

# OVERVIEW

Council of Scientific & Industrial Research, a premier autonomous R&D organization with its 38 laboratories and 47 regional centers undertakes research and development activities covering the entire canvas of S&T in the civilian sector. It has endeavored to carve out a niche for itself and its R&D activities are multidisciplinary, competitive and knowledge driven in the innovation chain. Through its R&D activities, CSIR is creating major and innovative knowledge networks across and beyond CSIR laboratories.

The Annual Report 2003-04 highlights the most significant S&T contributions under various sectors such as Aerospace Science & Technology, Biological Sciences & Technology, Chemical Science & Technology, Engineering Science & Technology, Food Science & Technology, Information Science & Technology, Leather Science & Technology, Material Science & Technology, Physical and Earth Science & Technology, Science & Technology for the Society. It also provides information for the activities pursued under Central Management & Headquarters and significant Dateline.

## Prime Minister lauds CSIR

Hon'ble Prime Minister of India Shri Atal Bihari Vajpayee, in his address to the 91st Session of Indian Science Congress, on January 3, 2004 commended CSIR as: "A latecomer in Industrial R&D, India now ranks the highest among all countries in the rate of growth of patent filings, which is now around 300% per year. In this context, the Council of Scientific & Industrial Research (CSIR) has done India proud by securing, under the Patents Cooperation Treaty, number one position as highest filer of patents from all developing countries, including South Korea, China and Brazil".

## SARAS

NAL's Light Transport Aircraft - SARAS - completed a significant milestone as it was rolled out during the 4th quarter of the last year. During the year, a large number of ground tests were performed on the aircraft in preparation for its flights. These included structural tests on full scale airframe, engine integration and running tests, instrumentation checks, tests on avionics and electronics systems and ground vibration tests. Flight readiness reviews were completed. All these developments resulted in DGCA giving clearance to the flight trials of the aircraft. The maiden test flight of SARAS took place on 29th May 2004.

## Head Up Display (HUD) for Light Combat Aircraft

HUD, which occupies the prime location in LCA cockpit and provides the pilot with essential flight information, navigational and target/weapon release cues etc., has been integrated successfully in LCA-TD2 and flights have taken place with CSIO developed HUD on board. The CSIO-HUD has superior features in comparison to those of international suppliers in terms of symbol brightness, field of view and the thermal management.

## CSIR exploiting the Power of Networking

New Millennium Technology Leadership Initiative (NMITLI) synergised the best competencies of publicly funded R&D organisation, academia and private industry. With over 50 private sector companies and over 150 institutes & laboratories networked together, NMITLI is the largest public-private partnership in India today. Under NMITLI, an Investigational New Drug (IND) application from an oral herbal formulation for the treatment of psoriasis, one of the most common dermatological diseases affecting around 2% of the world population, has been filed for the first time in the country. Also for the first time a versatile portable software for bioinformatics –

Biosuite® has been developed. This is a multi-purpose tool for carrying out diverse bio-analyses ranging from gene analysis to comparative genomics.

The mammoth coordinated network programme on bioactives involving twenty CSIR laboratories and thirteen universities and three well-known entities in the traditional system of medicine is contributing in the area of new drugs discovery. Some new chemical entities and new herbal formulations have been discovered by dedicated discovery groups. The discoveries covered are cancer, tuberculosis, filaria, malaria, ulcer, parkinsonism & alzheimer. Some interesting leads have been obtained on hepatoprotective cum immunomodulation as well as memory enhancement. Two entirely new anti cancer preparations in the area of women's cancer are being developed further with an Indian firm. Also short-term toxicity of two entirely new antiulcer preparations have been completed and clinical trials protocols have been worked out.

## Biotechnology

Bacterial Leaf Blight (BLB) resistant Samba Mahsuri and Triguna Rice lines have been developed through the application of DNA Marker Technology by Centre for Cellular & Molecular Biology (CCMB), in partnership with other institutes. These varieties have shown excellent resistance to BLB under green house conditions under limited field trials. The time required for development of durable resistance is now less than three years, which through conventional breeding would have taken at least five to six years.

NBRI has designed and synthesized three different genes that code for insecticidal d-endotoxin proteins, commonly known as Bt-proteins. These genes were then deployed to develop transgenic cotton lines that show a high level of resistant to target pests that damage cotton bolls. This is the first agronomically valuable transgenic technology developed in India that has been accepted in seed industry for commercialization.

A unique web enabled software (PLHOSTFA) has been developed by IGIB and commercialized. It enables a genome-wide comparison of several thousand proteins of one genome with all the other proteins of various other genomes.

## Drugs

Technology for the commercial manufacture of CONSAP, a vaginal contraceptive cream from Sapindas mukorosil has been licensed to M/s Hindustan Latex Limited. Bacopa extract (Promind) has been licensed to M/s Lumen Marketing Company and the product has been marketed by them as Memory Power and Memory Perfect. Also, double blind clinical trials for CT-1 (antihyperglycemic) are continuing. Permission has been obtained from DCG(I) to conduct clinical trials of a and b arteether (anti malarial).

## Development of high flux, thin film composite (TFC) reverse osmosis membrane

CSMCRI has successfully developed Thin Film Composite (TFC) reverse osmosis (RO) high flux membrane in-house. The indigenously developed membrane is suitable for treatment of tertiary treated sewage water. 1 million liters/day capacity plant has been commissioned at Chennai Petroleum Corporation Ltd (CPCL) Chennai. The use of this new membrane, which is non-biodegradable, and which has the ability to work over a wide pH range, would reduce capital investment and operating cost greatly.

## Contribution to new knowledge

For the first time CCMB scientists have discovered that interfering RNA can convert euchromatin in to heterochromatin, both components of chromosomes. This can, sometimes, result in virtually stopping the gene expression. The research carried out at CCMB on understanding the mechanism of gene silencing has been

published in the prestigious journal 'Science'. This finding is of great importance in treatment of many diseases, particularly cancer.

NCL has made a major contribution by designing novel structures like stacked sheets by using new channel guest system. It was challenging to design them (a) for special shapes and (b) of desired properties. This novel contribution has found a place on the cover page of prestigious Journal of Organic Chemistry.

## Protecting Traditional Knowledge from misappropriation

The concept of Traditional Knowledge Resource Classification (TKRC) was presented by CSIR to the experts of International Patent Classification (IPC) Union. The novelty of the classification scheme developed was well recognised by these experts and the IPC Union constituted a Task Force to further study the possibility of linking and/or integrating TKRC developed by India with IPC. The Task Force consisting of United States Patent Office, European Patent Office, China, Japan and India recognised the need of having a more detailed level of classification relating to medicinal plants. It has created approx. 200 subgroups for the classification of medicinal plants in IPC (under a new Group A61K 36/00) instead of the existing single sub-group (A61K 35/78). These are being included in the next edition of IPC to be published in July 2005. IPC Union has recommended that the TKRC developed by India and other countries may be linked to the IPC. CSIR's efforts have thus been successful in giving a rightful place to traditional knowledge.

## CSIR in the service of society

CSMCRI has installed 1200 Litre/hr Brackish water desalination plant in Kisari village of Rajasthan. This project was funded by Department of Science and Technology (DST), New Delhi. CSMCRI has established a model cultivation for *Jatropha curcus* from which biodiesel of international specifications can be produced. This is the first time that such biodiesel has been made from *Jatropha* oil by CSMCRI. The biodiesel has been evaluated at Daimler Chrysler AG and found to be matching all the specifications. Larger lots of biodiesel are now being made for evaluation in India in a Mercedes Benz car. Orchards are simultaneously being raised in Orissa (Huma & Mohuda villages) and Gujarat (Chorvadla village) to make elite germplasm available in sufficient quantity so that cultivation can subsequently be taken up in larger (100-200 hectares) tracts of wasteland. The project has the potential to use wasteland, create several jobs, solve Indian's energy problems and reduce environmental pollution.

## Institution of a National Award to promote Technology Innovation in Industry

In order to promote technology innovation in industry, CSIR has instituted the CSIR Diamond Jubilee Technology Award from the year 2003. The award carries a cash prize of Rs. 10 lakh. Tata motors is the winner of the first CSIR Diamond Jubilee Technology Award for the design, manufacturing and commercialization of Indica and Indigo cars. Indica has also been introduced in UK under the brand name 'City Rover'.

## All time high in CSIR's journey during the year

The year saw CSIR reach an all time high in science, patents & earnings. In terms of science, CSIR published 2188 papers in SCI journals, with an average impact factor per paper of 1.75; both being all time high. In terms of patents, it was granted 191 US patents (69% of the patents granted to Indians in India), an all time high again. In terms of its earnings, CSIR's external cash flow was Rs. 287 crores, an all time high again.

# Resource Base

1. Infrastructural	Number
• Laboratories/Institutes	38
• Extension/Field/Regional Centers	47
2. Human	18025
• Total Staff	13545
○ Total S&T Staff	4651
○ Scientists (Group IV)	2959
○ Technical (Group III)	5935
○ Technical (Group II+I)	4440*
• Total Administrative & non-technical (includes isolated staff strength)	
3. Financial	Rs. Crore
• Government budgetary support	1074.54
▪ Government plan allocation	430.00
▪ Government non-plan allocation	644.54
• Extra budgetary resource generation	255.20
▪ From contract R&D and consultancy	32.17
▪ Miscellaneous receipts (non-R&D)	
▪ Laboratory reserves	89.17

\*Provisional

## PERFORMANCE

1. science output	2188 (2012)
• paper contribute	1.749 (1.640)
○ number	
○ Average impact factor	
○ patents	
▪ filed in India	406 (421)
▪ Filed abroad	
▪ In force in India	495 (728)
▪ In force abroad	

	1083 (676)
	727 (533)
2. Technological Output	
• New Knowhow licensed	40 (42)
• Licensing agreements executed	165 (129)
3. National S&T Human Resource Development	
• Research Fellows / Associates supported	6755 (5934)
• Emeritus Scientists in position	137 (110)
• Pool Scientists (SRAs) in position	206 (202)
• Research schemes supported	728 (734)
4. Resource Mobilization	
• External Cash inflow	287 (270)

Figures in parenthesis correspond to the previous year 2002-03

# 1.0 S&T CONTRIBUTION

# SARAS

NAL's Light Transport Aircraft - SARAS - has completed a significant milestone of rollout just before the year commenced. During the year, preparations for its first flight were launched and a large number of ground tests were performed on the aircraft. These includes structural tests on full scale airframe, engine integration and running tests, instrumentation checks, tests on avionics and electronics systems and ground vibration tests. In addition a large number of materials' characterisation and other tests were conducted to satisfy the certification requirements. Extensive reviews have been completed. All these have resulted in Director General of Civil Aviation (DGCA) giving clearance to the flight trials of the aircraft. Low speed taxi trials are about to be commenced and these will be followed by high-speed taxi trials, analysis and discussion of the results with DGCA before the first flight.



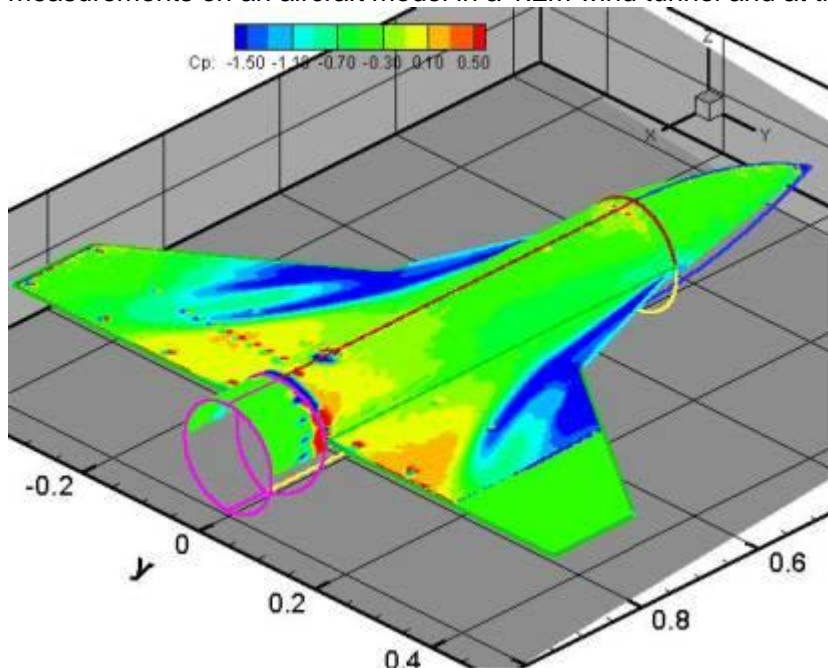
## Hardware for mesoscale modeling for monsoon related predictions developed

NAL has designed and developed Optical Floswitch - the hardware component of the Mesoscale Modeling for monsoon related predictions. NAL Floswitch has the decisive edge on the connectivity, bandwidth and information processing capability and is technically superior to the commercially available systems anywhere in the world. On the modeling front, components of modeling, which have been developed and integrated, specially address to the tropical region. It will, thus reduce, to a large extent, the dependencies on western models and consequently increase reliability in forecast for tropical regions.

## Improved software for Pressure Sensitive Paint (PSP) data processing

PSP technique involves the use of pressure sensitive paints for the measurement of surface pressure distributions on wind tunnel models. This method has a great advantage of no pressure probe intruder into the flow. The PSP data reduction process which transforms intensity data in the image plane to pressure data mapped to spatial coordinates of the model is an important element in the accurate determination of surface pressure on the wind tunnel model.

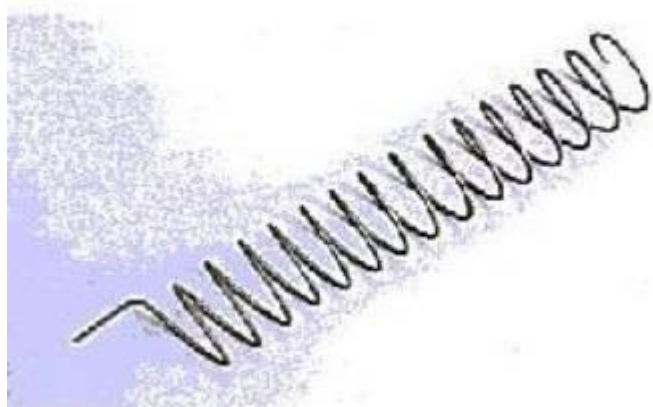
Keeping in view the futuristic requirements, NAL has developed a state-of-the-art PC-Windows based software. It has some excellent features like, automatic marker recognition, conventional methods of image alignment using warping transformations and image transformation using resection methodology onto a three-dimensional surface grid on the model. NAL scientists have validated the software against data and conventional pressure measurements on an aircraft model in a 1.2m wind tunnel and at transonic speeds at NAL.



