.2.5 Travel / Conference Grants

Travel grant is provided by CSIR to young researchers for presenting research papers at International Conferences abroad. Total of 1783 travel grant applications from students were considered and 1019 cases were recommended for support. Travel Grant Committee also considered 679 applications for travel support from regular employees and recommended 400 cases for support. For organizing national/international conferences/ symposia/ workshops etc., a total of 1806 proposals from universities/institutes/scientific societies etc. were considered and 842 cases were recommended for support.

3.2.2.6 Faculty Training & Motivation and Adoption of Schools & Colleges by CSIR Labs

The main objective of this scheme is to promote interest, excitement and excellence in science education at the school and under graduate level by taking up training and motivational programmes for students and science teachers. The scheme is implemented through CSIR labs.

3.3 OPEN SOURCE DRUG DISCOVERY (OSDD): An Alternative Innovation Model for Drug Discovery

Open Source Drug Discovery (OSDD) project launched in September 2008, is leading an initiative towards developing drugs for neglected diseases. Its first target disease is Tuberculosis and has now been extended to Malaria. CSIR is leading this initiative with active participation of a large number of scientists from CSIR and non-CSIR institutes across India.

Currently OSDD has about 7300 registered members from over 130 countries. OSDD has global collaborations with 'Global Alliance on Tuberculosis (TB Alliance)', 'Medicines for Malaria Venture (MMV)', 'Drugs for Neglected Diseases Initiative (DNDi)', 'Royal Society of Chemistry (RSC)' and many other organizations such as 'University of Cambridge, UK' and Indiana University, USA to achieve its objective of developing affordable drugs.

The OSDD platform has demonstrated an effective use of crowd sourced model where in a distributed network of community members voluntarily contribute towards a purposeful activity while maintaining the quality in order to solve complex scientific challenges that need enormous manpower and effort. Successful curation of the extensive annotation on Mycobacterium tuberculosis (Mtb, the pathogen that causes TB), leading to the largest ever metabolome and protein-protein functional network, enabling identification of potential drug

targets is an example of the power of crowd sourcing approach utilized by OSDD. Published estimates suggest that this innovative approach packed nearly 300 man-years into 4 months. The research from OSDD has been published in peer reviewed international journals and so far OSDD investigators have published over 20 papers.

OSDD is currently carrying out advanced discovery activities like lead optimizing two molecules CDRI-830 and LAMS from CSIR-CDRI and CSIR-IGIB respectively, with private partners. In contrast to the existing belief, OSDD has been able to involve wet-lab scientists to participate in open source collaborations. OSDD has successfully integrated the insilco or computer based approaches with the actual laboratory experiments with researchers sharing data in the open portal and receiving feedback from the open, collaborative community. Based on the solid foundations laid by its online community review followed by scientific review and budget review, OSDD chooses the projects and ideas, which are in the purview of its goals. Currently, OSDD has several funded projects from scientists across India spanning various areas of drug discovery activities. OSDD engages in a close scientific interaction with the Principal Investigator right from the inception of the project to its delivery by constant feedback, support and focus. The projects have well defined goals and milestones with 'go-no-go' criteria also built in each project for focused delivery.

In addition, OSDD also offers various research tools, databases and resources to the scientific community to facilitate and accelerate the research. Large number of computational resources for drug discovery developed by OSDD are available to the scientific community through web based platforms hosted by CSIR-IMTECH. OSDD has set up open access repositories, namely, biological repository of clinical Mtb strains and clones, chemical repository of small molecules and an open screening platform to screen compounds against TB and Malaria. Chemically diverse compound libraries are critical components of a successful drug discovery program. Towards this OSDD has adopted an innovative way of building this by involving chemists across India. In an unprecedented way OSDD has built a network of several chemists from various CSIR labs such as CSIR-IICT, CSIR-NCL, CSIR-CDRI, CSIR-IIIM, CSIR-IICB, CSIR-CLRI, CSIR-NIIST and CSIR-NEIST that are being screened at CSIR-IICT for anti TB activities. Under 'OSDDchem' programme, being run at CSIR-CDRI, compounds from various universities, colleges and institutions across India are being screened for anti TB and malaria activities. At CSIR-IIIM, scaffolds identified from screening of 20,000 compounds are being optimized further. In addition, 30,000 more compounds are being screened at CSIR-IIIM against replicating and non-replicating mycobacteria.

In addition, to carry out some of the complex activities like SAR optimization, DMPK, pharmacology and toxicology, OSDD is engaging in public private partnerships. This enables OSDD to provide an 'end-to-end' drug discovery platform, wherein compounds can enter at any stage and be taken forward along the discovery path. CSIR-CDRI is leading the malaria programme of OSDD where in scientists across India are involved in identification of new drug targets, screening of compounds and therapies.

The major goal of OSDD is to facilitate access of new drugs/combinations to Indian TB patients by paving way for their availability by conducting clinical trials in India. Towards this end, OSDD has entered into partnership with global TB alliance, where in OSDD will take PA-824 and the combination of PA-M-Z into Phase 2b clinical trials in India. An expert committee of Indian Clinicians after extensive examination and deliberation of the data of PA-824 and its combination, have recommended the conduct of the clinical trial. The trial would be conducted at LRS Institute of Respiratory Diseases, New Delhi on MDR patients, in line with the regulations and norms of DCGI and global standards. OSDD is also evaluating several other pre-clinical and clinical candidates for TB and Malaria from various academic labs and industry globally.

OSDD offers an alternative innovation model for drug discovery for neglected diseases. While it utilizes the open collaborative model with academia and industry for the discovery phase, it advocates public funding of clinical trials to derisk the development activity. With its efforts so far OSDD has built a portfolio of several early drug discovery projects and a candidate in Phase 2 clinical trial. OSDD ensures that the drugs developed by it are available on non-exclusive basis to the industry and hence at an affordable cost to patients in India.

In addition to accelerating drug discovery for diseases like TB and Malaria, OSDD is actively engaging the community in various crowd-sourced projects. In 2012, OSDD in collaboration with Vigyan Prasar (DST) organized an YouTube short video competition on the theme on the 'Need of New drugs for TB' where in 175 videos were submitted by participants across the country and prizes awarded for the shortlisted videos.

OSDD trains a large number of students in several disciplines like bioinformatics, cheminformatics, cloning, expression of proteins and chemical synthesis of compounds. Open labs have been set up at several cities such as Delhi (CSIR-IGIB), Bengaluru (OSDD-IISc) and Thiruvananthapuram (CSIR-NIIST) where in students can engage in various projects of OSDD. Further, online teaching courses through OSDD e-learning programme trains students and give them access to global experts in drug discovery. These initiatives are providing opportunities to students from across the country, even in remote areas to be involved and contribute to the cutting edging technology being employed in drug discovery thereby building the much needed human resources in areas of drug discovery.

3.4 INNOVATION PROTECTION UNIT (IPU)

The Unit manages 'CSIR Innovation Award for School Children'. Presentation of the awards for the year 2011 to the winners were given by Prof. C. N. R. Rao, Emeritus Scientist in Vigyan Bhawan on CSIR Foundation Day 26th September, 2012. The presentation includes cash prize and certificates to the winners.

'CSIR Innovation Award for School children for the year 2012 was announced on 26 April, 2012 - the day celebrated as 'WORLD INTELLECTUAL PROPERTY DAY' throughout the world.

The Unit was able to file 199 patents in India and 381 patents abroad on behalf of all the laboratories of CSIR. Besides, 108 patents were granted to CSIR in India and 272 abroad.

3.5 INTERNATIONAL S&T AFFAIRS DIRECTORATE (ISTAD)

3.5.1 Exchange visits under Bilateral Co-operation Programme

Australia

A CSIR delegation led by DG, CSIR visited University of Wollongong (UOW) to discuss strategic partnerships between CSIR and University of Wollongong & to explore R&D and Technology partnerships in the 'Future Materials' and the possibility of establishment of a Joint R&D Centre in the areas of Automotive, Healthcare, Renewable Energy and Nano-electronics & Electro-materials. A letter of intent with University of Wollongong and CSIR, India was signed.

Czech

Ten exchange visits have taken place under CSIR/ ASCR (Academy of Sciences of the Czech Republic) Programme in the areas of Chemical Sciences, Physical Sciences, Earth Sciences and Engineering to carry out experimental / research work.

Italy

Several Italian researchers from CNR, Italy to carry out the research work visited CSIR laboratories/ institutes under joint project entitled "Assessment of environmental hazard and groundwater vulnerability from ash ponds using stable and unstable isotopes (CSIR-NEERI)"; "Comparative studies on the physiological and biochemical aspects of adaption and productivity in *Camelia sativa* L. in different biogeography regions" (CSIR-NEIST), Structural and functional analysis of positive and detrimental effects of SNPs in miRNA (CSIR-NEERI), "Studies on composite membranes and new eletrocatalyst for PEM fuel cells", "Structural and functional analysis of positive and detrimental effects of SNPs in miRNA and target proteins involved in xenobiotic metabolism and focal adhesion" (CSIR-NEERI), "Phytoremediation and rhizoremediation of polychlorinated biphenyls contaminated soils ", "Assessment of environmental hazard and ground water vulnerability from ash ponds using stable and unstable isotopes (CSIR-NEERI)", and "Comparative studies on the physiological and biochemical aspects of adaptation and productivity in *Camilina sativa* L. in different biogeographic regions" (CSIR-NEIST).

The Italian researchers also participated in an Indo-Italian workshop on "Technological innovations for environmental sustainability".

Ad hoc Visits

Twelve distinguished scientists/researchers from different foreign universities/institutes visited several CSIR laboratories/ institutes to work in the cutting edge areas of S&T.

3.5.2 Sector specific Partnership

International Conference/Workshop etc.

During the year, 10 proposals were processed and granted CSIR's approval for holding the International Conferences/Seminars/Symposia etc. by CSIR Labs with international scientists/ experts in the area.

3.5.3 CSIR – BMBF Cooperation

To enhance the research partnership between CSIR and BMBF under the CSIR-IB BMBF Cooperative Science Programme 11 Exchange Visits were approved jointly by CSIR and Federal German Ministry of Education and Research (BMBF). Out of 11 projects, 2 projects from CSIR-IICB on "Indian-German glycoproteomics network & long term collaborative research"; and "Glycoproteomics-Network: Biomarkers for human diseases and formulation of future collaborative" projects and detailed planning of on-going and new projects, 4 projects from CSIR-IMMT on "Development of Nanostructured Oxide Thermoelectric Material"; to study the oxidation behavior of low alloy Cr-Mo steel in steam environment under isothermal and thermal cycling conditions which represent the service conditions of fossil fired thermal power plants under an ongoing project on High Temperature Oxidation of Low Alloy Cr-Mo Steels in Steam Environment"; "Maximum enzymatic convertibility of the waste biomass to sugar leading to higher productivities of bioethanol/butanol under an ongoing project on Improved Pre-treatment by the Wet Air Oxidation System and Enzymatic Saccharification using tailor-made enzyme system for enhanced sugar release from lignocellulosic biomass for biofuel production, two projects from CSIR-NCL on "Valorisation of glycerol by acetylation/acetoxylation processes using solid acid catalysts"; and "Valorisation of glycerol by acetylation/acetoxylation processes using solid acid catalysts" to review the work carried out so far and to plan for future work and prepare few catalysts in CSIR-NCL which will be tested for catalytic activity in LIKAT, and one project from CSIR-CECRI on "Preparation of high performing Li-ion battery electrode materials via solution combustion synthetic route and their performance evaluation using pouch cells".

3.5.4 Multilateral Co-operation

CSIR-TWAS Fellowships

CSIR in association with TWAS offers fellowship for Ph.D/ postdoctoral research studies at CSIR Institutes to scholars from developing countries. Eleven researchers from Bangladesh, Cameroon, Ethiopia, Ivory Coast, Kenya, Nepal, Nigeria and Pakistan were awarded fellowships for a period of one year to four years duration in the different areas of Biomedical, Chemical, Environmental, Information and Life Sciences.

Facilitated visits of Ms. Nodar Osman Khalifa of SUDAN to CSIR-CGCRI, Kolkata enabling her to carry out Ph.D. "Research in Nano Materials Synthesis and Characterization" under the CV Raman International Fellowships for African Researchers jointly offered by DST and FICCI and the fellowship programme of Organisation for Women in Science for the Developing World (OWSD), Italy.

European Union

a) European funded programme

Two Joint projects namely "Fate of anthropogenic nitrogen in aquatic systems of India" and "Improvement of technologies and tools, e.g. biosystems and biocatalysts, for waste conversion to develop and assortment of high added value eco-friendly and cost effective bio-products" submitted by CSIR-NIO, and CSIR-NIIST, respectively were approved for implementation.

EU Project - New INDIGO

ISTAD, CSIR is the co-coordinator in the EC funded ERA NET project - New INDIGO (Initiative for the Development of Indian & European Research) which is a consortium of European and Indian S&T organisations involved in promoting research cooperation between Europe and India. It intends to strengthen the international dimension of the European Research Area and provide a gateway to European S&T for Networking with Indian S&T platform.

Organisation of EU-India STI Cooperation days, CSIR-NGRI, Hyderabad, 8-9 November, 2012.

The third edition of "EU-India Science Technology and Innovation Cooperation Days" was organised in Hyderabad on 8-9 November 2012. This was a joint event organised by the following EU projects and initiatives; New INDIGO, INDIA GATE, EURAXESS Links INDIA and EBTC in close cooperation with the National Geophysical Research Institute (CSIR- NGRI). The purpose of organising to event was to showcase the good results of cooperation between Europe and India and to foster further STI cooperation.

The thematic focus was water-related research. Researchers working together in various types of projects (FP7, multilateral and bilateral) were invited to present their achievements and reflect on the cooperation. They had the chance to network with industries in a brokerage event.

Partial Financial Assistance (PFA) to non-CSIR Researchers

CSIR offers PFA to non-CSIR scientists/researchers holding a regular position in Scientific organizations/Universities and working in the areas of interest to the CSIR and its laboratories. The programme aims to encourage participation of other Indian Scientists in International conferences abroad with a view to obtain a state-of-the-art report on the subject of the conference for use by the CSIR. The financial assistance to the extent of 50% of total airfare or Rs. 30,000/- whichever is less is provided to the Indian scientists. About 110 scientists/academicians were provided the CSIR travel support for attending conferences/seminars etc. abroad.

Visits of foreign scientists under the CSIR - Distinguished Foreign Scientist (DFS) Scheme

Visits of Distinguished foreign scientists have been initiated by the Directorate to facilitate mobility of foreign researchers. Nine eminent scientists from different universities/ institutes have been benefitted by this scheme during the year.

3.5.5 Deputation of CSIR Scientists abroad

246 Directors/Scientists were deputed abroad under various S&T programmes like Business Development, Bilateral, Conference, Fellowship, Training etc.

3.5.6 Global Research Alliance

Global Research Alliance (GRA) Meeting

DG, CSIR attended the Annual meeting of the Global Research Alliance as the Principal & Director, CSIR-NML as the Champion from CSIR, India organized at Sydney, Australia during 3-4 May 2012. All other partners namely CSIRO Australia, Fraunhofer, Germany, TNO, Netherlands, DTI, Denmark, SIRIM, Malaysia, Battelle, USA, VTI, Finland & CSIRO South Africa were also represented at this meet. A Champions' Workshop on "Connectivity – how do we collaborate – our goals, drivers, imperatives and the way forward" as well as on Inclusive Innovation was organized where all the partners individually put forward their views on the way forward for GRA. CSIR presented its activities with Vietnam on the Idea Portal and Traditional Medicine Knowledge initiatives which are being carried out under GRA umbrella. The visit led to establishment of contacts with the leading research establishments who are partners in the Global Research Alliance and is expected to lead to enhance & to identify the research collaboration with some of these institutes. CSIR has offered to make available and implement technologies available with the GRA partners which can enhance the quality of life of a common man at an affordable cost.

CSIR, India offered to host the 2013 Annual Meeting at Delhi between 6-8 March 2013.

More for Less for More' 10th Anniversary Meeting of the Global Research Alliance

Shri S. Jaipal Reddy, Hon'ble Minister of Science & Technology and Earth Sciences, Govt. of India inaugurated the 10th Anniversary Meeting of the Global Research Alliance being hosted by CSIR, India, in New Delhi, during 6-9 March 2013. The Global Research Alliance (GRA), a large international body with members from Asia and other countries, including CSIR, India, promotes the Millennium Development Goals through research and development, fostering innovation in science and technology for the global world.

The following attended the 10th Anniversary Meeting of the Global Research Alliance

GRA Principals: Dr. Megan Clark – Chief Executive – CSIRO; Professor Erkki Leppävuori - President & CEO – VTT; Professor Alfred Gossner - Senior Vice President Finance (incl. Business Administration, Purchasing, Real Estate, Information Technology) – Fraunhofer Institute, Germany; Dr. C.M. Hooymans - TNO Board of Management, the Netherlands; Prof. Samir K. Brahmachari – Director General, CSIR (India); Mr. Soren Stjernqvist - President and CEO – DTI; Dr. Gerald Hane - President and Chief Executive Officer-Battelle-Japan; and Dr. Mohd. Jamil Suleiman, SIRIMBerhad, Malaysia. In addition, nine Champions from the GRA Members institutions also participated in the meeting.

The GRA delegation deliberated in details the Vision, roles strategies and road map for GRA during the coming years.

3.6 HUMAN RESOURCE DEVELOPMENT CENTRE (CSIR-HRDC)

The Human Resource Development Centre has a mandate to train, nurture and augment capabilities of scientists, technical personnel and administrative staff of CSIR laboratories. The year 2012-13 at the Centre was marked with new initiatives and activities in the area of human resource development. The Centre conducted 31 training programmes during the year. Highlights of the significant activities undertaken by the Centre during the year are given hereunder:

3.6.1 Workshop on MSME Cluster Innovation

The Centre in association with National Innovation Council (NInC) organized a two day Workshop on 'Launch of CSIR - NInC MSME Cluster Innovation Scale-up Programme'. The Workshop focused on methodologies relating to diagnostic studies for identification of relevant clusters wherein the CSIR Laboratories. can contribute significantly in enhancing the innovation capability & capacity of the identified cluster. Accordingly, 43 scientists working on cluster innovation initiative from 33 CSIR laboratories participated in the Workshop.

3.6.2 Major Training & Development Programmes

The major programmes organized to develop skills and competencies of the scientists for their efficient working included programmes on 'Project Management : Tools & Techniques', 'S&T Communication & Presentation Skills', 'Work Life Balance for Women Scientists & Officers', 'Creativity & Out of Box Thinking' and 'Innovation: begin doing right away'. For the 2012 batch of Post Graduate Research Programme in Engineering (PGRPE) a programme on 'Research Methodology & Science Communication' was organized.

In addition, the Centre also conducted various capacity building programmes for Administration, Finance and Stores & Purchase officials including 'Workshop on Policies and Procedures in Finance & Accounting', 'Training for ERP : HR Portal related processes and configuration of HR Processes' and 'Programme on Taxation Laws – Direct and Indirect Taxes'.

3.6.3 Leadership Capacity Building Programme

To meet newer challenges and responsibilities which keep on emerging, the Centre undertook 2nd series of Leadership Development Programmes. In order to develop the structured training modules a Training Need Assessment study was carried out through visionary interviews and assessment surveys amongst scientists & officers covering 9 Laboratories and CSIR Hqrs.

3.6.4 Joint Programmes with other CSIR Units

The Centre organized two special need based training programmes with the other CSIR Units for the participants from outside CSIR. One of the programmes was organized jointly with CSIR-TKDL Unit for the officials from Controller General of Patents, Designs & Trade Marks (CGPDTM) on the use of TKDL in examination of traditional knowledge related applications. The other specialized programme, organized in association with CSIR-Ayurgenomics Unit – TRISUTRA, was on 'Prakriti Methods of Ayurveda' for the ayurveda researchers associated with the R&D activities of CSIR- Ayurgenomics Unit.

3.7 UNIT FOR SCIENCE DISSEMINATION (USD)

The Unit for Science Dissemination is fully responsible for furthering favorable public image of CSIR as a whole. Several image-building activities were executed to achieve the overall objective through 'Team USD'.

Execution of Diverse Image Building Activities

Image Building through Print Media

Publicity Efforts

- Effective media relations helped in furthering result-oriented relationship with the key press persons covering science in their respective dailies. Appropriate logistics support was ensured to all of them to earn their confidence in this Unit; several features/ stories were published with the support of inputs provided by this Unit.
- Press coverage was successfully organized during important CSIR events.
- Press releases were prepared and disseminated on several occasions and their coverage monitored for effectiveness.

Advertising Efforts

- CSIR Diamond Jubilee Technology Award – 2012 (CDJTA - 2012).
- Innovation Award for School Children (CIASC - 2012).
- OSDD
- Technology Day – 2012.
- Scientist Awareness International Conference – 2012.
- Advt. on recruitment to the posts of Directors of CSIR Labs.
- Advt. on AcSIR.
- Advt. for various position in OSDD.
- Advt. on occasion of Inauguration of CSIR – IGIB, New Campus.
- Advt. on youtube based completion on need to new TB Drugs.
- Industry Originated Projects under CSIR – NMITLI.
- CSIR Award for S&T innovation for Rural Development – 2012.
- CSIR Diamond Jubilee Technology Award – 2013.
- Released advertisement in special issues of several publications.

Image Building through Interactive Media (Exhibitions, etc.)

- CSIR participates in various national/international exhibitions and other related events with two main objectives: (i) Creating awareness about CSIR and its achievements, and (ii) Supporting its business development efforts.

- This important activity was consolidated and efforts were made to project, as far as possible, an integrated picture of CSIR overall contribution to the theme areas of each event through extensive coordination with the participating CSIR labs on one side and the organizer of the event on the other.

Other events organized by the unit during this year include:

- Haryana S&T Workshop & Exhibition, Palwal 26-28 April, 2012;
- 10th Infra Educa – 2012, Patna(27-28 May, 2012), Delhi (23-24 June, 2012) & Jammu (14-15 July, 2012)
- Agri Tech India – 2012, Bangaluru 25-27 August, 2012;
- 6th Destination Uttarakhand, S&T Expo – 12, Ranikhet 7-9 June, 2012;
- 8th Food & Technology Expo – 2012, Pragati Maidan 27-29 July, 2012;
- 2nd Vision Harya, Sirsa 28-30 Oct., 2012;
- CSIR @ 70 Celebration, Vigyan Bhawan 26 Sept, 2012 & 27-29 Sept, 2012 at IGIB;
- 9th Jatiya Utsav – o – Bharat Mela – 2012 West Bengal 8-15, Dec., 2012;
- Agrovision – 2013, Nagpur 24-27 Jan., 2013;
- 100 Indian Science Congress, Kolkata 3-7 Jan., 2013;
- Lucknow Mahaotsava, Lucknow 25th Nov, 2012 to 5th Dec., 2012;
- Chemtech + Pharma World Expo – 2013, Mumbai 15-18 Jan, 2013;
- Bangalore India Bio – 2013, Bangaluru 4-6 Feb., 2013;
- 4th Vision Rajasthan – 2013, Jaipur 4-6 Feb, 2013; and
- 8th Nutra India Summit, Mumbai 13-16 March, 2013.

CSIR's participation in the following international exhibitions

- Bio – 2012, Bostan, USA 18-20 June, 2012.

Other Information Dissemination Services

The Unit provides press-clipping service to the office of the Minister of Science & Technology, DG, CSIR and other top management of CSIR after scanning about 25 papers and 14 magazines on a regular basis. This activity was consolidated to make it more professional and timely.

Value-addition to the regular Newspaper Clipping Service of this Unit

- Special compilations were brought on the coverage by media (of important CSIR events) (both national and international) for perusal of MOS(S&T), DG, CSIR and the concerned departments; and
- Special supplements were also brought out covering the latest developments in S&T and other areas of interest to CSIR as reported in national and international online sources for the perusal of DG, CSIR.

Technical Services

- A large number of information queries pertaining to CSIR activities were attended either in person or by way of post/e-mail to the best satisfaction of the users.

Office of the Public Information Officer under Right to Information Act 2005

As the Right to Information Act of Govt. of India has come into force. Head, USD has been appointed as the Public Information Officer, CSIR, by DG, CSIR. All the requests for information (on CSIR) under this Act are being processed by this Unit.

3.8 TRADITIONAL KNOWLEDGE DIGITAL LIBRARY (CSIR-TKDL)

TKDL Outcomes against Bio-Piracy

Traditional Knowledge Digital Library (TKDL) has been created to prevent the misappropriation of India's Traditional Knowledge at International Patent Offices (IPOs) so that the cases like misappropriation of 'Turmeric' and 'Neem' could be prevented. The reason for misappropriation of India's traditional knowledge at IPOs was that since such traditional medicinal knowledge exists in local languages and was either not available to patent examiners or even in case of availability it was incomprehensible for them. In other words there exists language and format barriers due to which patents are being taken on the existing knowledge. TKDL breaks the language and format barriers and makes the knowledge available to patent examiners in a language comprehensible for them, in patent application format.

The genesis of the maiden Indian effort dates back to the year 2000, when an interdisciplinary Task Force of experts was set up, to devise a mechanism on protection of India's Traditional Knowledge, after the wrong patents granted on the wound healing properties of turmeric (US patent No. 5,401,504) by USPTO and on the bio-pesticidal property of Neem (EPO patent No. 436257) by EPO, came to notice which were later fought and got revoked. Pursuant to this, studies were carried out to find out the extent of misappropriation of India's traditional knowledge which shows that there is a continuous rise in misappropriation of traditional medicinal knowledge of India at the International Patent Offices, and number of patents taken on Indian Systems of Medicine at International Patent Offices each year is approx. 2000.

Misappropriation is being done by MNCs of mainly developed countries, wherein the patent applications on medicinal plant use are being filed for which the prior art exists in documented form in India. Since, patents are being claimed on treatment of diseases with the constituent active ingredients/elements/metals/compounds/salts of the particular medicinal plant for which the prior art exists, hence for preventing misappropriation by opposing the claims at pre-grant stage, giving appropriate grounds for opposition along with substantive evidences from TKDL, it is essential to study the constituents and various aspects of medicinal plants like Pharmacology, pharmacognosy, toxicology, medicinal and other uses of the plants, for which value addition to TKDL database was done.

Efforts to devise a tool for protection of traditional knowledge are being made at various international fora like WIPO, WTO and CBD for more than a decade, but till date only TKDL has proved to be a successful tool in preventing the misappropriation of India's TK.

TKDL has placed CSIR/India in Global leadership position in the area of TK Protection. Recently, Dr. Manmohan Singh, Hon'ble Prime Minister of India, at the inauguration of High Level Segment of the 11th CoP to the Convention of Biological Diversity has highly appreciated the Traditional Knowledge Digital Library.

"In recent years there has been concern that this public knowledge may become restricted in its use because of the application of the modern intellectual property system. India has tried a unique approach to protection of traditional knowledge by establishing a Traditional Knowledge Digital Library. This database has 34 million pages of information in five international languages in formats easily accessible by patent examiners. This Library promotes the objectives of the Nagoya Protocol on the issue of protection of codified traditional knowledge systems such as the celebrated Ayurveda.

We decided to build this knowledge database because of the patent on the use of neem extract in Europe and another on the use of turmeric as a healing agent. Since then, because of this database, over 1000 cases of biopiracy have been identified and over 105 claims withdrawn or cancelled by patent offices.

We believe that the treasure trove of traditional knowledge should be used for the benefit of all humankind rather than for private profit. We will continue to work to strengthen our institutions to record this knowledge, to value its science and to provide benefits to its custodians. Multilateral agencies like the WIPO and some countries have approached us for assistance in setting up such libraries and our government will be happy to provide necessary assistance."

Since July 2009 till date India has been able to prevent misappropriation of India's Traditional Knowledge at International Patent offices in 140 cases without any cost and in few weeks of time, whereas cancellation of only few claims in wrong patent granted on Basmati costed more than seven crores to APEDA. During April 2012 – March 2013, TKDL Unit has identified 371 patent applications on India's Traditional knowledge and has filed 257 Pre-grant oppositions & has been successful in 55 cases, without any cost.

TKDL Outcomes Against Bio-Piracy

Successfully Safeguarded Bio-Piracy Attempts to Patent Medicinal Plants (usages)



Amla



Warmwood



Babool



Common Yarrow



Agaricus



Almond



Aloevera



Apple



Locoweed



Asvagandha



Eggplant



Baheda



Banana



Barley



Tulsi



Bel



Paan



Bhang



Black Pepper



Butter Milk



Capsicum



Carob bean



Cashew Nut



Chakshu



Daal chini



Citrus



Clove



Cow Milk



Curry Patta



DaruHaridra



Date Palm



Vidarikand



Kulthi



Ginger



Grape



Green Tea



Guava



Gurmar



Haldi



Harad



Hops



Jamun



Jashmine



Jatiphal



Makoya



Kalamegha



Kateri



Karanj



Kachoor



Kerala



Karpura



Katauki



Khadira



Knoch



Kaddu



Kustha



Kutaja



Lemon



Mulethi



Linseed



Pippali



Lupin



Saunf



Manjistha



Methi



Myrtle



Joss Flower



Neem



Olive Oil



Onion



Patola



Pepper Mint



Rose



Pomegranate



Punarnava



Radish



Rice



Rose



Sun Flower



Bhuin Amla



Taxus



Thyme



Water Lily



White Willow



Ber



Bamboo



Coconut

Common Juniper



Common Marjora



Corn Mint



Rumi Mastaje

World Intellectual Property Organization (WIPO), Geneva, has proposed to internationalize the TKDL for protection of traditional knowledge of other countries, especially developing nations. In 2013, WIPO in collaboration with CSIR and DIPP organized a three days 'Study Visit to TKDL' for 19 countries interested in replicating TKDL for protection of traditional knowledge of their country, pursuant to the International Conference on 'Utilization of TKDL as a Model for protection of traditional knowledge' organized by WIPO in collaboration with CSIR in 2011 wherein 33 countries participated.

Several Countries are approaching Council of Scientific and Industrial Research for getting access to TKDL for improving the quality of examination of Patent applications filed of Traditional Knowledge. During 2012-13, request for access to TKDL after signing of TKDL Access (Non-disclosure) Agreement has been received from Russian Patent Office and Chile Patent Office which is under consideration.

Also, during 2012-13 first amending agreement has been concluded with UK Patent Office.

Introduction to Traditional Knowledge Digital Library has been included in the Ayurveda PG Syllabus of prestigious Banaras Hindu University, Varanasi.

Several International delegations from countries like Peru, Ecuador had visited TKDL during 2012-13 also.