Pressure coefficient data on aircraft using resection method

## Shape Memory Alloys (SMAs) developed for aerospace applications

Ni-Ti based Shape Memory Alloys (SMAs) emerged as very promising material for aerospace applications. Some of the applications envisaged are active and adaptive in shape control in aerospace structures and various actuator applications. All these applications require SMAs in the form of wire with a range of transformation temperatures and mechanical properties. NAL has achieved capabilities for processing of Ni-Ti based actuator wires and springs from SMAs.



SMA Spring fabricated at NAL

## Civil aircraft avionics and stall warning systems



NAL has successfully developed avionics systems and electrical systems for SARAS aircraft to meet international airworthiness specifications. Necessary bench level test facilities and test methodologies are also established and proven. The systems developed have been tested using these facilities and also on aircraft tests. Application software for certain systems procured on a semi-knocked down basis have been developed and tested. A critical input on aircraft pilot is generated by the stall warning system, which warns about the aircraft's likelihood of entering into stall. NAL has also developed indigenous software for this system. All these have formed valuable inputs to the country's civil aviation programme in general and SARAS aircraft in particular.



SARAS Stall Warning System

## Cure controller for bonded repair developed

Cure controller is electronic equipment used for in-situ bonded repair of aircraft structures. Both metallic and composite structures can be repaired using this equipment. NAL has designed and developed two versions of cure controllers. One is a microprocessor-based system capable of single zone control and the other is a notebook PC based system capable of multizone control. This system is the first of its kind in the country and provides an essential tool for onsite, in-situ repairs. Being portable they are useful in a variety of industrial situations but the most important of these is repair of aircraft structures in the operational bases.

## Radomes

Over the years the multi-disciplinary radome activity has become a strength area of NAL. During the year NAL successfully completed development and production of nose radomes for Jaguar Maritime aircraft using resin injection technology, which is an in-house development. The radomes have successfully passed through the acceptance criteria and preliminary flight trials are in progress.

NAL has also developed ceramic radomes for strategic applications and handed over prototype radomes to DRDL (DRDO Laboratory) for field trials.

In the area of ground based radome, the process for development of large panels for second version of the Doppler Weather Radome (DWR-Mark II) has been successfully demonstrated.

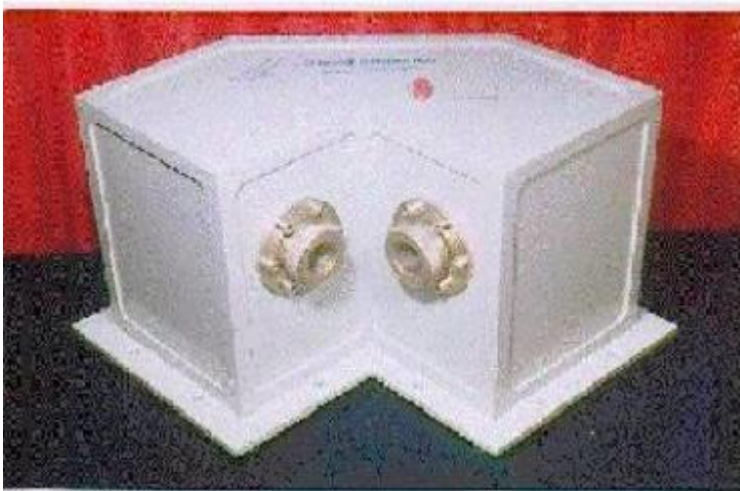
### **Acoustic test facility**

NAL has conducted detailed qualification tests of many space systems during the year using the Acoustic test facility. The significant systems tested included two major flight hardware systems of GSLV and 2 satellites (IRS

Pt and INSAT 3E). This facility is unique in the country and there are a few in the world, which are capable of meeting the space specific test standards. NAL's contributions in this discipline are both unique and invaluable. The Acoustic Test Facility has also developed gas jet noise generator whose performance is excellent and covers a range of operations, which is not covered by any other system anywhere in the whole world so far. This first-in-the world type system has been supplied to prestigious aerospace companies including Boeing, USA and has received wide recognition.



INSAT-3-E in Acoustic Test Facility



Noise Generator

## Automatic visual range assessor installed at Cochin

The visual range is a parameter of central importance in flight operations, which determines whether a pilot may land, or take-off. Over estimation assessments of visual range violate safety guidelines. On the other hand, heavy financial losses and inconvenience would be incurred by delays and diversions created by under assessments of visual range. To meet the need for timely yet accurate reports, NAL has designed and developed the Automatic Visual Range Assessor (AVRA). The AVRA automatically assesses and reports visual range at 10-second intervals. The system has met the acceptability criteria successfully

The Category 2 variant viz., the AVRA Mk2S, has been installed at Cochin International Airport in December 2003. This is a single baseline system that assesses and reports the Runway Visual Range (RVR) between

200m and 3300 m and the Meteorological Optical Range (MOR) between 200 m and 10000 m. The unit has been functioning satisfactorily for the last four months.



Automatic Visual Range Assessor at Cochin Airport

### **1.1.2 HUMAN RESOURCE DEVELOPMENT**

- A workshop on "Structural Dynamic Simulation and Testing - a Hybrid Approach" was organized at NAL between 10th and 12th March 2004 jointly by NAL and LMS International, Belgium. The workshop covered a variety of latest topics on the use of "virtual engineering" technology in aircraft design. Dr A R Upadhya, Associate Programme Director, Aeronautical Development Agency (ADA) and Programme Director, National Programme of Smart Materials made a presentation on 'Structural Dynamic Simulation and Testing of Aircraft' illustrating the ongoing testing and simulation studies on the Tejas- Light Combat Aircraft (LCA).
- Series of lectures were delivered by experts from General Aerospace Research Centre (DLR), Germany on the area of Flight Mechanics in March 2004.
- An Official Language Orientation Programme for NAL's Heads of Divisions was organised in March 2004. The training aimed at increase in use of official language at senior levels.
- Periodic orientation courses were conducted for fresh entrants to familiarise them with NAL's programmes and activities.
- Specially designed courses aimed at upgradation of PC Awareness among staff members were also conducted during the year.
- Under a special arrangement with Birla Institute of Technology & Science, Pilani a batch of their final year students participated in NAL programmes
- About 800 students of Engineering from different universities did their dissertation projects in NAL.
- Over 400 staff members were deputed to about 110 specialised Conferences / Symposia / Workshop to enable exposure and upgradation of their knowledge base.

### 1.1.3 RECOGNITION & AWARDS

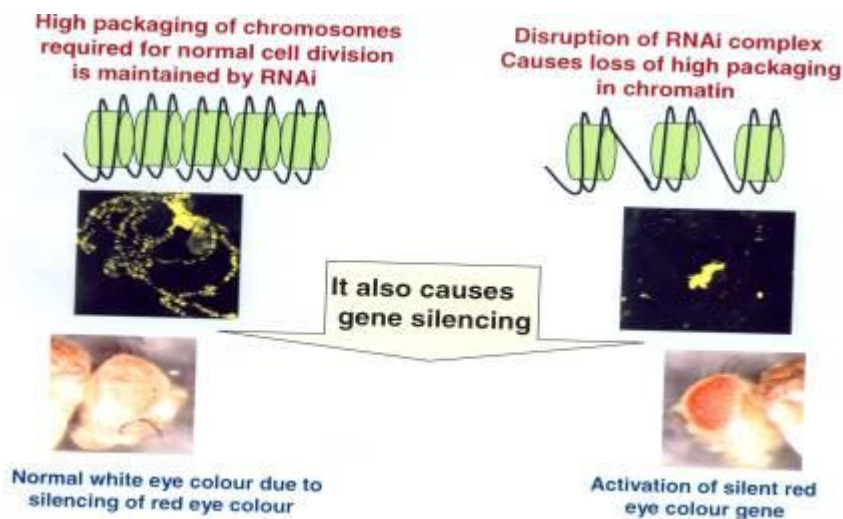
Padmashri	Dr. T.S. Prahlad, Distinguished Scientist & Ex Director, NAL
CSIR Technology Shield for Engineering Technology for integrated flight mechanics and control technology for aerospace vehicle	Dr. J.R. Raol & team, NAL
Young Scientist Award by Indian National Academy of Engineers	Dr. A.A. Pashilkar, NAL
MRSI Medal 2003 by Material Research Society of India	Dr. R. M.V.G.K. Rao, NAL
National Prize in aeronautics by Aeronautical Society of India	Mr. Subbarao, NAL
Mrs. Sabita Chaudhury Memorial Medal of Indian Institute of Science (2001-02)	Dr. A.A. Pashilkar, NAL

# Biological Sciences & Technology

## Gene silencing – A Hope for Cancer Control

When gene expression is completely stopped or drastically reduced, the phenomenon is called gene silencing. Scientists of CCMB have demonstrated that gene silencing in plants and animals can be achieved by interfering with gene activity through the small RNA molecules, the 'interfering RNA' (RNAi), at specific loci during the conversion of euchromatin to heterochromatin. This outstanding achievement, which has been reported in the prestigious *Journal Science* demonstrates that disruption of RNAi interference mechanism in living cell blocks the formation and maintenance of heterochromatin, eventually leading to disruption of specific chromosome regions.

The diseases coupled with cell division and cell proliferation, such as various types of cancers, appear to be controlled by heterochromatin formation and its functioning. Therefore understanding the role of RNAi intervention in these processes might pave a way to use RNAi as a possible therapy for cancer and other related diseases, which involve cell cycle controls.



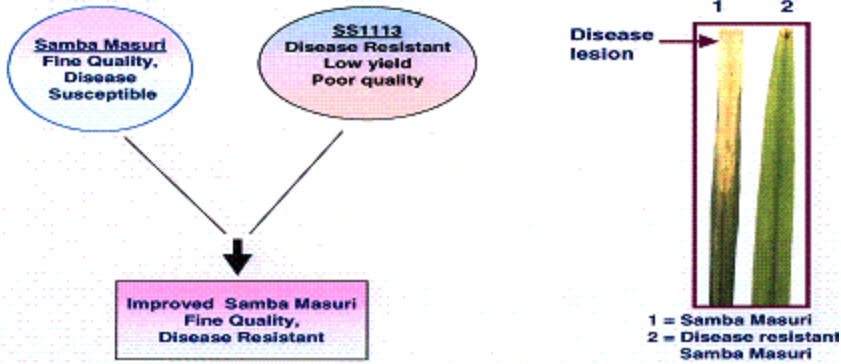
### ***Disease Resistant Rice***

In a unique collaborative effort by CCMB and Directorate of Rice Research (DRR), an applied agricultural research institute of the Indian Council of Agricultural Research (ICAR), Bacterial Leaf Blight (BLB) resistant Samba Masuri and Triguna Rice lines have been developed through the application of DNA Marker Technology. In past, several BLB resistant varieties were developed using traditional breeding methods. But, this process takes normally more than 5-7 years for incorporation of resistance and 4-5 years for evaluation and commercial release of the variety. The CCMB-DRR group in addition to using DNA markers for pyramiding BLB resistance genes from public domain for selection of disease resistant lines, has also used markers distributed through out the rice genome to select the plants that are likely to have other qualities like that of the original Samba Masuri or Triguna parents. This innovation has substantially reduced the time required for development of durable resistance to a short period of less than three years which through conventional breeding would have taken at least 5-6 years.

Presently, these varieties are showing excellent resistance to BLB under green house conditions and are performing well in limited field trials.

### Disease resistant Samba Masuri

The well known Samba Masuri, one of India's best and most extensively cultivated rice varieties, has been made resistant to the serious bacterial leaf blight disease by molecular breeding



### Study of genetic diversity in the Asiatic lions and other big cats

India is home to five of the eight majestic big cats of the world. The three major big cats namely, Lion, Tiger and Leopard, are listed in Schedule I of the Indian Wildlife Protection Act, 1972. Apart from the severe loss of habitat, these are continuously facing the danger of extinction mainly due to poaching and hunting for their body parts. Researchers at CCMB have developed several microsatellite markers from a partial genomic library of the Asiatic Lion, which have been found to be highly polymorphic in the Asiatic Lions as well as other big cats like Tigers and Leopards. The results obtained so far show that there is a substantial amount of genetic variation in the Asiatic Lion population. The variation in repeat size in different big cats can be easily visualized in agarose gels; the Gene Scan also reveals clear-cut variation among the big cats. This PCR-based, non-invasive method opens a new avenue towards forensic identification of big cats.

### Novel therapeutic strategies to tackle leishmaniasis

The relationship of the serotonin<sub>1A</sub> receptor with its membrane environment has been explored by Fluorescence Recovery After Photo bleaching (FRAP) experiments on receptors heterologously expressed in intact cells. CCMB has shown, for the first time, that cholesterol depletion from macrophage plasma membranes using methyl- $\beta$ -cyclodextrin results in a significant reduction in the extent of leishmanial infection. These results indicate a specific requirement of plasma membrane cholesterol in efficient attachment and internalization of the parasite to **macrophage cells leading to a productive infection. This was supported by the fact that the reduction in the ability of the parasite to infect host macrophages can be reversed upon replenishment of cell membrane cholesterol. More importantly, these results are significant in developing novel therapeutic strategies to tackle leishmaniasis.**

### Structural, functional and stability properties of some disease associated important proteins

*Streptococcus pneumoniae* is a gram positive bacteria that colonizes predominantly in the upper respiratory tract of humans. This human pathogen is responsible for various life threatening diseases such as pneumonia, bacteraemia, meningitis and sinusitis. Hyaluronidases form a special group of polysaccharide degrading enzymes. They predominantly cleave the N-acetylglucosamine bond of hyaluronic acid producing unsaturated polysaccharides of various lengths. These bacterial hyaluronidases are called hyaluronate lyase. Scientists at CDRI studied native *S. pneumoniae* hyaluronate lyase (SpnHL) structurally, which shows that the N- and C-terminal domains fold/unfold independently, suggesting absence of any significant cooperative

interactions between them. The isolated N-terminal domain of SpnHL is enzymatically active. Guanidine hydrochloride, guanidine isothiocyanate, L-arginine methyl ester and L-arginine inhibit enzyme activity at very low concentrations, thus providing leads for designing effective inhibitors of SpnHL.