Dateline



Date	Salient Details
April, 2012	
4 th	CSIR-CGCRI: Dr. Dennis Maier of Nikon, Germany delivered a lecture on 'Performance of software for analysis of ceramic sample by x-ray CT'.
14 th	CSIR-IIP: Dr Bhimrao Ambedkar Jayanti was celebrated.
26 th	CSIR-CSIO: CSIR Leadership Conference 2012 was held at CSIR-CSIO & CSIR-IMTech. The conference was inaugurated by the then Hon'ble MOS&T Shri Vilasrao Deshmukh.
May, 2012	
11 th	National Technology Day-2012 : Various lectures and workshops were organized by CSIR laboratories/ institutes.
29 th -30 th	CSIR-NEIST: Two days North East Graduate Congress was organized jointly with University of Science & Technology, Meghalaya (USTM).
	CSIR-NISCAIR: Two days conference on Vaigyanik Drishtikon Tatha Chetna Jagane Mein Sanchar Madhyamonki Bhumika par Antarrashtriya Sammelan (International Conference on Role of Communication Media in Promoting Scientific Temper) was organised. The Valedictory Function was graced by Prof. Yashpal, noted educationist and Ms. Mallika Sarabhai, renowned dancer and choreographer.
June, 2012	
5 th	CSIR-IITR: Institute celebrated World Environment Day with the theme entitled "Green economy: does it include you?"
6 th	CSIR-NCL: Dr. Ashwani Kumar, Hon'ble Minister of State for Planning, S & T and ES visited the laboratory.
8 th	CSIR-NIO: World Oceans day was celebrated.
10 th	CSIR-SERC: Prof. G.S. Ramaswamy Memorial Lecture on "Innovative Technologies in Construction Sector – Role of Scientist Innovators" was delivered by Shri Zacharia George, Principal Structural Consultant, M/s Pithavadian and Partners.
21 st	CSIR-IHBT: IHBT Foundation Day lecture was delivered by Prof. Deepak Pental, Director, CGMCP Delhi (Former VC, University of Delhi) on "Are model species and crop species two different worlds of scientific enquiry?"
28 th – 29 th	CSIR-IIP: Scientific Advisory Committee (SAC) on Hydrocarbons of Ministry of Petroleum & Natural Gas (MoP&NG) was organized. A SAC declaration "We Are Committed To Support Development Of Innovative Cutting Edge Technologies For Continued Globally Competitiveness And For Ensuring Energy Security of Our Nation" was signed by all SAC members.

July, 2012	
9 th	CSIR-IIP: Meetings of the Standing Committee on Emission Legislations (SCOE) and meeting of the Central Motor Vehicle Rules – Technical Standing Committee (CMVR-TSC) was organized. Around 60 participants from various Ministries, ARAI, Members of Society of Indian Automobile Manufacturer (SIAM), Emissions control Manufacturer Association (ECMA) and other industry experts attended the meetings.
11 th	CSIR-IMMT: A demonstration of rural technologies developed by CSIR-IMMT was organized for a team of delegates from Uganda.
August, 2012	
2 nd	CSIR-CFTRI: Workshop on “Recent Trends in Nutrition and Food Safety” was held.
2 nd -4 th	CSIR-IICT: Two days International Symposium on 'Chemistry and Chemical Biology of Natural Products' – CCBNP 2012 was organized. Around 800 delegates attended the event.
12 nd -16 th	CSIR-NEIST: International Coir Tech Expo 2012 was organised.
14 th	CSIR-CLRI: TAJ MODEUROP was launched on the occasion of the 145 th meeting of the Committee of Administration of the Council for Leather Exports held at FIEO, New Delhi. 32 delegates from Germany, Switzerland, Italy, Austria, Finland and USA visited.
16 th -17 th	CSIR-IICT: PEST-TECH 2012 was jointly organized with Pest Control Association of India. Shri. Sarve Satyanarayana, MP was the Chief Guest.
18 th	CSIR-NIIST: Dr. Kasturi Rangan, Member, Planning Commission, GOI, visited the Institute.
22 nd	CSIR-NCL: Public Lecture on Stories of Emerging Paradigms in Translational Cancer Research was delivered by Prof. Shiladitya Sengupta, MIT, Cambridge, USA
24 th	CSIR-NML: Industry Meet on Fly Ash was held. Fifty five participants attended the program.
25 th -27 th	CSIR-NEIST: Agri Tech India 2012 was organised by Media Today P. Ltd., Bengaluru. The Chief Guest Shri H D Deve Gowda, former PM of India inaugurated the Expo. Nearly 1500 visitors visited the stall.
27 th -29 th	CSIR-IICT: Four-days workshop on “Opportunities for Synergy and Avenues for Innovate, OSAI -2012” was organized. His Excellency Shri. E.S.L.Narasimhan, Governor of Andhra Pradesh inaugurated the workshop.
31 st	CSIR-CDRI: Symposium on “Sophisticated Instruments & their role in Drug Discovery” was organized. Padma Shri Dr. Nitya Anand delivered a lecture on “Some recollections & reflections of CSIR-CDRI”.

September, 2012	
6 th	CSIR-CLRI: South African delegates visited the institute.
7 th -8 th	CSIR-IICT: Two days National Symposium in Polymers & Coatings (NCPC-2012) was organized jointly with The Oil Technologists' Association of India (OTAI), Southern Zone along with Indian Small Scale Paints Association (ISSPA) and Indian Resin Manufacturers Association (IRMA).
11 th – 13 th	CSIR-IICB: First International Meet in Cell Signaling Network (CeSiN-2012) was organized.
21 st -24 th	CSIR-CEERI: National Conference on Vacuum Electronic Devices & Applications (VEDA-2012) was organized.
23 rd -28 th	CSIR-IMMT: XXVI International Mineral Processing Congress (IMPC 2012) was organized for the first time in India. More than 1100 delegates from 42 countries participated.
24 th	CSIR-CLRI: Common Market for Eastern and Southern Africa (COMESA) visited the institute.
26 th	70 th CSIR Foundation Day Celebrated by CSIR laboratories/ institutes.
October, 2012	
4 th	CSIR-CFTRI: VALUEFISH: The National conference on Research, Production & Marketing of Value Added Fish Products–Present status & Future directions was organised.
6 th – 7 th	CSIR-IHBT: Stakeholders Workshop on National Mission for Sustaining the Himalayan Ecosystem (NMSHE) was organized.
17 th	CSIR-NISCAIR: Celebrated 60 th Anniversary of the institute. Dr. A.P.J. Abdul Kalam, Hon'ble former President of India was the Chief Guest. Hon'ble Union Minister of S&T Shri Vayalar Ravi, Minister of State for S&T, Dr. Ashwani Kumar, and Dr. S.K. Brahmachari, DG-CSIR also attended the function.
25 th	CSIR-NBRI: Inauguration of Diamond Jubilee and Annual Day functions: Bharat Ratna Dr. APJ Abdul Kalam, Hon'ble former President of India was the Chief Guest. Guest of Honour were HE Shri BL Joshi, Governor of UP and Prof. Samir K Brahmachari, DG-CSIR. CSIR-CSMCRI: Dr. Farooq Abdulla, Former Minister of Environment & Forest poured biodiesel in CSIR-CSMCRI's Qualis car commemorating the milestone of over 2 lakh km of running of regular vehicle with B100 Jatropha Methyl Ester.
29 th - 3 rd	CSIR-IMMT: Vigilance Awareness Week was celebrated.
30 th	CSIR-CSIO: Three days National Symposium on Instrumentation was organized.

November, 2012	
1 st - 3 rd	CSIR-CBRI: National conference on Engineering Trends of Energy Conservation in Buildings was organized.
1 st - 5 th	CSIR-CCMB: Biophysical Society (USA) Thematic meeting titled "Lipid-protein Interactions in Membranes: Implications for Health and Disease" was organized.
22 nd - 24 th	CSIR-CCMB: 4 th Meeting of the Asian Forum of Chromosome and Chromatin Biology on "Epigenetic Mechanisms in Development and Disease" was organized.
23 rd - 25 th	CSIR-IICB: Hundred Years of Antimonials: An International Conference was organized. Sir U. N. Brahmachari Award was also announced.
25 th	CSIR-NML: Prof. P. Ramachandra Rao Memorial Quiz – 2012 was organized.
28 th – 29 th	CSIR-CLRI: Two days visit of delegates from Leather and Shoe Research Institute (LSRI), Vietnam, Official Asia and Africa Division, MoST (DIC), Vietnam.
29 th Nov–6 th Dec	CSIR-CCMB: EMBO Global Exchange Lecture Course: "Structural and Biophysical Methods for Biological Macromolecules in Solution" was organized.
December, 2012	
6 th – 7 th	CSIR-CFTRI: XXII Indian Convention of Food Scientists and Technologists (ICFoST). The theme of this conference was SAFEST (Safety Assurance of Foods through Emerging Science & Technology) Innovations.
8 th – 9 th	CSIR-NBRI: Annual Chrysanthemum and Coleus Show was organised.
11 th - 17 th	CSIR-CMERI: 11 th Indo-German Winter Academy
12 th - 14 th	CSIR-NEIST: Krishi Expo cum Kisan Mela-2012 was organized. Around 20,000 people visited the mela.
13 th - 15 th	CSIR-CFTRI: XXVII National Carbohydrates Conference on Prospects and perspectives of glycoscience and allied technologies was held.
22 nd - 24 th	CSIR-CDRI: XVIII Annual Congress of Society of Andrology India (SAI) on Global Perspective of Reproductive Biomedicine was organized.
23 rd - 24 th	CSIR-CMERI: Indo-US Workshop on Fabronics for Healthcare was organised.
26 th - 27 th	CSIR-IICT: Two days International Conference on Global Meet of Biologists was jointly organised with Osmania University and ZSI, Bodhgaya.
30 st	CSIR-CBRI: An Interactive meet with the industry on 'Fire Resistant Composite Panels' was organized.

January, 2013	
7 th	CSIR-NCL: NCL Foundation Day Lecture was delivered by Prof. Ei-ichi Negishi, Nobel Laureate on Magical Power of Transition Metals: Past, Present, and Future.
10 th - 12 th	CSIR-NISCAIR: Three days International Conference on Science Communication for Scientific Temper was organized. Justice Markandey Katju, Chairman, Press Council of India, was the Chief Guest, the other key speakers were Dr. P. M. Bhargava, former Vice Chairman, National Knowledge Commission; Prof. Bernard Schiele from the University of Quebec, Montreal and noted film producer Mr. Mahesh Bhatt.
15 th	CSIR-CLRI: Hon'ble Minister of S&T and ES Shri S. Jaipal Reddy visited CLAD design studio.
19 th - 20 th	CSIR-NBRI: Annual Rose and Gladiolus Show was organised.
19 th - 25 th	CSIR-NML: Delegation from KIGAM, Korea visited the laboratory.
21 st - 22 nd	CSIR-CDRI: Study-visit of the Department-related Parliamentary Standing Committee on S&T, Environment & Forests at Lucknow.
24 th	CSIR-IIP: Inaugural function of Oil and Gas Conservation Fortnight 2013 (OGCF 2013) was organised. The Chief Guest of the function was Mr. Pritam Singh, Minister of Food & Civil Supplies, Minor Irrigation, Rural Development & Panchayati Raj, Uttarakhand Government. CSIR-CLRI: A Press Meet was organized on 47 th Leather Industry Get - Together (LERIG).
27 th	CSIR-CLRI: Shri Tadesse Haile, State Minister, Ministry of Industry, Federal Democratic Republic of Ethiopia visited CLAD design studio.
27 th - 29 th	CSIR-IICB: Three days International Symposium on 'Challenges in Chemical Biology, (ISCCB 2013)' was organized.
28 th - 30 th	CSIR-NIO: Three days International workshop on "IMBER- IMBIZO III" was organised. "The Future of Marine Biogeochemistry, Ecosystems and Societies" was formally inaugurated by HE Shri Bharat Vir Wanchoo, Governor of Goa-in the presence of Prof. Eileen Hofmann, Old Dominion University, USA, Dr. Alida Bundy, Research Scientist, DFO, Canada, Prof. Kon Kee Liu, National Central University, Taiwan and Dr. Naqvi, Director, CSIR-NIO.
February, 2013	
4 th	CSIR-CGCRI: Dr. Vimal Kumar Pujari, Consultant, Advanced Ceramics, Northboro, USA delivered a lecture on 'Machining/grinding of advanced ceramic materials and its effect'.
6 th	CSIR-AMPRI: Raj Bhasha Parliamentary Standing committee visit was co-ordinated by the institute. Prof B K Mishra, Director, CSIR-AMPRI received a document from Shri Raghunandan Sharma, Member Rajya Sabha on Rajbhasha implementation in Central Govt. Offices at Bhopal.
8 th - 10 th	CSIR-CLRI: Three days Chennai Chemistry Conference (CCC) was held.

11 th	CSIR-CDRI: 38 th Mellanby Memorial Lecture was organized in memory of Sir Edward Mellanby, Founder Director, CSIR- CDRI. The lecture entitled `Four decades of discovery for the treatment and prevention of breast cancer: The SERM story was delivered by Dr. V. Craig Jordan, Professor of Oncology and Pharmacology, Georgetown University, USA.
11 th - 13 th	CSIR-IICT: 21 st National Symposium on Catalysis (CATSYMP-21) was organized in association with The Catalysis Society of India.
14 th	CSIR-AMPRI: National Level MSME Meet was organized.
19 th - 20 th	CSIR-IMMT: Two-days Workshop-cum-Exhibition of selected CSIR technologies suitable for socio-economic development of the Koraput region of Odisha, was organized under the CSIR-800 programme.
25 th - 28 th	CSIR-CDRI: Three days symposium on Current Trends in Drug Discovery and Research (CTDDR-2013) focusing on orphan and neglected diseases like malaria and tuberculosis was organized. Around 600 delegates participated in the event and more than 200 posters were presented.
28 th	CSIR laboratories/ institutes celebrated National Science Day.
March, 2013	
6 th	CSIR-CGCRI: Dr. Lena Hupa, Abo Akademi University, Finland delivered a lecture on `Bioactive glass and materials research' at Abo Akademi University.
8 th	CSIR-NAL: International Women's Day was celebrated
11 th	CSIR-CGCRI: Dr. Mervi Puska, Turku University, Finland delivered a lecture on `Functionally active materials and interfaces in the reconstruction of bone'.
11 th - 13 th	CSIR-CFTRI: XXXIV Annual Meeting of Plant Tissue Culture Association (India) and National Symposium on Plant Tissue Culture and Biotechnology for Food and Nutritional Security was organised.
12 th	CSIR-CGCRI: Dr. Susanne Fagerlund, Abo Akademi University, Finland delivered a lecture on in vitro dissolution rate of glasses with respect to future clinical application.
13 th - 15 th	CSIR-CBRI: Three days International Conference on Advanced Materials for Energy Efficient Buildings was held.
14 th	CSIR-CGCRI: Mr. Antonin Doupal, Tescan, Brno, Czechoslovakia delivered a lecture on `Focussed ion beam facility coupled with SEM/FESEM'.
19 th - 22 th	CSIR-NIO: The first ASEAN - India Marine Biotechnology Workshop was organized under the aegis of ASEAN-India S & T Development Fund and DST.
21 st - 23 rd	CSIR-CDRI: 5 th NIPER (RBL)-CSIR-CDRI Symposium on "Chemical and Biological Approaches in Drug Development & Delivery Strategies (CBADDDS-2013) in collaboration with NASI, Allahabad was organized.



Annexures

Awards/Recognitions 2012-13

During the year numerous awards and recognitions have come to CSIR staff, as under:

Awards/Recognition		Lab Name
Fellows of Indian Academy Sciences -2013	Dr. Nahid Ali Dr. Uday Bandyopadhyay Dr. Souvik Maiti Dr. G. N. Sastry	CSIR-IICB CSIR-IICB CSIR-IGIB CSIR-IICT
Shanti Swarup Bhatnagar Prize 2012 For Biological Sciences For Chemical Sciences	Dr. Shantanu Chowdhary Dr. G. J. Sanjayan	CSIR-IGIB CSIR-NCL
Fellows of Indian National Science Academy-2013	Dr. A. Ajayaghosh Dr. P. S. Ahuja Dr. Gautam Biswas Dr. Madhu Dikshit Dr. A. K. Giri Dr. S. K. Kolluru Dr. G. Parthasarthy Dr. R. Sankaranarayanan Dr. Yogendra Singh	CSIR-NIIST CSIR-IHBT CSIR CMERI CSIR-CDRI CSIR-IICB CSIR-NIO CSIR-NGRI CSIR-CCMB CSIR-IGIB
Fellows of Indian National Academy of Engineering- 2012	Dr. KSMS Raghavarao Dr. S. Tarafder Dr. A. B. Mandal	CSIR-CFTRI CSIR-NML CSIR-CLRI
Fellows of National Academy of Sciences, Allahabad-2012	Dr. Shantanu Chowdhury Dr. Amitava Das Dr. J. K. Ghosh Dr. Rajesh S. Gokhale Dr. U. C. Lavania Dr. Ashok Pandey Dr. B. M. Reddy Dr. S. M. Shashidhar Dr. Snehasikta Swarnakar Dr. Kunal Ray	CSIR-IGIB CSIR-CSMCRI CSIR-CDRI CSIR-IGIB CSIR-CIMAP CSIR-NIIST CSIR-IICT CSIR-NCL CSIR-IICB CSIR-IICB
INSA Young Scientist Medal - 2012	Dr. Kaushik Biswas Dr. Kausik Chakraborty Dr. R.K. Chatuvedi Dr. Suman Dasgupta Dr. Maheswar Ojha	CSIR-CGCRI CSIR-IGIB CSIR-IITR CSIR-NEIST CSIR-NGRI
Infosys Foundation Award 2012	Dr. Ashish Lele Dr. A. Ajayaghosh	CSIR-NCL CSIR-NIIST

TWAS Elected Fellow -2012	Dr. Chitra Mandal	CSIR-IICB
CRSI Silver Medal -2013	Dr. A. Ajayaghosh	CSIR-NIIST
SC Puranic Award for Young Scientist-2012	Sh. E. Nagaiah	CSIR-NGRI
CSIR Young Scientist Award, 2012		
Biological Sciences	Dr. Avinash Mishra Dr. Vinod Scaria	CSIR-CSMCRI CSIR-IGIB
Chemical Sciences	Dr. Dipti P Das Dr. N. Lakshminarasimhan	CSIR-IMMT CSIR-CECRI
Engineering Sciences	Dr. M. C. Gadgil Dr. P. H. Maheshwari	CSIR-NCL CSIR-NPL
Earth, atmosphere, Ocean & Planetary Sciences	Dr. Pawan Dewangan Dr. R. Ebhin Masto	CSIR-NIO CSIR-CIMFR
Physical Sciences (Including instrumentation)	Dr. Poonam Arora Dr. Umesh K. Tiwari	CSIR-NPL CSIR-CSIO
CSIR Technology Award – 2012		
Life Sciences	Team-CSIR-CIMAP	CSIR-CIMAP
Physical Sciences including Engineering	Team-CSIR-CIMFR	CSIR-CIMFR
Innovative	Team-CSIR-IGIB	CSIR-IGIB
Business Development & Technology Marketing	Team-CSIR-NEIST	CSIR NEIST
Most Significant CSIR Technology for the Five Year Plan Period	Team-CSIR-CGCRI	CSIR-CGCRI
NASI- Young Scientist Platinum Jubilee Award (2012)	Dr. S. P. Singh Dr. Rubina Tabassum Dr. Arun Kumar Trivedi Dr. S. K. Upadhyay Dr. R. K. Shukla	CSIR-IICT CSIR-IGIB CSIR-CDRI CSIR-NBRI CSIR-CIMAP
National Geoscience Award-2011	Dr. V. K. Singh Dr. Prakash Kumar Dr. Shantanu Sarkar	CSIR-CIMFR CSIR-NGRI CSIR-CBRI
MRSI Medal-2013 by the Materials Research Society of India	Dr. Sheela Berchman Dr. A. M. Biradar Dr. Lakshmi Kantam Dr. K. M. Parida	CSIR-CECRI CSIR-NPL CSIR-IICT CSIR-IMMT
ISCA Young Scientist Awards 2012-13	Dr. Parijat Roy Dr. Abhilas	CSIR-NGRI CSIR-NML
Hon. Fellow of Society for Applied Biotechnology	Dr. A. B. Mandal	CSIR-CLRI
Meritorious Invention Award by NRDC	Dr. C. Muralidharan Sh. V. John Sundar Sh. T. Rangasamy	CSIR-CLRI CSIR-CLRI CSIR-CLRI

Supreme Engineers Award-2012 by Economic Research India Ltd. (ERIL)	Sh. Kanwar Singh Sh. V. Gayathri Sh. V. G. Havanagi	CSIR -CRRI CSIR -CRRI CSIR -CRRI
Fellow of Royal Entomological Society London 2012	Dr. USN Murthy	CSIR-IICT
Fellow of Royal Society of Chemistry	Dr. P. Radhakrishna Dr. Ahmed Kamal	CSIR-IICT CSIR-IICT
NASI- Reliance Industries Platinum Jubilee Award (2012)	Dr. M. P . Bhadra	CSIR-IICT
Prof. CNR Rao Award (2012-13)	Dr. S. Chandrasekhar	CSIR-IICT
Herdillia Award for Excellence by Indian Institute of Chemical Engineers (2012)	Dr. P. S. Sai Prasad	CSIR-IICT
Hindustan Dorr-Oliver Award for Excellence by Indian Institute of Chemical Engineers (2012)	Dr. S. Sridhar	CSIR-IICT
Conferred Scientist of the Year 2012 by National Environmental Science Academy, New Delhi	Dr. Ghousia Begum	CSIR-IICT
Awarded a Gold medal and citation from Zoological Society of India in Global Meet of Biologists	Dr. USN Murthy	CSIR-IICT
JC Bose National Fellowship	Dr. K. S. Krishna	CSIR-NIO
MRSI-2011 Medal by the Materials Research Society of India	Dr. Amitava Mitra Dr. Avanish Kumar Srivastava Dr. Harish C Barshilia Dr. O S Panwar	CSIR-NML CSIR-NPL CSIR-NAL CSIR-NPL
MRSI Medal-2012 by the Materials Research Society of India	Dr. B L V Prasad Dr. S. A. R. Hashmi	CSIR-NCL CSIR-AMPRI
National Women Bioscience Award	Dr. Chitra Mandal	CSI-IICB
National Bioscience Award	Dr. A. B. Pant	CSIR-IITR
Raman Fellowship Award	Dr. Pradeep Agarwal Dr. Puyam Singh	CSIR-CSMCRI
Decennial Award-2012	Prof. Mrinal K. Sen	CSIR-NGRI
L&T Dr. A. Ramakrishna Young Engineer Award-2012	Ms Smitha Gopinath	CSIR-SERC
Ocean Science and Technology Award	Dr. Satish R. Shetye	CSIR-NIO
Life Time Achievement Award-2011 by Biotech Research Society of India (BRSI)	Dr. C. S. Nautiyal	CSIR--NBRI
Young Scientist Award-2013 by Indian Society Electro Analytical Chemistry	Dr. B. K. Jena	CSIR-IMMT
National Award for Empowerment of persons with disabilities-2012	Dr. Neelesh Kumar	CSIR-CSIO
CRSI Bronze Medal-2013	Dr. A. K. Sinha	CSIR-IHBT

Distinguished Alumunus Award-2013	Prof. Gautam Biswas	CSIR-CMERI
Metallurgist for the year 2011-12 from Indian Institute of Metals	Dr. Dipankar Chhatterjee	CSIR-CMERI
National Award for Technology Innovation in Petrochemicals-2012-13 by Ministry of Chemicals and Fertilizers	Team CSIR-IIP	CSIR-IIP
Fellow Award (FBRS) by Biotech Research Society of India (BRSI)	Dr. Thallada Bhaskar	CSIR-IIP

Human Resource Development

PGRPE- Two year Post-Graduate Research Programme in Engineering (PGRPE) are designed to give in-depth exposure and hands-on R&D experience to the candidates in cutting-edge technological areas. They are trained in existing live projects so that they emerge as research ready scientist/ engineers for taking up challenging positions. Candidates graduates in the relevant discipline of engineering depending on the specific programme with outstanding academic credential preferably with a valid GATE score were given admission in the following programmes:

- (i) Advanced Automotive Technology (CSIR-IIP);
- (ii) Advanced Electronic Systems (CSIR-CEERI);
- (iii) Advanced Instrumentation Engineering (CSIR-CSIO);
- (iv) Advanced Materials Physics and Engineering (CSIR-NPL);
- (v) Advanced Petroleum Science and Technology (CSIR-IIP);
- (vi) Advanced Semiconductor Electronics (CSIR-CEERI);
- (vii) Applied and Computational Mechanics (CSIR-CMERI);
- (viii) Building Engineering and Disaster Mitigation (CSIR-CBRI);
- (ix) Chemical Engineering- Modeling & Simulation and Materials & Processes (CSIR-NCL);
- (x) Engineering of Structures (CSIR-SERC); Environmental System Engineering and Modeling(CSIR-NEERI);
- (xi) Glass and Ceramic Engineering (CSIR-CGCRI);
- (xii) High Power Microwave Devices and System Engineering (CSIR-CEERI);
- (xiii) Mechatronics (CSIR-CMERI);
- (xiv) Mineral Processing, Metal Extraction and Resource & Waste Management (CSIR-NML);
- (xv) Mine Safety Engineering (CSIR-CIMFR);
- (xvi) Process Engineering Science (CSIR-IICT);
- (xvii) Renewable Energy (CSIR-SERC); and
- (xviii) Transportation Engineering (CSIR-CRRI).

In addition to above many specialized training courses were also conducted by the CSIR institute to benefit the industry and the students.

CSIR-CBRI

Conducted training of six months duration for two groups of Civil Engineering Students of BITS, Pilani.59 graduated and P.G. students from various Science and Engineering Institutes were provided vocational training.

CSIR-CCMB

Summer Training Programmes were conducted to 80 for pre-M.Sc. students during May-June 2012.

CSIR-CDRI

During the year Advance Training Courses for more than 140 Post-graduate students from about 51 Colleges were imparted in various disciplines of drugs and pharmaceutical research for 4-10 months duration. Under

the NASI & INSA summer fellowship programme, 07 student fellows from different institutes were provided training in different aspects of biomedical research. Under international bilateral cooperation, 10 fellows from abroad were imparted short and long term training in different aspects.

A practical training course on "Isolation and separation of proteins and their detection by immunoblotting" was held from 28-29 Jan 2013. This workshop was attended by PhD aspirants from various institutions viz. Dr. Ram Manohar Lohia Institute of Medical Sciences (RMLIMS), King George's Medical University (KGMU), Amity University and from different divisions of CSIR-CDRI of Lucknow.

A one-day workshop, approved and sponsored by the Ministry of Environment and Forests, Govt. of India was organized on July 13, 2012. The aim of Workshop was to sensitizing the research and academic institutions engaged in performing animal experiments for the benefit of mankind and scientific pursuit. About 40 participants from 20 different Institutions/ Universities attended the workshop.

CSIR-CDRI in collaboration with CSIR-HRDC organized a Competency Development Programme for Technical Supporting Personnel for Lucknow based CSIR research laboratories from March 11-14, 2013. A practical training course on "2D gel electrophoresis" was held from 27-28 March 2012. Total of 19 students from CSIR-CDRI and CSIR-CIMAP participated.

CSIR-CECRI

CSIR-CECRI conducts Anna University's 4-year B.Tech. (Chemical and Electrochemical Engineering) and M.Tech. (Electrochemical Engineering).

CSIR-CECRI also offers a variety of short-term courses to scientific and technical personnel employed in industries, government and academic institutions. These courses are designed to impart necessary knowledge and skill. During the year 12 industry-oriented technology courses were conducted to 82 participants in the following topics:

- Corrosion Science and Engineering (4 modules);
- Batteries (1 module);
- Central Instrumental Facility (1 module);
- Pollution Control (1 module);
- Industrial Metal Finishing (2 modules); and
- Electroplating Metal Finishing Technology (3 modules).

CSIR-CEERI

Long term Trainings (6 months and above) were provided to about 116 BE/B.Tech./MCA/ ME/M.Tech./M.Sc. students from various academic institutions. Short-term (2-6 months) trainings were provided to 240 students.

CSIR-CFTRI

Conducts two year fulltime M.Sc. Food Technology programme, that imparting training in specialized areas of Food Science and Technology with the state-of-art facilities in the institute. The students get equipped with the basic and applied aspects of Food Science and Technology with a hands-on training. Food industries in the country has gained with the training of quality professionals from the Institute.

CSIR-CGCRI

Conducted summer training of two months duration during May-July, 2012 for B.Tech, BE, B.Sc., M.Sc., Students from Govt. Colleges, IITs, NITs and private colleges. 29 students underwent training specially in Glass and Advance Ceramic Technology.

CSIR-CIMAP

A six-day 'Hands on' Entrepreneurial Training-cum-Workshop on Essential Oil Processing Technologies was organized from 23rd – 28th April, 2012 for budding entrepreneurs interested in setting up of processing units for processing and value addition of essential oils. Twelve participants from different states of Karnataka, Tamilnadu, Andhra Pradesh, Gujarat, Haryana and UP participated in the workshop.

A three-day 'Hands on' "Processing and Quality Aspects of Mentha Avensis Essential Oil" was organised during 28-30 August, 2012. The programme was attended by 10 participants from Bihar, Delhi and UP.

A four-day 'Hands on' "Entrepreneurial training for budding entrepreneurs interested in setting up of processing units for processing of Aloe vera for Juice, Sap and Gel was organised during 20-23 November 2012. The programme was attended by 22 participants from Bengal Bengal, MP, Haryana, Uttarakhand, Delhi and UP.

CSIR-CLRI

B.Tech Leather Technology, M. Tech Leather Technology, M. Tech Footwear Science & Engineering, and M.S. by Research/Ph.D are being conducted in collaboration with Anna University. 42 students in B.Tech Leather Technology, two in M.Tech Leather Technology, Three in M.Tech Footwear Science & Engineering, and 28 students in M.S. by Research/Ph. D participated in the courses. Also conducts three Diploma courses and one certificate course related to leather (Goods and Footwear Manufacturing). Total of 69 students got benefitted from these diploma courses.

Conducted four training programmes with International collaboration/participation for 29 participants. Also organized short and long term programmes, in which 431 students got the training.

CSIR-CMERI

During the year seven training courses on various topics like "Computational Fluid Dynamics with Aerospace Applications", "WAM Robot Arm of Barrett Technology Inc.", "MSC Adams", "Advanced Control Systems", "Simulation Capabilities of COMSOL Multiphysics", and "Mechanics and Analog Electronics" were conducted. These courses were attended by more than 250 participants.

CSIR-CRRI

The Institute conducted customer oriented programmes to meet the specific training requirements of the user agencies. During the year, the Institute conducted following customer oriented training programmes:

- Training programme for the engineers involved in PMGSY (in seven batches);
- Training programme on Flexible and Rigid Pavements for Rural Roads under PMGSY (two batches);
- Training programme on "Contract Management and Quality Control Aspects" for the contractors and young engineers of PWD at Tura and at Shillong;
- International Course on Dissemination of Highway Development and Management;
- A Special Training Programme on "Air and Noise Pollution Modeling for Environmental Professionals" ;
- "Environmental Impact Assessment (EIA) and Environmental Clearance Process for Roads and Highways Projects and Road Safety Aspects" for the Engineers of RCD, Bihar;
- Good Practices in Highway Construction and Quality Assurance and Quality Control Aspects" for Engineers of RCD, Bihar;
- A Customized Training Programme on Design, Construction and Maintenance of Flexible and Rigid Pavements for Rural Roads for the engineers of RCD, Bihar;

- Training on New Construction Materials for the Engineers of Kerela Highway Research Institute, Thiruvananthapuram; and
- Training on Bridge Diagnostics, Performance Evaluation and Rehabilitation the Engineers of RCD Bihar.

CSIR-CSIO

Indo-Swiss Training Centre (ISTC) is a constituent unit of CSIR-CSIO, Chandigarh. It imparts high grade technical training by conducting AICTE approved courses such as Three-Year Diploma in Instrument Technology; Four-Year Advanced Diploma in Mechatronics & Industrial Automation; Four-Year Advanced Diploma in Die & Mould Making. A batch of 70 students was admitted during the year.

Conducts M.Tech (Mechatronics)- together with Bengal Engineering and Science University (BESU) Shibpur and CSIR-CMERI, Durgapur.

Specialised Capsule Management Development Training Programmes of eight weeks duration each under Indian Technical and Economic Co-operation (ITEC) and Special Commonwealth African Assistance Plan (SCAAP) were conducted on Operation, Maintenance & Repair of Bio-Medical Equipments. The delegates normally came from Tanzania, Kenya, Zimbabwe, Ghana, South Africa, Uzbekistan, Afghanistan, Palestine, Sudan, Commonwealth of Dominica, Togo, Kenya, Sri Lanka, Nigeria, Uganda, Oman, etc and other developing countries. During the year total of 62 persons participated in three programs.

CSIR-CSMCRI

Central Pollution Control Board (CPCB) sponsored training programme on "EIA and EMP of contaminated sites for industrial sector" was conducted during 13 to 15th Feb. 2013. Fifteen officers from different state pollution control boards, CPCB and industries/consultancy firms participated.

CSIR-IICT

CSIR-IICT has organized a three day Refresher Course on Analysis of Oils and Fats by Conventional, Chromatographic and Spectral Methods during March 20-22, 2013, for the benefit of the industry and academia. 25 participants from industry, institutes and academia across the country attended this course. This event was supported by Oil Technologists' Association of India (OTAI) and Solvent Extractors' Association of India (SEA).

CSIR-IITR

One month training on in-vitro toxicology techniques was provided to a trainee of the USA.

CSIR-IHBT

During the year ten trainings of three days each were conducted on "Sustainable Utilization of Regional Bioresource and Floriculture for Enhancing Livelihood Options" organised for 250 participants from Rampur and Basantpur Development Block of District Shimla (HP).

Training on advances in tea husbandry practices, nursery management and large cardamom cultivation, sponsored by State Agriculture Department was organised on April 6, 2012. Sixty one participants attended the training.

Imparted training to 53 students of M.Sc./ M. Pharma/ M.Tech./ B.E./ B.Tech students of different Institutes/Universities during summer/winter training programme.

CSIR-IMMT

CSIR-IMMT conducts one year Post-Graduate Diploma in Mineral Engineering for both sponsored and non-sponsored candidates. During the year thirteen students have been taken admission.

Imparted short-term training of 3-6 months duration were provided to 150 students of M.Sc./ M.Tech./ B.E./ B.Tech students of different Institutes/Universities.

CSIR-NAL

During the year a total of 72 batches comprising 350 students from BE/B.Tech, ME/M.Tech, MCA of VTU Bangalore University and other outside state universities were imparted project related training. The period of the project work varies from 3- 6 months.

CSIR-NBRI

Three training programmes were organized on Dry Flower Technology, during the year for mentally challenged (borderline category) and hearing impaired students. 115 students participated in the trainings.

Two training programmes from April 16 to May 15, 2012 and August 1-31, 2012 were organized on "Indoor and Outdoor Gardening".

Also organized a training programme on "Faculty Motivation and Adoption of Schools" during August 29-30, 2012. Forty-five representatives of 17 institutions participated in the programme.

CSIR-NEERI

Various training programs were organized to strengthen the knowledge on water quality monitoring, and surveillance including advance instrumentation related to: field and laboratory practices for onsite and offsite monitoring of water quality to meet the statutory requirements; analysis and interpretation of water quality data; water quality data management; advanced understanding in water quality assessments and treatment technologies; and capacity building on water resources management. Eight training programmes were organized during the year in which 251 participants from various public health engineering departments took part.

CSIR-NGRI

A four day DST sponsored Training Course on "Geochemical Modelling in Igneous Petrogenesis: An Introduction to GCD Kit and R-Language" was organized during 12-15 January, 2013. About 52 members including research scholars and a few younger staff members from universities/R&D organizations from across the country attended this workshop.

Training Programme was held on Remediation Technology and Modeling of Assessment of Ground water Contamination (during January 21-25, 2013). Twenty professionals working in the field of environmental sciences including control, monitoring, legislative bodies and NGOs.

CSIR-NIIST

The Institute hosted a two-day workshop on 'National Knowledge Network (NKN)' during 9 – 10 May 2012. The workshop was attended by 250 participants comprising of network professionals, scientists, and students from all over the country.

A publishing connect workshop was conducted in collaboration with M/s Elsevier Science, to train and inform the researchers on various aspects of scholarly communication process on 30th November 2012. The Workshop was attended by 100 participants which included faculty and students from various research organizations in Trivandrum apart from scientists and student from CSIR-NIIST.

CSIR-NISTADS

A total of 24 BE/ B.Tech./ M.Sc./ MCA students from various universities/ technical Institutions were provided training as a partial fulfillment towards completion of their degrees in different subject areas.

CSIR-NISCAIR

Conducted two short term courses of five weeks duration and two courses of three months duration on "Information Technology for Information Management". Total of 42 R&D Personnel participated in these course.

CSIR-SERC

An Advanced Course on Uncertainty Handling in Structural Engineering (UNCHANSE 2013) was organized during 30 Jan - 1 Feb, 2013 and an Advanced Course on Communication and Power Transmission Towers organized by CSIR-Structural Engineering Research Centre, Chennai during 6th-8th February 2013. The courses was attended by 88 participants from different parts of the country, comprising of academicians, research scholars, students and practicing engineers.

Area-wise Research Publications (TOP 50 Papers)
BASED ON IMPACT FACTOR OF THE JOURNALS

BIOLOGICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
1.	CSIR-CSIO	Saurabh, S	Global reduction in measles mortality	Lancet, 2012, Vol. 380, Iss. 9850, pp. 13-03	39.06
2.	CSIR-IGIB	Sharma, A	Enhance visibility of India's academies	Nature, 2012, Vol. 484, Iss.7395, pp. 455-455	38.597
3.	CSIR-CCMB	Chatterjee, B	Extend ethnicity of human microbiome	Nature, 2012, Vol. 487, 7405, pp. 39-39	38.597
4.	CSIR-CCMB	Laurance, WF	Averting biodiversity collapse in tropical forest protected areas	Nature, 2012, Vol. 489, Iss.7415, pp. 290-294	38.597
5.	CSIR-CCMB	Saxena, SK	A Global Perspective on HIV/AIDS	Science, 2012, Vol. 337, Iss. 6096, pp. 798-798	31.027
6.	CSIR-CCMB	Bhargava, PM	India Lacks Scientific Leadership	Science, 2012, Vol.335, Iss. 6075, pp.1440-1440	31.027
7.	CSIR-IIIM	Korkaya, H	Activation of an IL6 Inflammatory Loop Mediates Trastuzumab Resistance in HER2+ Breast Cancer by Expanding the Cancer Stem Cell Population	Molecular Cell, 2012, Vol.47, Iss. 4, pp. 570-584	15.280
8.	CSIR-IMTECH	Vyas, R	Structures of ternary complexes of aspartate-semialdehyde dehydrogenase (Rv3708c) from Mycobacterium tuberculosis H37Rv	Acta Crystallographica Section D-Biological Crystallography, 2012, Vol. 68, pp. 671-679	14.103
9.	CSIR-IGIB	Bose, D	The Tuberculosis Drug Streptomycin as a Potential Cancer Therapeutic: Inhibition of miR-21 Function by Directly Targeting Its Precursor	Angewandte Chemie-International Edition, 2012, Vol.51, Iss. 4, pp.1019-1023	13.734
10.	CSIR-IHBT	Kumar, R	Palladium-Catalyzed Dehydrative Heck Olefination of Secondary Aryl Alcohols in Ionic Liquids: Towards a Waste-Free Strategy for Tandem Synthesis of Stilbenoids	Angewandte Chemie International Edition, 2012, Vol. 51, Iss.11, pp. 2636-2639	13.734
11.	CSIR-IHBT	Shard, A	Tandem Heck/Decarboxylation/ Heck Strategy: Protecting-Group Free Synthesis of Symmetric and Unsymmetric Hydroxylated Stilbenoids	Angewandte Chemie International Edition, 2012, Vol. 51, Iss. 49, pp.12250-12253	13.734

BIOLOGICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
12.	CSIR-IGIB	Bandyopadhyay, A	Chemical chaperones assist intracellular folding to buffer mutational variations	Nature Chemical Biology, 2012, Vol.8, Iss. 3, pp. 238-245	12.948
13.	CSIR-IIIM	Felnagle, LA	Engineering synthetic recursive pathways to generate non-natural small molecules	Nature Chemical Biology, 2012, Vol. 8, Iss. 6, pp. 518-526	12.948
14.	CSIR-IGIB	Singh, V	Mycobacterium tuberculosis-Driven Targeted Recalibration of Macrophage Lipid Homeostasis Promotes the Foamy Phenotype	Cell Host & Microbe, 2012, Vol.12, Iss. 5, pp. 669-681	12.609
15.	CSIR-IGIB /NCL	Patil, KM	Highly Efficient (R-X-R)-Type Carbamates as Molecular Transporters for Cellular Delivery	Journal of the American Chemical Society Biomaterials, 2012, Vol. 134, Iss. 17, pp. 7196-7199	10.677
16.	CSIR-CCMB	Romero, IG;	Herders of Indian and European Cattle Share their Predominant Allele for Lactase Persistence	Molecular Biology and Evolution, 2012, Vol. 29, Iss.1, pp. 248-259	10.353
17.	CSIR-IGIB	Aich, J	Loss-of-function of inositol polyphosphate-4-phosphatase reversibly increases the severity of allergic airway inflammation	Nature Communications, 2012, Vol. 3, pp. 877	10.015
18.	CSIR-CCMB/ IIIM/IGIB	Chhabra, A	Nonprocessive [2+2]e(-) off-loading reductase domains from mycobacterial nonribosomal peptide synthetases	Proceedings of the National Academy of Sciences of the United States of America, 2012, Vol.109, Iss.15, pp. 5681-5686	9.737
19.	CSIR-IGIB	Mabalirajan, U	15-Lipoxygenase eicosanoids are the putative ligands for vanilloid receptors and peroxisome proliferator-activated receptors (PPARs)	Proceedings of the National Academy of Sciences of the United States of America, 2012, Vol.109, Iss.1, pp. E1E1	9.737
20.	CSIR-IICB	Maiti, G	The Wingless homolog Wnt5a stimulates phagocytosis but not bacterial killing	Proceedings of the National Academy of Sciences of the United States of America, 2012, Vol.109, Iss. 41, pp.16600-16605	9.737
21.	CSIR-IMTECH	Lie, TJ	Essential anaplerotic role for the energy-converting hydrogenase Eha in hydrogenotrophic methanogenesis	Proceedings of the National Academy of Sciences of the United States of America, 2012, Vol.109, Iss. 38, pp. 15473-15478	9.737

BIOLOGICAL SCIENCES

S.No.	Lab	First Author	Title	Journal	IF
22.	CSIR-CIMAP	Banerjee, S	Biotransformation studies using hairy root cultures A review	Biotechnology Advances, 2012, Vol.30, Iss. 3, pp. 461-468	9.599
23.	CSIR-CDRI	Saxena, R	ErbB family receptor inhibitors as therapeutic agents in breast cancer: Current status and future clinical perspective	Medicinal Research Reviews, 2012, Vol. 32, Iss.1, pp. 166-215	9.583
24.	CSIR-IMTECH	Gowthaman, U	Lipidated promiscuous peptides vaccine for tuberculosis-endemic regions	Trends in Molecular Medicine, 2012, Vol.18, Iss.10, pp. 607-614	9.571
25.	CSIR-CIMAP	Klempien, A	Contribution of CoA Ligases to Benzenoid Biosynthesis in Petunia Flowers	Plant Cell 2012, Vol. 24, Iss. 5, pp. 2015-2030	9.251
26.	CSIR-IITR	LaFlamme, BA	The Drosophila melanogaster Seminal Fluid Protease "Seminase" Regulates Proteolytic and Post-Mating Reproductive Processes	Plos Genetics, 2012, Vol.8, Iss. 1, pp 1002-2435	8.517
27.	CSIR-CCMB	Srinivasan, A	Chromatin domain boundary element search tool for Drosophila	Nucleic Acids Research, 2012, Vol. 40, Iss. 10, pp. 4385-4395	8.278
28.	CSIR-IGIB	Sati, S	Genome-wide analysis reveals distinct patterns of epigenetic features in long non-coding RNA loci	Nucleic Acids Research, 2012, Vol. 40, Iss. 20, pp.10018-10031	8.278
29.	CSIR-IGIB	Kar, A	Metastases suppressor NME2 associates with telomere ends and telomerase and reduces telo-merase activity within cells	Nucleic Acids Research, 2012, Vol. 40, Iss. 6, pp. 2554-2565	8.278
30.	CSIR-IGIB	Bargaje, R	Proximity of H2A.Z containing nucleosome to the transcription start site influences gene expression levels in the mammalian liver and brain	Nucleic Acids Research, 2012, Vol. 40, Iss. 18, pp. 8965-8978	8.278
31.	CSIR-IGIB	Baral, A	Quadruplex-single nucleotide polymorphisms (Quad-SNP) influence gene expression difference among individuals	Nucleic Acids Research, 2012, Vol. 40, Iss. 9, pp. 3800-3811	8.278
32.	CSIR-IICB	Kundu, P	HuR protein attenuates miRNA-mediated repression by promoting miRISC dissociation from the target RNA	Nucleic Acids Research, 2012, Vol. 40, Iss.11, pp. 5088-5100	8.278
33.	CSIR-IICB	Chakraborty, A	DBETH: A Database of Bacterial Exotoxins for Human	Nucleic Acids Research, 2012, Vol. 40, Iss. D1, pp. D615-D620	8.278

BIOLOGICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
34.	CSIR-IICB	Goyal, M	Identification and molecular characterization of an Alba-family protein from human malaria parasite Plasmodium falciparum	Nucleic Acids Research, 2012, Vol. 40, Iss. 3, pp. 1174-1190	8.278
35.	CSIR-IICB	Chakraborty, A	SPEER-SERVER: a web server for prediction of protein specificity determining sites	Nucleic Acids Research, 2012, Vol. 40, Iss. W1, pp. W242-W248	8.278
36.	CSIR-IITR	Lai, X; Schmitz, U	Computational analysis of target hub gene repression regulated by multiple and cooperative miRNAs	Nucleic Acids Research, 2012, Vol. 40, Iss. 18, pp. 8818-8834	8.278
37.	CSIR-IMTECH	Thakur, N	AVPpred: collection and prediction of highly effective antiviral peptides	Nucleic Acids Research, 2012, Vol. 40, Iss. W1, pp. W199-W204	8.278
38.	CSIR-IMTECH	Singh, H	ccPDB: compilation and creation of data sets from Protein Data Bank	Nucleic Acids Research, 2012, Vol. 40, Iss. D1, pp. D486-D489	8.278
39.	CSIR-IMTECH	Thakur, N	VIRsiRNAdb: a curated database of experimentally validated viral siRNA/shRNA	Nucleic Acids Research, 2012, Vol. 40, Iss. D1, pp. D230-D236	8.278
40.	CSIR-CCMB	Panda, SK	Chitohexaose Activates Macrophages by Alternate Pathway through TLR4 and Blocks Endotoxemia	Plos Pathogens, 2012, Vol. 8, Iss. 5, pp. e100-2717	8.136
41.	CSIR-IICB	Karmakar, S	TLR4 and NKT Cell Synergy in Immunotherapy against Visceral Leishmaniasis	Plos Pathogens, 2012, Vol. 8, Iss. 4, pp. e1002646	8.136
42.	CSIR-IMTECH	Khan, N	Manipulation of Costimulatory Molecules by Intracellular Pathogens: Veni, Vidi, Vici!!	Plos Pathogens, 2012, Vol. 8, Iss. 6, pp. e1002676	8.136
43.	CSIR-CSIR-HQ	Choudhury, D	Near-Room-Temperature Colossal Magnetodielectricity and Multi-glass Properties in Partially Disordered La ₂ NiMnO ₆	Physical Review Letters, 2012, Vol.108, Iss.12, pp. 127-201	7.943
44.	CSIR-IGIB	Tabassum, R	Common Variants of IL6, LEPR, and PBEF1 Are Associated With Obesity in Indian Children	Diabetes, 2012, Vol.61, Iss. 3, pp. 626-631	7.895
45.	CSIR-IICB	Chowdhury, S	The lignanniranthin poisons Leishmania donovani topoisomerase IB and favours a Th1 immune response in mice	Embo Molecular Medicine, 2012, Vol. 4, Iss. 10 pp. 1126-1143	7.795

BIOLOGICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
46.	CSIR-IITR	Chaturvedi, RK	Transducer of regulated CREB-binding proteins (TORCs) transcription and function is impaired in Huntingtons disease	Human Molecular Genetics, 2012, Vol.21, Iss.15, pp. 3474-3488	7.692
47.	CSIR-IGIB	Mann, RA	Structural rearrangements and chemical modifications in known cell penetrating peptide strongly enhance DNA delivery efficiency	Journal of Controlled Release, 2012, Vol. 157, Iss. 2, pp. 260-271	7.633
48.	CSIR-CCMB	Govindarajan, S	Targeting human epidermal growth factor receptor 2 by a cell-penetrating peptide-affibody bioconjugate	Biomaterials, 2012, Vol.33, Iss. 8, pp. 2570-2582	7.604
49.	CSIR-CDRI	Jain, V	Paclitaxel loaded PEGylated glyceryl monooleate based nanoparticulate carriers in chemotherapy	Biomaterials , 2012, Vol. 33, ss. 29, pp. 7206-7220	17.604
50.	CSIR-IGIB/IITR	Unzueta, U	Non-amyloidogenic peptide tags for the regulatable self-assembly of protein-only nanoparticles	Biomaterials, 2012, Vol. 33, Iss.33, pp. 8714-8722	7.604
51.	CSIR-IICB	Chakraborty, S	The use of nano-quercetin to arrest mitochondrial damage and MMP-9 upregulation during prevention of gastric inflammation induced by ethanol in rat	Biomaterials, 2012, Vol. 33, Iss.10, pp. 2991-3001	7.604
52.	CSIR-IITR	Khan, MI	Induction of ROS, mitochondrial damage and autophagy in lung epithelial cancer cells by iron oxide nanoparticles	Biomaterials, 2012, Vol. 33,Iss. 5, pp. 1477-1488	7.604
53.	CSIR-IITR /IGIB/CDRI	Tripathi, SK	Depolymerized chitosans functionalized with bPEI as carriers of nucleic acids and tuftsin-tethered conjugate for macrophage targeting	Biomaterials, 2012, Vol. 33, Iss. 16, pp. 4204-4219	7.604

**Area-wise Research Publications (TOP 50 Papers)
BASED ON IMPACT FACTOR OF THE JOURNALS**

CHEMICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
1.	CSIR-NCL	Mashelkar, RA	India's "Science for All" Academy	Science, 2012, Vol. 335, Iss. 6071, pp. 891-891	31.027
2.	CSIR-NIIST /NCL	Nair, V	1,2-Benzoquinones in Diels Alder reactions, dipolar cycloadditions, nucleophilic additions, multicomponent reactions and more	Chemical Society Reviews, 2012, Vol.41,Iss.3, pp.1050-1059	24.892
3.	CSIR-NCL	Bhunia, A	Recent advances in transition-metal-free carbon-carbon and carbon-hetero atom bond-forming reactions using arynes	Chemical Society Reviews, 2012, Vol.41,Iss.8, pp. 3140-3152	24.892
4.	CSIR-NEIST	Pal, D	Fetuin-A acts as an endogenous ligand of TLR4 to promote lipid-induced insulin resistance	Nature Medicine, 2012, Vol.18,Iss.8, pp. 1279- +	24.302
5.	CSIR-NCL	Menon	Trends in bioconversion of lignocellulose: Biofuels, platform chemicals & biorefinery concept	Progress In Energy and Combustion Science, 2012, Vol. 38, Iss. 4, pp. 522-550	15.089
6.	CSIR-NCL	Mandal, LA	Quasi-Liquid Iontronic-Electronic Light-Harvesting Hybrid Photo-detector with Giant Response	Advanced Materials, 2012, Vol. 24, Iss. 27, pp. 3686-3691	14.829
7.	CSIR-NCL	Bhojgude, SS	Arynes in Transition-Metal-Free Multicomponent Coupling Reactions	Angewandte Chemie-International Edition, 2012, Vol. 51, Iss. 7, pp. 1520-1522	13.734
8.	CSIR-NCL	Prabhakaran, P	Foldamers: They're Not Just for Biomedical Applications Anymore	Angewandte Chemie-International Edition, 2012, Vol.51, Iss.17, pp.4006-08	13.734
9.	CSIR-CSMCRI	Sen, A	Is Dual Morphology of Rock-Salt Crystals Possible with a Single Additive? The Answer Is Yes, with Barbituric Acid	Angewandte Chemie-International Edition, 2012, Vol. 51, Iss. 45, pp. 11279-11283	13.734
10.	CSIR-NIIST	Babu, SS	Self-Assembled Gelators for Organic Electronics	Angewandte Chemie-International Edition, 2012, Vol. 51, Iss. 8, pp. 1766-1776	13.734
11.	CSIR-NIIST	Babu, SS	Solvent-Free Luminescent Organic Liquids	Angewandte Chemie-International Edition, 2012, Vol.51Iss.14, pp. 3391-3395	13.734
12.	CSIR-NIIST	Gopal, A	Thermally Assisted Photonic Inversion of Supramolecular Handedness	Angewandte Chemie-International Edition, 2012, Vol.51, Iss.42, pp.10505- 09	13.734

CHEMICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
13.	CSIR-NCL	Pathigoolla, A	Topochemical Click Reaction: Spontaneous Self-Stitching of a Monosaccharide to Linear Oligomers through Lattice-Controlled Azide-Alkyne Cycloaddition	Angewandte Chemie International Edition, 2012, Vol. 51, Iss.18, pp. 4362-4366	13.734
14.	CSIR-CLRI	Das, SK	Biom mineralization Mechanism of Gold by Zygomycete Fungi <i>Rhizopus oryzae</i>	ACS Nano, 2012, Vol. 6, Iss. 7, pp. 6165-6173	12.062
15.	CSIR-IICT	Han, LY	High-efficiency dye-sensitized solar cell with a novel co-adsorbent	Energy & Environmental Science, 2012, Vol.5, Iss.3, pp. 6057-6060	11.653
16.	CSIR-NCL	Kelkar, SA	Nanostructured Cd ₂ SnO ₄ as an energy harvesting photoanode for solar water splitting	Energy & Environmental Science, 2012, Vol. 5, Iss. 2, pp. 5681-5685	11.653
17.	CSIR-NIIST	Kartha, KK	Attogram Sensing of Trinitrotoluene with a Self-Assembled Molecular Gelator	Journal of the American Chemical Society, 2012, Vol.134,Iss.10, pp. 4834-4841	10.677
18.	CSIR-NEIST	Tibrewal, N	Baeyer-Villiger C-C Bond Cleavage Reaction in Gilvocarcin and Jadomycin Biosynthesis	Journal of the American Chemical Society, 2012, Vol.134,Iss.44, pp. 18181-18184	10.677
19.	CSIR-NCL	Kandambeth, S	Construction of Crystalline 2D Covalent Organic Frameworks with Remarkable Chemical (Acid/Base) Stability via a Combined Reversible and Irreversible Route	Journal of the American Chemical Society, 2012, Vol.134, Iss. 48, pp. 19524-19527	10.677
20.	CSIR-NIIST	Mahesh, S	Light-Induced Ostwald Ripening of Organic Nanodots to Rods	Journal of the American Chemical Society, 2012, Vol. 134, Iss.17, pp. 7227-7230	10.677
21.	CSIR-NCL	Pati, D; Kalva	Multiple Topologies from Glycopolyptide-Dendron Conjugate Self-Assembly: Nanorods, Micelles, and Organogels	Journal of the American Chemical Society, 2012, Vol. 134, Iss.18, pp. 7796-7802	10.677
22.	CSIR-NCL	Bogle, KA	Epitaxial Magnetic Oxide Nanocrystals Via Phase Decomposition of Bismuth Perovskite Precursors	Advanced Functional Materials, 2012, Vol. 22, Iss. 24, pp. 5224-5230	9.765

CHEMICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
23.	CSIR-IICT	Singh, SP	Synthesis of a Modified PC70BM and Its Application as an Electron Acceptor with Poly (3-hexylthio-phenylene) as an Electron Donor for Efficient Bulk Heterojunction Solar Cells	Advanced Functional Materials, 2012, Vol. 22, Iss. 19, pp. 4087-4095	9.765
24.	CSIR-IICT	Joly, D	White Organic Light-Emitting Diodes Based on Quench-Resistant Fluorescent Organophosphorus Dopants	Advanced Functional Materials, 2012, Vol. 22, Iss. 3, pp. 567-576	9.765
25.	CSIR-NCL	Shin, K	Ammonia clathrate hydrates as new solid phases for Titan, Enceladus, and other planetary systems	Proceedings of the National Academy of Sciences of the United States of America, 2012, Vol. 109, Iss. 37, pp. 14785-14790	9.737
26.	CSIR-NCL	Sengupta, P	Cholesterol-tethered platinum II-based supramolecular nanoparticle increases antitumor efficacy and reduces nephrotoxicity	Proceedings of the National Academy of Sciences of the United States of America, 2012, Vol.109, Iss. 28, pp. 11294-11299	9.737
27.	CSIR-NCL	Phadke, A	Rapid self-healing hydrogels	Proceedings of the National Academy of Sciences of the United States of America, 2012, Vol. 109, Iss.12, pp. 4383-4388	9.737
28.	CSIR-NCL	Jijil, CP	Disordered Brownmillerite Ba_2InCeO_5 with Enhanced Oxygen Reduction Activity	Chemistry of Materials, 2012, Vol. 24, Iss.14, pp. 2823-2828	8.238
29.	CSIR-CECRI	Sathiya, M	Synthesis, Structure, and Electrochemical Properties of the Layered Sodium Insertion Cathode Material: $NaNi_{1/3}Mn_{1/3}Co_{1/3}O_2$	Chemistry of Materials, 2012, Vol. 24, Iss.10, pp. 1846-1853	8.238
30.	CSIR-IICT	Srinivas, R	A long-lasting dendritic cell DNA vaccination system using silylated amphiphiles with mannose-mimicking head-groups	Biomaterials, 2012, Vol.33, Iss.26, pp. 6220-6229	7.604
31.	CSIR-NCL	Yadav, P	A 3D Hexaporous Carbon Assembled from Single-Layer Graphene as High Performance Supercapacitor	Chemsuschem, 2012, Vol. 5, Iss. 11, pp. 2159-2164	7.475

CHEMICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
32.	CSIR-NCL	Sahu, R	A One-Pot Method for the Selective Conversion of Hemicellulose from Crop Waste into C5 Sugars and Furfural by Using Solid Acid Catalysts	Chemsuschem, 2012, Vol. 5, Iss. 4, pp. 751-761	7.475
33.	CSIR-NCL	Kotbagi, T	Transesterification of Diethyl Oxalate with Phenol over Sol-Gel MoO ₃ /TiO ₂ Catalysts	Chemsuschem, 2012, Vol. 5, Iss. 8, pp. 1467-1473	7.475
34.	CSIR-CECRI	Kandhasamy, S	Role of structural defects in olivine cathodes	Progress In Solid State Chemistry, 2012, Vol.40, Iss.2 Jan, pp. 1-5	7.429
35.	CSIR-NCL	Kale, SN	Characterization of biocompatible NiCo ₂ O ₄ nanoparticles for applications in hyperthermia and nology drug delivery	Nanomedicine-Nanotech-Biology and Medicine, 2012, Vol. 8, Iss. 4, pp. 452-459	6.93
36.	CSIR-CSMCRI	Trivedi, TJ	Agarose processing in protic and mixed protic-aprotic ionic liquids: dissolution, regeneration and high conductivity, high strength ionogels	Green Chemistry, 2012, Vol. 14, Iss.10, pp. 2831-2839	6.828
37.	CSIR-NCL	Bhirud, AP	An eco-friendly, highly stable and efficient nanostructured p-type N-doped ZnO photocatalyst for environmentally benign solar hydrogen production	Green Chemistry, 2012, Vol.14, Iss.10, pp. 2790-2798	6.828
38.	CSIR-IIP	Pendem, C	Aqueous phase reforming of glycerol to 1,2-propanediol over Pt-nanoparticles supported on hydrotalcite in the absence of hydrogen	Green Chemistry, 2012, Vol.14, Iss.11, pp. 3107-3113	6.828
39.	CSIR-NEIST	Sarmah, PP	Chemoselective reduction of a nitro group through transfer hydrogenation catalysed by Ru-O-nanoparticles stabilized on modified Montmorillonite clay	Green Chemistry, 2012, Vol. 14, Iss. 4, pp. 1086-1093	6.828
40.	CSIR-IICT	Kuhbeck, D	Critical assessment of the efficiency of chitosan biohydrogel beads as recyclable and heterogeneous organocatalyst for C-C bond formation	Green Chemistry, 2012, Vol.14, Iss. 2, pp. 378-392	6.828
41.	CSIR-NCL	Hengne, AM	Cu-ZrO ₂ nanocomposite catalyst for selective hydrogenation of levulinic acid and its ester to gamma-valerolactone	Green Chemistry, 2012, Vol.14, Iss. 4, pp. 1064-1072	6.828