### ***Serine hydroxymethyl transferase from Mycobacterium tuberculosis.***

Serine hydroxymethyl transferase (SHMT) is a key enzyme in the folate pathway which provides one carbon fragment for the biosynthesis of a variety of end products like DNA, RNA, ubiquinone, methionine, etc. Analysis of Mycobacterium tuberculosis genome by CDRI led to the identification of two genes, GlyA and GlyA2 proposed to be putative genes encoding for SHMTs. The studies on recombinant SHM1 and SHM2, the protein products of putative genes GlyA and GlyA2 revealed that SHM1 contains one mole of PLP per mole enzyme dimer whereas SHM2 contains two mole of PLP per mole of enzyme dimer. Unlike SHMT from other organisms, the SHM1 and SHM2 do not undergo half-transamination reaction with D-alanine, resulting in formation of apo-enzyme, a unique enzyme.

### ***Hemolysin E***

Hemolysin E is a potent virulence factor of pathogenic E.coli. CDRI has investigated the structure -function of the amphipathic leucine zipper motif. Amino acid segment 205-235 corresponding to the motif may play a significant role in binding and assembly of toxin in target cell membrane and its destabilization.

### ***Animal models and animal substitute technologies***

It is now felt that there must be reduction in use of animals in drug discovery and the emphasis should be on the development of genetically modified lower organisms (Drosophila and some prokaryotes) and transgenic animals. CDRI efforts in this direction are acquisition of **acquired cell lines namely MG-63, SP 2/0 HeLa THP-1, U-373 which are being maintained and routinely used in drug screening. Db/db mouse acquired from Novo Nordisk, Denmark has been established for anti-diabetic screening. Novel assays for genotoxicity i.e. Spot assay using Salmonella his deficient strains and in vitro sister exchange assay** have been standardized. Production of gerbils, mostly required for antifilarial and antithrombotic screening has been enhanced by adopting innovative methods.

### ***Molecular biology of selected pathogens for developing drug targets***

The pathogens selected for investigation at CDRI are Mycobacterium tuberculosis, Plasmodium falciparum and Leishmania donovani. The drug targets being explored from M. tuberculosis are ESAT-6 region of the genome involved in virulence, proteins responsible for enhanced survival within macrophages and those involved in host cell-pathogen interactions. In malaria the genome database is being explored for identification and characterization of putative proteins and molecular targets in P. falciparum infected erythrocytes. A new protein that polymerizes heme to hemozoin has been identified, purified and characterized. In Leishmania, a gene involved in drug resistance and another novel gene, Pteridine reductase-1 have been cloned and expressed.

### ***Biore restoration of OB dumps through the plantation of selected efficient photosynthetic/soil conserver species in EJ area (BCCL)***

The plantation of efficient soil binder and high photosynthetic plant species such as *Leonotis nepataefolia*, *Lantana camara*, *Sida acuta*, *Saccharam benghalensis*, *Vetevaria zizanoides*, Lemon grass among shrubby vegetation and *Cassia siamea*, *Dalbergia sissoo*, *Acacia auriculiformis*, *Ficus religiosa*, *F. benghalensis*, *Delonix regia*, *Switenia microphylla*, *Thuja orientalis*, *Saraca indica* from hardy species along with other suitable amendments have considerably improved the fertility status/biological activity and significantly reduced the erosional losses of the mine spoil. Bio-restoration of OB dumps/wasteland have been applied by CFRI to reclaim OB dumps of different coalfields in an eco-friendly manner, which can solve the vexing problem of ever-increasing GHGs from the surrounding environment, besides turning the overlaying waste dumps into a monetary source by means of plantation (social forestry).



### ***Alpha arteether resistance domain in gyrase A gene of Escherichia coli mapped***

CIMAP has discovered a novel selective property of the compound  $\alpha$ -arteether, which is inhibitory against the gyr mutant strains of *E. coli*, but ineffective against wild type strains. Also a strategic and novel combination of  $\alpha$ -arteether which can be used as advanced generation drug(s) to counter the resistance development itself while, having a potential to be used in treating infectious diseases particularly in those cases where drug resistant strains are known to appear very frequently has been developed. The uniqueness and most useful feature is that, in a combination of  $\alpha$ -arteether and quinolone drugs, the spontaneous mutants which are resistant to quinolones (or their derivatives) can be killed by  $\alpha$ -arteether and at the same time, any  $\alpha$ -arteether resistant strains become highly sensitive to nalidixic acid. The new composition of compounds inhibits the resistance development due to mutation in the gyr A gene of bacteria, in which one component is  $\alpha$ -arteether and the other may be nalidixic acid or any of the fluoroquinolones (comprising of Ciprofloxacin, Norfloxacin, Levofloxacin, Sparfloxacin, Oxifloxacin and Lomefloxacin etc.) or compounds of similar nature against which the resistance develops through a related process.



Also a sequence of nucleotides in the DNA of *Escherichia coli* gyrase A gene which when changed provides resistance to a-arteether to the bacteria is identified. This sequence is also defined as the a-arteether resistance domain and has wide spread application in the detection of resistance to a-arteether and related sesquiterpene endoperoxides.

High herb, phyllanthin and hypophyllanthin yielding cultivar of **Phyllanthus amarus 'CIM-Jeevan'**

*Phyllanthus amarus* (Family: Euphorbiaceae) occurs widely all over India. It is an important medicinal plant known for its hepatoprotective and antiviral properties useful against liver infection. It is also used in stomach troubles like dyspepsia, colic, diarrhoea, dysentery, dropsy and urinogenital problems and also for external application against oedematous swelling, inflammation and as an ingredient in many Ayurvedic preparations especially those used in the treatment of jaundice. Traditionally, the plant is collected from wild to be used in formulations in which the chemical components vary leading to variation in the quality. The need was, therefore, felt to develop a high yielding cultivar for large-scale cultivation saving the wild germplasm. CIMAP has developed the cultivar CIM-Jeevan of *Phyllanthus amarus* through directed breeding efforts having high biomass yield and defined marker chemical profile like phyllanthin and hypophyllanthin for quality validation.

**Eugenol rich cultivar of *Ocimum sanctum* 'CIM-Ayu'**

Tulsi (*Ocimum sanctum*) Family: Lamiaceae is known for traditional medicinal value and also the aromatic properties. It is used in Ayurvedic medicines and pharmaceutical preparations. Due to its anti-oxidant and anti-ageing properties, people use its fresh leaves daily in various ways. At present the production of plant herb and quality oil is quite low. The need was therefore felt to develop a high yielding cultivar for herb and essential oil with better quality. The cultivar CIM-Ayu of *Ocimum sanctum* has been developed by CIMAP through intensive breeding efforts possessing high yield of herb and essential oil with higher eugenol content.

DNA Marker tagged variety 'CIM-Arogya' of *Artemisia annua* for high artemisinin yield

The plant *Artemisia annua* (family: Asteraceae) produces a sesquiterpenoid lactone endoperoxide named artemisinin, which is a promising antimalarial drug effective against *Plasmodium falciparum* and *Plasmodium vivax* at nanomolar concentration. Earlier CIMAP has developed a few varieties of the plant *Artemisia annua*. But it is always beneficial to have diversity in genotypes in different background than a single genotype for commercial cultivation. CIMAP, with this objective, has developed a novel, distinct, high herb and artemisinin yielding genotype of *Artemisia annua* through systematic marker assisted breeding followed by selection of uniform population. The genotype is distinct, uniform and stable, maintainable by continuous rouging of off types in the population using DNA marker at early seedling stage from nursery itself and suitable for commercial cultivation. At the initial stage of selection the high and low artemisinin containing plants are analysed through RAPD and the band consistently present in the high artemisinin containing type is cloned and sequenced. Based on the sequence, forward and reverse primers are synthesized, which are used in subsequent generation to screen out the low artemisinin containing genotypes. One such population of plant represents CIM-Arogya. The genotype 'CIM-Arogya' possesses the traits of increased herb yield than the other check varieties and genotypes. CIM-Arogya produces higher biomass leading to high artemisinin yield. Its genetic make up is distinct in terms of DNA profile. The genotype in the population has expressed a genetic enhancement of artemisinin content to a very high content of artemisinin through strategic marker aided selection indicating the distinctiveness from the parent genotype. The plant has a unique globular canopy.

High menthofuran producing genotype of *Mentha piperita* 'CIM-Indus'

Menthofuran (3,6-dimethyl-4,5,6,7-tetrahydrocoumarone) is one of the major constituents of aroma of the essential oil extracted from the leaves of *Mentha piperita*. Because no other compound has duplicated the aroma effect, menthofuran is important in the formulation of certain synthesized essential oils, such as

peppermint oil. However, menthofuran is an expensive compound of limited availability as the plants produce 0 to 6% menthofuran (US Patent PP11,788). Considering the importance of menthofuran in aroma industry CIMAP has undertaken a systematic approach to evaluate the existing germplasm for high menthofuran biosynthesis in the *Mentha piperita* essential oil.

CIMAP, after thorough screening of the open pollinated seed progenies of the variety 'Kukrail', obtained a high menthofuran and pulegone producing plant chemotype. The selected plant possesses the property of accumulating more menthofuran and pulegone at specific developmental stages. This plant is unique and clearly distinct from all other existing varieties of *Mentha piperita*. The new plant type 'CIM-Indus' can be propagated vegetatively through suckers and twigs for commercial cultivation. The genotype 'CIM-Indus' has a characteristic oil profile which expresses differentially at different stage of growth. The menthofuran content is found to be higher at 75 days stage, which decreases during 95 days and again increases during harvesting time (115 days). The menthol content in the essential oil is negatively correlated to the menthofuran content at corresponding stages of growth. Pulegone content increases after 75 days and stabilizes after 95 to 115 days. No variation of any kind observed in this genotype for the last 3 years of trial maintaining the quality of oil and phenotype. The RAPD analysis of random plant samples in different years of trial also does not show any variation in profiles for this genotype indicating its stability. The genotype 'CIM-Indus' was 54.1%, 50.2% and 51.1% different from the varieties 'Kukrail', 'Tushar' and 'Pranjai' respectively in RAPD analysis establishing the uniqueness of the genotype.

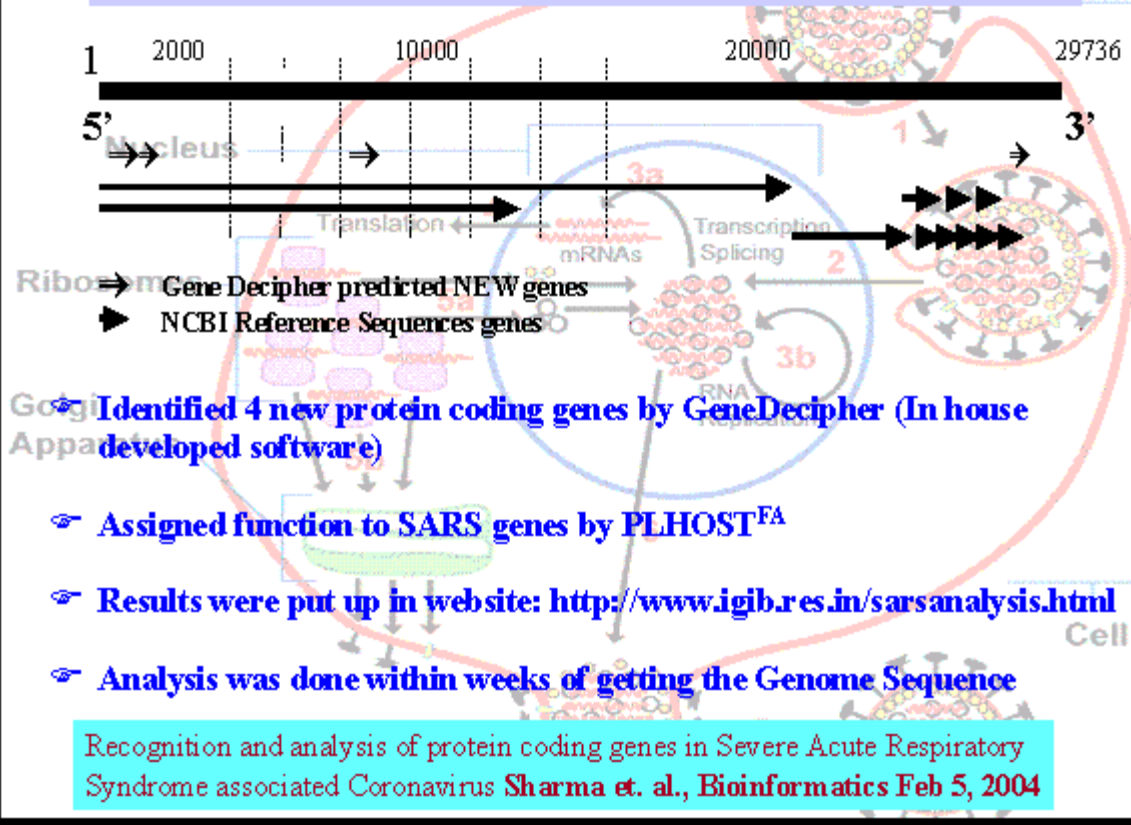
Genomic database yield novel bioplastic producers

Polyhydroxy alcohols (PHAs) are a group of biodegradable plastics produced by bacteria such as *Alcaligenes eutrophes* and *Pseudomonas oleovorans* under certain stress conditions. However, they are more expensive to produce than synthetic plastics. By simple bioinformatic searches of 89 complete and 34 partially sequenced genomes, IGIB has revealed 13 putative PHA producers. Among the identified organisms, *Microbulbifer degradens*, *Burkholderia fungorum*, *Novosphingobium aromaticivorans* and *Rhodopseudomonas palustris* have the ability to degrade a range of biological wastes containing carbon compounds with low nitrogen content. Except *Microbulbifer*, all others are highly significant since they also have the genetic makeup to produce hydrogen in addition to bioplastic.

Recognition and analysis of protein coding genes in Severe Acute Respiratory Syndrome associated coronavirus

The recent outbreak of Severe Acute Respiratory Syndrome caused by SARS coronavirus has necessitated in-depth molecular understanding of the virus to identify new drug targets. IGIB has developed software "Gene Decipher" by using gene prediction method and has done a novel analysis of SARS genome. The software has identified three key proteins in the virus, which are required for multiplication of the virus inside the body. These proteins can act as potential drug targets. The software has also predicted the functions of at least two broad classes of SARS proteins that has so far not been realized by foreign scientists.