CHEMICAL SCIENCES

S.No.	Lab	First Author	Title	Journal	IF
42.	CSIR-IICT	Layek, K	Gold nanoparticles stabilized on nanocrystalline magnesium as an active catalyst for reduction of nitroarenes in aqueous medium at room temperature	Green Chemistry, 2012, Vol.14, Iss.11, pp. 3164-3174	6.828
43.	CSIR-NCL	Hiyoshi, N	Kinetic analysis of 4-isopropyl-phenol hydrogenation over activated carbon-supported rhodium catalysts in supercritical carbon dioxide solvent	Green Chemistry, 2012, Vol.14, Iss. 3, pp. 633-638	6.828
44.	CSIR-NCL	Sivaranjani, K	Molecular oxygen-assisted oxidative dehydrogenation of ethylbenzene to styrene with nanocrystalline Ti _{1-x} V _x O ₂	Green Chemistry, 2012, Vol.14, Iss. 2, pp. 461-471	6.828
45.	CSIR-IIP	Sarkar, B	Room temperature selective oxidation of cyclohexane over Cu-nanoclusters supported on nanocrystalline Cr ₂ O ₃	Green Chemistry, 2012, Vol.14, Iss. 9, pp. 2600-2606	6.828
46.	CSIR-NCL	Mane, RB	Simultaneous glycerol dehydration and in situ hydrogenolysis over Cu-Al oxide under an inert atmosphere	Green Chemistry, 2012, Vol.14, Iss.10, pp. 2780-2789	6.828
47.	CSIR-IIP	Sibi, MG	Single-step catalytic liquid-phase hydroconversion of DCPD into high energy density fuel exo-THDCPD	Green Chemistry, 2012, Vol.14, Iss. 4, pp. 976-983	6.828
48.	CSIR-IICT	Rao, KTV	Solvent-free hydration of alkynes Prasad, PSS; over a heterogeneous silver Lingaiah, Nexchanged silicotungstic acid catalyst	Green Chemistry, 2012, Vol.14, Iss. 5, pp. 1507-1514	6.828
49.	CSIR-NCL	Singh, R	Towards biodegradable elastomers: Varma, AJ green synthesis of carbohydrate unfunctionalized styrene-butadiene styrene copolymer by click chemistry	Green Chemistry, 2012, Vol.14, Iss. 2, pp. 348-356	6.828
50.	CSIR-CLRI/NPL	Ashokkumar, M	Transforming collagen wastes into doped nanocarbons for sustainable energy applications	Green Chemistry, 2012, Vol.14, Iss. 6, pp. 1689-1695	6.828
51.	CSIR-IICT	Kamal, A	Water mediated Heck and Ullmann couplings by supported palladium nanoparticles: importance of surface polarity of the carbon spheres	Green Chemistry, 2012, Vol.14, Iss. 9, pp. 2513-2522	6.828

Area-wise Research Publications (TOP 50 Papers) BASED ON IMPACT FACTOR OF THE JOURNALS

ENGINEERING SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
1.	CSIR-NEERI	Jagtap, S	Fluoride in Drinking Water and Defluoridation of Water	Chemical Reviews, 2012, Vol., 112, Iss. 4, pp. 2454-2466	41.298
2.	CSIR-NEERI	Tak, YK	High-content quantum dot-based subtype diagnosis and classification of breast cancer patients using hypermulticolor quantitative single cell imaging cytometry	Nano Today, 2012, Vol., 7, Iss. 4, pp. 231-244	17.689
3.	CSIR-CGCRI	Papagno, M	Two Distinct Phases of Bilayer Graphene Films on Ru(0001)	Acs Nano, 2012, Vol., 6, Iss.10, pp. 9299-9304	12.062
4.	CSIR-NEERI	Rajkumar, M	Perspectives of plant-associated microbes in heavy metal phytoremediation	Biotechnology Advances, 2012, Vol., 30, Iss. 6, pp. 1562-1574	9.599
5.	CSIR-CGCRI	Harun, SW	Fiber laser at 2 micron region using double-clad thulium/ytterbium co-doped yttria-alumino-silicate fiber	Laser Physics Letters, 2012, Vol., 9, Iss.1, pp. 50-53	7.714
6.	CSIR-CGCRI	Ahmad, H	Supercontinuum from Zr-EDF using Zr-EDF mode-locked fiber laser	Laser Physics Letters, 2012, Vol., 9, Iss.1, pp. 44-49	7.714
7.	CSIR-NAL	Krishnan, GS	Eco-friendly synthesis of carbon fiber precursor polymers and their molecular characteristics	Green Chemistry, 2012, Vol., 14, Iss. 6, pp. 1778-1785	6.828
8.	CSIR-CGCRI	Mitra, A	A facile synthesis of cubic (Im(3) over-bar) alumina films with potential catalytic activity	Chemical Communications, 2012, Vol., 48, Iss. 27, pp. 3333-3335	6.378
9.	CSIR-NML	Dey, RS	A rapid room temperature chemical route for the synthesis of graphene: metal-mediated reduction of graphene oxide	Chemical Communications, 2012, Vol., 48, Iss.12, pp. 1787-1789	6.378
10.	CSIR-IMMT	Chaudhary, YS	Visible light-driven CO ₂ reduction by enzyme coupled CdS nanocrystals	Chemical Communications, 2012, Vol. 48, Iss.1, pp. 158-160	6.378
11.	CSIR-NEERI	Mangrulkar, PA	Nano-ferrites for water splitting: unprecedented high photocatalytic hydrogen production under visible light	Nanoscale, 2012, Vol.416, Iss.16, pp. 5202-5209	6.233
12.	CSIR-CGCRI	Bhowmik, K	Covalently functionalized reduced graphene oxide by organically modified silica: a facile synthesis of electrically conducting black coatings on glass	Journal of Materials Chemistry, 2012, Vol. 2247, Iss. 47, pp. 24690-24697	6.108

ENGINEERING SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
13.	CSIR-IMMT	Pradhan, AC	Facile synthesis of mesoporous composite Fe/Al ₂ O ₃ -MCM-41: an efficient adsorbent/catalyst for swift removal of methylene blue and mixed dyes	Journal of Materials Chemistry, 2012, Vol. 22, Iss.15, pp. 7567-7579	6.108
14.	CSIR-IMMT	Martha, S	Facile synthesis of visible light responsive V ₂ O ₅ /N,S-TiO ₂ composite photocatalyst: enhanced hydrogen production and phenol degradation	Journal Of Materials Chemistry, 2012, Vol. 22, Iss.21, pp. 10695-10703	6.108
15.	CSIR-IMMT	Parida, K	Incorporation of Fe ³⁺ into Mg/Al layered double hydroxide framework: effects on textural properties and photocatalytic activity for H-2 generation	Journal Of Materials Chemistry, 2012, Vol. 22, Iss.15, pp. 7350-7357	6.108
16.	CSIR-CGCRI	Chall, S	Single step aqueous synthesis of pure rare earth nanoparticles in biocompatible polymer matrices	Journal Of Materials Chemistry, 2012, Vol.22, Iss.25, pp. 12538-12546	6.108
17.	CSIR-NAL	Manjunatha, C	Transformation of hydrothermally derived nanowire cluster intermediates into CdSiO ₃ nanobelts	Journal Of Materials Chemistry, 2012, Vol.22, ss.42, pp. 22392-22397	6.108
18.	CSIR-NML/ CSMCRI		Preparation and characterization of graphene and Ni-decorated graphene using flower petals as the precursor material	Carbon, 2012, Vol. 50, Iss.11, pp. 4123-4129	5.868
19.	CSIR-IMMT	Nayak, S	Preparation of transparent and conducting carbon nanotube/ N-hydroxymethyl acrylamide composite thin films by in situ polymerization	Carbon, 2012, Vol. 50, Iss.11, pp. 4269-4276	5.868
20.	CSIR-NAL	Hornes, A	Catalytic and redox properties bimetallic Cu-Ni systems combined with CeO ₂ or Gd-doped CeO ₂ for methane oxidation and decomposition	Applied Catalysis B-5.825 of Environmental, 2012, Vol.111, pp. 96-105	
21.	CSIR-IMMT	Behera, GC	Facile fabrication of aluminum-promoted vanadium phosphate: A highly active heterogeneous catalyst for isopropylation of toluene to cymene	Journal Of Catalysis, 2012, Vol.289, pp.190-198	5.787
22.	CSIR-CMERI	Ganguly, A	Studies on ethanol production from water hyacinth A review	Renewable & Sustainable Energy Reviews, 2012, Vol.16, Iss.1, pp. 966-972	5.627

ENGINEERING SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
23.	CSIR-CGCRI	Rakshit, T	CdS-Decorated ZnO Nanorod Heterostructures for Improved Hybrid Photovoltaic Devices	Acs Applied Materials & Interfaces, 2012, Vol.4, Iss.11, pp. 6085-6095	5.008
24.	CSIR-CGCRI	Jana, D	High Raman Enhancing Shape Tunable Ag Nanoplates in Alumina: A Reliable and Efficient SERS Technique	Acs Applied Materials & Interfaces, 2012, Vol. 4, Iss. 7, pp. 3330-3334	5.008
25.	CSIR-CGCRI	Dandapat, A	Host-Mediated Synthesis of Cobalt Aluminate/gamma-Alumina Nanoflakes: A Dispersible Composite Pigment with High Catalytic Activities	Acs Applied Materials & Interfaces, 2012, Vol. 4, Iss.1, pp. 228-234	5.008
26.	CSIR-CGCRI	Roy, M	MgO-Doped Tantalum Coating on Ti: Microstructural Study and Biocompatibility Evaluation	Acs Applied Materials & Interfaces, 2012, Vol. 4, Iss. 2, pp. 577-580	5.008
27.	CSIR-IMMT	Pradhan, GK	Synthesis of Multifunctional Nanostructured Zinc-Iron Mixed Oxide Photocatalyst by a Simple Solution-Combustion Technique	Acs Applied Materials & Interfaces, 2012, Vol. 4, Iss. 2, pp. 707-713	5.008
28.	CSIR-IMMT	Parida, K	Effect of Co ²⁺ Substitution in the Framework of Carbonate Intercalated Cu/Cr LDH on Structural, Electronic, Optical, and Photocatalytic Properties	Journal of Physical Chemistry C, 2012, Vol.116, Iss. 42, pp. 22417-22424	4.814
29.	CSIR-IMMT	Nayak, S	In Situ Encapsulation and Release Kinetics of pH and Temperature Responsive Nanogels	Journal of Physical Chemistry C, 2012, Vol. 116, Iss.1, pp. 30-36	4.814
30.	CSIR-CGCRI	Chakraborty, C	Lamination of Cationic Perylene in Montmorillonite Nano-Gallery: Induced J-Aggregated Nano-structure with Enhanced Photo-physical and Thermogravimetric Aspect	Journal of Physical Chemistry C, 2012, Vol.116, Iss. 39, pp. 21116-21123	4.814
31.	CSIR-IMMT	Mohapatra, L	Molybdate/Tungstate Intercalated Oxo-Bridged Zn/Y LDH for Solar Light Induced Photodegradation of Organic Pollutants	Journal of Physical Chemistry C, 2012, Vol.116, Iss. 24, pp.13063-13070	4.814
32.	CSIR-NEERI	Gabhane, J	Additives aided composting of green waste: Effects on organic matter degradation, compost maturity, and quality of the finished compost	Bioresource Technology, 2012, Vol.114, pp.382- 388	4.75

ENGINEERING SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
33.	CSIR-NEERI	Chandra, R	Characterization of Phragmite-scummunis rhizosphere bacterial communities and metabolic products during the two stage sequential treatment of post methanated distillery effluent by bacteria and wetland plants	Bioresource Technology, 2012, Vol.103, Iss.1, pp. 78-86	4.75
34.	CSIR-NEERI	Puranik, S	Demonstration of sequential adaptation strategy for developing salt tolerance in bacteria for wastewater treatment: A study using Escherichia coli as model	Bioresource Technology, 2012, Vol.121, pp. 282-289	4.75
35.	CSIR-IMMT	Senapati, PK	Experimental investigation on an entrained flow type biomass gasification system using coconut coir dust as powdery biomass feedstock	Bioresource Technology, 2012, Vol. 117, pp. 99-106	4.75
36.	CSIR-IMMT	Behera, SK	Extraction of nickel by microbial reduction of lateritic chromite overburden of Sukinda, India	Bioresource Technology, 2012, Vol.125, pp. 17-22	4.75
37.	CSIR-NEERI	Dubey, KV	Surface-active potential of biosurfactants produced in curd whey by Pseudomonas aeruginosa strain-PP2 and Kocuriaturfanesis strain-Jat extreme environmental conditions	Bioresource Technology, 2012, Vol.126, pp. 368-374	4.75
38.	CSIR-NEERI	Padoley, KV	Wet air oxidation as a pretreatment option for selective biodegradability enhancement and biogas generation potential from complex effluent	Bioresource Technology, 2012, Vol. 120, pp. 157-164	4.75
39.	CSIR-IMMT	Sahoo, N	Direct shoot organogenesis from hypocotyl explants of Jatropha curcas L. an important bioenergy feedstock	Global Change Biology Bioenergy, 2012, Vol. 4, Iss. 2, pp. 234-238	4.714
40.	CSIR-IMMT	Mohapatra, M	Influence of Ca Ions on Surfactant Directed Nucleation and Growth of Nano Structured Iron Oxides and their Magnetic Properties	Crystal Growth & Design, 2012, Vol.12, Iss.1, pp. 18-28	4.689
41.	CSIR-NAL	Prakash, BS	A single step solution combustion approach for preparing gadolinia doped ceria solid oxide fuel cell electrolyte material suitable for wet powder and plasma spraying processes	Journal of Power Sources, 2012, Vol. 214, pp. 358-364	4.675

ENGINEERING SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
42.	CSIR-NAL	Selvakumar, N	Design and fabrication of highly thermally stable HfMoN/HfON /Al ₂ O ₃ tandem absorber for solar thermal power generation applications	Solar Energy Materials and Solar Cells, 2012, Vol.102, pp. 86-92	4.63
43.	CSIR-NAL	Barshilia, HC	Nanometric multi-scale rough, transparent and anti-reflective ZnO superhydrophobic coatings on high temperature solar absorber surfaces	Solar Energy Materials and Solar Cells, 2012, Vol. 107, pp. 219-224	4.63
44.	CSIR-NAL	Selvakumar, N	Review of physical vapor deposited (PVD) spectrally selective coatings for mid- and high-temperature solar thermal applications	Solar Energy Materials and Solar Cells, 2012, Vol. 98, and pp. 1-23	4.63
45.	CSIR-CGCRI	Nag, P	Sonochemical Synthesis and Properties of Nanoparticles of FeSbO ₄	Inorganic Chemistry, 2012, Vol. 512, pp. 844-850	4.593
46.	CSIR-SERC	Anoop, MB	A Refined Methodology for Durability-Based Service Life Estimation of Reinforced Concrete Structural Elements Considering Fuzzy and Random Uncertainties	Computer-Aided Civil and Infrastructure Engineering, 2012, Vol. 27, Iss.3, pp. 170-186	4.46
47.	CSIR-AMPRI	Bajpai, SK	Nano Zinc Oxide-Loaded Calcium Alginate Films with Potential Antibacterial Properties	Food and Bioprocess Technology, 2012, Vol. 5, Iss. 5, pp. 1871-1881	4.115
48.	CSIR-CGCRI	Sarkar, S	New clay-alumina porous capillary supports for filtration application	Journal of Membrane Science, 2012, Vol.392, pp.130-136	4.093
49.	CSIR-CGCRI	Mandal, A	Magic sized ZnS quantum dots as a highly sensitive and selective fluorescence sensor probe for Ag ⁺ ions	Analyst, 2012, Vol.137, Iss. 3, pp. 765-772	3.969
50.	CSIR-NML	Sahu, P	Low strain rate deformation behavior of a Cr-Mn austenitic steel at -80 degrees C	ActaMaterialia, 2012, Vol. 60, Iss. 20690-76919	3.941
51.	CSIR-NML	Madge, SV	Toughness, extrinsic effects and Poisson's ratio of bulk metallic glasses	ActaMaterialia, 2012, Vol.60, Iss.12, pp. 4800-4809	3.941

Area-wise Research Publications (TOP 50 Papers) BASED ON IMPACT FACTOR OF THE JOURNALS

PHYSICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
1.	CSIR-NIO	Palike, H;	A Cenozoic record of the equatorial Pacific carbonate compensation depth	Nature, 2012, Vol. 488, Iss. 7413, pp. 609-+	38.597
2.	CSIR-NIO	Smetacek, V;	Deep carbon export from a Southern Ocean iron-fertilized diatom bloom	Nature, 2012, Vol. 487, Iss. 7407, pp. 313-319	38.597
3.	CSIR-NPL	Matharu, Z;	Fundamentals and application of ordered molecular assemblies to affinity biosensing	Chemical Society Reviews, 2012, Vol. 41, Iss.3, pp. 1363-1402	24.892
4.	CSIR-NPL	Narayanan, TN	Hybrid 2D Nanomaterials as Dual-Mode Contrast Agents in Cellular Imaging	Advanced Materials, 2012, Vol.24, Iss. 22, pp. 2992-2998	14.829
5.	CSIR-NPL	Gupta, V	Multifunctional Ferromagnetic Carbon-Nanotube Arrays Prepared by Pulse-Injection Chemical Vapor Deposition	Angewandte Chemie-International Edition, 2012, Vol. 51, Iss.12, pp. 2916-2919	13.734
6.	CSIR-NPL	Gao, GH	Artificially Stacked Atomic Layers: Toward New van der Waals Solids	Nano Letters, 2012, Vol.12, Iss. 7, pp. 3518-3525	13.025
7.	CSIR-NPL	Peng, J	Graphene Quantum Dots Derived from Carbon Fibers	Nano Letters, 2012, Vol. 12, Iss.2, pp. 844-849	13.025
8.	CSIR-NPL	Schmitt, SW	Nanowire Arrays in Multicrystalline Silicon Thin Films on Glass: A Promising Material for Research and Applications in Nano-technology	Nano Letters, 2012, Vol.12, Iss. 8, pp. 4050-4054	13.025
9.	CSIR-NGRI	Satyabala, SP	Stick-slip advance of the Kohat Plateau in Pakistan	Nature Geoscience, 2012, Vol. 5, Iss.2, pp.147-150	12.367
10.	CSIR-NPL	Srivastava, RK	Functionalized Multilayered Graphene Platform for Urea Sensor	Acs Nano, 2012, Vol. 6, Iss.1, pp. 168-175	12.062
11.	CSIR-NPL	Singh, SK	Bulk Superconductivity in Bismuth Oxysulfide $\text{Bi}_4\text{O}_4\text{S}_3$	Journal of the American Chemical Society, 2012, Vol.13, 4 Iss. 40, pp. 16504-16507	10.677
12.	CSIR-CSIR-HQ	Choudhury, D	Near-Room-Temperature Colossal Magnetodielectricity and Multiglass Properties in Partially Disordered $\text{La}_2\text{NiMnO}_6$	Physical Review Letters, 2012, Vol.108, Iss.12, pp. 127-201	7.943

PHYSICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
13.	CSIR-NPL	Biscaras, J	Two-Dimensional Superconducting Phase in $\text{LaTiO}_3/\text{SrTiO}_3$ Heterostructures Induced by High-Mobility Carrier Doping	Physical Review Letters, 2012, Vol.108, Iss. 24, pp. 247-004	7.943
14.	CSIR-NPL	Gupta, BK	Highly Luminescent-Paramagnetic Nanophosphor Probes for In Vitro High-Contrast Imaging of Human Breast Cancer Cells	Small, 2012, Vol.8, Iss.19, pp. 3028-3034	7.823
15.	CSIR-NPL	Kumar, P	Recent progress and future aspects of organic solar cells	Progress in Photovoltaics, 2012, Vol. 20, Iss.4, pp. 377-415	7.712
16.	CSIR-NGRI	Yellappa, T	A Neoproterozoic dismembered ophiolite complex from southern India: Geochemical and geochronological constraints on its suprasubduction origin	Gondwana Research, 2012, Vol. 21, Iss.1, pp. 246-265	7.396
17.	CSIR-NGRI	Sarma, DS	Detrital zircon U-Pb ages and Hf-isotope systematics from the Gadag Greenstone Belt: Archean crustal growth in the western Dharwar Craton, India	Gondwana Research, 2012, Vol. 22, Iss. 4-Mar, pp. 843-854	7.396
18.	CSIR-NGRI	Sain, K	Gas hydrates in India: Potential and development	Gondwana Research, 2012, Vol. 22, Iss. 2, pp. 645-657	7.396
19.	CSIR-NGRI	Gahalaut, VK	Possible influence of subducting ridges on the Himalayan arc and on the ruptures of great and major Himalayan earthquakes	Gondwana Research, 2012, Vol. 21, Iss. 4, pp.1080-1088	7.396
20.	CSIR-NGRI	Mahesh, P	Rigid Indian plate: Constraints from GPS measurements	Gondwana Research, 2012, Vol. 22, Iss. 4-Mar, pp. 1068-1072	7.396
21.	CSIR-NPL	Asthana, D	NTCDA-TTF first axial fusion: emergent panchromatic, NIR optical, multi-state redox and high optical contrast photooxidation	Chemical Communications, 2012, Vol. 48, Iss.52, pp. 6475-6477	6.378
22.	CSIR-NPL	Shukla, VK	A new class of PANI-Ag core-shell nanorods with sensing dimensions	Nanoscale, 2012, Vol. 4, Iss.13, pp. 3886-3893	6.233
23.	CSIR-NPL	Dhyani, H	Electrophoretically deposited CdS quantum dots based electrode for biosensor application	Journal of Materials Chemistry, 2012, Vol. 22, Iss.11, pp. 4970-4976	6.108
24.	CSIR-NPL	Das, M	Electrophoretically fabricated core-shell CNT-DNA biowires for biosensing	Journal of Materials Chemistry, 2012, Vol. 22, Iss. 6, pp. 2727--2732	6.108

PHYSICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
25.	CSIR-NPL	Pasricha, R	Directed nanoparticle reduction on graphene	Materials Today,2012, Vol.15, Iss. 3, pp 118-125	6.071
26.	CSIR-NPL	Singh, AP	Phenolic resin-based composite sheets filled with mixtures of reduced graphene oxide, gamma-Fe ₂ O ₃ and carbon fibers for excellent electromagnetic interference shielding in the X-band	Carbon,2012, Vol.50, Iss.10, pp. 3868-3875	5.868
27.	CSIR-NPL	Singh, G	ZnO decorated luminescent graphene as a potential gas sensor at room temperature	Carbon,2012, Vol. 50, Iss. 2, pp. 385-394	5.868
28.	CSIR-NIO	Parvatkar, PT	Recent Developments in the Synthesis of Five- and Six-Membered Heterocycles Using Molecular Iodine	Chemistry-A European Journal, 2012, Vol. 18, Iss.18, pp. 5460-5489	5.831
29.	CSIR-NPL	Sharma, A	Nanopatterned Cadmium Selenide Langmuir-Blodgett Platform for Leukemia Detection	Analytical Chemistry, 2012, Vol. 84, Iss.7, pp. 3082-3089	5.695
30.	CSIR-NPL	Sharma, A	Chitosan encapsulated quantum dots platform for leukemia detection	Biosensors & Bioelectronics, 2012, Vol. 38, Iss.1, pp. 107-113	5.437
31.	CSIR-CSIO	Deep, A	Immobilization of enzyme on long period grating fibers for sensitive glucose detection	Biosensors & Bioelectronics, 2012, Vol. 33, Iss.1, pp. 190-195	5.437
32.	CSIR-NPL	Shamjad, PM	Comparison of Experimental and Modeled Absorption Enhancement by Black Carbon (BC) Cored Polydisperse Aerosols under Hygroscopic Conditions	Environmental Science & Technology, 2012, Vol. 46, Iss.15, pp. 8082-8089	5.257
33.	CSIR-NIO	Malik, A	Online Stable Isotope Analysis of Dissolved Organic Carbon Size Classes Using Size Exclusion Chromatography Coupled to an Isotope Ratio Mass Spectrometer	Environmental Science & Technology, 2012, Vol.46, Iss.18, pp. 10123-10129	5.257
34.	CSIR-NPL	Dwiyedi, N	Structural and Electronic Characterization of Nanocrystalline Diamondlike Carbon Thin Films	Acs Applied Materials & Interfaces, 2012, Vol. 4, Iss.10, pp. 5309-5316	5.008
35.	CSIR-NPL	Dar, MA	High Magneto-Crystalline Anisotropic Core-Shell Structured Mn _{0.5} Zn _{0.5} Fe ₂ O ₄ /Polyaniline Nanocomposites Prepared by in Situ Emulsion Polymerization	Journal of Physical Chemistry C, 2012, Vol. 116, Iss.9, pp. 5277-5287	4.814

PHYSICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
36.	CSIR-NPL	Saini, P	Improved Electromagnetic Interference Shielding Response of Poly(aniline)-Coated Fabrics Containing Dielectric and Magnetic Nanoparticles	Physical Chemistry Journal of C, 2012, Vol. 116, Iss. 24, pp. 13403-13412	4.814
37.	CSIR-NPL	Reddy, ALM	Probing of Ni-Encapsulated Ferromagnetic Boron Nitride Nanotubes by Time-Resolved and Steady-State Photoluminescence Spectroscopy	Journal of Physical Chemistry C 2012, Vol. 116, Iss. 23, pp. 12803-12809	4.814
38.	CSIR-NPL	Sinha, S	Electrospun polyacrylonitrile nanofibrous membranes for chitosanase immobilization and its application in selective production of chitooligosaccharides	Bioresource Technology, 2012, Vol. 115, pp. 152-157	4.75
39.	CSIR-NIO	Levy, M	Contribution of tropical cyclones to the air-sea CO ₂ flux: A global view	Global Biogeochemical Cycles, 2012, Vol. 26 pp. GB2001	4.682
40.	CSIR-NPL	Batra, N	A comparative study of silicon surface passivation using ethanolic iodine and bromine solutions	Solar Energy Materials and Solar Cells, 2012, Vol.100, pp. 43-47	4.63
41.	CSIR-NPL	Sharma, AK	Determination of minority carrier diffusion length from distance dependence of lateral photocurrent for side-on illumination	Solar Energy Materials and Solar Cells, 2012, Vol. 100, pp. 48-52	4.63
42.	CSIR-CEERI	Taube, WR	Efficiency enhancement of silicon solar cells with silicon nanocrystals embedded in PECVD silicon nitride matrix	Solar Energy Materials and Solar Cells, 2012, Vol. 101, pp. 32-35	4.63
43.	CSIR-NPL	Ahmad, S	Growth of N-substituted polypyrrole layers in ionic liquids: Synthesis and its electrochromic properties	Solar Energy Materials and Solar Cells, 2012, Vol. 99, pp. 95-100	4.63
44.	CSIR-NPL	Sharma, SN	Ligand-dependent transient absorption studies of hybrid polymer:CdSe quantum dot composites	Solar Energy Materials and Solar Cells, 2012, Vol.100, pp. 6-15	4.63
45.	CSIR-NPL	Srivastava, SK	Silver catalyzed nano-texturing of silicon surfaces for solar cell applications	Solar Energy Materials and Solar Cells, 2012, Vol.100, pp. 33-38	4.63

PHYSICAL SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
46.	CSIR-NPL	Khan, F	Sol-gel derived hydrogen annealed ZnO: Al films for silicon solar cell application	Solar Energy Materials and Solar Cells, 2012, Vol. 100, pp. 57-60	4.63
47.	CSIR-NGRI	Manikyamba, C	Arc picrite-potassicadakitic-shoshonitic volcanic association the of Neoproterozoic Sigegudda greenstone terrane, western Dharwar craton: Transition from arc wedge to lithosphere melting	Precambrian Research, 2012, Vol. 212, pp. 207-224	4.441
48.	CSIR-NGRI	Plavsa, D	Delineating crustal domains in Peninsular India: Age and chemistry of orthopyroxene-bearing felsic gneisses in the Madurai Block	Precambrian Research, 2012, Vol. 198, pp. 77-93	4.441
49.	CSIR-NGRI	Kumar, A	New age, geochemical and paleomagnetic data on a 2.21 Ga dyke swarm from south India: Constraints on Paleoproterozoic reconstruction	Precambrian Research, 2012, Vol. 220, pp. 123-138	4.441
50.	CSIR-NGRI	Singh, A	Seismic signatures of an altered crust and a normal transition zone structure beneath the Godavari rift	Precambrian Research, 2012, Vol. 220, pp. 1-8	4.441
51.	CSIR-NGRI	Mall, DM	Sub-crustal LVZ below Dharwar craton, India: An evidence for mantle metasomatism and tectonothermal activity in the Archean crust	Precambrian Research, 2012, Vol. 208, pp. 161-173	4.441
52.	CSIR-NGRI	Santosh, M	The Neoproterozoic subduction complex in southern India: SIMS zircon U-Pb ages and implications for Gondwana assembly	Precambrian Research, 2012, Vol.192-95, pp.190-208	4.441

Area-wise Research Publications (TOP 50 Papers) BASED ON IMPACT FACTOR OF THE JOURNALS

INFORMATION SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
1.	CSIR-C-MMACS/IICT	Goswami, P	A Model of Malaria Epidemiology Involving Weather, Exposure and Transmission Applied to North East India	Plos One, 2012, Vol. 7, Iss.11, pp. e49713	3.73
2.	CSIR-NISTADS	Chaudhuri, A	ICT for Development: solutions seeking problems?	Journal of Information Technology, 2012, Vol. 27, Iss. 4, pp. 326-338	3.532
3.	CSIR-C-MMACS	Singh, T	The sub-Himalayan fold-thrus belt in the 1905 Kangra earthquake zone: A critical taper model perspective for seismic hazard analysis	Tectonics, 2012, Vol. 31, Iss., pp. TC6002	3.487
4.	CSIR-C-MMACS	Shukla, AK	Homotopy analysis method with a non-homogeneous term in the auxiliary linear operator	Communications In Nonlinear Science and Numerical Simulation, 2012, Vol.17, Iss. 10, pp. 3776-3787	2.773
5.	CSIR-C-MMACS	Singh, S	Palaeoprecipitation record using O-isotope studies of the Himalayan Foreland Basin sediments, NW India	Palaeogeography Palaeoclimatology Palaeoecology, 2012, Vol. 331, Iss., pp. 39-49	2.745
6.	CSIR-C-MMACS	Srinivas, S	A study on thermal-diffusion and diffusion-thermo effects in a two dimensional viscous flow between slowly expanding or contracting walls with weak permeability	International Journal of Heat and Mass Transfer, 2012, Vol. 55,Iss., 12-Nov pp. 3008-3020	2.315
7.	CSIR-URDIP	Potdar, D	Phyto-chemical and pharmacological applications of Berberisaristata	Fitoterapia, 2012, Vol. 83, Iss. 5, pp. 817-830	2.231
8.	CSIR-NISCAIR	Prathap, G	A comment to the papers by Opthof and Leydesdorff, Scientometrics, 88, 1011-1016, 2011 and Waltman et al., Scientometrics, 88, 1017-1022, 2011	Scientometrics, 2012, Vol. 90, Iss. 2, pp. 737-743	2.133
9.	CSIR-NISCAIR	Nishy, P	An impact-citations-exergy (iCX) trajectory analysis of leading research institutions in India	Scientometrics, 2012, Vol. 91, Iss. 1, pp. 245-251	2.133