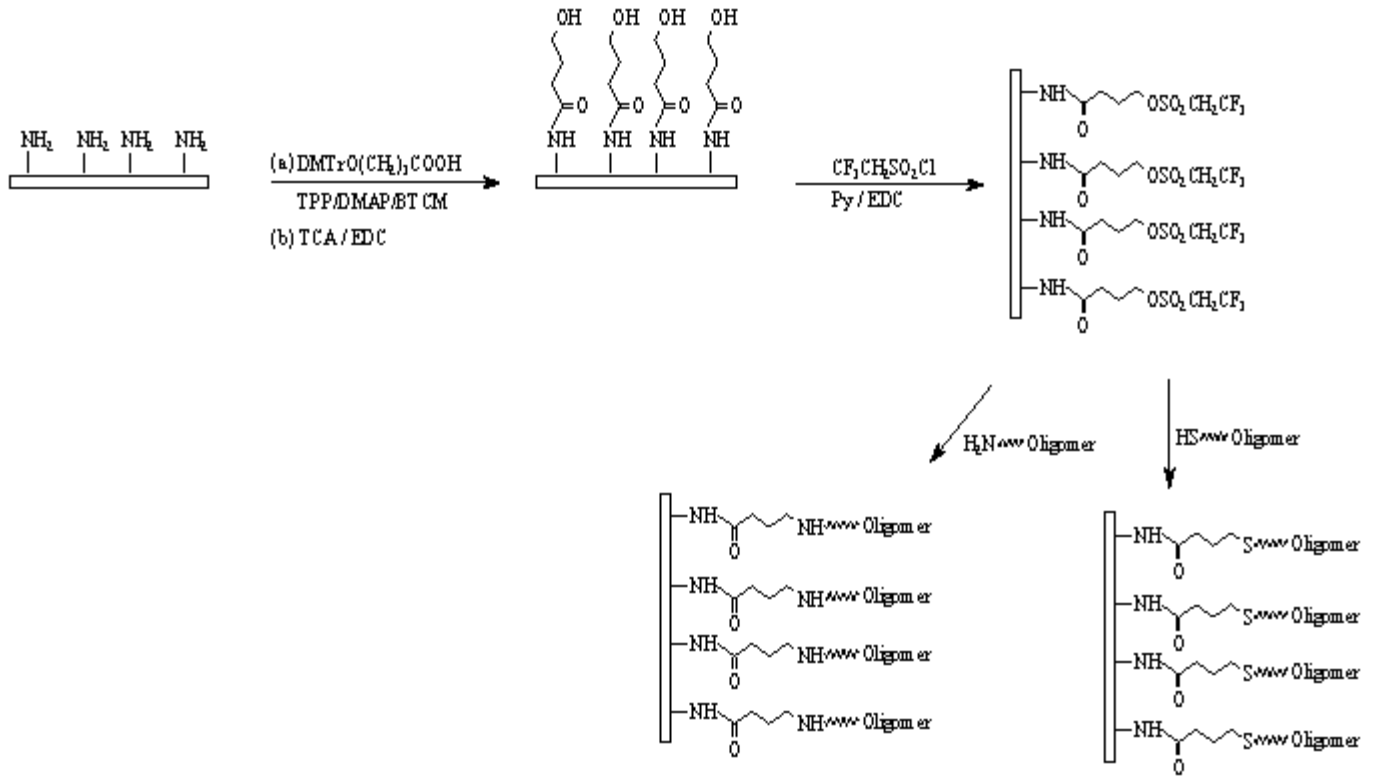
## SARS Genome Analysis using GeneDecipher and PLHOST<sup>FA</sup>



Rapid method for the construction of oligonucleotide Arrays

Recently, micro array has emerged as an important tool for molecular biological studies. IGIB has developed a general and simple method for construction of oligonucleotide arrays. The method is based on post synthesis covalent fixing of oligonucleotides with desired modifications on the desired surface e.g. glass polypropylene, polyethylene and polystyrene into regioselective fashion.

This approach offers great flexibility and accommodates different chemistries as well as surfaces of choice for the synthesis of oligonucleotide arrays.

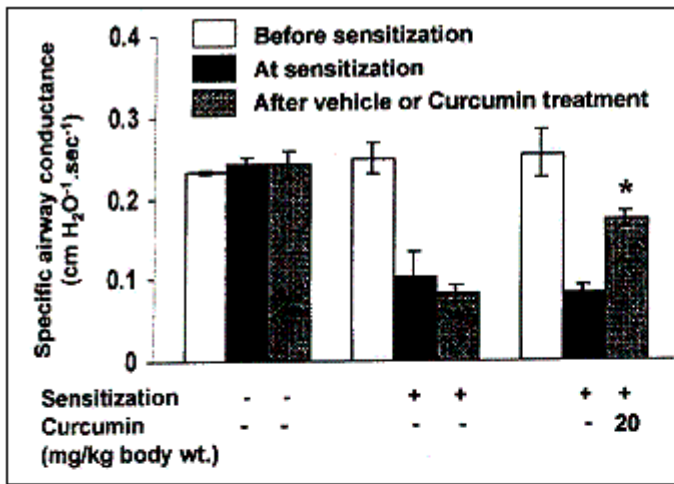


### Immobilization of oligonucleotides

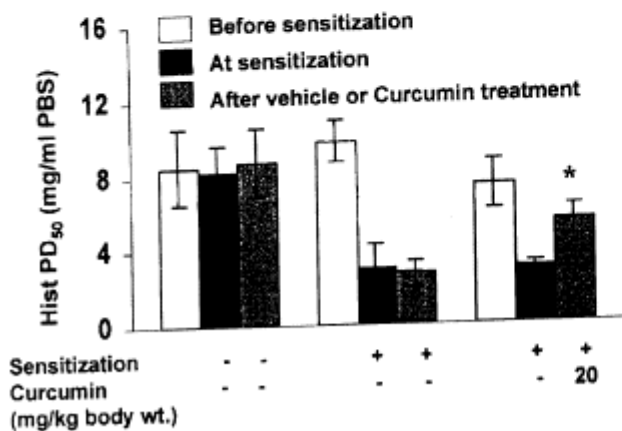
Curcumin attenuates Allergen-induced Airway Hyper responsiveness in sensitized guinea pigs

The guinea pigs sensitized with ovalbumin (OVA) develop certain characteristic features of Asthma: allergen induced airway constriction and airway hyperactivity to histamine. IGIB has tested the Anti-asthmatic property of Curcumin (diferulolymethane), a natural product from rhizomes of *Curcuma longa* in guinea pig model of hyper responsiveness.

The curcumin (20mg/kg body weight) treatment significantly inhibits OVA-induced airway constriction and hyper reactivity and is thus effective in improving the impaired airway in the OVA sensitized guinea pigs.



Curcumin Reverses the Developed airway Constriction



Curcumin decreases Airway Hyperreactivity to Histamine

#### (TG/CA)<sub>n</sub> Repeats in Human Housekeeping Genes

The unraveling of the human genome sequence gives a new opportunity to investigate the role of repetitive sequences in gene regulation.

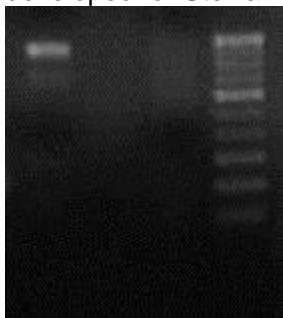
IGIB has analyzed the distribution of (TG/CA)<sub>n</sub> (n<sup>3</sup> 6) unit repeats in human housekeeping gene on which recently released gene chip data is available. The results indicate that (i) the no. of short (TG/CA)<sub>n</sub> repeats is higher than the number of long repeats. (ii) The proportion of genes with (TG/CA)<sub>n</sub> repeats (n<sup>3</sup> 12 units) have lower mean expression levels compared to those without these repeats and (iii) The genes belonging to the functional class of signaling and communication have a positive association with repeats and the genes belonging to information class are negatively associated with the repeats.

Mean expression levels of housekeeping genes without (TG/CA)<sub>n</sub> repeats and with intragenic long (n<sup>3</sup>12) (TG/CA)<sub>n</sub> repeats.

#### Cloning of kaurene synthase from Stevia

IHBT has successfully cloned 800 bases of kaurene synthase from Stevia that shared about 80% homology with kaurene synthase from Lactuca sativa and Cucumis sativus. Stevia rebaudiana is 300 times sweeter than sucrose and sweetness is mainly attributed to the water soluble white compounds, stevioside and rebaudioside. Steviosides are polycyclic diterpenes synthesized from geranyl geranyl diphosphate. Kaurene synthase is an important enzyme in the pathway catalysing the conversion of copalyl diphosphate into kaurene. A complete

package of production technology including nursery development, cultivation practices, and processing has been developed for *Stevia rebaudiana* .

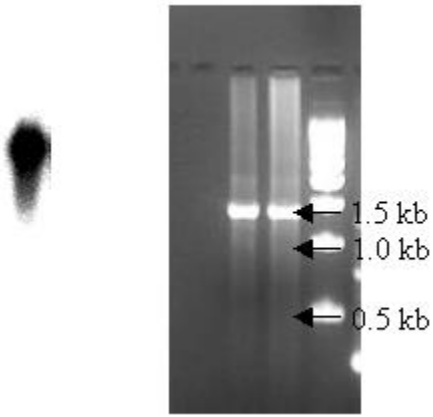


Amplification of cloned kaurene synthase gene from *Stevia*

The plant is of immense importance because of the zero calorie Steviosides and Rebaudiosides in its leaves. The crop is mainly propagated by stem cuttings. Seed germination is a problem in this plant due to high incompatibility, but cross pollination of two lines resulted in production of viable seed with 35-40% germination rate. IHBT has supplied planting materials to CSK Himachal Pradesh Krishi Vishvavidyalaya for further extension at farmers field. Nursery plants have been provided to growers in Haryana, J&K, Karnataka, New Delhi and Uttaranchal. A process has also been developed at lab scale for the production of Steviosides.

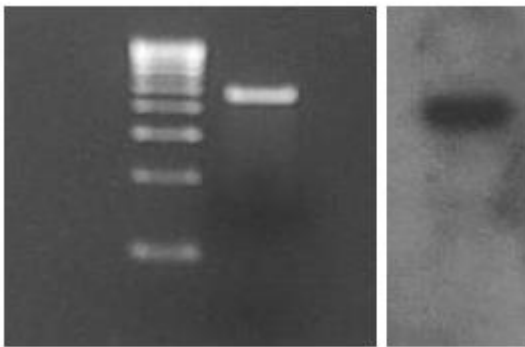
#### Clone of niche pathway genes from tea

Catechins are important pharmaceutical compounds preventing cancer by inhibiting urokinase enzyme and are strong antioxidants. They are known to be the taste controller in tea. While the biochemistry of catechin biosynthesis in tea is known, the control points and molecular aspects have not been considered. To engineer the pathway for its desired modulation in the clone or the plant of choice, or to synthesize the flavonoid compounds in vitro for use in pharmaceutical and other relevant industries, it is important to clone the niche-pathway genes from tea. IHBT successfully cloned the following 3 genes of the pathway. (i) Gene for dihydroflavanone reductase (DFR): A 1.4 kb fragment showed homology with the reported sequences of DFR. The region 119 to 1078 showed 84% homology with DFR of *Rhododendron simsii*. Cloned sequence had a start and end codon at positions 117 and 1160, respectively. Northern hybridization confirmed the size of the fragment to be 1.4 kb. (ii) Gene for phenyl alanine ammonia lyase (PAL): A 2.3 kb fragment showed homology with the reported sequences of PAL. The region 176 to 693 showed 84% homology with PAL of *Rehmannia glutinosa*. Cloned sequence had start codon at 132. Northern hybridization confirmed the size of the fragment to be 2.3 kb, and (iii) Gene for chalcone synthase (CHS): A 1.4 kb fragment showed homology with the reported sequences of CHS. The region 4 to 761 showed 84% homology with CHS of *Hydrangea macrophylla* . Cloned sequence had start codon at position 72. Northern hybridization confirmed the size of the fragment to be 1.4 kb.



confirmation of clone by northern analysis

PCR Amplification of cloned full-length cDNA of DFR and



confirmation of clone by northern analysis

PCR Amplification of cloned full-length cDNA of PAL and

Alstroemeria (*Alstroemeria hybridus*) is an exotic high value cut flower crop belonging to the family Alstroemeriaceae. IHBT procured nine different coloured cultivars of Alstroemeria from Shimla, Ooty and Bangalore and under a project sponsored by the National Horticultural Board developed a complete agrotechnology package. High quality planting materials have been distributed to flower growers of the region. Responding to the increased demand for the plant, two demonstration units of alstroemeria were established at Kandwari, Dist. Kangra and Mohal, Dist. Kullu by IHBT.



Cultivation of Alstroemeria

Tumor inhibitors developed by rearranged diterpenoids with novel skeleton

IICB has rearranged diterpenoids possessing of the uncommon 4a-methyl tetra- or hexa-hydrofluorene skeleton like dichroanals A, B and dichroanone isolated recently from natural sources. The first total synthesis of ( $\pm$ ) dichroanal B and ( $\pm$ ) dichroanone have now been achieved through a common hexahydrofluorene intermediate obtained via Pd (0)-catalysed reductive cyclisation of a substituted 2-(2-bromobenzyl) methylene cyclohexane. This simple and convergent route utilises a number of novel reactions and is suitable for the preparation of other members of the family, which include potential tumour inhibitors.

### ***Identification and characterization of adsorbed serum sialoglycans on Leishmania donovani promastigotes***

Sialic acid as terminal residues of oligosaccharide chains play a crucial role in several cellular recognition events. Using fluorometric high-performance liquid chromatography showing Neu5Ac and, to a minor extent, Neu5,9Ac2 IICB has confirmed the presence of sialic acid on promastigotes of *Leishmania donovani*, the causative organism of Indian visceral leishmaniasis. The presence of Neu5Ac was confirmed by GC/MS analysis. Furthermore, binding with sialic acid-binding lectins *Sambucus nigra* agglutinin (SNA), *Maackia amurensis* agglutinin (MAA), and Siglecs showed the presence of both  $\alpha$ 2,3- and  $\alpha$ 2,6-linked sialic acids. Concomitant western blotting of parasite membranes and culture medium with SNA demonstrates the presence of common sialoglyconjugates (123, 90, and 70 kDa). Similarly, binding of MAA with parasite membrane and culture medium shows three analogous sialoglycans corresponding to 130, 117, and 70 kDa, indicating that  $\alpha$ 2,3- and  $\alpha$ 2,6-linked sialoglycans are adsorbed from the foetal calf serum present in the culture medium. *L. donovani* promastigotes also reacted with Achatinin-H, a lectin that preferentially identifies 9-O-acetylated sialic acid in  $\alpha$ 2 $\rightarrow$ 6 GalNAc linkage. This determinant is shown to be present on parasite cell surfaces by cell agglutination, ELISA, and flow cytometry, where its binding is abolished by pre-treatment of cells with a recombinant 9-O-acetyl esterase derived from the HE1 region of the influenza C esterase gene. Additionally, binding of CD60b, a 9-O-acetyl GD3-specific monoclonal antibody corroborated the presence of terminal 9-O-acetylated disialoglycans. The results indicate that sialic acids ( $\alpha$ 2 $\rightarrow$ 6 and  $\alpha$ 2 $\rightarrow$ 3 linked) and 9-O-acetyl derivatives constitute components of the parasite cell surface. This is a major finding as sialic acid source is very cheap.

### **Characterization of Integrase and Mechanism of recombination**

Characterization of the integrase gene of this phage is an important aspect as it has a wide host range. In order to purify the integrase protein, it was over-expressed in *E. coli*. There is very good expression though most of the protein goes to inclusion bodies. It is noticed by IMT that as the protein expresses, *E. coli* cells start dying. Cells death and protein expression are directly related. Further, to get the integrase protein in its native form, a vector which carries *E. coli* chaperone genes (*groEL/groES*) under constitutive promoter is used. Thus expression of chaperone genes is independent of any outside force. In this particular condition, when integrase gene is allowed to express in presence of chaperone genes, the chaperone protein does not express while under control condition where integrase is not present or some other gene is present, chaperone production does not get affected. Thus, the fate of the vectors, which carry the integrase gene as well, as chaperone genes is checked.



During the course of the analysis of integrity of these two vectors, scientists of IMT discovered that the two vectors have recombined. Further analysis of the recombined product revealed that recombination has occurred in such a way that the integrase gene is intact but the chaperone gene that is groEL/groES was lost. Thus, the final recombination product is devoid of groEL/groES genes. It is further intriguing because the phage, which carries the integrase gene under study, does not infect E. coli but caused recombination in such a way that the E. coli groEU/groES gene was lost. It appears that the phage attachment site is close to or within the groEL/groES gene in other organisms as well. Because the groEL/groES gene is ubiquitous and highly conserved, apparently phage is evolved with a general mechanism of recombination and that is the reason it has such a wide host range.

### **Mycobacterial serine/threonine kinases characterized**

Analysis of Mycobacterium tuberculosis genome sequence reveals the presence of genes encoding eukaryotic-type serine/threonine kinases and phosphatases. Among eleven such putative kinases, it is found by IMT that PknA is located adjacent to the genes encoding bacterial morphogenic proteins and in close proximity of the only serine/threonine phosphatase, PPP. The results corroborated well with the phylogenetic analysis and placed PPP as a PP2C family of bacterial protein phosphatase homologue. Furthermore, mutations in a few invariant amino acid residues (Glu-24, Asp-38 and Gly-117 mutated to Ala, Ala and Asp respectively) characteristic of this group of phosphatases completely abolished the enzyme activity.

Inspection of the bacterial genomes has revealed the genetic linkage between SerThr kinases and phosphatases, suggesting that phosphatases are reversing protein phosphorylation reactions catalyzed by linked kinases. Therefore, detailed in vitro studies were carried out to assess the ability of PPP to interact with PknA. PknA has been shown to phosphorylate known exogenous substrates. The ability of PPP to dephosphorylate the artificial substrates phosphorylated by PknA was therefore examined. Casein was labelled with  $\gamma$ -<sup>32</sup>P in the presence of PknA followed by the initiation of dephosphorylation reaction by the addition of PPP. It was observed that PPP dephosphorylated labelled casein. However, dephosphorylation was not observed in the presence of boiled PPP, thereby ensuring the validity of the experiment. 1-338 deletion mutant of PknA possessing the catalytic domain and the Ala/Pro-rich region exhibited autophosphorylating ability. The mutant is also able to phosphorylate the exogenous substrate, like casein and is efficiently dephosphorylated in the presence of PPP.

In protein-protein interaction studies, PknA is observed to phosphorylate at least a -56 kDa soluble protein from E. coli. To elucidate the possibility of dephosphorylation of this -56 kDa protein by PPP, soluble fraction of cell lysates from E. coli strain DH5a incubated for 10 h at 4°C with MBP-PknA fusion protein immobilized on amylose resin.

The observations establish that genetically linked mycobacterial SerThr kinase and phosphatase (PknA-PPP) form a functional unit in vitro.

*Identification of a mediator of Rhp6 in gene silencing in fission yeast*

The concept of histone code developed during the last few years envisages a dynamic and integral role of nucleosomal structure comprising various post-translational modifications, like acetylation, methylation and ubiquitination, in serving as important determinants of the expression or silencing of genes. IMT has identified RAD6/Rhp6 as an important molecule in this respect. It performs a role in ubiquitylation of H2B, which, in turn, is necessary for the methylation of histone H3 at lysine 4 position and eventually in silencing in the budding yeast. Corresponding information regarding the mechanism of action of Rhp6 in *S. pombe* is lacking. The studies have led to identification of a protein called Uhp1, as a target for Rhp6-mediated ubiquitylation in *S. pombe*. This protein interacts with histone H28 in vitro and associates with chromatin during S phase, where it is thought to play a transient role in chromatin remodelling at the silent mating type loci.

Potent role of the vaccines prepared from macro phages infected with live bacteria in protection against *M. tuberculosis* and *S. typhimurium* infections.

The study carried out by IMT describes a novel and simple vaccination strategy, involving culturing live *M. tuberculosis* and *S. typhimurium* in syngeneic, allogeneic and xenogeneic macrophages, followed by drug treatment and gamma-irradiation to kill the bacteria. It is observed that the lymphocytes obtained from the vaccinated animals proliferated and secreted mainly IFN- $\gamma$  and IgG2a but not IL-4 and IgG1. The enumeration of viability of *M. tuberculosis* by CFU indicates a significant level of protection in the vaccinated mice upon challenge with live *M. tuberculosis*. This vaccination strategy worked successfully not only for tuberculosis but also shows significant decrease in mortality of mice challenged with live *S. typhimurium*.

Relation between organochlorines and breast cancer in India

Organochlorine pesticides are widely distributed among the general population and could be risk for breast cancer among women in India. ITRC has studied the environmental exposure of organochlorines pesticides considering it as potential risk factor for breast cancer. The scientists collected blood samples from Sir Ganga Ram Hospital, New Delhi and monitored the level of DDT, DDD, DDE and isomers of HCH in the blood and surrounding breast tissues and tumor in women suffering from benign or malignant breast diseases. Results show that p, p' -DDE level was significantly higher both in benign and malignant specimens as compared to other pesticide's level ( $p < 0.05$ ). Pesticide levels in blood were higher in malignant than benign cases. This preliminary data based on only 50 cases reaffirms the suspicion of organochlorines as one of the risk factors for breast cancer in women and lays down the basis for further study with larger sample size involving all the confounders of the disease to arrive at a statistically significant association between exposure to organochlorine pesticides and breast cancer.

Persistent chlorinated pesticides and intra-uterine fetal growth retardation: a possible association

ITRC has studied the association between DDT (dichlorodiphenyl trichloroethane) and HCH (hexachlorocyclohexane) exposure and intra-uterine growth retardation. There seems to be a statistically significant association between maternal blood levels of  $\alpha$ -HCH,  $\gamma$ -HCH,  $\delta$ -HCH total HCH and p, p' DDE and IUGR after adjustment for potential confounders. A significant association between cord blood levels of  $\gamma$ -HCH,  $\delta$ -HCH total HCH and IUGR was also found after adjusting for potential confounders. A significant negative correlation between body weight of newborn babies and p, p'-DDE in maternal blood and  $\delta$ -HCH and p, p'-DDE in the cord blood is noticed after accounting for the gestational age. The results suggest an association between organochlorine pesticide levels and higher incidence of IUGR in pregnant women.

#### Paraneural cell transplantation in animal model of Parkinson's disease

Fetal neural transplantation approach is the recent approach for restorative potential in neurodegenerative diseases (Parkinson's diseases, Alzheimer's etc). In order to substitute the fetal brain cells for transplantation in animal model of Parkinson's disease, ITRC used paraneural cells olfactory ensheathing cells (OEC), which have substantial advantages in providing the trophic support for long-term functional restoration of fetal cell. Significant long term functional restoration was observed in rodent model of Parkinson's disease where OEC are co-transplanted with dopaminergic rich fetal brain cells (ventral mesencephalic cells) over the group of animals transplanted fetal dopaminergic rich cells. Functional restoration was assessed using neurobehavioral, neurochemical & immunohistochemical parameters. Functional viability of dopaminergic cells in co-transplanted animals is reflected in the Immunohistochemical studies of specific transplanted brain region.

#### Development of electrochemical technique based on transition metal complex modified electrode for detection and oxidation of phenol

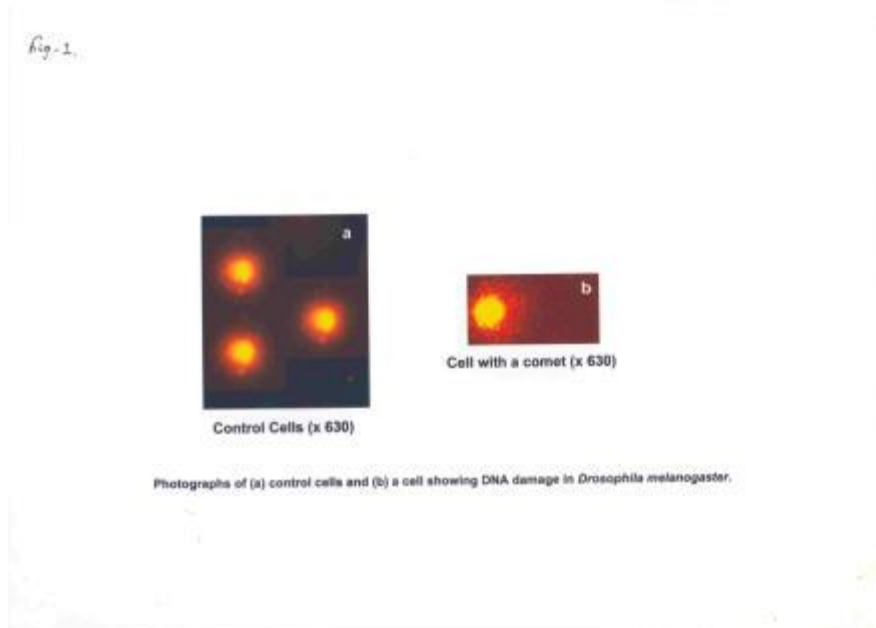
A new octahedral high spin Ni (II) and Co (II) mixed ligand complex with cyclam (14 ane N<sub>4</sub>) and thiocyanate is synthesized and characterized by UV, visible, fluorescence and electrochemical techniques. Metal-cyclam-thiocyanate complexes are quite stable under ambient conditions. Redox properties and fast electron transfer properties of these complexes have been determined by electrochemical analysis by ITRC scientists. These properties are attributed to existence of the higher oxidation states of central metal ion in these complexes. The synthesized complexes can be used as catalysts for detection and catalytic oxidation of the phenolic compounds in wastewater effluent samples.

The complexes are used for construction of chemically modified electrodes by incorporating them in graphite paste to achieve the catalytic oxidation of the organic compounds. Due to their fast electron transfer property these complexes have potential to detect and oxidize the ppb level of the phenolic compounds viz. (phenol, chlorophenol and aminophen etc.) in waste water/effluent samples.

The direct beneficiaries of these findings are soap, fertilizer and tannery industries that might be in quest of such technology to detect phenolic contents in the effluents. In addition, regulatory bodies may be indirect users of the technology.

## **in vivo genotoxicity of cypermethrin in *Drosophila melanogaster* evaluated using alkaline Comet assay**

Use of animal models that are alternative to mammals, for research, education and testing, is the need of the hour. The insect, fruit fly *Drosophila*, has been recommended by different agencies for toxicological studies. ITRC has evaluated in vivo genotoxicity of synthetic pyrethroid pesticides, cypermethrin. Freshly emerged first instar larvae (22±2H) were exposed to the food that contained different concentrations of cypermethrin (0.0004, 0.0008, 0.002, 0.2 and 0.5ppm), and were allowed to grow. At 96±2h stage, brain ganglia and anterior mid gut from control and treated larvae were dissected out, single cell suspension was prepared, and single cell gel electrophoresis (SCGE) comet assay, was performed. The results reveal a significant dose-dependent increase in DNA damage in the cells of brain ganglia and anterior mid gut of *Drosophila melanogaster* as compared to control. The cypermethrin manifested in vivo genotoxicity, even at very low concentrations, affirms the concept that comet assay of *Drosophila* can be a very successful model for in vivo genotoxicity assessment.



The data provide new insights into the use of *Drosophila melanogaster* as an alternate animal model for in vivo genotoxicity assessment using comet assay. The usefulness of the modified method of comet assay for the evaluation of in vivo genotoxicity in *Drosophila melanogaster* will be further validated using known genotoxicants.

## **The Novel Insecticidal D - Endotoxin Developed for Plant Protection**

NBRI has designed a hybrid d-endotoxin protein with insecticidal activity against the larvae of a polyphagous lepidopteran insect pest *Spodoptera litura*, which is tolerant to most of the known d-endotoxins. The hybrid d-

endotoxin has been created by replacing amino acid residues 530 to 587 in a poorly active natural Cry1Ea protein, with 70 amino acid region of Cry1Ca in domain III. The truncated d-endotoxins Cry1Ea, Cry1Ca and the hybrid protein Cry1EC accumulated in *Escherichia coli* to form inclusion bodies. The solubilised Cry1EC made from *E. coli* was four fold more toxic to the larvae of *S. litura* than Cry1Ca, the best-known d-endotoxin against *Spodoptera* sp. A gene coding for the novel hybrid toxin was designed for high level of expression in dicot plants and introduced in tobacco and cotton. The resulting transgenic lines were highly resistant to the target pest. Studies on the d-endotoxin protein showed that the protein folds into a functionally more active form in plants rather than *E. coli*. The d - endotoxin proteins developed at NBRI are of interest to agriculture since these can be deployed for developing transgenic insect resistant cultivars. The research at NBRI has led to the development of such cultivars of cotton. The transgenic lines have been licensed by NBRI to cotton seed industry.