INFORMATION SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
10.	CSIR-NISCAIR	Prathap, G	Energy indicators and percentile ranking normalization	Scientometrics, 2012, Vol. 91, Iss. 3, pp. 997-1003	2.133
11.	CSIR-NISCAIR	Prathap, G	Evaluating journal performance metrics	Scientometrics, 2012, Vol. 92, Iss. 2, pp. 403-408	2.133
12.	CSIR-NISCAIR	Prathap, G	The quality-quantity-quasity and energy-exergy-entropy exegesis of expected value calculation of citation performance	Scientometrics, 2012, Vol. 91, Iss. 1, pp. 269-275	2.133
13.	CSIR-NISTADS	Bhattacharya, S	China and India: The two new players in the nanotechnology race	Scientometrics, 2012, Vol. 93, Iss.1, pp. 59-87	2.133
14.	CSIR-NISTADS	Basu, A	'Cognitive mobility' or migration of authors between fields used in mapping a network of mathematics	Scientometrics, 2012, Vol. 91, Iss. 2, pp. 353-368	2.133
15.	CSIR-NISTADS	Gupta, BM	S&T publications output of Nepal: a quantitative analysis, 2001-10	Scientometrics, 2012, Vol. 93, Iss. 3, pp. 1029-1046	2.133
16.	CSIR-NISTADS	Pal, BD	Social Accounting Matrix for India	Economic Systems Research, 2012, Vol. 24, Iss.1, pp. 77-99	2.098
17.	CSIR-NISCAIR	Prathap, G	The Inconsistency of the H-Index	Journal of the American Society for Information Science and Technology, 2012, Vol. 63, Iss. 7, pp. 1480-1481	2.005
18.	CSIR-NISCAIR	Prathap, G	The Thermodynamics-Bibliometrics Consilience and the Meaning of h-Type Indices	Journal of the American Society for Information Science And Technology, 2012, Vol. 63, Iss. 2, pp. 430-430	2.005
19.	CSIR-C-MACS/NAL	Rajendran, K	Monsoon circulation interaction with Western Ghats orography under changing climate	Theoretical and Applied Climatology, 2012, Vol. 110, Iss. 4, pp. 555-571	1.759
20.	CSIR-C-MMACS	Goswami, P	Comparative analysis of the role of domain size, horizontal resolution and initial conditions in the simulation of tropical heavy rainfall events	Meteorological Applications, 2012, Vol. 19, Iss. 2, pp. 170-178	1.318
21.	CSIR-NISCAIR	Upadhyay, A	Elastic properties of Al ₂ O ₃ -NiAl: a modified version of Hashin-Shtrikman bounds	Continuum Mechanics and Thermodynamics, 2012, Vol. 24, Iss. 3, pp. 257-266	1.091

INFORMATION SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
22.	CSIR-NISCAIR	Tripathi, A	Docking studies on novel alkaloid tryptanthrin and its analogues against enoyl-acyl carrier protein reductase (InhA) of Mycobacterium tuberculosis	Indian Journal of Biochemistry & Biophysics, 2012, Vol. 49, Iss. 6, pp. 435-441	1.026
23.	CSIR-NISCAIR	Mahesh, G	'Champion works': how countries pan out?	Current Science, 2012, Vol. 103, Iss. 11, pp. 1260-1261	0.905
24.	CSIR-NISCAIR	Mahesh, G	Indian and Chinese papers in Nature	Current Science, 2012, Vol.103, Iss. 2, pp. 127-127	0.905
25.	CSIR-NISCAIR	Prathap, G	Is the IIT JEE a conundrum?	Current Science,2012, Vol. 103, Iss. 8, pp. 869-870	0.905
26.	CSIR-NISCAIR	Mahesh, G	Open access and impact factors	Current Science,2012, Vol. 103, Iss. 6, pp. 610-610	0.905
27.	CSIR-NISCAIR	Prathap, G	The decline of the West-II	Current Science,2012, Vol. 103, Iss. 4, pp. 351-352	0.905
28.	CSIR-NISCAIR	Prathap, G	The research performance of top Indian and Chinese higher education institutions compared	Current Science, 2012, Vol. 102, Iss. 6, pp. 827-827	0.905
29.	CSIR-NISCAIR	Prathap, G	'Top 50' national rankings in mathematics	Current Science, 2012, Vol. 102, Iss. 10, pp. 1349-1350	0.905
30.	CSIR-NISCAIR	A; Wadia, N	Antimalarial patent landscape: a qualitative and quantitative analysis	Current Science, 2012, Vol. 103, Iss.10, pp. 1162-1174	0.905
31.	CSIR-NISCAIR	Prathap, G	The gross prosperity product as a second-order econometric indicator	Current Science, 2012, Vol. 103, Iss. 3, pp. 260-262	0.905
32.	CSIR-NISTADS	Dutt, B	S&T coverage in English-language Indian dailies	Current Science, 2012, Vol. 102, Iss. 9, pp. 1244-1245	0.905
33.	CSIR-NISTADS	Madhavi, Y	National vaccine policy in the era of vaccines seeking diseases and governments seeking public private partnerships	Current Science, 2012, Vol. 102, Iss. 4,	0.905
34.	CSIR-C-MMACS	Gaur, VK	Discussion of seismicity near Jaitapur	Current Science,2012, Vols. 11, pp. 1273-1278	0.905

INFORMATION SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
35.	CSIR-C-MMACS	Sinha, UN	On the predictive behaviour of the Indian Summer Monsoon, 2012,	Current Science, 2012, Vol. 103, Iss. 7, pp. 761-762	0.905
36.	CSIR-C-MMACS	Yajnik, KS	Inter-decadal trends in the annual cycles of atmospheric CO ₂ at Mauna Loa	Current Science, 2012, Vol. 102, Iss.5, pp. 774-782	0.905
37.	CSIR-C-MMACS	Goswami, P	Real-time quantitative rainfall forecasts at hobli-level over Karnataka: evaluation for the winter monsoon 2010	Current Science, 2012, Vol. 102, Iss.10, pp. 1426-1433	0.905
38.	CSIR-C-MMACS	Raman, KMT	Simulation of Spread and Control of Lesions in Brain In Medicine, 2012,	Computational and Mathematical Methods Vol. Iss., pp. 383-546	0.791
39.	CSIR-C-MMACS	Rajendran, K	How good are the simulations of tropical SST-rainfall relationship by IPCC AR4 atmospheric and coupled models?	Journal of Earth System Science, 2012, Vol. 121, Iss. 3, pp. 595-610	0.695
40.	CSIR-C-MMACS	Sajani, S	Monsoon sensitivity to aerosol direct radiative forcing in the community atmosphere model	Journal of Earth System Science, 2012, Vol. 121, Iss. 4, pp. 867-889	0.695
41.	CSIR-NISCAIR	Nishy, P	Visibility and impact of the Indian Journal of Chemistry, Section B during 2005-2009 using scientometric techniques	Indian Journal of Chemistry Section B-Organic Chemistry Including Medicinal Chemistry, 2012, Vol. 51, Iss. 1, pp. 269-284	0.689
42.	CSIR-NISCAIR	Nobi, EP	Evaluation of the spatial in seagrass cover in the lagoons of Lakshadweep islands, India, using IRS LISS III satellite images	Geocarto International, 2012, Vol. 27, Iss. 8, pp. 647-660	0.575
43.	CSIR-C-MMACS	Upadhyayula, SM	Impact of weather variables on mosquitoes infected with Japanese encephalitis virus in Kurnool district, Andhra Pradesh	Asian Pacific Journal of Tropical Medicine, 2012, Vol. 5, Iss.5, pp. 337-341	0.502
44.	CSIR-NISCAIR	Kumar, R	Folk veterinary medicines in Jalaun district of Uttar Pradesh, India	Indian Journal of Traditional Knowledge, 2012, Vol. 11, Iss. 2, pp. 288-295	0.492
45.	CSIR-NISTADS	Chaudhuri, A	Creeping Tiger, Soaring Dragon: India, China and Competition in Information Technologies	China & World Economy, 2012, Vol. 20, Iss. 6, pp. 1-28	0.476

INFORMATION SCIENCES					
S.No.	Lab	First Author	Title	Journal	IF
46.	CSIR-NISTADS	Gupta, BM	Sri Lanka S & T output during 2001-2010: A scientometric assessment	Malaysian Journal of Library & Information Science, 2012, Vol. 17, Iss. 3, pp. 49-65	0.423
47.	CSIR-NISTADS	Krishna, VV	Internationalisation of R&D and Global Nature of Innovation: Emerging Trends in India	Science Technology and Society, 2012, Vol. 17, Iss. 2, pp. 165-199	0.312
48.	CSIR-NISTADS	Sinha, B	Global biopesticide research trends: a bibliometric assessment	Indian Journal of Agricultural Sciences, 2012, Vol. 82, Iss. 2, pp. 95-101	0.17
49.	CSIR-NISCAIR	Beniwal, RS	Prediction of Effective Heat Storage Coefficient of Multi-phase Materials	Diffusion In Solids and Liquids VII, 2012, Vol. 326-328, Iss., pp. 132-140	
50.	CSIR-C-MMACS	Kumar, VA	Feedback Manipulation Flooding Attack: Feasibility Evaluation and Impact Quantification on Stream Control Transmission Protocol	2012, International Conference for Internet Technology and Secured Transactions, 2012, Vol., Iss., pp. 420-425	

Annexure-IV

CSIR Patent Applications Filed and Patents Granted during 2012-13

	India		Abroad	
	Filed	Granted	Filed	Granted
CSIR-AMPRI	3	2	1	0
CSIR-CBRI	0	0	0	0
CSIR-CCMB	0	0	3	3
CSIR-CDRI	6	6	6	3
CSIR-CECRI	0	1	3	0
CSIR-CEERI	2	0	1	0
CSIR-CFTRI	3	12	0	8
CSIR-CGCRI	6	3	3	0
CSIR-CIMAP	0	1	4	11
CSIR-CIMFR	0	3	5	4
CSIR-CLRI	6	5	1	1
CSIR-CMERI	0	1	0	0
CSIR-CRRI	2	0	0	0
CSIR-CSIO	1	0	0	2
CSIR-Schemes	4	3	4	10
CSIR-CSMCRI	17	6	43	41
CSIR-IGIB	2	0	5	27
CSIR-IHBT	3	1	8	5
CSIR-IICB	0	0	3	6
CSIR-IICT	15	11	26	43
CSIR-IIIM	1	0	9	0
CSIR-IIP	22	4	9	14
CSIR-IITR	0	1	0	0
CSIR-IMMT	4	3	2	6
CSIR-IMTECH	1	2	28	9
CSIR-NAL	4	3	1	0
CSIR-NBRI	1	2	3	4
CSIR-NCL	73	20	159	31
CSIR-NEERI	1	1	3	1
CSIR-NEIST	6	4	24	4
CSIR-NGRI	0	0	2	5
CSIR-NIIST	5	3	18	12
CSIR-NIO	0	0	0	2
CSIR-NMITLI	0	0	4	3
CSIR-NML	7	7	0	0
CSIR-NPL	4	3	2	17
CSIR-SERC	0	0	1	0
Total	199	108	381	272

Annexure-IVA

Foreign Patents Granted to CSIR during 2012-13

SNo.	Country	Patent No.	Title of invention	Inventors
CSIR-CCMB				
1	Japan	4927309	Universal primers for wildlife identification	Verma Sunil Kumar, Singh Lalji
2	Egypt	25707	Nucleic acids and methods for producing seeds having a full diploid complement of the maternal genome in the embryo	Ravi Maruthachalam, Mohan Prem Anand Marimuthu, Imran Siddiqi
3	South Africa	2008/05005	Nucleic acids and methods for producing seeds having a full diploid complement of the maternal genome in the embryo	Ravi Maruthachalam, Mohan Prem Anand Marimuthu, Imran Siddiqi
CSIR-CDRI				
4	North Korea	1006060	Novel donor-acceptor fluorene scaffolds:a process and uses thereof	Atul Goel, Sumit Chaurasia, Vijay Kumar, Sundar Manoharan, R S Anand
5	Canada	2524568	Mercapto-phenyl-naphthyl-methane derivatives and preparation thereof	Sangita, Kumar Atul, Singh Man Mohan, Jain Girish Kumar, Murthy Puvvada Sri Ramchandra, Ray Suprabhat
6	Malaysia	MY-147944-A	Substituted 1,2,4-trioxanes as antimalarial agents and a process of producing the substituted 1,2,4-trioxanes	Chandan Singh, Sunil Kumar Puri
CSIR-CFTRI				
7	United States of America	8158608	Bioactive fraction from Zingiber officinale and a process for the preparation thereof	Dharmesh; Shylaja Mallaiah Siddaraju; Mugur Nanjudaiah
8	Malaysia	MY146038-A	A process for the preparation of antioxidants from Dillenia indica	Jena Bhabani Sankar, Jayaprakasha Guddadarangawanahally Krishnareddy, Singh Ravendra Pradap, Sakariah Kunnumpurath Kurian
9	Indonesia	IDP0031432	An improved process for the preparation of soy protein concentrate with improved functional properties	Swamylingappa Bhagya, Rao Appu Rao Gopala Rao Appu, Prakash Vishweshwariah
10	Philippines	12005501732	Process for the encapsulation garcinia extract	Chinnaswamy Anandha of Ramakrishnan, Guddadaran gawanahally Krishnareddy Jayaprakasha, Bhabani Sankar Jena, Rajendrakumar

11	Indonesia	CN100564488	A process for the preparation of pacha taint free tea using	Sreekantayya Nagalakshmi, Lingamalla Jagan Mohan Rao, enzymes Nanjundswamy Chandrasekhar, Ramaswamy Shanmu gasundaram Senthil Kumar
12	United States of America	8323704	Process for preparation of extract of decalepis hamiltonii having antioxidant activity	Kotamballi Nagendra Murthy Chidambara Murthy, Giridhar Parvatam, Thammannan Rajasekaran, Gokare Aswathanarayana Ravishankar
13	Indonesia	IDP0032470	A process for the preservation of deodourised coconut sap (Neera)	Bashyam Raghavan, Kulathooran Ramalakshmi, Mysore Nagarajarao Ramesh, Babasaheb Bhaskarrao Borse, Vishweshwaraiah Prakash
14	Mozambique	65/2005	A soy based composition useful as supplementary food and a process for preparing the same	Singh Sridevi Annapurna, Kanya Tirumakudalu Chikkaraja Sindhu, Tiku Purnima Kaul, Swamylingappa Bhagya, Rao Appu Rao Rao Gopala Appu, Prakash Vishweshwariah
CSIR-CIMAP				
15	United Kingdom	1968575	Immunomodulatory pharmaceutical composition containing a combination of three coumarinolignoids	Suman Preet Singh Khanuja, Anirban Pal, Sunil Kumar Chattopadhyay, Mahendra Pandurang Darokar, Rajendra Prasad Patel, Anil Kumar Gupta, Arvind Singh Negi, Tanpreet Kaur, Sudeep Tandon, Atul Prakash Kahol, Ankur Garg
16	European Patent office	1968575	Immunomodulatory pharmaceutical composition containing a combination of three coumarinolignoids	Suman Preet Singh Khanuja, Anirban Pal, Sunil Kumar Chattopadhyay, Mahendra Pandurang Darokar, Rajendra Prasad Patel, Anil Kumar Gupta, Arvind Singh Negi, Tanpreet Kaur, Sudeep Tandon, Atul Prakash Kahol, Ankur Garg
17	Germany	1968575	Immunomodulatory pharmaceutical composition containing a combination of three coumarinolignoids	Suman Preet Singh Khanuja, Anirban Pal, Sunil Kumar Chattopadhyay, Mahendra Pandurang Darokar, Rajendra Prasad Patel, Anil Kumar Gupta, Arvind Singh Negi, Tanpreet Kaur, Sudeep Tandon, Atul Prakash Kahol, Ankur Garg

18	France	1968575	Immunomodulatory pharmaceutical composition containing a combination of three coumarinolignoids	Suman Preet Singh Khanuja, Anirban Pal, Sunil Kumar Chattopadhyay, Mahendra Pandurang Darokar, Rajendra Prasad Patel, Anil Kumar Gupta, Arvind Singh Negi, Tanpreet Kaur, Sudeep Tandon, Atul Prakash Kahol, Ankur Garg
19	China	ZL200680051962.3	Immunomodulatory pharmaceutical composition containing a combination three coumarinolignoids	Suman Preet Singh Khanuja, Anirban Pal, Sunil Kumar of Chattopadhyay, Mahendra Pandurang Darokar, Rajendra Prasad Patel, Anil Kumar Gupta, Arvind Singh Negi, Tanpreet Kaur, Sudeep Tandon, Atul Prakash Kahol, Ankur Garg
20	Australia	2005338556	Novel loganin analogues and a process for the preparation thereof	Suman Preet Singh Khanuja, Santosh Kumar Srivastava, Ankur Garg, Merajuddin Khan, Mahendra Pandurang Darokar, Anirban Pal
21	Germany	1963349	Novel loganin analogues and a process for the preparation thereof	Suman Preet Singh Khanuja, Santosh Kumar Srivastava, Ankur Garg, Merajuddin Khan, Mahendra Pandurang Dardokar, Anirban Pal
22	France	1963349	Novel loganin analogues and a process for the preparation thereof	Suman Preet Singh Khanuja, Santosh Kumar Srivastava, Ankur Garg, Merajuddin Khan, Mahendra Pandurang Dardokar, Anirban Pal
23	European Patent office	1963349	Novel loganin analogues and a process for the preparation thereof	Suman Preet Singh Khanuja, Santosh Kumar Srivastava, Ankur Garg, Merajuddin Khan, Mahendra Pandurang Dardokar, Anirban Pal
24	United Kingdom	1963349	Novel loganin analogues and a process for the preparation thereof	Suman Preet Singh Khanuja, Santosh Kumar Srivastava, Ankur Garg, Merajuddin Khan, Mahendra Pandurang Dardokar, Anirban Pal
25	China	ZL200780012274	A pharmaceutical composition useful as an immunomodulating agent and a process for the preparation thereof	Rajender Singh Sangwan, Anirban Pal, Rajiv Sharma, Suman Preet Singh Khanuja, Rajendra Prasad Patel, Payare Lal, Laxmi Narain Misra, Neelam Singh Sangwan

CSIR-CIMFR				
26	Germany	EP1678279	Method for predicting amount of gas produced during coal gasification	Barun Kumar Mall, Rajiv Anant Sohony, Sukuru Rama krishna Rao, Sibendra Kumar Basu, Kalyan Sen
27	France	EP1678279	Method for predicting amount of gas produced during coal gasification	Barun Kumar Mall, Rajiv Anant Sohony, Sukuru Rama krishna Rao, Sibendra Kumar Basu, Kalyan Sen
28	European Patent office	EP1678279	Method for predicting amount of gas produced during coal of gasification	Barun Kumar Mall, Rajiv Anant Sohony, Sukuru Rama krishna Rao, Sibendra Kumar Basu, Kalyan Sen
29	South Africa	2011/07734	Tracking and monitoring system for opencast mines	Lakshmi Kanta Bandyopadhyay, Swades Kumar Chaulya, Pankaj Kumar Mishra
CSIR-CLRI				
30	Canada	2592856	Process for the preparation of bio-tanning agent	Thanikaivelan Palanisamy, Saravanabhavan Subramani, Jonalagadda Raghava Rao, Chandrasekaran Bangaru, Balachandran Unni Nair, Ramasami Thirumalachari
CSIR-CSIO				
31	China	ZL200580014693.9	Improved fake currency detector using visual and reflective spectral response	Murli Manohar Joshi, Ram Prakash Bajpai, Gautam Mitra, Harish Kumar Sardana, Hari Naryan Bhargaw, Saroj Batra
32	Canada	2559102	Improved fake currency detector using visual and reflective spectral response	Murli Manohar Joshi, Ram Prakash Bajpai, Gautam Mitra, Harish Kumar Sardana, Hari Naryan Bhargaw, Saroj Batra
CSIR (Schemes)				
33	China	ZL200580051794.3	Novel multifunctional additive graft rubber and preparation method thereof	Bihari Nando Golok, Vikram Tiruchanur
34	United States of America	8207222	Nitric oxide releasing derivatives of paracetamol	Tilak Raj Bhardwaj, Manoj Kumar, Necraj Mehta, Neelima Dhingra
35	European Patent office	EP1934241	Novel series of imidazolyl substituted steroidal and indan-1-one derivatives	Ranju Bansal, Sheetal Guleria, Gaurav Narang, Rolf W. Hartmann
36	France	EP1934241	Novel series of imidazolyl substituted steroidal and indan-1-one derivatives	Ranju Bansal, Sheetal Guleria, Gaurav Narang, Rolf W. Hartmann

37	United Kingdom	EP1934241	Novel series of imidazolyl substituted steroidal and indan-1-one derivatives	Ranju Bansal, Sheetal Guleria, Gaurav Narang, Rolf W. Hartmann
38	Germany	EP1934241	Novel series of imidazolyl substituted steroidal and indan-1-one derivatives	Ranju Bansal, Sheetal Guleria, Gaurav Narang, Rolf W. Hartmann
39	China	ZL200680038698.X	Novel series of imidazolyl substituted steroidal and indan-1-one derivatives	Gaurav Narang, Ranju Bansal, Sheetal Guleria, Rolf W. Hartmann
40	United States of America	8361996	Imidazolyl substituted steroidal and indan-1-one derivatives	Ranju Bansal, Sheetal Guleria, Gaurav Narang, Rolf Wolfgang Hartmann
41	Indonesia	IDP0032889	Novel multi functional additive grafted rubber and process for preparation thereof	Bihari Nando Golok, Vikram Tiruchanur
42	United States of America	8389638	Development of new grades of rubbers by grafting with metaalkenyl phenols and its derivatives	Bihari Nando Golok, Vikram Tiruchanur
CSIR-CSMCRI				
43	Philippines	1-2005-501203	Animal powered mechanical device for water desalination	Sanat Natubhai Patel, Pushpito Kumar Ghosh, Nagendra Pathak, Sohan Lal Daga, Virendra Jayantilal Shah
44	European Patent office	1966177	Catalytic epoxidation of styrene with molecular oxygen using metal ion exchanged zeolites	Raksh Vir Jasra, Jince Sebastian
45	Germany	1966177	Catalytic epoxidation of styrene with molecular oxygen using metal ion exchanged zeolites	Raksh Vir Jasra, Jince Sebastian
46	Israel	IL178215	Enhancement of antitubercular activity of extracts of Salicornia brachiata	Rajnikanth Rathod Meena, Bhupendra Dhanvantrai Shethia, Jayant Batukrai Pandya, Pushpito Kumar Ghosh, Prakash Jagjivanbhai D
47	Israel	190373	Improved process for the recovery of sulphate of potash (SOP) from sulphate rich bittern	Parimal Paul, Pushpito Kumar Ghosh, Kaushik Jethalal Langalia, Palani Sivagnana Subramanian, Suresh Eringathodi, Subrata Patra, Pragati Agnihotri

48	Canada	2562109	Low sodium salt of botanic origin	Pushpito Kumar Ghosh, Kalpana Haresh Mody, Muppala Parandhami Reddy, Jinalal Shambhubhai Patolia, Karuppanan Eswaran, Rajul Ashvinbhai Shah, Bhargav Kaushikbhai Barot, Mahesh Ramniklal Gandhi, Aditya Shantibhai Mehta, Ajoy uralidharbhai Bhatt, Alamuru Venkata Rami Reddy
49	China	ZL200580052409.7	Molecular oxygen catalysis epoxidation vinyl benzene used for exchanging zeolite with metallic ion	Raksh Vir Jasra, Jince Sebastian
50	United States of America	8182784	Process for the recovery of sulphate of potash (SOP) from sulphate rich bittern	Parimal Paul, Pushpito Kumar Ghosh, Kaushik Jethalal Langalia, Palani Sivagnana. Subramanian, Suresh Eringathodi, Subrata Patra, Pragati Agnihotri
51	Indonesia	IDP0030969	A method for the preparation of k carrageenase	Yasmin Najmuddin Khambhaty, Kalpana Haresh Mody, Bhavanath Jha
52	South Korea	10-1154447	Catalysed acylation of alkylated benzene derivatives	Raksh Vir Jasra, Beena Tyagi, Yogiraj Mansuklal Badheka
53	Nigeria	NG/C/2011/570-001057	A manually operated continuous flow type drinking water disinfecter using concentrated solar radiation	Rajan Thimmannabhat Sodankur, Pushpito Kumar. Ghosh, Sanatkumar Natvarlal Patel, Jitendrabhai Narsinbhai Bharadia
54	Germany	10314576	Process to separate nitrogen and argon from air by application of alkoxide to zeolite at room temperature and pressure	Raksh VirJasra, Chintansinh Dharmendrasinh Chudasama, Jince Sebastian
55	United States of America	8241483	Process for the preparation of stable iodate-exchanged synthetic hydrotalcite with zero effluent discharge	Pushpito Kumar Ghosh, Mahesh Ramaniklal Gandhi, Satish Hariray Mehta, Ramachandraiah Gadde, Rameshchandra Jatin, Mirnal Vinodbhai Sheth, Girirajsinh Sabalsinh Gohil

56	United States of America	8252261	Process for the preparation of finely divided precipitated silica	Raksh Vir Jasra, Haresh Mahipatlal Mody, Rajesh Shantilal Somani, Hari Chand Bajaj, Dipak Balwantraai Shukla, Niraj Ramesh chandra Vyas
57	United States of America	8252359	Method for the preparation of refreshing drink and use thereof	Pushpito Kumar Ghosh, Maheshchandra Rameshchandra Rajyaguru, Jinalal Shambhubhai Patolia, Peddi Venkata Subbarao, Mukesh
58	Australia	2006200932	Improved process for the recovery of sulphate of potash (SOP) from sulphate rich bittern	Kaushik Jethalal Langalia, Palani Sivagnana Subramanian, Parimal Paul, Suresh Eringathodi, Pushpito Kumar Ghosh, Subrata Patra, Pragati Agnihotri
59	Philippines	12008502142	A method for the preparation of k-carrageenase	Yasmin Najmuddin Khambhaty, Kalpana Haresh Mody, Bhavanath Jha
60	Japan	5095632	An improved process for preparation of magnesium oxide	Pushpito Kumar Ghosh, Himanshu Labhshanker Joshi, Hasina Hajibhai Deraiya, Mahesh kumar Ramniklal Gandhi, Rohit Harshadrai Dave, Kaushik Jethalal Langalia, Vadakke Puthoor Mohandas
61	Israel	176482	Process for recovery of sulphate of potash	Pushpito Kumar Ghosh, Kaushik Jethalal Langalia, Mahesh kumar Ramniklal Gandhi, Rohit Harshadray Dave, Himanshu Labshanker Joshi, Rajinder Nath Vohra, Vadakke Puthoor Mohandas, Sohanlal Daga, Koushik Halder, Hasina Hajibhai Deraiya, Ramjibhai Devji bhai Rathod, Abdul hamid Usman bhai Hamdani
62	Japan	5102780	An improved process for the preparation of magnesia (MgO)	Pushpito Kumar Ghosh, Himanshu Labhshanker, Hasina Hajibhai Deraiya, Mahesh kumar Ramniklal Gandhi, Rohit Harshadrai Dave, Kaushik Jethalal Langalia, Vadakke Puthoor Mohandas
63	United States of America	8282690	Process for the preparation of solar salt having high purity and whiteness	Indrajit Mukhopadhyay, Pushpito Kumar Ghosh, Vadakke Puthoor Mohandas, Abdulhamid Usmanbhai Hamidani, Venkata Rama Krishna Sarma Susarla, Rahul Jasvantraai Sanghavi

64	Canada	2592499	Process for preparing detergent builder zeolite - a from kimberlite tailings	Raksh Vir Jasra, R. S. Somani, H. M. Mody, H. C. Bajaj, J. R. Chunawala, Hemal Ranpara, Dipti Barochiya, Devendra Ghelani, Suresh Chandra, M. K. Dhar, Keshav Rao, Kamlesh Kumar
65	Japan	5133683	Enhancement of antitubercular activity of extracts of <i>Salicornia brachiata</i>	Meena Rajnikant Rathod, Bhupendra Dhanvantrai Shethia, Jayant Batukrai Pandya, Puspito Kumar Ghosh, Prakash Jagjivanbhai Dodia, Brahm Shankar Srivastava, Ranjana Srivastava, Anil Srivastava, Vinita Chaturvedi, Mariappanadar Viramani
66	Mexico	305596	A process for the eco-friendly preparation of 3, 5-dibromo-4-hydroxybenzonitrile	Subbayarappa Adimurthy, Gadde Ramachandraiah, Girdhar Joshi, Rajendra Patil, Maheshkumar Ramniklal Gandhi, Mallampati Subbareddy, Pratyush Maiti
67	China	ZL200880018780.5	A process for manufacturing precipitated silica	Raksh Vir Jasra, Hareh finely Mahiptalal Mody, Rajesh Shantilal Somani, Hari Chand Bajaj, Dipak Balwantrai Shukla, Niraj Rameshchandra Vyas
68	Japan	5143330	An improved process for the cultivation of algae	Radhakrishn Chennur Reddy, Om Prakash Mairh, Guru Rajakrishna Kumar, Kuruppanan Eswaran, Peddi Venkata Subba Rao. Kalpana Hareh Mody, Pushpito Kumar Ghosh
69	Brazil	P0318668-7	Simultaneous recovery of potassium chloride and KCl enriched edible salt	Rajinder NathVohra, Pushpito Kumar Ghosh, Ashok kumar Bhagvanji bhai Kasundra, Himanshu Labhshanker Joshi, Rohit Harshadray Dave, Mahesh Kumar Ramniklal Gandhi, Kaushik Jethalal Langalia, Koushik Halder, Sohan Lal Daga, Ramjibhai Devjibhai Rathod, Hasina Hajibhai Deraiya, Purashottambhai Ravajibhai Jadav, Vadakke Puthoor Mohandas, Abdul hamid Usmanbhai Hamidani

70	China	ZL200680054085.5	A method for the preparation of k-carrageenase	Yasmin Najmuddin Khambhaty, Kalpana Haresh Mody, Bhavanath Jha
71	Australia	2004325362	Process of preparation of biodegradable films from semi refined kappa carrageenan	Pushpito Kumar Ghosh, Arup Kumar Siddhanta, Kamalash Prasad, Ramavatar Meena, Amit Bhattacharya
72	South Africa	2011/07043	A manually operated continuous flow type drinking water disinfectant using concentrated solar radiation	Rajan Thimmannabhat Sodankur, Pushpito Kumar Ghosh, Sanatkumar Natvarlal Patel, Jitendrabhai Narsinbhai Bharadia
73	United States of America	8343282	Photocatalytic auto-cleaning process of stains	Pushpito Kumar Ghosh, Raksh Vir Jasra, Dipak Balvantraj Shukla, Anjani Ketan Bhatt, Rajesh Jagannath Tayade
74	Japan	5177956	A cost-effective process for the preparation of solar salt having high purity and whiteness	Indrajit Mukhopadhyay, Pushpito Kumar Ghosh, Puthoor Mohandas Vadakke, Abdulhamid Usmanbhai Hamidani, Venkata Rama Krishna Sarma Susarla, Rahul Jasvantrai Sanghavi
75	European Patent office	1836148	Process for the preparation of aldol derivatives from alkenes using catalyst	Raksh Vir Jasra, Vivek Kumar Srivastava, Ram Sambhar Shukla, Hari Chand Bajaj, Bhatt Sharad Durgashankerbhai
76	China	ZL200580015459.8	Enhancement of antitubercular activity of extracts of Salicornia brachiata	Meena Rajnikanth Rathod, Bhupendra Dhanvantrai Shethia, Jayant Batukrai Pandya, Pushpito Kumar Ghosh, Prakash Jagjivanbhai Dodia, Brahm Shankar Srivastava, Ranjana Srivastava, Anil Srivastava, Vinita Chaturvedi, Mariappanadar Viramani
77	South Korea	10-1231894	Photocatalytic auto-cleaning process of stains	Ghosh Pushpito Kumar, Jasra Raksh Vir, Shukla Dipak Balvantrai, Bhatt Anjani Ketan, Tayade Rajesh Jagannath
78	Canada	2617677	A cost-effective process for preparation of solar salt having purity and whiteness	Indrajit Mukhopadhyay, Pushpito Kumar Ghosh, high Vadakke Puthoor Mohandas, Abdulhamid Usman bhai Hamidani, Venkata Rama Krishna Sarma Susarla, Rahul Jasvantrai Sanghavi
79	Australia	2008246949	A process for the preparation finely divided precipitated silica	Raksh Vir Jasra, Hareh of Mahiptalal Mody, Rajesh Shantilal Somani, Hari Chand Bajaj, Dipak Balwantrai Shukla, Niraj Rameshchandra Vyas

80	Israel	192926	An improved process for preparation of magnesium oxide	Himanshu Labhshanker Joshi, Hasina Hajibhai Deraiya, Mahesh kumar Ramniklal Gandhi, Rohit Harshdrai Dave, Kaushik Jethalal Langalia, Vadakke Puthoor Mohandas
81	African Regional Intellectual Property	AP2624	A process for the preparation of stable iodate-exchanged synthetic hydrotalcite with zero effluent discharge	Pushpito Kumar Ghosh, Organization Mahesh Ramaniklal Gandhi, Satish Hariray Mehta, Gadde Ramachandraiah, Jatin Rameshchandra Chunawala, Mrinal Vinodbhai Sheth, Girirajsinh Sabalsinh Gohil
82	Malaysia	148335	A solid nutrient media useful for isolating and identifying alkaliphilic bacteria	Gopalsamy Gnanasekaran, Mody Kalpana Haresh, Datta Sumitra Haresh, Jha Bhavanath
83	South Africa	2006/02576	Herbal extracts of salicornia species, process of preparation thereof, use thereof against Pandya, tuberculosis	Meena Rajnikant Rathod, Bhupendra Dhanvantrai Shethia, Jayant Batukrai Pushpito Kumar Ghosh, Prakash Jagjivanbhai Dodia, Brahm S. Srivastava, Ranjana Srivastava, Anil Srivastava, C. M. Gupta, Vinita Chaturvedi
CSIR-IGIB				
84	Canada	2427502	Novel primers for screening schizophrenia and a method thereof	Samir Kumar Brahmachari, Verma Ranjana, Chauhan Chitra, Q. Salim, S. Jain
85	Canada	2549914	A novel protein capable of inhibiting anthrax toxin activity	Naveen Arora, Kaiser Mohammed Bijli, Bhanu Pratap Singh, Susheela Sridhara
86	China	ZL200380110865.3	A method for the detection of predisposition to high altitude pulmonary edema(HAPE)	Mohammad Abdul Qadar Pasha, Aarif Ahsan
87	Australia	2006307640	Genetic variants of human inositol polyphosphate-4-phosphatase, type i (INPP4A) useful for prediction and therapy of immunological disorders	Balaram Ghosh, Mamta Sharma, Jyotsna Batra
88	New Zealand	567726	Genetic variants of human inositol polyphosphate-4-phosphatase, type i (INPP4A) useful for prediction and therapy of immunological disorders	Balram Ghosh, Mamta Sharma, Jyotsna Batra

89	Italy	1996520	A bacterium consortium, bio-electrochemical device and a process for quick and rapid estimation of biological oxygen demand	Rita Kumar, Abha Joshi, Anil Kumar, Tushya Kumar Saxena
90	Belgium	1996520	A bacterium consortium, bio-electrochemical device and a process for quick and rapid estimation of biological oxygen demand	Rita Kumar, Abha Joshi, Anil Kumar, Tushya Kumar Saxena
91	Switzerland	1996520	A rapid bio-electrochemical device for the estimation of bod of beverage waste water	Rita Kumar, Abha Joshi, Anil Kumar, Tushya Kumar Saxena
92	European Patent Office	1996520	A bacterium consortium, bio-electrochemical device and a process for quick and rapid estimation of biological oxygen demand	Rita Kumar, Abha Joshi, Anil Kumar, Tushya Kumar Saxena
93	Germany	1996520	A bacterium consortium, bio-electrochemical device and a process for quick and rapid estimation of biological oxygen demand	Rita Kumar, Abha Joshi, Anil Kumar, Tushya Kumar Saxena
94	Spain	1996520	A bacterium consortium, bio-electrochemical device and a process for quick and rapid estimation of biological oxygen demand	Rita Kumar, Abha Joshi, Anil Kumar, Tushya Kumar Saxena
95	United Kingdom	1996520	A bacterium consortium, bio-electrochemical device and a process for quick and rapid estimation of biological oxygen demand	Rita Kumar, Abha Joshi, Anil Kumar, Tushya Kumar Saxena
96	France	1996520	A bacterium consortium, bio-electrochemical device and a process for quick and rapid estimation of biological oxygen demand	Rita Kumar, Abha Joshi, Anil Kumar, Tushya Kumar Saxena
97	South Korea	10-1178776	A computer apparatus for identifying adhesin and adhesin-like proteins of therapeutic potential	Gaurav Sachdeva, Kaushal Kumar, Preti Jain, Samir Kumar Brahmachari, Srinivasan Ramachandran
98	United States of America	8268983	Primers for amplifying and detecting the beta 2 adrenergic receptor gene	Ritushree Kukreti, Pallav Bhatnagar, Chandrika Rao, Balram Ghosh, Samir Kumar Brahmachari, Randee Guleria, Chinmoyee Das

99	Italy	EP1954810	Genetic variants of human inositol polyphosphate-4-phosphatase, type i (INPP4A) useful for prediction and therapy of immunological disorders	Balram Ghosh, Mamta Sharma, Jyotsna Batra
100	United Kingdom	EP1954810	Genetic variants of human inositol polyphosphate-4-phosphatase, type i (INPP4A) useful for prediction and therapy of immunological disorders	Balram Ghosh, Mamta Sharma, Jyotsna Batra
101	France	EP1954810	Genetic variants of human inositol polyphosphate-4-phosphatase, type i (INPP4A) useful for prediction and therapy of immunological disorders	Balram Ghosh, Mamta Sharma, Jyotsna Batra
102	Spain	EP1954810	Genetic variants of human inositol polyphosphate-4-phosphatase, type i (INPP4A) useful for prediction and therapy of immunological disorders	Balram Ghosh, Mamta Sharma, Jyotsna Batra
103	European Patent office	EP1954810	Genetic variants of human inositol polyphosphate-4-phosphatase, type i (INPP4A) useful for prediction and therapy of immunological disorders	Balram Ghosh, Mamta Sharma, Jyotsna Batra
104	Germany	EP1954810	Genetic variants of human inositol polyphosphate-4-phosphatase, type i (INPP4A) useful for prediction and therapy of immunological disorders	Balram Ghosh, Mamta Sharma, Jyotsna Batra
105	China	ZL200380110277.X	Bacterial strain and a method of reducing total dissolved solids	Rita Kumar, Deepa Kachroo Tiku, Poonam Sharma
106	Australia	2004326113	Process for preparing microbial consortium useful as seeding material for bod analysis of pulp and paper industrial wastewater	Rita Kumar, Shikha Rastogi, Anil Kumar
107	Israel	176125	A computer based versatile method for identifying protein coding DNA sequences useful as drug targets	Samir Kumar Brahmachari, Debashish Dash, Ramakant Sharma, Jitendra Kumar Maheshwari
108	Israel	177308	Computational method for identifying adhesin and adhesin-like proteins of therapeutic potential	Gaurav Sachdeva, Kaushal Kumar, Preti Jain, Samir Kumar Brahmachari, Srinivasan Ramachandran

109	United States Of America	8367603	Protein capable of inhibiting anthrax toxin activity	Naveen Arora, Kaiser Mohammed Bijli, Bhanu Pratap Singh, Susheela Sridhara
110	Hungary	228447	A computer based method for identifying conserved invariant peptide motifs.	Samir Kumar Brahmachari, Debasis Dash
CSIR-IHBT				
111	Bulgaria	66228B1	A simple process for obtaining beta-aescin from indian horse hestnut (<i>Aesculus Indica</i>)	Bikram Singh
112	Australia	2006341291	A method for rapid isolation of RNA and a kit thereof	Sanjay Ghwana, Kashmir Singh, Jyoti Raizada, Arti Rani, Pradeep Kumar Bhardwaj, Sanjay Kumar
113	Indonesia	IDP0031987	Development of diagnostic kit for the detection of chrysanthemum virus b	Lakhmir Singh, Vipin Hallan, Aijaz Asghar Zaidi
114	China	ZL200680054561.3	A method for rapid isolation of RNA and a kit thereof	Sanjay Ghwana, Kashmir Singh, Jyoti Raizada, Arti Rani, Pradeep Kumar Bhardwaj, Sanjay Kumar
115	Vietnam	1-0011187-000	Process for production of steviosides from <i>Stevia rebaudiana bertonii</i>	Jonnala Kotesw Kumar, Garikapati Dyva Kiran Babu, Vijay Kumar Kaul, Paramvir Singh Ahuja
CSIR-IICB				
116	South Africa	2011/06443	Flavanoid compounds and process for preparation thereof	Pratap Kumar Das, Suchandra Goswami, Annalakshmi Chinniah, Janaswamy Madhusudana Rao, Katragadda Suresh Babu
117	Japan	5037778	Antimonocytic activity of extracts of piper betel leaves	Santu Bandyopadhyay, Bikash Pal, Samir Bhattacharya, Mitali Ray, Keshab Chandra Roy
118	South Africa	2011/08148	Triazine-aryl-bis-indoles and process for preparation thereof	Vasanta Madhava Sharma Gangavaram, Jhillu Singh Yadav, Radha Krishna Palakodety, Arun Bandyopadhyay, Siddhartha Roy, Santu Bandyopadhyay, Rakesh Kamal Johri, Subhash Chander Sharma, Balaram Ghosh, Mabalirajan Ulaganathan, Sakshi Balwani, Bholanath Paul, Ashok Kumar Saxena

119	China	ZL200680032192.8	A pharmaceutical composition useful for the treatment of prostate cancer	Swati Sinha, Bikas Chandra Pal, Samir Bhattacharya
120	United States of America	8383690	Pharmaceutical composition useful for the treatment of peptic ulcer diseases	Sukdeb Banerjee, Pratap K Das, Suchandra Goswami, C. Annalakshmi, Nilendu Panda, Niranjan Prasad Sahu, Basudeb Achari
121	Australia	2007213423	A pharmaceutical composition comprising oenothien c useful for the treatment of peptic ulcer diseases	Annalakshmi Chinniah, Basudeb Achari, Nilendu Panda, Sukdeb Banerjee, Pratap Kumar Das, Suchandra Goswami, Niranjan Prasad Sahu
CSIR-IICT				
122	United States of America	8153627	Quinazoline linked pyrrolo [2,1-c] [1, 4] benzodiazepine hybrids as potential anticancer agents and process for the preparation thereof	Ahmed Kamal, Rajendra Prasad Bandari, Malla Reddy Adla
123	South Korea	10-1150231	A method for standardization of chemical and therapeutic values of foods & medicines using animated chromatographic fingerprinting	Vijayakumar Dadala, Kondapuram Vijaya Raghavan
124	Norway	331997	A novel method for chromatographic finger printing and standardization of single medicines and formulations	Vijaya Kumar Dadala, Kondapuram Vijaya Raghavan
125	Japan	5001953	Process for preparing long-chain dicarboxylic acids	Kamal Ahmed, Gurralla, Sheelu Fadnavis Wasantrao Nitin
126	United States of America	8202989	One step process for the preparation of substituted 5, 10-dihydrodibenzo [b,e] [1, 4]diazepine-11-ones	Harshadas Mitaram Meshram, Palakuri Ramesh Goud, Bandi Chennakesava Reddy, Jhillu Singh Yadav
127	Japan	5032560	A biosensor to determine potassium concentration in human blood serum	Sunkam Vanaja, Mandapati Jayalakshmi, Sunkara Sakunthala Madhavendra, Kaki Rajgopal, Mannepalli Lakshmi Kantam, Sunkara Vardhireddy Manorama, Vinod Kumar Khanna, Shamim Ahmad, Yogendra Kumar Jain, Chandra Sekhar

128	United States of America	8217167	Phenanthrylphenol linked pyrrolo [2, 1-c] [1, 4] benzodiazepine hybrids as potential antitumour agents and process for the preparation thereof	Ahmed Kamal, Sreekanth Kokkonda, Praveen Kumar Pogula, Balakishan Gorre
129	United States of America	8227046	A process for preparing self-assembling nanobinary and ternary oxy/hydroxides	BM Choudary, VS Jaya, BR Reddy, ML Kantam, MM Rao, KK Rao, KN Raghavan
130	United States of America	8242051	Carbon supported activated alumina adsorbent for removal of fluoride ion from water and a process for the preparation thereof	Kamaraju Seeth Rama Rao, Veldurthi Shashikala, Aytam Hari Padmasri, Burri David Raju, Vasireddy Siva Kumar, Bhari Mallaanna Naga, Ramulu Podila Seetha Reddy, Sanapureddy Sreevardhan ulshreshta Umesh Chandra Chary, Kamandur Vehkata Raghvan
131	Japan	5075826	A single pot process for the Boddu preparation of diazonaphthoquinonesulfonyl ester	Vummadi Venkat Reddy, Ananda Rao, Maruthi Janaki Ram Reddy, Chiguru Srinivas, Chilukuri Ramesh, Vaidya Jayathirtha Rao
132	Japan	5078987	Integrin binding rgd-lipopeptides with gene transfer activities	Bharat Kumar Majeti, Priya Prakash Karmali, Dipankar Pramanik, Arabinda Chaudhari
133	United States of America	8278483	Process for synthesis of glycomimicking cationic amphiphiles	Yenugonda Venkata Mahidhar Arabinda Chaudhuri, Rama Mukherjee
134	Japan	5103021	A method for standardization of chemical and therapeutic values of foods & medicines using animated chromatographic fingerprinting	Vijayakumar Dadala, Kondapuram Vijaya Raghavan
135	United States of America	8288387	Napthalimide-benzimidazole hybrids as potential antitumor agents and process for the preparation thereof	Kamal Ahmed, Praveen Kumar Pogula
136	Australia	2007357284	Novel glycerol-based heterogeneous solid acid catalysts useful for the esterification of fatty acids, a process and use thereof	Gangadhar Katkam Nadpi, Narayana Prasad, Rachapudi Badari, Prabhavathi Devi, Bethala Lakshmi Anu, Sai Prasad, Potharaju Seetharamanjaneya

137	United States of America	8309726	Substituted piperazine compounds of formula 8	Ahmed Kamal, Bandari Rajendra Prasad
138	Indonesia	IDP0032300	Novel glycerol-based heterogeneous solid acid catalysts useful for the esterification of fatty acids, a process and use thereof	Gangadhar Katkam Nadpi, Narayana Prasad, Rachapudi Badari, Prabhavathi Devi, Bethala Lakshmi Anu, Sai Prasad, Potharaju Seetharamanjaneya
139	United States of America	8318726	Benzylidineanthracenone linked pyrrolobenzodiazepine hybrids useful as anticancer agents and process for the preparation thereof	Ahmed Kamal, Mallareddy Adla, Suresh Paidakula, Rajesh Venkata Chenna Rama Narasimha Chennamshetti
140	United Kingdom	2271647	C2-fluoro substituted piperazine linked pyrrolo [2,1-c] [1,4] benzodiazepine dimers and a process for the preparation thereof	Ahmed Kamal, Rajender, Metuku Kashireddy, Gorre Balakishan
141	European Patent Office	2271647	C2-fluoro substituted piperazine linked pyrrolo[2,1-c][1,4] benzodiazepine dimers and a process for the preparation thereof	Ahmed Kamal, Rajender, Metuku Kashireddy, Gorre Balakishan
142	France	2271647	C2-fluoro substituted piperazine linked pyrrolo [2,1-c] [1,4] benzodiazepine dimers and a process for the preparation thereof	Ahmed Kamal, Rajender, Metuku Kashireddy, Gorre Balakishan
143	Germany	2271647	C2-fluoro substituted piperazine linked pyrrolo [2,1-c] [1,4] benzodiazepine dimers and a process for the preparation thereof	Ahmed Kamal, Rajender, Metuku Kashireddy, Gorre Balakishan
144	Japan	5149193	A novel pyrrolo[2,1-c][1,4] benzodiazepine hybrid and a process for the preparation thereof	Ahmed Kamal, Ankati Hari Babu, Adhi Venkata Ramana, Earla Vijaya Bharathi
145	United States of America	8354547	4.beta-amino podophyllotoxin congeners as anti tumour antibiotics a process for the preparation thereof	Ahmed Kamal, Banala Ashwini Kumar, Paidakula Suresh
146	United States of America	8357275	Potentiometric cholesterol sensor for the quantitative estimation of total cholesterol in human blood serum	Sunkam Vanaja, Mandapati Jayalakshmi, Sunkara Sakunthala Madhavendra, Mandapati Mohan Rao, Mannepalli Lakshmi Kantam, Isukapally Margaret, Vinod Kumar Khanna, Shamim Ahmad, Yogendra Kumar Jain, Chandra Sekhar

147	Philippines	PH/1/2005/501147	A process for the extraction of nickel from low grade chromite ore	Radhanath Prasad Das, Anil Kanta Tripathy, Shashi Anand, Sudipta Das, Snehasis Behera, B V Raman Murty, Partha Sarathi Datta, Bhagyadhar Bhoi, Malay Kumar Ghosh, Kali Sanjay, Subir Das, Tondepu Subaiah, Karnam Srinivas Rao, Indra Narayan Bhattachary, Ramchandra Nagesh Parlikar, Gajula Venkata Yugandhar, Ugle Ashutosh, Hari Simha, Kataram Rajeswar Rao, Kodali Hirnya Varna Prasad, Rajendra Kumar Singhvi, Vakil Singh, Baij Nath Mittal, Bhuban Lal Agarwal
148	Germany	2346876	4.beta-amino podophyllotoxin congeners as anti tumour antibiotics a process for the preparation thereof	Ahmed Kamal, Banala Ashwini Kumar, Paidakula Suresh
149	France	2346876	4.beta-amino podophyllotoxin congeners as anti tumour antibiotics a process for the preparation thereof	Ahmed Kamal, Ashwini Kumar Banala, Suresh Paidakula
150	European Patent office	2346876	4.beta-amino podophyllotoxin congeners as anti tumour antibiotics a process for the preparation thereof	Ahmed Kamal, Ashwini Kumar Banala, Suresh Paidakula
151	United Kingdom	2346876	4.beta-amino podophyllotoxin congeners as anti tumour antibiotics a process for the preparation thereof	Ahmed Kamal, Ashwini Kumar Banala, Suresh Paidakula
152	United States of America	8372831	Isoxazoline linked pyrrolo [2,1-c][1,4]benzodiazepine hybrids as potential anticancer agents and the process for preparation thereof	Ahmed Kamal, Jonnala Surendranadha Reddy, Dudekula Dastagiri, Earla Vijaya Bharathi
153	United Kingdom	2271648	Isoxazoline linked pyrrolo [2,1-c] Ahmed Kamal, Jonnala [1,4] benzodiazepine hybrids as potential anticancer agents and the process for preparation thereof	Surendranadha Reddy, Dudekula Dastagiri, Earla Vijaya Bharathi
154	France	2271648	Isoxazoline linked pyrrolo [2,1-c] [1,4] benzodiazepine hybrids as potential anticancer agents and the process for preparation thereof	Ahmed Kamal, Jonnala Surendranadha Reddy, Dudekula Dastagiri, Earla Vijaya Bharathi

155	Germany	2271648	Isoxazoline linked pyrrolo [2,1-c] [1,4] benzodiazepine hybrids as potential anticancer agents and the process for preparation thereof	Ahmed Kamal, Jonnala Surendranadha Reddy, Dudekula Dastagiri, Earla Vijaya Bharathi
156	European Patent Office	2271648	Isoxazoline linked pyrrolo [2,1-c] [1,4] benzodiazepine hybrids as potential anticancer agents and the process for preparation thereof	Ahmed Kamal, Jonnala Surendranadha Reddy, Dudekula Dastagiri, Earla Vijaya Bharathi
157	United States of America	8383373	Process for preparing long-chain dicarboxylic acids	Ahmed Kamal, Sheelu Gurrala, Wasantrao Nitin Fadnavis
158	United States of America	8383618	C2-fluoro substituted piperazine linked pyrrolo [2,1-c] [1,4] benzodiazepine dimers and a process for the preparation thereof	Ahmed Kamal, Rajender, Metuku Kashireddy, Balakishan Gorre
159	United States of America	IDP8383847	Process for the enrichment of methyl ricinoleate from castor oil methyl esters by liquid-liquid extraction	Kasturi Venkata Sessa Adinarayana Rao, Penumarthy Vijayalakshmi, Badari Narayana Prasad Rachapudi
160	Indonesia	0033123	An improved process for the pretreatment of vegetable oils for physical refining	PP Chakrabarti, VSK Rao, SK Roy, Blap Devi, KNP Rani, V Vandana, C Kalyani, K Gaddam, V Kale, RBN Prasad
161	United States of America	8394954	Benzophenone hybrids as anticancer agents and processes for the preparation thereof	Ahmed Kamal, Bandari Rajendra Prasad
162	Canada	2660799	Pyrrolo [2,1-c] [1,4] benzodiazepine hybrids and a process for the preparation thereof	Ahmed Kamal, Rajendra Prasad Bandari
163	United States of America	8188143	Pharmaceutical composition useful as acetylcholinesterase inhibitors	Janaswamy Madhusudana Rao, Bhimapaka China Raju, Pullela Venkata Srinivas, Katragadda Suresh Babu, Jhillu Singh Yadav, Kondapuram Vijaya Raghvan, Hemant Kumar Singh, Chandiswar Nath
164	China	ZL200780016176.4	A pharmaceutical composition useful as acetyl cholinesterase inhibitors	Janaswamy Madhusudana Rao, Bhimapaka China Raju, Pullela Venkata Srinivas, Katragadda Suresh Babu, Jhillu Singh Yadav, Kondapuram Vijaya Raghvan, Hemant Kumar Singh, Chandiswar Nath

CSIR-IP				
165	China	ZL200580052271.0	A composition of lubricating oil for two stroke gasoline engine process for the preparation thereof	Arun Kumar Singh, Naval Kishore Pandey, Ashok and Kumar Gupta
166	United Kingdom	GB2460983	A process for the preparation of ethanol from starch	Dilip Adhikari, Tsering Stobdan, Ravindra Pal Singh, Ashok Kumar Gupta
167	China	CN101326592B	Composition of insulating fluid and process for the preparation thereof	Arun Kumar Singh, Naval Kishore Pandey, Ashok Kumar Gupta
168	China	ZL200580049287.6	Process for the preparation of p-toluic acid by liquid phase oxidation of p-xylene in water	Mahendra Pratap Saxena, Ashok Kumar Gupta, Satish Kumar Sharma, Dinesh Prasad Bangwal, Krishan Kumar
169	Taiwan	I368607	A process for the preparation of p-toluic acid by liquid phase oxidation of p-xylene in water	Mahendra Pratap Saxena, Ashok Kumar Gupta, Satish Kumar Sharma, Dinesh Prasad Bangwal, Krishan Kumar
170	United States of America	8227220	Process for the preparation of ethanol from starch	Dilip Adhikari, Tsering Stobdan, Ravindra Pal Singh, Ashok Kumar Gupta
171	Japan	5055262	A process for the preparation of p-toluic acid by liquid phase oxidation of p-xylene in water	Mahendra Pratap Saxena, Ashok Kumar Gupta, Satish Kumar Sharma, Dinesh Prasad Bangwal, Krishan Kumar
172	United States of America	8268600	Strain and a novel process for ethanol production from lignocellulosic biomass at high temperature	Adhikari Dilip Kumar, Sachin Kumar, Sharma Chandra Dutt, Deep Chand
173	Australia	2011201929	A process for metal working fluid from heavy alkylate	AK Singh, ON Anand, AK Gupta
174	Japan	5097710	A composition of lubricating oil for two stroke gasoline engine and process for the preparation thereof	Arun Kumar Singh, Naval Kishore Pandey, Ashok Kumar Gupta
175	China	ZL200580052250.9	Composition of hydraulic fluid and process for the preparation thereof	Arun Kumar Singh, Naval Kishore Pandey, Ashok Kumar Gupta
176	China	ZL200880017851.X	A process for the preparation of ethanol from starch	Dilip Adhikari, Tsering Stobdan, Ravindra Pal Singh, Ashok Kumar Gupta

177	United States of America	8349754	Modified zeolite catalyst useful for the conversion of paraffins, olefins and aromatics in a feedstock into isoparaffins and a process thereof	Viswanadham Nagabhatla, Raviraj Kamble, Amit Sharma, Singh Negi, Muralidhar mixed Jagdish Kumar, Bhagwan Gudimella, Madhukar Gudimella, Madhukar Onkarnath Garg
178	Canada	2632225	A composition of insulating fluid and process for the preparation thereof	Arun Kumar Singh, Naval Kishore Pandey, Ashok Kumar Gupta
CSIR-IMMT				
179	Brazil	PI0215677-6	Process for manufacture of high iron hydraulic cement clinker	Bansidhar Nayak, Vibhuti Narain Misra
180	United States of America	8257486	Composition for building material and a process for the preparation thereof	Banshidhar Nayak, Barada Kanta Mishra, Snehasis Behera, Rajeev, Vimal Kumar
181	European Patent Office	1991329	Jet-wheel impact atomizer for spray drying and a process for the preparation of finely dispersed spray of slurry/liquid	Bijan Bihari Nayak, Pratima Kumari Mishra, Hemanta Kumar Tripathy, Bhabani Sankar Acharya
182	Denmark	1991329	Jet-wheel impact atomizer for spray drying and a process for the preparation of finely dispersed spray of slurry/liquid	Bhabani Sankar Acharya, Pratima Kumari Mishra, Bijan Bihari Nayak, Hemanta Kumar Tripathy
183	Netherlands	1991329B1	Jet-wheel impact atomizer for spray drying and a process for the preparation of finely dispersed spray of slurry/liquid	Bijan Bihari Nayak, Pratima Kumari Mishra, Hemant Kumar Tripathy, Bhabani Sankar Acharya
184	Norway	1991329B1	Jet-wheel impact atomizer for spray drying and a process for the preparation of finely dispersed spray of slurry/liquid	Bhabani Sankar Acharya, Pratima Kumari Mishra, Bijan Bihari Nayak, Hemanta Kumar Tripathy
CSIR-IMTECH				
185	China	ZL200680038094.5	Use of bipyridine compound caeruleomycin a' derivatives and analogs thereof as immunosuppressive agents	Arvind Kumar Singla, Javed Naim Agrewala, Rakesh Mulraj Vohra, Ravinder Singh Jolly
186	Australia	2006273735	An immuno conjugate and process for preparation thereof	Chander Raman Suri, Girish Chandra Varshney, Manoj Raje, Kanwar Vikas Singh, Jasdeep Kaur
187	Australia	2007318868	A recombinant meso-active thermo-stable protein and the process of design and biosynthesis thereof	Balvinder Singh, Divya Kapoor, Karthikeyan Subramanian, Swati Sharma, Pumananda Guptasarma, Sanjeev Kumar Chandrayan, Shubbir Ahmed, Manish Datt

188	South Africa	2011/04156	New staphylokinases carrying amino and carboxy-terminal extension and their peg (polyethylene glycol) conjugated forms	Satish Singh, Kanak Lata Dikshit
189	Germany	1982995	Improved recombinant staphylokinases	Monika Dahiya, Kanak Lata Dikshit, Ranjana Pathania, Govindan Rajamohan
190	European Patent Office	1982995	A novel method for the oxygen regulated production of recombinant staphylokinase and its derivatives useful for thrombolytic therapy	Monika Dahiya, Kanak Lata Dikshit, Ranjana Pathania, Govindan Rajamohan
191	France	1982995	Improved recombinant staphylokinases	Monika Dahiya, Kanak Lata Dikshit, Ranjana Pathania, Govindan Rajamohan
192	United Kingdom	1982995	Improved recombinant staphylokinases	Monika Dahiya, Kanak Lata Dikshit, Ranjana Pathania, Govindan Rajamohan
193	Japan	5203366	Peptide deformylase as a tool for development of mycobacteria specific antisense nucleic acid molecules	Rahul Saxena, Pradip Kumar Chakraborti
CSIR-NBRI				
194	Vietnam	1-0010188-000	A chimeric g protein based rabies vaccine	Rakesh Tuli, Samir Vishwanath Sawant, Shadma Ashraf, Pradhyuman Kumar Singh, Dinesh Yadav, Mohammad Shahnawaz, Satish Mishra
195	Canada	2521037	A synergistic fermented plant growth promoting, bio-control Composition	Chandra Shekhar Nautiyal, Sangeeta Mehta, Harikesh Bahadur Singh, Sunil Balkrishna Mansinghka, Suresh Haribhau Dawle, Naryan Eknath Rajhans, Palpu Pushpangadan
196	Canada	2512198	Development of an anti-cough, anti-tussive and throat soothing herbal formulation	Pushpangadan Palpu, Govindarajan Raghavan, Vijayakumar Madhavan, Shanta Mehrotra, Ajay Kumar Singh Rawat, Chandana Venkateshwara Rao
197	Canada	2480319	Protein delta endotoxine chimerique cry1ea et cry1ca	Rakesh Tuli