### **Revegetating Fly-Ash Landfills with *Prosopis juliflora* L**

NBRI has evaluated the feasibility of growing a legume species, *Prosopis juliflora* L., on fly ash ameliorated with combination of various organic amendments, blue green algal biofertilizer and *Rhizobium* inoculation. Significant enhancements in plant biomass, photosynthetic pigments, protein content, and *in vivo* nitrate reductase activity were found in the plants grown on ameliorated fly ash in comparison to the plants growing in unamended fly ash or garden soil. There is higher growth in fly ash amended with blue green algae than farmyard manure and press mud, a waste from sugar industry, the growth attributed to the greater contribution of plant nutrients, supply of fixed nitrogen and increased availability of phosphorus. Nodulation is suppressed in different amendments of fly ash with soil in a concentration-duration dependent manner, but not with other amendments. Plants accumulated higher amounts of Fe, Mn, Cu, Zn and Cr in various fly ash amendments than in garden soil. Further, inoculation of the plant with a fly ash tolerant *Rhizobium* strain conferred tolerance for the plant to grow under fly ash stress conditions with more translocation of metals to the above ground parts. The results showed the potential of *P. juliflora* to grow on fly ash landfills and to reduce the metal contents of fly ash by bioaccumulation in its tissues.

### **Transgenic Cotton Lines**

Transgenic cotton cultivars that express d - endotoxins have been globally accepted as a solution to enhancing cotton productivity, saving farmers from toxic exposure to the pesticides and providing an environmentally safe technology. NBRI has designed and chemically synthesized two genes coding for the insecticidal D - endotoxin proteins targeted against pests that defoliate cotton crop and seriously damage the bolls. The genes have been deployed for the development of transgenic cotton lines. This is the first agronomically valuable transgenic technology developed in India that has been accepted by seed industry for commercialization. The cotton cultivars made transgenic with the NBRI d - endotoxin genes provide a globally competitive agribiotech solution to the problem of insects in agriculture.

Seven reputed Indian cottonseed companies, including Nuziveedu Seeds, who own the largest market share and together represent 30% of Indian cottonseed market, have joined together to make a consortium. The NBRI Bt – cotton has been licensed to the consortium, registered as Swarnabharat Biotech Pvt. Ltd., Hyderabad.

### ***High Yielding Varieties in Opium Poppy***

On the basis of multilocational performance, a high yielding variety NBRI-10 of opium poppy has been developed following pedigree method of cross IC30 x IS 10 and released for commercial cultivation. On the basis of 3 years locational trial following standard cultural practices, the average yield is around 63.0 kg opium yields per hectare and 13.0 q seed yield per hectare. The morphine content in opium latex appears to be as high as 17 percent. It has recorded 22.0%, 15.0% and 10.0% higher yield for opium, seed and morphine content respectively over local check 'BROP-1'- a synthetic and commercial variety of the region and about 26.0% (opium yield), 24.0 % (seed yield) and 13.0% (morphine content) over national check IC-42.



High yielding Opium Poppy

This variety is moderately resistant to downy mildew, tolerant to lodging and widely adoptable.

### ***Nutraceuticals / Functional Foods developed from Natural Antioxidants***

NBRI has identified certain promising plant sources of carotenoids (Carotenoids 30-50 mg/100g; antioxidant activity >80 % Fresh wt) available in abundance to develop functional foods/nutraceuticals based on the results of screening programme. These natural sources can be used for large-scale extraction of carotenoids. The results may be of significant importance for utilization of under utilized parts from herbal industries, weeds and

agricultural waste etc. for their phytonutrients/phytochemicals and nutraceutical potential in order to identify the low cost basic raw material for the isolation of antioxidants.

## **Aspartic protease inhibitor**

The human immunodeficiency virus (HIV), the causative agent of the acquired immunodeficiency syndrome (AIDS) requires the HIV protease enzyme in order to multiply, making this enzyme an excellent target for developing drugs against the virus. The enzyme inhibitors have not only provided effective therapeutic agents for the treatment of diseases but also have led to a detailed understanding of enzyme mechanisms.

NCL has isolated an extremophilic *Bacillus* sp, which produces an aspartic protease inhibitor (ATBI). ATBI has been shown to inhibit recombinant HIV-1 protease, pepsin, and the protease from the fungus *Aspergillus saitoi*. ATBI inhibited human pathogens like *Candida* and *Aspergillus* species effectively as seen in the microscopic studies. Based on the amino acid sequence of the natural inhibitor a peptide was synthesized. Currently the potency of the synthetic peptide and the analogues is being evaluated against HIV-1 protease in vitro. A few peptidic inhibitors isolated from plant and microbial sources are being characterized.

## **Biochemical molecular studies on non-mulberry silkworms**

The muga silkworm, *Antheraea assama* is very susceptible to bacterial infection called "Flacherie" caused by *Pseudomonas aeruginosa* and develops certain symptoms such as poor appetite, retarded growth, black body fluid and hanging upside down. Several known outer membrane permeabilizers increase susceptibility of a highly resistant pathogenic strain *Pseudomonas aeruginosa* AC-3 to different antibiotics and plant extracts. Of all the chemicals tested RRL-Jorhat found, EDTA, sodium citrate and sodium hexametaphosphate (HMP) potent permeabilizers as shown by enhanced lysis of the bacteria in the presence of lysozyme. In the presence of EDTA and sodium citrate susceptibility of the strain to gentamicin and rifampicin increased markedly. The strain was resistant to vancomycin but became susceptible when grown in the presence of increasing amounts of EDTA and sodium citrate. RRL-Jorhat found EDTA to be most potent permeabilizer in enhancing the activity of the plant extracts. The strain *P. aeruginosa* AC-3 causes heavy economic loss to farmers by damaging entire broods of muga silkworm.

### **In vitro micropropagation of High Altitude Himalayan plant *Hedychium spicatum***

RRL-Jammu has standardized rapid in vitro micropropagation protocol for mass propagation of *H. spicatum* collected from the Darjeeling hills. The vegetative propagation through rhizomes is very slow and takes 2-3 years. Multiple shoot cultures were established from pre-existing buds of rhizomes on MS medium. Liquid medium is more suitable. A successful protocol was developed that gives 99 % root formation and 80-85% survival in the field. The rhizome extracts of the plant are used as pharmaceutical in blood purification, bronchitis, indigestion, eye diseases and inflammations.

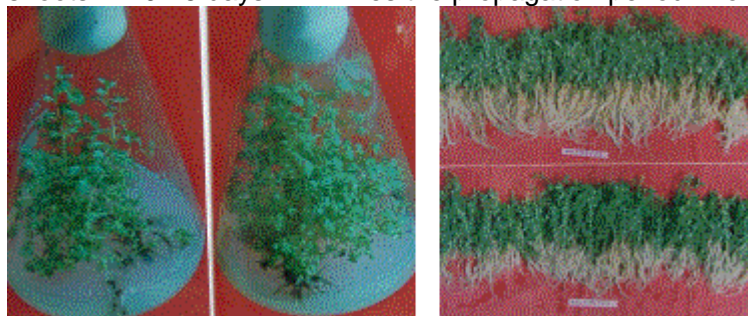
### **Micropropagation of *Hedychium spicatum***

Hyperforin isolated from St. John's Wort, ***Hypericum perforatum*** by Semipreparative HPLC technique

RRL-Jammu has developed a novel HPLC process for the isolation of 98% pure bioactive constituent, Hyperforin from St. John's Wort, *Hypericum perforatum*. Hyperforin is the natural antidepressant compound. The earlier reported extraction and isolation method uses antioxidants. The HPLC method does not use antioxidants and the yield is 1% of dry plant material.

#### ***Micropropagation of antidepressant plant-St. John's Wort, Hypericum perforatum***

RRL-Jammu has developed rapid in vitro and ex vitro micropropagation protocols for mass propagation of St. John's Wort, one of the popular herbal remedies for mild and moderate depression. The compounds involved in antidepressant activity are hypericins and flavonoids. The mass propagation of 5 cm long in vitro developed shoots in 10-15 days minimizes the propagation period. More than a lakh plantlets were developed.



#### ***Immunopotentiating properties of Cryptolepis buchanani***

In Ayurvedic system of medicine,

#### ***Cryptolepis buchanani***

is used as antidiarrhoeal, antibacterial, antiulcerative, anti-inflammatory, blood purifier, for cough and for lactation for women and for rickets in children. RRI-Jammu has conducted experiments in animal models, which show immunostimulant activity of the plant. This shows the plant could be used in immunodeficiency associated with diseases like AIDS and cancer.

A novel enantioselective hydrolysis from

#### ***Bacillus subtilis***

RRL-Jammu has isolated a novel enzyme designated BBS1 from *Bacillus subtilis*, exhibited enantioselectivity ( $ee = 99\%$ ) with acyl derivatives of unsubstituted and substituted 1-(phenyl) ethanols and 1-(6-methoxy-2-naphthyl) ethanols. The enzyme is purified to above 90% and the yield was 26%. The purified enzyme was a 45KD monomer. The optimum activity is reported at 37°C, pH 8.0 and is stable up to 40°C, pH 6-10. The bacterial lipases are used as catalysts for both hydrolysis and synthesis of long chain acyl glycerols with high regioselectivity and enantioselectivity. The microbial lipases have wide application in organic chemistry and biotechnology.

#### ***A new rat urinary metabolite of piperine identified& characterized***

Piperine, an active alkaloid of black pepper has great clinical significance as a bioenhancer. RRL-Jammu has detected a new major urinary metabolite in rat urine. The metabolite is partially purified by using reverse phase column chromatography. The metabolite has a unique structure when compared to the earlier reported metabolites that the methylenedioxy ring and conjugated double bonds are retained whereas the piperine ring is



modified to form propionic acid group. In rats, the kidney seems to be the major excretion route for piperine metabolites as no metabolite could be detected in faeces. LC/NMR-MS studies were conducted to understand the metabolism of the new metabolite.

### ***Extraction and purification of natural edible colours Bixin from Annatto***

Annatto is the seed of the tropical bush *Bixa orellana* and its products are bixin and norbixin. These products have shade of yellow, yellow-orange to orange and are used as natural edible colours. RRI-Jammu has optimized the process of extraction and purification of Bixin from Annatto seeds through solvent extraction which yielded 6.8% of crude bixin. The purification method has been standardized to get pure bixin with 18.6% carotenoids. The process has a capacity of 10 Kg level.

## **1.2.2 HUMAN RESOURCE DEVELOPMENT**

### **CCMB**

- Hands on Training Course on “DNA markers: Development and Applications” – February 25 to March 12, 2004
- A Two-Day Symposium on “Comparative and Functional Genomics” on February 23& 24, 2004
- Workshop on Digital Library Development for Information Workers in South Asia organized by UNESCO-DSIR-CCMB was held from 28th Jan to February 7, 2004, wherein 18 persons from all over South Asia participated
- Indo-French Interactive Seminar on Bioinformatics and Proteomics was held on December 15& 16, 2003, wherein 50 participants took part.
- Workshop on “Priorities of research and HRD in fisheries biotechnology” was held on August 25, 2003, wherein 45 persons from all over India participated.
- **Innovative approach of training by collaboration**  
CCMB conducts Summer Training Programme for M.Sc. students every year in the month of May-June. During the year, about 28 M.Sc. students were chosen on a national basis for a hands on research training.
- During the year, 38 M.Sc. students have carried out their 6 months Project work in the area of human genome diversity in tribal populations.

### **Training under cooperation with Indian Universities**

- CDRI has provided six-months training (PS II) to 18 students of Birla Institute of Technology& Science (BITS), Pilani on monthly stipend in various R&D disciplines of the Institute.
- One scientist of IHBT was trained at CDRI in the field of sophisticated instruments.
- More than two hundred post-graduate students from Indian Universities& sponsored personnel were trained in the field of Tissue Culture, Medicinal Chemistry, Biochemistry and Molecular& Structural Biology.

- Seven sponsored personnel from Industry & Academia were trained in Management of Laboratory Animals, Drug design and Synthesis, Clinical & Experimental Medicine and Quality Control & Drug Delivery system.
- Short-term training was given to one WHO sponsored fellow from Bangladesh in Pharmacological evaluation & Endocrinology & one fellow from Netherlands in Toxicity evaluation.

### **CIMAP**

- CIMAP Summer School was organised on "Molecular Techniques in Bioprospection and Biodiversity Analysis" during 1 June - 15 July, 2003 to expose the young students and investigators to the modern biological techniques such as DNA cloning, bio-prospecting bio-active molecules and gene (s), plant transformation and plant DNA fingerprinting.
- CIMAP Winter School on "Recent techniques in gene cloning, DNA analysis and Functional Genomics" was held at CIMAP, Lucknow during 1-10 December, 2003
- CIMAP organized the CSIR sponsored CIMAP Refresher Course (CRC-2003) at Lucknow during 6-26 April 2003. Twenty participants from CSIR, ICAR and Universities participated in the programme that covered lectures on recent advances in traditional and modern subjects of biological sciences in plant system.
- CIMAP organized the two days CPYLS (CSIR Programme on Youth for Leadership in Science) programme during 19-20 December, 2003 for the state of Uttar Pradesh.
- CIMAP organized eleven training-cum demonstration programmes in different parts of the country through which 550 persons were provided technical knowledge and guidance for cultivation, processing, marketing, etc. for quality production of medicinal and aromatic plants of economic importance.
- Two days training-cum-demonstration programme was organized by CIMAP's Resource Centre, Pantnagar on 7-8 February for technical staff of Horticulture Department, Uttaranchal Govt., regarding cultivation and post harvest technology of medicinal and aromatic plants related to hilly areas of Uttaranchal.
- A Farmer's demonstration programme on medicinal plants was conducted on 21.01.2004 at CIMAP's Resource Centre, Bangalore where 42 farmers including 22 women participated. Cultivation and post harvest techniques and handling of medicinal plants and advantages of intercropping were explained and they shown the live demonstration. Officer from BABARD explained the activities of the bank to the farmers and a meeting with CEO of Karnataka State Medicinal Plants Authority was also arranged.
- To create awareness about the production of vermicompost from distillation and other farm waste, training was imparted to 180 farmers at CIMAP on March 5, 2004, where demonstration on raising of menthol mint nursery, transplanting, distillation and practices followed in vermicomposting were arranged.