CSIR-NCL				
198	Singapore	164736	A process for the preparation of primary alkyl glycerol ethers useful as biofuel additive from glycerol	Dharbha Srinivas, Lakshmi Saikia, Paul Ratnasamy
199	Japan	5000890	pH sensitive polymer and process for preparation thereof	Mohan Gopal krishna Kulkarni, Anupa Ramesh Menjoge
200	Japan	5001287	A process for the preparation of hydrocarbon fuel	Darbha Srinivas, Rajendra Srivastava, Paul Ratnasamy
201	Japan	5006329	A novel transesterification catalyst and a process for the preparation thereof	Darbha Srinivas, Rajendra Srivastava, Paul Ratnasamy
202	Italy	2257555	Thieno [2,3-d]-pyrimidine-4 (3H) one compounds with antifungal properties and process thereof	Hanumant Bapurao Borate, Suleman Riyaj saheb Maujan, Sangmeshwer Prabhakar Sawargave, Shreerang Vidhyadhar Joshi, Sharangi Ravindra Vaiude, Mohan Anand Chandavarkar
203	France	2257555	Thieno [2,3-d]-pyrimidine-4 (3H)-one compounds with antifungal properties and process thereof	Hanumant Bapurao Borate, Suleman Riyaj saheb Maujan, Sangmeshwer Prabhakar Sawargave, Shreerang Vidhyadhar Joshi, Sharangi Ravindra Vaiude, Mohan Anand Chandavarkar
204	United Kingdom	2257555	Thieno [2,3-d] -pyrimidine-4 (3H)-one compounds with antifungal properties and process thereof	Hanumant Bapurao Borate, Suleman Riyajsaheb Maujan, Sangmeshwer Prabhakar Sawargave, Shreerang Vidhyadhar Joshi, Sharangi Ravindra Vaiude, Mohan Anand Chandavarkar
205	Germany	2257555	Thieno [2,3-d] -pyrimidine-4 (3H)-one compounds with antifungal properties and process thereof	Hanumant Bapurao Borate, Suleman Riyajsaheb Maujan, Sangmeshwer Prabhakar Sawargave, Shreerang Vidhyadhar Joshi, Sharangi Ravindra Vaiude, Mohan Anand Chandavarkar
206	European Patent Office	2257555	Thieno [2,3-d] -pyrimidine-4 (3H)-one compounds with antifungal properties and process thereof	Hanumant Bapurao Borate, Suleman Riyajsaheb Maujan, Sangmeshwer Prabhakar Sawargave, Shreerang Vidhyadhar Joshi, Sharangi Ravindra Vaiude, Mohan Anand Chandavarkar

207	Philippines	12008500844	A process for the preparation of hydrocarbon fuel	Darbha Srinivas, Rajendra Srivastava, Paul Ratnasamy
208	Philippines	12008500855	A novel transesterification catalyst and a process for the preparation thereof	Darbha Srinivas, Rajendra Srivastava, Paul Ratnasamy
209	Japan	5048687	Novel dicarbonic initiator, a process for the preparation and use thereof	Gnanou Vyes, Matmour Rachid, More Arvind Sudhakar, Wadgaonkar Prakash Purushottam
210	Australia	2006300758	A novel transesterification catalyst and a process for the preparation thereof	Darbha Srinivas, Rajendra Srivastava, Paul Ratnasamy
211	United States of America	8236840	Thiopene containing analogues of fluconazole as antifungal agents and process for their preparation	Hanumant Bapurao Borate, Sangmeshwer Prabhakar Sawargave, Suleman Riyajsaheb Maujan, Mohan Anand Chandavarkar, Sharangi Ravinda Vaiude, Vinay Anant Joshi
212	New Zealand	588450	Method for the preparation of biofuels from glycerol	Darbha Srinivas, Lakshmi Saikia, Paul Ratnasamy
213	Germany	1694724	pH sensitive polymer and process for preparation thereof	Mohan Gopalkrishna Kulkarni, Anupa Ramesh Menjoge
214	European Patent Office	1694724	pH sensitive polymer and process for preparation thereof	Mohan Gopalkrishna Kulkarni, Anupa Ramesh Menjoge
215	France	1694724	pH sensitive polymer and process for preparation thereof	Mohan Gopalkrishna Kulkarni, Anupa Ramesh Menjoge
216	United Kingdom	1694724	pH sensitive polymer and process for preparation thereof	Mohan Gopalkrishna Kulkarni, Anupa Ramesh Menjoge
217	South Africa	2011/05212	One step electrochemical process for the synthesis of pure rutile titanium dioxide nanoneedles	Rajesh kumar Shankar Hyam, Reshma Kanta Bhosale Satish chandra Bal krishna Ogale
218	United States of America	8324227	Thieno [2,3-d] -pyrimidine-4 (3H)-one compounds with antifungal properties and process thereof	Hanumant BapuraoBorate, Suleman RiyajsahebMaujan, Sangmeshwer Prabhakar Sawargave, Shreerang Vidhyadhar Joshi, Sharangi Ravindra Vaiude, Mohan Anand Chandavarkar
219	Australia	2007219101	Novel dicarbonic initiator, a process for the preparation and use thereof	Arvind Sudhakar More, Vyes Wadgaonkar Gnanou Purushottam Prakash, Matmour Prakash

220	China	ZL200880111416.3	Process for fractionating sugarcane bagasse into high a-cellulose pulp, xylan and lignin	Anjani kumar, Jyotiprasad Varma
221	France	2346861	Thiophene containing analogues of fluconazole as antifungal agents and process thereof	Borate Hanumant Bapurao, Sawargave Sangmeshwer Prabhakar, Maujan Suleman Riyajsaheb, Chandavarkar Mohan Anand, Vaiude Sharangi Ravindra, Vinay Anant Joshi
222	United Kingdom	2346861	Thiophene containing analogues of fluconazole as antifungal agents and process thereof	Borate Hanumant Bapurao, Sawargave Sangmeshwer Prabhakar, Maujan Suleman Riyajsaheb, Chandavarkar Mohan Anand, Vaiude Sharangi Ravindra, Vinay Anant Joshi
223	Germany	2346861	Thiophene containing analogues of fluconazole as antifungal agents and process thereof	Borate Hanumant Bapurao, Sawargave Sangmeshwer Prabhakar, Maujan Suleman Riyajsaheb, Chandavarkar Mohan Anand, Vaiude Sharangi Ravindra, Vinay Anant Joshi
224	European Patent Office	2346861	Thiophene containing analogues of fluconazole as antifungal agents and process thereof	Borate Hanumant Bapurao, Sawargave Sangmeshwer Prabhakar, Maujan Suleman Riyajsaheb, Chandavarkar Mohan Anand, Vaiude Sharangi Ravindra, Vinay Anant Joshi
225	Italy	2346861	Thiophene containing analogues of fluconazole as antifungal agents and process thereof	Borate Hanumant Bapurao, Sawargave Sangmeshwer Prabhakar, Maujan Suleman Riyajsaheb, Chandavarkar Mohan Anand, Vaiude Sharangi Ravindra, Vinay Anant Joshi
226	Canada	2549539	Taste masked pharmaceutical composition comprising ph sensitive polymer	Mohan Gopalkrishna Kulkarni, Anupa Ramesh Menjoge
227	United States of America	8399149	Composition with enhanced proton conductivity	Vijayamohanan K. Pillai, R. Kannan, Bhalchandra A. Kakade

CSIR-NEERI				
229	Australia	2007330354	Circular secondary clarifier for the wastewater treatment	Girish Ramesh Pophali, Tapas Nandy, Santosh Narain Kaul, Sukumar Devotta
CSIR-NEIST				
230	United States of America	8148118	Method of inducing chirality to epoxides using 2,3:4,6 di-o-isopropylidene-2-keto-l-gulonic acid monohydrate	Amrit Goswami, Kuladip Sarma, Ajit Kumar Hazarika
231	United Kingdom	GB2471619	Method for the simultaneous preparation of 3-acetoxy-17-acetamido-16-formyl-androst-5,16-diene and 3-acetoxy-2'-chloro-5-androsteno[17,6-b]pyridine	Romesh Chandra Boruah, Moyurima Borthakur, Madan Gopal Barthakur, Paruchuri Gangadhar Rao, Sudip Kumar Kar, Annalakshmi Chinniah, Suchandra Goswami, Pratap Kumar Das
232	United Kingdom	2488946	Compounds as antiulcer agents	Romesh Chandra Boruah, Moyurima Borthakur, Madan Gopal Barthakur, Paruchuri Gangadhar Rao, Sudip Kumar Kar, Annalakshmi Chinniah, Suchandra Goswami, Pratap Kumar Das
233	United Kingdom	2470338	Process for the preparation of 4-(4-hydroxyphenyl)butan-2-one using solid acid clay catalyst	Dipak Kumar Dutta, Madan Gopal Pathak
CSIR-NGRI				
234	Mexico	299021	A process utilizing natural carbon-13 isotope for identification of early breakthrough of injection water in oil wells	Balbir Singh Sukhija, Donti Reddy Venkat Reddy, Pasupuleti Nagabhusanam, Dattatray Jaiwant Patil, Syed Hussain
235	United States of America	8178356	Method for evaluation of performance of percolation tanks using environmental chloride as a tracer	Balbir Singh Sukhija, Donti Reddy Venkat Reddy, Nagabhusanam, Muthyala Venkata Nanda Kumar
236	Russia	2456448	A process utilizing natural carbon-13 isotope for identification of early breakthrough of injection water in oil wells	Balbir Singh Sukhija, Donti Reddy Venkat Reddy, Pasupuleti Nagabhusanam, Dattatray Jaiwant Patil, Syed Hussain
237	Australia	2007232095	Method for evaluation of performance of percolation tanks using environmental chloride as a tracer	Balbir Singh Sukhija, Donti Reddy Venkat Reddy, Pasupuleti Nagabhusanam, Muthyala Venkata Nanda Kumar

238	United States of America	8283173	Process utilizing natural carbon -13 isotope for identification of early breakthrough of injection water in oil wells	Balbir Singh Sukhija, Donti Reddy Venkat Reddy, Pasupuleti Nagabhushanam, Dattatray Jaiwant Patil, Syed Hussain
CSIR-NIIST				
239	China	ZL200580052408.2	Amphiphilic squaraine dyes, a process for the preparation thereof and their use as near infrared fluorescence probes for biological biochemical and industrial applications	Danaboyina Ramaiah, Kalliat Thazhathveetil Arun, Jyotish Kuthanapillil
240	Japan	5123200	A process for the continuous production of magnesium diboride based superconductors	Syamaprasad Upendran, Abhilash Kumar Raveendran Amma, Girijakumari Nair, Vinod Krishnan Kutty, Aloysius Rajappan Padmavathy, Sarun Pallian Murikoli, Thennavarajan Subramanianm Guruswamy Perumal
241	United States of America	8303706	Yellow inorganic pigment from samarium and molybdenum compounds and a process for preparing the same	Mundlapudi Lakshmi pathi Reddy
242	United States of America	8323732	Nanocomposite material useful for the preparation superhydrophobic coating and a process for the preparation thereof	Ayyappanpillai Ajayaghosh, Sampath Srinivasan, Vakayil K Pravin
243	Netherlands	1347942	Device for treatment of wastewater	Ajit Haridas
244	Germany	1347942	Device for treatment of wastewater	Ajit Haridas
245	European Patent office	1347942	Device for treatment of wastewater	Ajit Haridas
246	France	1347942	Device for treatment of wastewater	Ajit Haridas
247	United States of America	8344150	Pyrrrole end-capped bipyridine assay powder for selective detection of zinc ions and a process for the preparation thereof	Ayyapanpillai Ajayaghosh, Sivaramanicker Sreejith
248	United States of America	8350066	Process for the extraction of bioactive lignans with high yield and purity from sesame oil	Chami Arumughan, Chandrasekharan Pillai Balachandran, Mullan Velandy Reshma, Andikannu Sundaresan, Shiny Thomas, Divya Sukumar, Syamala Kumari Sathyanandan Saritha

249	United States of America	8372649	End-capped bipyridine compound, process for preparation thereof and process for selective detection of cyanide anions therewith	Ayyapanpillai Ajayaghosh, Sivaramapanicker Sreejith, Kizhumuri P. Divya, Puroshothaman Jayamurthy
250	United States of America	8378135	Multifunctional alcohols obtained from cardanol, multifunctional acrylic crosslinker and pendant phosphorous flame retardant derivatives thereof	Vadakkethonippurathu Sivankutty Nair Prasad, Chennakkattu Krishna Sadasivan Pillai
CSIR-NIO				
251	Australia	2007237861	Antibacterial compounds	Girish Badrinath Mahajan, Saji David George, Prafull Vasant Ranadive, Prabhu Dutt Satyanarayan Mishra, Sreekumar Sankaranarayanan Eyyammadichiyil, Rajan Mukund Panshikar, Satish Namdeo Sawant, Sridevi Krishna, Meenakshi Sivakumar, Koteppa Pari, Becky Mary Thomas, Zarine Eruch Patel, Ram Vishwakarma, Chandrakant Govind Naik, Lisette D` Souza, Prabha Devi
252	Israel	194634	Antibacterial compounds	Girish Badrinath Mahajan, Saji David George, Prafull Vasant Ranadive, Prabhu Dutt Satyanarayan Mishra, Sreekumar Sankaranarayanan Eyyammadichiyil, Rajan Mukund Panshikar, Satish Namdeo Sawant, Sridevi Krishna, Meenakshi Sivakumar, Koteppa Pari, Becky Mary Thomas, Zarine Eruch Patel, Ram Vishwakarma, Chandrakant Govind Naik, Lisette D` Souza, Prabha Devi
NMITLI-SCHEME				
253	Japan	5025648	Method for diagnosis of glioma distinguishing between progressive and denovo types	Kumaravel Somasundaram, Alangar Sathyanarjandas Hegde, Sridevi Hegde, Paturu Kondaiah, Manchanahalli Rangaswamy Satyanarayana Rao

254	New Zealand	582232	A novel method for simultaneous detection and discrimination of bacterial, fungal, parasitic and viral infections of eye and Hajib central nervous system	Chintalagiri Mohan Rao, Kunchala Sridhar Rao, Puppala Venkat Ramchander, Naraharirao Madhavan, Savitri Sharma, Gita Satpathy, Ravi Kumar Venkata Banda
255	Japan	5080474	pH sensitive nanoparticle formulation for oral delivery of proteins/peptides	Chandra Prakash Sharma, Mannemcherril Ramesan Rekha
CSIR-NPL				
256	Japan	4995284	A process for joining oxide superconducting tubes with a superconducting joint	Shrikant Narayan, Padam Gurusharan Kaur, Arora Narendra Kumar, Sharma Mukul, Sethi Ramesh
257	Japan	4995839	Monoclinic CeTi ₂ O ₆ thin film and a sol-gel process for the preparation thereof	Amita Verma, Suhasini Avinash Agnihotry, Ashok Kumar Bakhshi
258	Italy	0851324	Device useful as a master/slave clock for transmitting standard time over a telephone network and a telephone network incorporating the device for transmitting and receiving standard time	Parameswar Banerjee
259	Sweden	0851324	Device useful as a master/slave clock for transmitting standard time over a telephone network and a telephone network incorporating the device for transmitting and receiving standard time	Parameswar Banerjee
260	United Kingdom	0851324	Device useful as a master/slave clock for transmitting standard time over a telephone network and a telephone network incorporating the device for transmitting and receiving standard time	Parameswar Banerjee
261	France	0851324	Device useful as a master/slave clock for transmitting standard time over a telephone network and a telephone network incorporating the device for transmitting and receiving	Parameswar Banerjee
262	Germany	0851324	Device useful as a master/slave clock for transmitting standard time over a telephone network and a telephone network incorporating the device for transmitting and receiving standard time	Parameswar Banerjee

263	European Patent office	0851324	A device useful as a master/slave clock for transmitting standard time over a telephone network and a telephone network incorporating the device for transmitting and receiving standard time	Parameswar Banerjee
264	Japan	5021866	Simulated circuit layout for low voltage, low power and high performance typelli current conveyor	Sher Singh Rajput, Sudhanshu Shekhar Jamuar
265	United States of America	8277690	Conducting copolymer ferromagnetic composite and a process for the preparation thereof	Sundeeep Kumar Dhawan, Kuldeep Singh, Nikhil Sobti, Anil Ohlan, Parveen Saini, Beena Gupta, Rajendra Prasad Pant, Ravinder Kumar Kotnala, Kishan Hari, Prafulla Chandra Kothari
266	African Regional Intellectual Property Organization	AP2499	Combustible gas sensor	Vipin Kumar, KiranJain, ST Lakshmikummar, T Raghavendra
267	South Africa	2011-00701	A process for the removal of arsenic and chromium from water	Nahar Singh, Rashmi, Sukhvir Singh, Daya Soni, Renu Pashricha, Prabhat Kumar Gupta
268	United States of America	8304372	Process for joining oxide superconducting tubes with a superconducting joint	Shrikant Ekbote, Gurusharan Kaur Padam, Narendra Kumar Arora, Mukul Sharma, Ramesh Sethi, Mrinal Kanti Banerjee
269	United States of America	8306590	Process for the preparation of low contact resistant contact on a high transition temperature superconductors	Shrikant Ekbote, Gurusharan Kaur Padam, Narendra Kumar Arora, Mukul Sharma, Ramesh Sethi, Mrinal Kanti Banerjee
270	United States of America	8349284	Sol-gel process for the preparation of nanocrystalline $CeTi_2O_6$ powder	Amita Verma, Suhasini Avinash Agnihotry
271	Germany	102007036214	An automated dead weight force machine useful for calibrating strain gauge load cells	Kamlesh Kumar Jain, Hari Nandan Prasad Poddar, Raghunandan Prasad Singhal
272	Japan	5226658	Process for preparation of high temperature superconducting bulk current leads with improved properties and superconducting bulk current leads made thereby	Shrikant Ekbote, Gurusharan Kaur Padam, Narendra Kumar Arora, Mukul Sharma, Ramesh Sethi, Mrinal Kanti Banerjee

Members of CSIR Society

Annexure-V

1.	Hon'ble Prime Minister of India (Dr. Manmohan Singh), Office of the President, CSIR Prime Minister's Office Block, Room No. 148-B, South Block, New Delhi – 110 011	President
2.	Minister of Science & Technology, Vice President, CSIR, Council of Scientific & Industrial Research, Anusandhan Bhavan, 2, Rafi Marg, New Delhi – 110 001	Vice-President
3.	Shri P. Chidambaram, Minister of Finance, Ministry of Finance, Room No. 132-C North Block, New Delhi – 110 001	Member
4.	Shri Anand Sharma, Minister of Commerce & Industry, Ministry of Commerce & Industry, Room No. 45, Udyog Bhawan, New Delhi 110011	Member
5.	Shri Kapil Sibal, Minister of Human Resource Development, Ministry of Human Resource Development, Room No. 313 C- Wing, Shastri Bhawan, Dr. Rajendra Prasad Road, New Delhi- 110 001	Member
6.	Dr. K. Kasturirangan, Member, Planning Commission, Yojana Bhawan, Sansad Marg, New Delhi- 110001	Member
7.	Dr. Ratan Kumar Sinha, Secretary, Department of Atomic Energy & Chairman, Atomic Energy Commission, Anushakti Bhawan, Chatrapathi Shivaji Maharaj Marg, Mumbai – 400 001	Member
8.	Dr. Ashok Jhunjhunwala, Professor, Deptt. of Electrical Engineering ESB 331-B, Indian Institute of Technology, Madras, Chennai – 600 036	Member
9.	Shri Pratip Chaudhuri, Chairman, State Bank of India, State Bank Bhavan, Mumbai – 400 021	Member
10.	Dr. Anand G Mahindra, Vice –Chairman & Managing Director, Mahindra & Mahindra Group, Mahindra Towers, GM Bhosle Marg, Worli, Mumbai- 400 018	Member
11.	Ms. Chanda Kochhar, Chief Executive Officer & Managing Director, ICICI Bank Limited, 9 th Floor, South Towers, ICICI Towers, Bandra, Kurla Complex, Bandra, (East) Mumbai-400 051	Member
12.	Shri R.S. Butola, Chairman, Indian Oil Corporation Limited, Corporate Office, 3079/3, JB Tito Marg, Sadiq Nagar, New Delhi- 110 049	Member
13.	Dr. Desh Bandhu Gupta, Chairman, Lupin Limited, B/4, Laxmi Towers, Bandra Kurla Complex, Bandra (W), Mumbai –400 051	Member
14.	Shri Azim H. Premji, Chairman, Wipro Ltd, Doddakanneli, Sarjapur Road, Bengaluru-560 035	Member
15.	Ms. Mallika Srinivasan, Director, Tractors and Farm Equipment Limited, 35, Nungambakkam High Road, Nungambakkam, Chennai- 600 034	Member
16.	Prof. M.M. Sharma, Former Director, University Department of Chemical Technology, 2/3, Jaswant Bagh, Behind AK Barally's VN Purav Marg, Mumbai – 400 071	Member

17.	Prof. M. Gourie Devi, Emeritus Professor of Neurology, Flat No. 9, Doctors' Apartment, Vasundhara Enclave, New Delhi -110 096	Member
18.	Shri D.S. Kalha, Secretary, Department of Pharmaceuticals, Ministry of Chemicals & Fertilizers, Shastri Bhawan, Dr. Rajendra Prasad Road, New Delhi- 110 001	Member
19.	Shri Sourabh Chandra, Secretary, Department of Industrial Policy & Promotion Room No. 157, Udyog Bhawan, New Delhi – 110 011	Member
20.	Shri J Satyanarayana, Secretary, Department of Electronics & Information Technology, Ministry of Communications & Information Technology, Electronics Niketan 6, CGO Complex, Lodi Road, New Delhi – 110 003	Member
21.	Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences, Mahasagar Bhavan, Block No. 12, CGO Complex, Lodi Road, New Delhi- 110 003	Member
22.	Prof. S.K. Brahmachari [#] , Director-General Council Scientific & Industrial Research Anusandhan Bhavan 2, Rafi Marg New Delhi – 110 001	Secretary of (EX-officio)
23.	Shri R.S. Gujral*, Secretary (Expenditure), Ministry of Finance, North Block, New Delhi – 110 001	Member
24.	Dr. Girish Sahni*, Director, CSIR-Institute of Microbial Technology, Sector -39A, Chandigarh- 160 036	Member
25.	Dr. S. Srikanth*, Director, CSIR-National Metallurgical Laboratory, Jamshedpur – 831007	Member
26.	Ms. Anuradha Acharya*, Chief Executive Officer, Ocimum Biosolutions Limited, 6 th Floor, Reliance Classic Road No. 1, Banjara Hills, Hyderabad – 500 034	Member
27.	Shri B.P Rao*, Chairman & Managing Director, Bharat Heavy Electricals Limited, BHEL House, Siri Fort, New Delhi – 110 049	Member
28.	Prof. M. Vijayan*, Honorary Professor / Distinguished Biotechnologist Molecular Biophysics Unit, Indian Institute of Science, Bengaluru – 560 012	Member
29.	Shri H.M. Nerurkar*, Managing Director, Tata Steel Limited, Jamshedpur – 831 001	Member
30.	Dr. Arun Firodia*, Chairman, Kinetic Engineering Limited, Kinetic Innovation Park, D -1 Block, Plot No. 18/2, MIDC Chinchwad, Pune – 411 019	Member
31.	Dr. T. Ramasami*, Secretary, Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi – 110 016	Member
32.	Dr. K. Radhkrishanan*, Chairman, ISRO & Secretary, Department of Space, Antariksh Bhavan, New BEL Road, Bengaluru – 560 094	Member

#Chairman, CSIR Governing Body

*Members of CSIR Governing Body

CSIR Foundation Day Welcome Address by Prof. Samir K. Brahmachari, DG, CSIR

Our beloved Hon'ble Prime Minister and President, CSIR Society, Dr. Manmohan Singh, our own Minister of Science and Technology and Vice President CSIR, Shri Vayalar Ravi, Foundation Day Speaker, respected Prof. C.N.R. Rao, the beacon of Indian science, Chancellor of AcSIR, Dr. R. A. Mashelkar, former DGs' of CSIR, distinguished Champions of CSIR, guests from academia, industries and institutions, Awardees and their proud families, members of electronic and print media, members of my CSIR family, ladies and gentlemen, those who are present in Vigyan Bhawan Hall and those who are watching this programme through the webcast. It is indeed a rare honour and privilege for me to extend a very warm welcome on behalf of the CSIR family. I thank all of you for joining us on this happy occasion. CSIR has completed 70 years of the service to the nation. This 70th Foundation Day is thus of added significance to all of us.

I am of the belief that to craft a masterpiece there has to be a dream, courage to stand by it, passion and determination to realize it. A group of Indian scientists dared to have this dream of creating CSIR as R&D hub of India. Hence, we were born in 1942.

The visionaries and foot soldiers of CSIR worked tirelessly to create institutions founded on science and technology which were ahead of its time in birth, withstood the vagaries of time through the seven decades and continue to flourish and be relevant even today. Hon'ble Prime Minister, Sir, your presence today in this function to honour the outstanding young scientists of this country testifies to your commitment to science and technology and the priority you attach to scientific excellence, be it for breaking the frontiers of science or its application to nation building. It is extremely gratifying to note that the legacy of giving away the SSB award by the Prime Minister set by Pandit Nehru and is being continued by you even today. Sir, we thank you for your gracious presence. We are happy to welcome our S&T Minister and VP, CSIR Shri Valayar Ravi, who has given us immense support and confidence at the time when we needed it most after the sudden demise of Shri Vilasrao Deshmukh ji, who brilliantly steered the AcSIR Bill in the Parliament. For this, he will be fondly remembered, not only today, but for generations to come. CSIR 'Foundation Day' is an occasion which many young and not so young scientists across India, keenly wait for. They look forward to the most coveted Shanti Swarup Bhatnagar Prize, Young Scientists awards, CSIR Diamond Jubilee Technology Awards and CSIR awards for S&T Innovations for Rural Development. It is thus also the day to celebrate the achievements of Scientists and Technologists. I welcome all of them and congratulate them on their achievements. Today being the day to mark a long journey of seven decades, it is the day to thank our past leaders and distinguished champions, visionaries and scientific leaders. CSIR recognizes that an infusion of young and bright scientists is imperative if India is to forge ahead in the global science and technology arena. And so, DG CSIR, Prof. Samir. K. Brahmachari delivering the Welcome Address innovating from the conventional education system, Sir on your advice, CSIR has now leveraged the infrastructure and scientific strengths of CSIR, to form a self sustaining organization – the "Academy of Scientific and Innovative Research (AcSIR)". Today afternoon, 71 Engineers will receive their M. Tech degree under AcSIR banner, where 68 of them have received distinction. They all want to continue research in CSIR for their Ph. D. (like the 52 M.Tech. of the previous batch) instead of leaving for abroad; a dream come true. Innovation is the ability to see change as an opportunity. CSIR changed with changing opportunities and recent years created opportunities to change. CSIR is poised to lead in this Indian decade of innovation benchmarking itself globally. CSIR has recently fostered a major strategic partnership with the setting up Cluster Innovation Centres to promote innovation at the grassroots level particularly in Micro, Small & Medium Enterprises (MSMEs) sector. Through this initiative, we are providing innovative S&T solutions to small industrial clusters such as the Krishnagiri cluster in Tamil Nadu, which is the largest producer of mangoes to brass cluster at Moradabad, touching the life of millions of people

CSIR is committed to create hamlets of technology-enabled villages, called CSIR TECHVILs in the 12th Plan, which will typically have 40,000 inhabitants where more than 50% live below the poverty line. We have identified 24 such locations across the country. TECHVIL will go much beyond mere demonstration of technology and gauge the needs of the villagers and map these needs against the technologies already in CSIR's portfolio or will source all sectors of society such as NGOs, universities and entrepreneurs to suggest solutions. Fifteen years ago, Sir, I moved from Bangalore to Delhi as the Director of the Centre for Biochemical Technology, CSIR with a dream to place India on the genomics map of the world. The same small Centre today, is the Institute of Genomics in India and known worldwide. Hon'ble Prime Minister, Sir, we express our gratitude for inaugurating a futuristic International Campus for CSIR-IGIB recently which was a dream come true. Sir, this is a sign that CSIR is changing... transforming itself to embrace all sections of the society, while at the same time exploring the unexplored frontiers of science. While on the one hand, with the setting up of AcSIR we are creating the next generation human resource that would be truly interdisciplinary, on the other hand, as an organization, CSIR is moving from creating to collaborating, from isolated laboratories to innovation complexes, from creating wealth for a few large industries to creating wealth for many. We have created a happy CSIR...an organization that is young at heart even after 70years...an organization that strives to work for the happiness of the bottom of the pyramid.

We will be showcasing in an exhibition at Vigyan Bhawan (and subsequently this will move) CSIR's best 70 papers; 70 best patents; 70 best technologies that created wealth; 70 best societal interventions and 70 scientific leaders who made a difference. We herald the awakening of a new CSIR equipped with sensitivity and skills, the tools and the drive to succeed, the vision and the mission to take the country to great heights. That's the new CSIR for a new India I present to you, President Sir, on this your eightieth birthday. Welcome again and thank you.

Annexure-VII

CSIR Foundation Day Speech by Hon'ble Minister of Science & Technology and Earth Sciences and Vice President, CSIR, Shri Vayalar Ravi

Hon'ble Prime Minister, Dr. Manmohan Singh, DG, CSIR Prof. S.K. Brahmachari, distinguished scientists, awardees, ladies and gentlemen. At the outset, I congratulate CSIR Family on this eventful day, the 70th anniversary of founding CSIR. My congratulations to all those who have been associated with this great organisation over the years, and contributed to its success. CSIR is an organization known for several accolades.

I wish Hon'ble Prime Minister and President, CSIR, Dr. Manmohan Singh ji a very happy birthday –wish you many many happy returns of the day. I congratulate all the awardees and their families. They have done us proud. I am sure the awards they have received, would motivate them, to enhance their R&D efforts, so as to create newer and newer innovations, benefiting our society. The distinguished journey of CSIR -how its constituent laboratories were established, how CSIR repositioned itself time to time to deliver high quality innovation, benefitting the society, is worth learning.

CSIR performed as per its assigned mandate, promoted scientific and industrial research through its laboratories, provided fellowships, transferred technologies and disseminated research and industrial information. Dr. Bhatnagar at the helm of CSIR had glimpsed what he had once described as, "...the dim lights of a new dawn." His dynamic leadership gave the new nation its first eleven laboratories in the years spanning 1950-1953.