## **IGIB**

- 34 Ph.D. scholars (JRF/SRF) joined IGIB.
- 35 students summer trainee/project trainee worked for completing their post-graduate degree.
- 22 medical practitioners were trained in the field of Respiratory Allergy during 30th workshop on “Diagnosis and Management of Respiratory Allergy” organized jointly by IGIB and V .P. Chest Institute from June 4-10, 2003.
- CPYLS organized for students of Punjab& Chandigarh.
- Training Programme on “Fungal Taxonomy: Classical& Molecular Approaches” was conducted by Microbial Type Culture Collection during March 3-19, 2004.

## ***IHBT***

- Training of Tea Planters
- One day training-cum-awareness meeting for the tea planters of Himachal Pradesh was organized on May 1, 2003, The main objective of this meeting was to sensitize the tea planters of Kangra valley on value addition and tea product diversification. The meeting was attended by forty participants including tea planters from different tea growing zones of the state, representatives of Regional Cooperative and private tea manufacturing units, and Technical Officer (Tea), Department of Agriculture, H.P. Government.
- Two-day programme on field management of tea, was organised by the Institute on October 8-9, 2003. Twenty nine participants including tea growers from Bir, Baijnath, Palampur and Dharamshala divisions and personnel from the State Department of Agriculture stationed at "Chay Bhawan", Kalu-di-Hatti attended the training. During the training, the tea planters observed that the improved agrotechniques and state-of-art manufacturing process should be adopted for higher production of better quality tea.
- In addition to these trainings, under CSIR Rural Development Programme regular advisory services were provided to the tea planters of the region and interactive meeting organized to apprise them about the tea management practices and tea processing techniques.
- Training on Medicinal and Aromatic Plants
- A training entitled “Cultivation, Processing and Quality Evaluation of Medicinal and Aromatic Crops for Income Generation and Marketing” conducted during October 20-24, 2003. It was sponsored by Regional Training Centre for IWDP (PAU), Ballawal Saunkhri, Tehsil Balachaur, Distt. Nawanshahr (Punjab) Twenty participants attended the programme.
- Technology demonstration cum training course entitled “Cultivation, Processing and Quality Evaluation of Medicinal and Aromatic Crops” was conducted during November 10-14, 2003. There were twenty participants from ICAR institutions, State Agricultural Universities, Forest departments, Industrialists, and progressive growers.
- One-Day Awareness Programme on “Cultivation and Processing of Medicinal& Aromatic Plants for Members of Self Help Groups” conducted on November 19, 2003, sponsored by Child Development Project Officer, Chamba (HP), which was organized at Institute of Himalayan Bioresource Technology, Palampur (HP). There were 30 women participants.

- IHBT and Wild Life Institute, Dehradun organized a training programme on Bioresource for School children from 23.05.2003 to 04.06.2003. The aim of the programme was to generate awareness about the nature. Twenty seven children from different schools from Uttaranchal and Himachal Pradesh participated in the programme

#### ***IMT***

- Summer Training Programme for M.Sc. (Biotechnology)
- Winter Training Programme for M.Sc. (Biotechnology)
- Training Programme on Fungal Taxonomy: Classical and Molecular Approaches conducted by Microbial Type Culture Collection

#### ***NBRI***

- A 10-day South Asian Regional Training Workshop for “Empowerment of Women with Traditional Knowledge for Sustainable Utilization of Local Biological Resources” was organized by NBRI from April 7-16, 2003.
- NBRI organized the 2nd Indo-Sudanese workshop on “Medicinal and Aromatic Plants”.
- 1st Indo-China Workshop on Quality Control and Standardization of Traditional Medicine organized at NBRI during January 8-10, 2004 under the bilateral collaboration of National Natural Science Foundation of China (NSFC) and Council for Scientific and Industrial Research (CSIR), New Delhi.
- National Workshop on Ayurveda Research Scenario-Challenges, Opportunities and Prospects for Excellence: A three-day workshop was held at Arogyadham, Deendayal Research Institute (DRI), Chitrakoot in association with NBRI during May 24-26, 2003.

#### ***RRL-JAMMU***

- CPYLS Programme: CSIR Programme on Youth for Leadership in Science for the meritorious senior secondary students of J& K state was organized. It was attended by 59 students.
- Summer School Training: Seventy two M.Sc., M.C.A., B.Tech, B.Sc Engineering/IT students from different universities and institutes from all over the country undertook 1 to 6 months trainings for their project work in the relevant areas of research.
- National workshop on quality control & assurance - Challenges for R& D and export Industry. More than 60 delegates participated.
- Training programme on intellectual property rights : The workshop was attended by more than 78 delegates from all over India who were educated on various aspects of IPR Management by eminent experts in the field.
- Five days Indo-US Workshop on Application of Flow Cytometry in Drug Mechanistic. Thirty delegates were imparted training by eminent experts in the field.

### **RRL-Jorhat**

- A three-day Training-cum-orientation Programme on Cultivation of Medicinal and Aromatic Plants for Bank Officials and NGOs was organized in the laboratory during 03-06 December 2003. Twenty participants from North Eastern States attended the programme. The training was aimed at providing a thrust for cultivation of medicinal and aromatic plants in this part of the country.

#### **1.2.3 RECOGNITION & AWARDS**

Padma Shri for distinguished services FICCI award for R&D in Life Sciences including Agriculture & Bio-technology Vigyan Gaurav Award by Govt. of Uttar Pradesh	Dr. Lalji Singh, CCMB
Fellow of Indian National Science Academy	Dr. Veena K Parnaik, CCMB
National Bioscience award for career development of the year 2003-04 by DBT	Dr. Ramesh V. Sonti, CCMB
CSIR Technology Award for Biological Sciences & Technology for “A novel in-vivo assay system for screening and validation of drugs”	Dr. L. S. Shashidhara & team, CCMB
Selected as Maruis Who’s Who in Science and Engineering	Dr. G.R. Chandak, CCMB
Dr. B.N. Ghosh Oration Award of Indian Pharmacological Society 2003	Dr. C.M. Gupta, CDRI
Dr. S.B. Pandey Oration Award of Indian Pharmacological Society 2003	Dr. Gautam Palit, CDRI
K.G. Nair Oration Award of the Indian Society of Hypertension	Dr. Ashim Ghatak, CDRI
Fellow of Indian Academy of Sciences, Bangalore	Dr. Vinod Bhakuni, CDRI
Indira Gandhi Official Language Award	Dr. V.N. Tiwari, CDRI
Fellow of Indian Society of Agricultural Biochemists	Dr. S.P.S. Khanuja, CIMAP
President of Lucknow Chapter of Indian Society of Soil Sciences	Dr. D.D. Patra, CIMAP
Fellow of National Academy of Agricultural Sciences (NAAS)	Dr. E.V.S.P. Rao, CIMAP
CSIR Young Scientist Award	<b>Dr. Taruna Madan, IGIB</b>
B. K. Bachhawat Oration Award	<b>Prof. S. K. Brahmachari, IGIB</b>

P.H. Gregory Contest Award for presentation of research paper at 12th National Conference on Aerobiology, Department of Botany, Visva Bharati, Santiniketan	<b>Rashmi Sharma, IGIB</b>
<b>Recognition granted by Molecular Biochemistry &amp; Diagnostics Divisions</b>	<b>Dr. Taruna Madan, IGIB</b>
<b>Invited as Specialty Council Member by World Allergy Organization</b> <b>Nominated as member standardization committees on the methodology for allergen monitoring in Asia-Pacific for patients and physicians</b>	<b>Dr. A. B. Singh, IGIB</b>
<b>Young Investigator Prize at International Conference on Recent Advances in Biomedical &amp; Therapeutic Sciences, Jhansi, Uttar Pradesh</b>	<b>Ms. Jyotsana Gupta, IGIB</b>
<b>Elected as a fellow of the National Academy of Science, Allahabad</b>	<b>Dr. Jagmohan Singh, IGIB</b>
<b>Dr. B.C. Guha Memorial Award for outstanding achievements</b>	<b>Prof. Samir Bhattacharya, IICB</b>
<b>Fellow of National Academy of Sciences (FNA), India</b>	<b>Dr. H.K. Mazumdar, IICB</b>
<b>Fellow of National Academy of Sciences (FNA), India</b>	<b>Dr. Samit Adhya, IICB</b>
<b>National Young Woman Scientist Award, DBT</b>	<b>Dr. Rukhsana Chaudhary, IICB</b>
Elected as a Fellow of Indian National Science Academy (INSA).	Dr. Amit Ghosh, IMT
Best Invention -2nd Prize for “Fermentation Technology for the Production of various Gluconate Salts” during 64th All India Industrial Exhibition ( 1st January to 15th February 2004) organised by The Exhibition Society , Hyderabad.	Dr. G. N. Qazi & Dr. R. Prasad, RRL-Jammu
National Academy of Sericultural Sciences, India (NASSI) National Fellow Award for meritorious scientific contribution in the field of sericultural research during last two decades.	Dr S.N. Chaudhary, RRL-Jorhat

President' visit to RRL-Jammu

Hon'ble President of India His Excellency Dr. A.P.J. Abdul Kalam visited RRL-Jammu. He has shown keen interest in R&D work of the Laboratory.



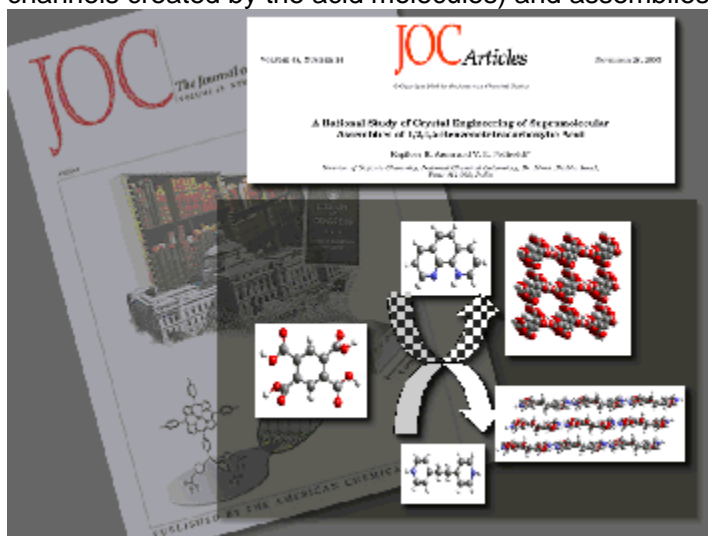
On this occasion Hon'ble President had remarked "Delighted to visit RRL(Jammu). I can see excellence in many areas of herbal plant (end to end solution). My best greetings to Director and the team and to the inspirer (Mashelkar)".

# Chemical Sciences & Technology

## Supramolecular chemistry

Synthesis of supramolecular assemblies using the knowledge of intermolecular interactions such as hydrogen bonds is currently an area of frontier research, with a focus on developing catalysts with tailor-made properties and design of miniature circuits in the electronic industry. In this direction, NCL has developed cavity and channel structures by employing molecules with functional groups such as -COOH, -CONH<sub>2</sub>, -NO<sub>2</sub> etc. that form robust hydrogen bonds. Studies conducted on the development of polymorphs and pseudopolymorphs through various crystallization procedures.

Supramolecular assemblies of benzenetetracarboxylic acid with aza donor molecules like phenanthrolines, phenazine and bipyridyls with and without water molecule are characterized by single crystal X-ray diffraction methods. These assemblies occur in two classes - host-guest systems (with aza molecules being in the channels created by the acid molecules) and assemblies with infinite molecular tapes.



### ***Structure of the supramolecular assembly, which appeared on the cover of Journal of Organic Chemistry***

1 Million litres/day RO plant commissioned at CPCL, Chennai

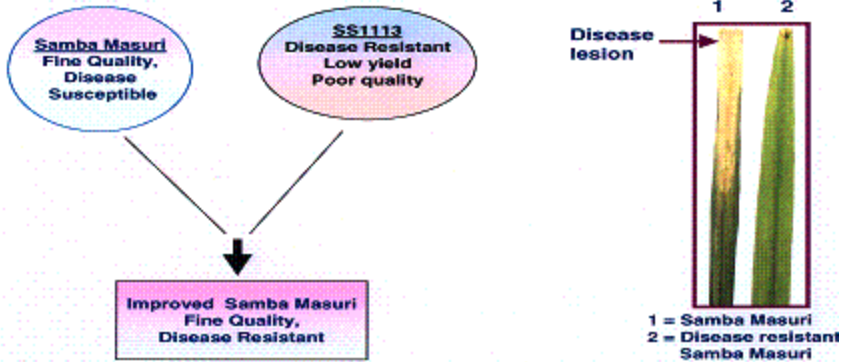
CSMCRI has developed reverse osmosis (RO) membranes based on the state-of-the-art thin film composite (TFC) membrane technology for desalination of brackish water. The inherent advantages of the TFC membrane are its non-biodegradability, low compaction rate, and ability to work under a wide pH range, all of which have resulted in more robust and economical operation and longer membrane life. At present, CSMCRI membrane gives <95 per cent salt separation and 35-40 gallons per square foot per day permeation rate under standard conditions of testing, making it ideally suited for brackish water application.

CSMCRI has commissioned a one million litre per day desalination plant based on RO technique for treatment of tertiary treated sewage water at the Chennai Petroleum Corporation Ltd. (CPCL), Chennai, in November 2003. Data on plant performance indicate that feed water is of salinity around 2000 ppm and 75% of the water is recovered in permeate. The unit was built at a cost of Rs. 6 million, which includes Rs. 400,000 for building renovation. The plant does not have a pre-treatment system, normally required for RO, since pre-treated water is available in the factory.



## Disease resistant Samba Masuri

The well known Samba Masuri, one of India's best and most extensively cultivated rice varieties, has been made resistant to the serious bacterial leaf blight disease by molecular breeding



1 MLD Sewage Water Treatment Plant at CPCL, Chennai

Establishment of model cultivation for *Jatropha curcus* and production of bio-diesel of international specification from the oil

CSMCRI has successfully cultivated elite varieties of *Jatropha curcus* on marginal land to assess practically realizable seed yields. Scientists of CSMCRI have achieved a great feat in developing a simplified process for production of biodiesel from the oil complying with Euro 3 specifications for free fatty acid methyl ester. A third objective is to identify outlets for by-products to enhance the overall value of the seed and thereby make cultivation of the plant more remunerative.