CSIR did not look back. It was an uphill climb, struggling with a lack of resources. Yet... from chemicals to glass and ceramics, from physics to metallurgy, from tractors and food products to fuel research... CSIR was everywhere; meeting the needs of the people of a new nation.

Most importantly it also began to build trained human resource, which in the final analyses, is the deciding factor transcending every other resource. Today too, the schemes of CSIR cover a wide spectrum, ranging from 15 years to 65 years of age. Perhaps, there is hardly a scientist anywhere in India who has not benefited from at least one of the schemes.

This great heritage you have inherited. Our nation has been lucky that CSIR was founded at the right juncture. We had a great visionary in Pandit Jawaharlal Nehru, our first Prime Minister, who along with Dr. Shanti Swarup Bhatnagar nurtured CSIR in its formative years and put it on a well thought out path which CSIR treads dedicatedly, even today. This path is the unique one and is driven by the philosophy of "challenge oneself". CSIR has followed it in letter and spirit and has challenged itself to do better and better and thus it moved further and higher. The significant role of subsequent Director Generals in enhancing CSIR's S&T prowess in the irrespective regimes is praiseworthy. I thank them, some of them are present here. I also thank CSIR Leadership Team on this occasion.

Today we remember, Pandit Nehru and Dr. Bhatnagar and pay our tribute. Respected Prime Minister, CSIR have been fortunate that you always went out of the way to find time, out of your busy schedule and guided CSIR. Your advice and directions have not only challenged the CSIR system but motivated it to achieve the unachievable. Sir, as you are aware, CSIR has put in place the CSIR@80: Vision & Strategy 2022 as per your direction and scientists in the system are committed to achieve the performance targets for CSIR@80.

One can speak for hours about CSIR, the outputs and outcomes, it has achieved. I remember, CSIR had brought out the encyclopedia named Wealth of India. Aptly named, this publication covers all of India's raw material resources be it plants, animals or minerals. Pandit Jawaharlal Nehru wrote and I quote: "I have no doubt that this book. will be of great value to the builders of new India. It should be of value also in educating the average citizen, who should take interest in this fascinating land and its enormous potentialities".

Even in the 21st century this publication is an authentic source to establish India's biodiversity and traditional knowledge. It played a major role in backing up India's claim against the US patent on turmeric; the case that paved the path for the globally appreciated Traditional Knowledge Digital Library (TKDL) project.

CSIR has been a partner in the nation's industrial development for indigenous capacity creation after India's independence. With the change in policy regime, CSIR endeavored since 1990s and successfully developed patent protected technologies. Beyond 2005, it focused on the development of niche creating globally competitive technologies.

CSIR is granted 90% of US patents granted to any Indian publicly funded R&D organization and has a wide portfolio of patents in its armoury. About 9% of its patents are licensed, a number which is above the global average. Amongst its peers in publicly funded research organizations in the world, CSIR is a leader in terms of filing and securing patents worldwide.

Major industry houses of India and innumerable MSMEs have benefitted from CSIR. CSIR's contribution to the development of North- Eastern States is commendable. CSIR is documenting economic impact of many of its technologies through a systematic effort.

CSIR has pursued cutting edge science and advanced knowledge frontiers. The scientific staff of CSIR only constitute about 3-4% of India's scientific man power but they contribute to 11% of India's scientific outputs. CSIR is the fountainhead of innovation in the country. In the present economic scenario, its efforts are of immense value. I would like to see CSIR connecting to international innovation systems more and more, for the benefit of the society. I am glad to see that CSIR and National Innovation Council (NInC) have come together to make an economic difference for the MSME clusters. Also, CSIR through its CSIR-800 programme is putting concerted efforts to improve the quality of life of people at the bottom of economic pyramid through desired S&T interventions.

DG, CSIR Prof. Samir K. Brahmachari, is an outstanding scientist, an ardent visionary, a perfect executor and achiever. CSIR in no way can fall behind to achieve the targets set for it, I would like CSIR to achieve all what it has planned through its vision document much before 2022. That is the pledge CSIR Scientists and Staff should take today.

Jai Hind.

Annexure-VIII

CSIR Foundation Day Address by Hon'ble Prime Minister and President, CSIR Dr. Manmohan Singh

I am delighted to join you on the 70th Foundation Day of the Council of Scientific and Industrial Research. Dr. Brahmachari just reminded me of a personal attribute that I happen to share with the Council - we were both born on 26th September. I can think of no better company than this illustrious gathering of men and women of science, with whom to have my first public engagement on this very special day.

With your indulgence, I could stretch my association with the Council fraternity even farther. Dr. Shanti Swarup Bhatnagar, the man whose memory we cherish today, came to this city from Lahore with a dream to build the chain of CSIR's national Laboratories. I followed him with a more modest dream of my own, to make a fresh beginning in free India, though in the tragedy and chaos of partition that forced this choice upon my family, to dream was indeed to dare!

Partition was, of course, in many ways a national tragedy far more poignant than our personal losses. In those days of horror, it was easy to write off India, with its deep-rooted poverty, widespread ignorance, frequent epidemics and an economy that had remained stagnant in the five preceding decades.

But we were fortunate to have in Jawaharlal Nehru a leader who saw science and technology as an elixir for India's development, and in Dr. Bhatnagar a scientist of extraordinary organizational capacity and caliber to implement this vision of Jawaharlal Nehru.

Recognizing the potential of scientific research, Jawaharlal Nehru placed the Council under his personal charge, thereby beginning a tradition that successive Prime Ministers have continued. Science has always commanded the utmost priority of our policymakers. I consider it a privilege to preside over this hallowed organization in the seventh decade of its outstanding service to our nation.

I glad that the Council has proven its professional worth in every phase of India's growth, in line with prevailing national policies and national priorities. In the early days of Independence, it was a champion of import substitution, rebuilding our industrial base in the face of shortages and resource crunch. When India became a victim of technology denial, CSIR laboratories created advanced products and technologies, such as India's first super computer, radiation shielding glasses and components for aerospace and satellites, emerging as a credible partner for our strategic sector. During this time, the Council also catapulted India as the top generic drug producer.

After India embraced globalization, introduced economic reforms and joined the WTO, the CSIR quickly emerged as the flag bearer of the Intellectual Property movement in our country and became the single largest holder of US and European patents. The Council, in recent years, has also become a world leader in specific domains of biotechnology and recombinant DNA products.

I would like to particularly compliment the Council on its unique attempt to make healthcare affordable by exploiting the power of open source drug discovery. As a concept, this is a global first and the world has turned from skepticism to partnership. I am happy to learn that the Council has opened its patent chest for accelerated drug discovery for hitherto neglected diseases like tuberculosis and malaria.

While we aim for global excellence and competitive advantage for our country in science, the Council must not lose sight of the mandate of science in our country that Jawaharlal Nehru spoke about while addressing the Indian Science Congress in 1947.

He said, "Science must think in terms of the 400 million persons in India". I am glad that the Council has remained firmly rooted in the social milieu of our country while selecting and implementing projects. I commend the recent CSIR 800 programme which aims at affordable scientific interventions to improve the quality of life of the people at the base of the economic pyramid. The Council's thrust on research and innovation in renewable energy, in water,

environment and waste management also reflect its awareness of contemporary challenges that our country faces.

In recent times, conventional scientific disciplines and approaches are proving unequal to dealing with complex developmental challenges. New disciplines are emerging at the interface of traditional boundaries. The newly created Academy of Scientific and Innovative Research promises to train our young scientists and engineers in trans-disciplinary skills by tapping into the entire resources and infrastructure of the CSIR fraternity. This is a good initiative and I look forward to early results.

Last week, while inaugurating a new campus of the Council's Institute of Genomics and Integrative Biology, I was impressed by the power and potential of public-private partnership in scientific research. I am told that across CSIR laboratories, new ecosystems like Innovation Complexes are being created to foster innovation through partnership with industry, academia and other R&D institutions. Mechanisms have been put in place to identify needs of India's industries and to tap bright ideas of the CSIR's young talent. The Council has announced policies to encourage scientists to create spin offs and new ventures. It is also partnering with the National Innovation Council to provide focused technology assistance to small and medium enterprises.

However, with all our achievements, we cannot rest on our laurels. As a nation, we have not succeeded in mobilizing enough private investment into science to raise our investment in scientific research to 2% of GDP. We need to recognize that excellence has not percolated across all our research and academic institutions. We have not been able to make an impact on a world scale commensurate with our large scientific manpower pool. CSIR, therefore, will need to devote itself to these national challenges in the years to come. It will have to take up national leadership in science, engineering and technology.

In this journey, young people like many of those gathered here are our nation's hope and future. I congratulate the awardees for their talent, for their devotion to duty and for their aspirations for Indian science. Young scientists must dream big and refuse to despair. I would like to remind them of the exemplary determination and selfless patriotism of Dr. Shanti Swarup Bhatnagar that led to the establishment of one of the finest scientific institutions of our great country – The Council of Scientific and Industrial Research.

With these words, I wish you all success in your endeavours.

Jai Hind."

CAG Report

- (1) There are no Audit Observations received from Office of C&AG for the inclusion in Annual Report of CSIR for the year 2012-13.
- (2) Details of ATNs are given below

Sl.No.	No. & Year of the Report	Number of Paras /PA Reports on which ATNs have been submitted to Monitoring Cell, Ministry of Finance	Details of the Paras/PAC Reports on which ATNs are pending		
			Number of ATNs not sent by the Ministry even for the first time	Number of ATNs sent but returned with observations and Audit is awaiting their resubmission by the Ministry	Number of ATNs which have been finally vetted by Audit but have not been submitted by the Ministry
1.	From year 1996 to 2003 (Total = 9 Paras)	-	NIL	5 @	NIL
2.	Report 5 of 2004 (Total = 1 Para)	1	NIL	NIL	NIL
3.	Report 5 of 2005 (Total = 2 Paras)	1	NIL	NIL	NIL
4.	Report 2 of 2006 (Total = 2 Paras)	2	NIL	NIL	NIL
5.	Report 2 of 2007 (PA) (Total = 1 Para)	1	NIL	NIL	NIL
6.	Report 2 of 2007 (TA) (Total = 1 Para)	NIL	NIL	1 @	NIL
7.	Report PA 2 of 2008 (Total = 1 Para)	1	NIL	NIL	NIL
8.	Report CA 3 of 2008 (Total = 3 Paras)	2	NIL	NIL	NIL
9.	Report CA 16 of 2008-09 (Total = 5 Paras)	1	NIL	4	NIL
10.	Report 16 of 2011-12 (Total = 2 Paras)	1	NIL	1	NIL
	Total = 27 Paras	10	NIL	11	NIL

@ Audit vide their letter dated 30/12/2010 has sent further vetting comments in the ATNs which have already been furnished to Monitoring Cell, Min. of Finance.

Note: 6 ATNs are pending with the Office of PDA(SD) for vetting comments.

A. List of Approved Projects in Twelfth Five Year Plan

Nodal Lab	Project Name
Biological Sciences	
CSIR-CCMB	1. Epigenetics in Health & Disease (EpiHeD)
CSIR-CCMB	2. Biology of Ageing and Human Health (BioAge)
CSIR-CCMB	3. Plant-Microbe and Soil Interactions (PMSI)
CSIR-CCMB	4. Conservation of endangered animals of India: Molecular Genetics and Reproduction Approaches (Conserve)
CSIR-CCMB	5. Plant Breeding, Genomics and Biotechnology (PLOMICS)
CSIR-CDRI	6. Factors Governing competent gamete production and reproductive dysfunction (PROGRAM)
CSIR-CDRI	7. Towards holistic understanding of Complex Diseases: Unraveling the Threads of Complex Diseases (THUNDER)
CSIR-CDRI	8. New Approaches Towards Understanding of Disease Dynamics and to Accelerate Drug Discovery (UNDO)
CSIR-CDRI	9. Emerging and re-emerging challenges in infectious diseases: Systems based drug design for infectious diseases (SPlenDID)
CSIR-CDRI	10. Anabolic Skeletal Targets in Health and Illness (ASTHI)
CSIR-CFTRI	11. Wellness through Foods and Nutraceuticals (WELFO)
CSIR-CFTRI	12. Lipidomics Center (LIPIC)
CSIR-CIMAP	13. Chemical Biology of Ocimum and other Aromatic Plants (ChemBio)
CSIR-IGIB	14. Centre for Cardiovascular and Metabolic Disease Research (CARDIOMED)
CSIR-IGIB	15. Wellness Genomics Project - Understanding genomic signatures of health living in Indian population (WG 100)
CSIR-IGIB	16. Towards Understanding skin Cell Homeostasis (TOUCH)
CSIR-IGIB	17. Visualisation of Organisms in Action (VISION)
CSIR-IGIB	18. Genome Dynamics in cellular organization, differentiation and enantiostasis (GenCODE)
CSIR-IGIB	19. CSIR-NCL-IGIB Joint Research Initiative: Interfacing Chemistry and Biology (CSIR-NCL-IGIB-JRI)
CSIR-IHBT	20. Plant Diversity: Studying adaptation biology and understanding/exploiting medicinally important plants for useful bioactives (SIMPLE)
CSIR-IHBT	21. Introduction, domestication, improvement and cultivation of economically important plants (AGTEC)
CSIR-IICB	22. Understanding supra molecular ensembles and machines (UNSEEN)

Nodal Lab	Project Name
CSIR-IICB	23. Host Interactome analysis: Understanding the Role of Host molecules in Parasitic Infection (HOPE)
CSIR-IICB	24. Neurodegenerative diseases: Causes and Corrections (miND)
CSIR-IICB	25. Therapeutics of Chronic Obstructive Pulmonary Disease (COPD) and Related Respiratory Disorders (TREAT)
CSIR-IICB	26. Bio-energetic Disorders: A multi-model approach to monitoring and management (BenD)
CSIR-IICT	27. CSIR-Mayo Clinic Collaboration for Innovation and Translational Research (CKF)
CSIR-IIIM	28. Medicinal Chemistry for stem cell biology and regenerative medicine (MEDCHEM)
CSIR-IIIM	29. Nurturing a new Pan-CSIR drug pipe line: high intensity preclinical, clinical studies on lead candidates (CSIR-DPL)
CSIR-IITR	30. Integrated NextGen approaches in health disease and environmental toxicity (INDEPTH)
CSIR-IITR	31. Nanomaterials: Applications and Impact on Safety, Health and Environment (NanoSHE)
CSIR-IMTECH	32. Genomics and Informatics Solutions for Integrating Biology (GENESIS)
CSIR-IMTECH	33. Multidirectional approaches for molecular and systems level understanding of regulatory networks in pathogenic microbes (INFECT)
CSIR-IMTECH	34. Drug Discovery: Bugs to Drugs Programme (BUGS TO DRUGS)
CSIR-IMTECH	35. Man as a Superorganism: Understanding the Human Microbiome (HUM)
CSIR-IMTECH	36. Centre for BIOtherapeutic Molecule DISCOVERY (BIODISCOVERY)
CSIR-NBRI	37. Root Biology (Cross Flow of Technology Project) (RootSF)
CSIR-NBRI	38. Bioprospection of plant resources and other natural products (BioprosPR)
CSIR-NBRI	39. Genomics of Medicinal Plants and Agronomically Important Traits (PlaGen)

Chemical Sciences

CSIR-CECRI	40. Multifunctional electrodes & Electrolytes for Future Technologies (MUTLIFUN)
CSIR-CLRI	41. Research Initiative for Waterless Tanning (RIWT)
CSIR-CLRI	42. Design Innovation for Smart Material Transformation Yearning Leather Life Style Products (D'STYLE)
CSIR-CSMCRI	43. Membrane & Adsorbent Technology Platform for Effective Separation of Gases and Liquids (MATES)
CSIR-CSMCRI	44. Potassic (K) fertilizer Technology to Empower the Nation (K-TEN)
CSIR-IICT	45. Biocatalysts for Industrial Applications & Greener Organic Synthesis (BIAGOS)

Nodal Lab	Project Name
CSIR-IICT	46. Inherently Safer Practices for Industrial Risk Reduction (INSPIRE)
CSIR-IICT	47. Organic reactions in generating innovative and natural scaffolds (ORIGIN)
CSIR-IICT	48. Non-Infringing chemistry and engineering for pharmaceuticals (NICE-P)
CSIR-IICT	49. Metabolic profiling of human body fluids by MS and NMR (CMET)
CSIR-IICT	50. Screening molecules in lead exploration (SMiLE)
CSIR-IICT	51. Development of Sustainable Processes for Edible Oils with Health Benefits from Traditional and New Resources (PEOPLE HOPE)
CSIR-IICT	52. Development of Sustainable Waste Management Technologies for Chemical and Allied Industries (SETCA)
CSIR-IICT	53. Development of Innovative Technologies for Strategic Fluorochemicals (DITSF)
CSIR-IICT	54. Development of Novel Vaccine Adjuvants (DENOVA)
CSIR-IICT	55. Affordable Cancer Therapeutics (ACT)
CSIR-IICT	56. Advance Drug Delivery System (ADD)
CSIR-IICT	57. Augmentation of Analytical Research Facilities (AARF)
CSIR-IIP	58. Energy Efficient Technologies (E2++)
CSIR-IIP	59. Biomass to Energy (BioEn)
CSIR-IIP	60. Catalysts for Sustainable Energy (ECat)
CSIR-IIP	61. New generation lubricants and additives (GenLube)
CSIR-IIP	62. Research Initiative for Low Emissions (RILE)
CSIR-IIP	63. Waste to Wealth - Waste plastic (W2W)
CSIR-IIP	64. Advanced Carbon Materials (AdCarbMate)
CSIR-NCL	65. Encapsulated Microorganisms for Environmental Protection (EMEP)
CSIR-NCL	66. Up gradation of Facilities/National Repository of Molecules and National Collection of Industrial Micro Organisms Resource Centre (NCIMRC)
CSIR-NCL	67. Hydrogen Energy: Overcoming materials challenges in PEMFC towards generation, separation, storage and conversion of hydrogen (HYDEN)
CSIR-NCL	68. Innovate, develop and up-scale modular, agile, intensified and continuous processes and plants (Indus MAGIC)
CSIR-NCL	69. Catalysts for Speciality Chemicals (CSC)
CSIR-NCL	70. Creating intellectual property and capabilities for the development of improved security features and substrates for the Indian currency note (FUTURE)
CSIR-NCL	71. A Multi-Scale Simulation and Modeling Approach to Designing Smart Functional Materials for use in Energy, Electrochemistry and Bio-mimetics (MSM)

Nodal Lab	Project Name
CSIR-NCL	72. Centre for Surface and Interface Science Research (CSISR)
CSIR-NCL	73. Nuclear Magnetic Resonance Centre for Advanced Research (NMRCAR)
CSIR-NCL	74. National Repository of Molecules (NORMS)
CSIR-NEIST	75. Natural Products as Affordable Healthcare Agents (NaPAHA)
CSIR-NEIST	76. Environmental Research Initiative for Paper and Process Industry (ERIPP)
CSIR-NEIST	77. Advanced Polyolefins (SPIRIT)
CSIR-NEIST	78. North East Exploration for Pharmaceutical (NEEP)
CSIR-NEIST	79. CSIR Advanced Analytical Facility for North East (CAAF-NE)CSIR-NIIST80. Sustainable Technologies for the Utilization of Rare Earths (SURE)
CSIR-NIIST	81. Molecules to Materials and Devices (M2D)
CSIR-NIIST	82. Development of functional foods and their formulations for potential health benefits of common man (FUNHEALTH)
CSIR-NIIST	83. Speciality Materials based on Engineered Clays (SPECS)

Engineering Sciences

CSIR-AMPRI	84. Novel Energy Effective Metallic Materials for Automotive and General Engineering Application (LWM)
CSIR-AMPRI	85. Design and Development of Thermo Responsive & Magnetic Shape Memory Materials and Devices for Engineering Applications (TR&MSMM)
CSIR-CBRI	86. Innovative Materials and Technologies for Next Generation Green buildings (INMATE-NGGB)
CSIR-CBRI	87. Engineering of Disaster Mitigation and Health Monitoring for Safe and Smart Built Environment (EDMISSIBLE)
CSIR-CGCRI	88. Development of Novel CSIR Technologies for Manufacturing Tailored and Patient-Specific Bioceramic Implants and Biomedical Devices at Affordable Cost (BIOCERAM)
CSIR-CGCRI	89. Advanced ceramics materials and components for energy and structural application (CERMESA)
CSIR-CGCRI	90. Leadership in Specialty Glass and Optical Fiber Technologies (GLASSFIB)
CSIR-CIMFR	91. Development of a technology for optimal extraction of locked-up coal from underground mines using artificial pillars (DeCoalArt)
CSIR-CIMFR	92. Development of underground coal gasification technology in India (Coal Gas Urja)
CSIR-CMERI	93. Intelligent devices and smart actuators (InDeSa)
CSIR-CRRI	94. Evaluation of Economic Loss Due to Idling of Vehicles at Signalized and Mitigation Measures (ELSIM)
CSIR-CRRI	95. Development and Application of Technologies for Sustainable Transportation (SUSTRANS)

Nodal Lab	Project Name
CSIR-CRRI	96. Development of Indian Highway Capacity Manual (Indo-HCM)
CSIR-IMMT	97. Processing of natural gemstones for aesthetic improvement and value addition (PNG)
CSIR-IMMT	98. Centre for Special Materials (CSM)
CSIR-IMMT	99. Minerals to Metals for Sustainable Planet (MINMET)
CSIR-NAL	100. Technology Solutions for Micro Air Vehicle Development (MAT)
CSIR-NAL	101. Augmentation and Refurbishment of National Transonic Aerodynamic Facilities (NTAF)
CSIR-NEERI	102. Centre of Excellence: Waste Utilization and Management (WUM)
CSIR-NEERI	103. National Clean Air Mission (NACM)
CSIR-NML	104. Development of Zero Waste Technology for Processing and Utilization of Thermal Coal (ZWT-CUP)
CSIR-NML	105. Development of Magnesium Metal Production Technology (MPT)
CSIR-SERC	106. Engineering Sustainable Materials and Structures Action Plan I: Sustainability Through Eco-Balancing (SUSMAS)
CSIR-SERC	107. Innovative Technologies for Health Assessment and Damage Mitigation of Structures (I-HEAL)
CSIR-SERC	108. Engineering Sustainable Materials and Structures Action Plan II: Sustainability Through Nano-Technology and Bio-Mimetics (eNano-Tics)

Information Sciences

CSIR-NISCAIR	109. CSIR Knowledge Gateway and Open Source Private Cloud Infrastructure (KNOWGATE)
CSIR-NISCAIR	110. CSIR--Wide Consortium Access to Online Information Resources (NKRC)
CSIR-NISTADS	111. Indian S&T and Innovation Policy (ISTIP)
CSIR-TKDL	112. Analysis and Monitoring of patent applications in International Patent Office for preventing misappropriation of India's Traditional Knowledge (CSIR-TKDL)
CSIR-TKDL	113. Traditional Knowledge Digital Library (Enhanced TKDL-2020)
CSIR-URDIP	114. Patinformatics (Patinformatics)
CSIR-URDIP	115. Chembioinformatics for Drug Discovery (ISC0203)
CSIR-URDIP	116. Open Science and Open Innovation Infrastructure (OSOII)

Physical Sciences

CSIR-CEERI	117. Advanced Facility for Nano Electronics (AFNE)
CSIR-CEERI	118. Research Initiative on Nano Devices and Nano-Sensors (R-Nano)
CSIR-CEERI	119. Advanced Microsensors and Microsystems : Design, Development and Applications (MicroSensys)

Nodal Lab	Project Name
CSIR-CSIO	120. Opto-Mechatronics Technologies for Next Generation Sensors and Applications (OMEGA)
CSIR-CSIO	121. Advance Instrumentation Solutions for Helath Care and Agro-based Applications (ASHA)
CSIR-NGRI	122. Geodynamic and Earthquake Generating Processes in NE India and Andaman Subduction Zone (GENIAS)
CSIR-NGRI	123. Hazard due to Earthquakes and Tsunami in the Indian region (HEART)
CSIR-NGRI	124. India Deep Earth Exploration Programme (INDEX)
CSIR-NGRI	125. Shallow subsurface Imaging of India for resource exploration (SHORE)
CSIR-NIO	126. Geological processes in the Indian Ocean - Understanding the input fluxes, sinks and Paleoceanography (GEOSINKS)
CSIR-NIO	127. Analyses and Harnessing of Marine Biodiversity for Bioremediation of Aquaculture and Industrial Effluents (MARINEBIOTECH)
CSIR-NIO	128. Geo-scientific investigations for deciphering the Earth's internal processes and exploration of energy resources (GEOSCAPE)
CSIR-NIO	129. Indian Aquatic Ecosystems: Impact of Deoxygenation, Eutrophication and Acidification (INDIAS IDEA)
CSIR-NPL	130. Advanced Quantum Research and Innovation with Ultra Small Systems (AQuARIUS)
CSIR-NPL	131. Measurement for Innovation in Science & Technology (MIST)
CSIR-NPL	132. Research and Development on Single Trapped Ion based Frequency Standard (STIOS)
CSIR-NPL	133. Development of Advanced Materials for Next-Generation Energy-Efficient Devices (D-NEED)
CSIR-NPL	134. Probing the Changing Atmosphere and its Impacts in Indo-Gangetic Plains (IGP) and Himalayan Regions (AIM-IGPHim)

B. List of Projects Spill over from Eleventh Five Year Plan

Nodal Lab	Project Name
CSIR-NAL	1. Enhancement of Knowledgebase in Aerospace Sciences and Development of Cutting Edge Technology
CSIR-NAL	2. Spearheading small civilian aircraft design, development and manufacture
CSIR-CRRI	3. Development of Management System for Maintenance Planning and Budgeting of High Speed Corridors
CSIR-CGCRI	4. Ceramic Materials for Emerging Technologies involving Liquid and Gas Separation
CSIR-NCL	5. Development of Clean Coal Technologies
CSIR-CGCRI	6. Non-Oxide Ceramics based advance structural materials: Armours and Refractories
CSIR-CMMACS	7. Setting up State-of-the-art Multi-Teraflop High Performance Computing (HPC) Facility
CSIR-CMMACS	8. Integrated Analysis for Impact, Mitigation and Sustainability; Regional Climate Modelling at Decadal Scale
CSIR-IMTECH	9. Microbial Type Culture Collection (International Depository Authority)
CSIR-NIO	10. Acquisition of Oceanographic Research Vessel#
CSIR-CCMB	11. Multi-agent therapy for Cancer: A System Biology Approach
CSIR-IICB	12. Metabolic Engineering of Azadirachtin Biosynthesis Pathway
CSIR-IICB	13. Metabolic Engineering of Vinica Alkaloid Pathway
CSIR-NPL	14. Advances in Metrology
CSIR-NPL	15. Fabrication of LED Devices and Systems for solid state lighting applications
CSIR-CECRI	16. Innovative solutions for solar energy storage*
CSIR-NPL	17. Novel approaches for solar energy conversion*
CSIR-NPL	18. Efficient Silicon photovoltaics with smart electronics and lighting systems*
CSIR-HQ	19. CSIR-Ayurgenomics Unit*

* These are projects formulated as trans-Plan initiatives

10th FYP Project

CSIR Establishments

	BIOLOGICAL SCIENCES		ENGINEERING SCIENCES
CSIR-CCMB	Centre for Cellular and Molecular Biology, Hyderabad	CSIR-AMPRI	Advanced Materials and Processes Research Institute, Bhopal
CSIR-CDRI	Central Drug Research Institute, Lucknow	CSIR-CBRI	Central Building Research Institute, Roorkee
CSIR-CFTRI	Central Food Technological Research Institute, Mysore	CSIR-CGCRI	Central Glass and Ceramic Research Institute, Kolkata
CSIR-CIMAP	Central Institute of Medicinal & Aromatic Plants, Lucknow	CSIR-CMERI	Central Mechanical Engineering Research Institute, Durgapur
CSIR-IGIB	Institute of Genomics & Integrative Biology, Delhi	CSIR-CRRI	Central Road Research Institute, New Delhi
CSIR-IHBT	Institute of Himalayan Bioresource Technology, Palampur	CSIR-IMMT	Institute of Minerals and Materials Technology, Bhubaneswar
CSIR-IICB	Indian Institute of Chemical Biology, Kolkata	CSIR-NAL	National Aerospace Laboratories, Bengaluru
CSIR-IIIM	Indian Institute of Integrative Medicine, Jammu	CSIR-NEERI	National Environmental Engineering Research Institute, Nagpur
CSIR-IMTECH	Institute of Microbial Technology, Chandigarh	CSIR-NML	National Metallurgical Laboratory, Jamshedpur
CSIR-IITR	Indian Institute of Toxicology Research, Lucknow	CSIR-SERC	Structural Engineering Research Centre, Chennai
CSIR-NBRI	National Botanical Research Institute, Lucknow		
	CHEMICAL SCIENCES		INFORMATION SCIENCES
CSIR-CLRI	Central Leather Research Institute, Chennai	CSIR-NISCAIR	National Institute of Science Communication and Information Resources, New Delhi
CSIR-CECRI	Central Electrochemical Research Institute, Karaikudi	CSIR-NISTADS	National Institute of Science Technology and Development Studies, New Delhi
CSIR-CSMCRI	Central Salt & Marine Chemicals Research Institute, Bhavnagar	CSIR-4PI	Fourth Paradigm Institute, Bengaluru
CSIR-CIMFR	Central Institute of Mining & Fuel Research, Dhanbad		
CSIR-IICT	Indian Institute of Chemical Technology, Hyderabad	PHYSICAL SCIENCES	
CSIR-IIP	Indian Institute of Petroleum, Dehradun	CSIR-CEERI	Central Electronics Engineering Research Institute, Pilani
CSIR-NCL	National Chemical Laboratory, Pune	CSIR-CSIO	Central Scientific Instruments Organisation, Chandigarh
CSIR-NEIST	North-East Institute of Science and Technology, Jorhat	CSIR-NGRI	National Geophysical Research Institute, Hyderabad
CSIR-NIIST	National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram	CSIR-NIO	National Institute of Oceanography, Goa
		CSIR-NPL	National Physical Laboratory, New Delhi
	Units		Innovation Complexes:
CSIR-HRDC	Human Resource Development Centre, Ghaziabad		Innovation Complex Chennai
CSIR-TKDL	Traditional Knowledge Digital Library, Ghaziabad		Innovation Complex, Kolkata
CSIR-URDIP	Unit for Research and Development of Information Products, Pune		Innovation Complex, Mumbai
CSIR-OSDD	Open Source Drug Discovery, New Delhi		
CSIR-TRISUTRA	Translational Research and Innovative Science through Ayurgenomics, New Delhi		



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