While biodiesel complying with Euro 3 specification is produced in Europe from rapeseed oil, this is the first time that such biodiesel has been made from *Jatropha* oil. The biodiesel has been evaluated at DaimlerChrysler AG and found to be matching all specifications. The cetane number has been established to be 58.5. Larger lots of biodiesel are now being made for evaluation in India in a Mercedes Benz car. Orchards are simultaneously being raised in Orissa (Huma & Mohuda villages) and Gujarat (Chorvadla village) to make elite germplasm available in sufficient quantity so that cultivation can subsequently be taken up in larger (100-200 hectares) tracts of wasteland.

Elite *Jatropha curcus*

### **Synthesis of butyrolactone**

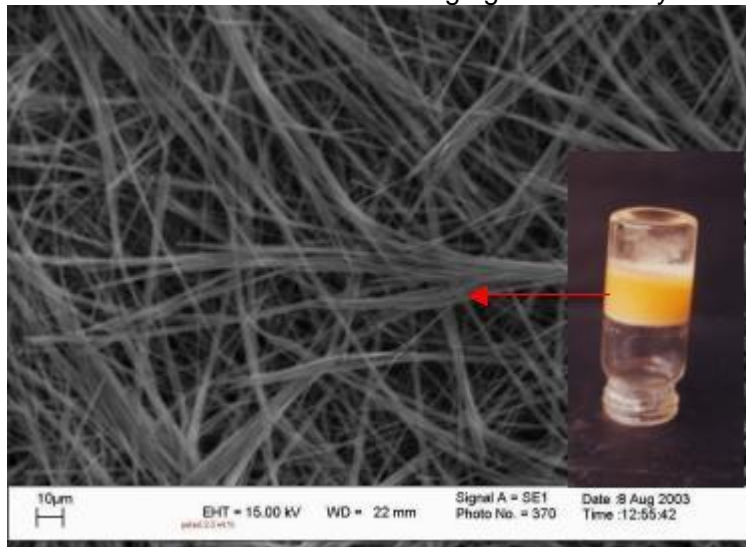
(S)-3-hydroxy- $\gamma$ -butyrolactone (HGB) is an important synthetic intermediate for a variety of chiral compounds. NCL has synthesized HGB by using inexpensive and readily available carbohydrate materials such as maltose. A carbohydrate source is treated with cumene hydroperoxide in the presence of a base, which leads to the formation of (S)-3,4-dihydroxybutyric acid and glycolic acid. The subsequent acidification and removal of solvent affords the desired butyrolactone in about 50 per cent yield. The new process developed in NCL offers a practical and cost effective route and avoids use of expensive starting materials.

Recovery of Sulphate of Potash (SOP) fertilizer integrated with production of high purity magnesia from bittern sources in Greater Rann of Kutch

The entire requirement (2-3 M tons) of potash (K<sub>2</sub>O) in the country is met through imports. Sulphate of potash (SOP) is preferred to Muriate of Potash (MOP) as potassic fertilizer due to its double nutrient value and low salt

index. CSMCRI has developed a process for production of SOP from pristine or debrominated bittern in Greater Rann of Kutch. Lime and bittern are the only raw materials required in the process. High purity MgO, which is in high demand for refractory applications, is also produced as co-product in the integrated process.

The technology involves the well-known route of recovery of mixed salt from bittern, followed by its conversion into schoenite and subsequent reaction with KCl to produce SOP. The novelty of the integrated process is that the KCl (MOP) required for this purpose is generated from the effluent of schoenite production. KCl is produced cost-effectively by integrating its production with recovery of magnesium hydroxide. An agreement has been signed with M/s Hindustan Lever Limited for transfer of technology for production of low sodium salt through a related process. Magnesia produced from the corresponding hydroxide has been characterized by CGCRI, Kolkata that confirms it to be of a high grade and very suitable for refractory applications.



View of bench scale unit for recovery of SOP and MgO from bittern at Experimental Salt Farm of CSMCRI

CSMCRI is providing technology support to M/s ABC& Sons, Mumbai for setting up of a semi-commercial (2500 tons) SOP plant integrated with production of refractory grade MgO.

The newly developed technology achieves several things at one go. There is an opportunity to make the country at least partially self sufficient in potash. It will also be able to improve soil quality by substituting MOP with SOP. Moreover, high quality refractory grade magnesia that is imported from overseas will also be produced in this process. Where debrominated bittern is used, the problem of effluent discharge will also be mitigated. Finally, opening up of a new industry will offer the scope for large-scale employment generation.

#### **Saloni K- The Low Sodium Vegetable Salt**

CSMCRI had developed Saloni vegetable salt in the year 2002 and the product has generated worldwide interest since it was first reported in the media in May 2003. CSMCRI has now developed Saloni K, a low sodium vegetable salt.

The market for low sodium salt is growing as it is considered a healthier salt. The Institute has already signed an agreement with M/s Hindustan Lever Limited for transfer of know how for manufacture of low sodium salt directly from bittern. The new product, Saloni K, has a special appeal because it is entirely of vegetable origin. It would be possible to produce the salt for Rs. 25-30/kg, which is an attractive price given that the salt will have a niche market and is entirely of vegetable origin.

Institute has received orders from Kyoei Trading Co., Japan for supply of 100 kg each of Saloni and Saloni K for test marketing in Japan and 100 kg each salt by Nisha Medical Stores, Bhavnagar.

The most important aspect of the salt is that it is produced from vegetable waste and greatly contributes to improving the viability of cultivation of weed on saline wasteland, which is an important societal objective.

### ***Biorefining of Rice Bran Oil***

IICT has developed and patented enzymatic degumming of rice bran oil. The technology ensures a residual phosphorus level of 0-5 ppm after bleaching and dewaxing which is the required level in national standards. This eco-friendly refining process yields quality rice bran oil particularly for direct human consumption. India has potential of 1.2 million tonnes of rice bran oil and present production levels 0.6 million tonnes. IICT has identified 4 firms and transferring the technology on 50 TPD scale to all the firms to modernise the existing rice bran oil refineries and adopt the new and innovative enzymatic degumming processes.

### ***Nano Tubes***

IICT has developed synthetic, peptide - based nanotubes that have a wide range of futuristic applications. This new class of compounds could be used for delivering DNA material for gene therapy and also making biochemical sensors. Nanotubes would help in developing a new generation of "molecular machines" and would benefit polymer, materials and electronics industries.

The IICT scientists have also demonstrated that the shape and size of the nanotubes developed by them could be altered to suit various applications. Natural proteins have the inherent problem of "enzymatic cleavage" - the process in which the enzymes break the protein structure. To overcome this problem, the IICT scientists, have developed synthetic peptides that produce helical structures similar to natural proteins that are resistant to "enzymatic cleavage".

### ***Carbon microtubes developed using pyrolysis***

**CECRI has prepared 5 mm** dia carbon microtubes by pyrolysis of a composite of inner fibre and an outer layer of polypyrrole. The tubes are characterised with Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD) and Fourier Transform Infra Red (FTIR) spectroscopy. These are applied for fluoride removal. Scientists of CECRI have used different precursor materials as inner fibre. Carbon micro tubes exhibit higher surface area than carbon materials and hence, these tubes find applications in pollution control, gas purification etc.

### ***Oxidation of alkyl aromatics***

IIP has carried out oxidation of p-Xylene by molecular oxygen in aqueous medium in view to develop Green Technology for converting p-xylene into p-toluic acid/tere-phthalic acid. More than 70% p-xylene got oxidized in aqueous medium to p-toluic acid as major product when pressurized liquid phase system catalysed by cobalt based homogeneous catalyst are used.

Application of water as reaction medium in organic transformations of commercial importance is a significant observation for developing green technology

Development of an easy-to-prepare organic salt as low molecular mass organic gelator capable of selective gelation of oil from oil/water mixtures

Salts derived from 4-Chloro- and 3-Chloro cinnamic acid and dicyclohexyl amine are shown to gelate various polar and nonpolar organic solvents including various oils. 4-Chloro salt is also capable of selective gelation of oils from oil/water biphasic mixtures. The corresponding 2-Chloro salt is a nongelator.

CSMCRI has developed a low molecular weight gelator. This low molecular weight gelator is of interest in mopping up oil slicks. CSMCRI is already pursuing investigations of seaweed polysaccharide gels and clay-based gelling systems.

Selective gelation of petrol from petrol/water mixture and SEM image of gelator (Dicyclohexylammonium-4-chlorocinnamate salt) fibers

### ***Methyltrioxorhenium Catalyzed Aerobic Oxidation of Organonitrogen Compounds***

For the first time IIP reports methyltrioxorhenium catalyzed oxidation of organonitrogen compounds with molecular oxygen as the sole oxidant where tertiary amines were oxidized to N-oxides, and secondary and primary amines to nitrones and as nitro compounds respectively. Molecular oxygen is an attractive oxidant both from environmental and economic viewpoints. Oxidation of organonitrogen compounds is important both from industrial and synthetic viewpoint. N-oxides obtained by oxidation of tertiary nitrogen compounds find wide applications as oxidants, and offer functional group manipulation and structural modification possibilities not accessible by other methods. Nitrones obtained by oxidation of secondary amines are versatile synthetic intermediates for the synthesis of heterocycles, natural products. Nitro, azo, and azoxy compounds obtained by oxidation of primary amines are important synthetic intermediates.

### ***Magnetic properties of closed-shell-like molecules using coupled-cluster method***

Coupled-cluster methods have emerged as state-of-the-art class of methods in the electronic structure, spectra and properties of closed-shell-like molecules. Novel extended coupled-cluster (ECC) method, based on double-similarity transformation, has been developed in NCL for the first time for magnetic properties, e.g. magnetic moment, dia-magnetic and para-magnetic contribution of susceptibility for closed shell molecules. ECC method has been successfully used earlier for non-linear electric properties due to the advantage of a stationary framework.

### ***Demonstration of membrane electrode assembly and testing small fuel cells***

CECRI has developed and patented a novel method to synthesize ultra pure carbon nano-particles for catalyst carrier. Membrane electrode assembly has been fabricated by depositing Pt catalysts prepared by a proprietary technique. Hot pressing of the catalyst layer onto the membrane is also done.

Five different compositions of partially substituted LaGaO<sub>3</sub> perovskites with Sr in the La site and Mg in the Ga site are prepared by mixed oxide solid state and by glycine nitrate combustion and characterized for application as oxide ion conducting electrolytes in ITSOFC system. The identification profiles with temperature of annealing are obtained in air to realize very dense and thin layers.

## ***H<sub>2</sub> based Fuel cell produced by hydrocarbon reforming***

The major components of the fuel cell power pack are: fuel processor, fuel cell stack, power conditioner and reformer.

Fuel processor is an integrated unit used for the conversion of LPG to a fuel gas reformat suitable for the fuel cell anode reaction. Fuel processing encompasses: (i) raw cleaning - removal of sulphur, halides and ammonia, (ii) raw fuel conversion- converting a hydrocarbon fuel to a hydrogen rich gas reformat, (iii) reformat gas alteration converting carbon monoxide and water in the fuel gas reformat to hydrogen and carbon dioxide via the water gas shift reaction; selective oxidation to reduce CO to a few ppm. The hydrogen rich product and oxygen (air) are fed to fuel cell stack to generate electricity. NCL has developed the steam reformer (SR) and preferential oxidation (PROX) catalysts. The know-how for scale-up (kg size) of SR catalysts has been transferred to the industrial collaborator. The catalyst is giving an excellent performance in terms of conversion as well as hydrogen yield. Preparation of platinum based PROX catalyst is scaled up to 500 g size at catalyst pilot plant of NCL. The processor, NCL has designed, is compact, light weight and can be adopted for different fuels.

NCL has also designed two reformers with an individual capacity to produce 1000 LPH of hydrogen. Fuel processor with both the reformers is operated for hundred hours with same operating conditions. The high temperature shift (HTS), low temperature shift (LTS) and PROX reactors are identical in both cases.

The CO concentration after PROX is reduced to 20-25 ppm range. In the fuel processor, 97% conversion of LPG obtained.

### ***A novel bio-physico technology for treatment of industrial effluents by specific microbial packages and innovative flotation techniques***

The existing technologies for the treatment of tannery effluents are inadequate to address the issues such as TDS, low density colloidal suspended solids, colour and pathogenic bacteria. As the nature of suspended solids differ widely it is necessary to employ different types of coagulants / flocculants to remove the entire spectrum of suspended solids. Under such circumstances, the cost of chemicals and in turn the overall economic viability is affected. Conventional coagulation is extremely slow and it takes several days. Depending on the quality of the waste water, the retention period varies from 2-24 days. Consequently, large treatment ponds are essential which in turn require large space. The drying of separated sludge takes a minimum of 12 days. The technology of Electro-coagulation and floatation developed by NML is very effective for separation of suspended solids, sulfides, sulfates, colour and pathogenic bacteria. Above all, the technology is simple and environmental friendly. The advantages of electroflotation technology are Technology is simple and effective, quality and quantity of effluent have minimum impact on the process of flotation compared to conventional treatment, flotation cells occupy less space and can be easily implemented within the plant premises of individual tannery, separation of suspended solids is faster [retention time less than 30 minutes], no need to add coagulants / flocculants.

This increases the organic load and solids separated by flotation technique contain minimum water and thus requires less drying time. Hydrogen is also generated, which can be used as a fuel. The atomic oxygen and hydrogen generated from respective electrodes and oxidizing / reducing agents formed as secondary reaction products are so active that the complex organic and inorganic compounds could be instantaneously oxidized or reduced, effluents subjected to electro flotation become rich in oxygen content that is congenial for bacterial growth and chlorine liberated during electrolysis acts as a disinfectant. Effluent is free from pathogenic bacteria.

### ***Electrodes for desalination of brackish water***

CECRI has developed an electrode suitable for desalination of brackish water by electro dialysis with periodic current reversal. The electrode withstands periodic current reversal - half of the time, it has to function as anode and rest of the time it has to act as cathode. Very few electrodes are capable of performing this dual role. These electrodes have a valve metal substrate activated by a noble metal based coating. Accelerated life testing in an artificial desalination set up predicts over 10,000 current reversals without any potential escalation. The main user for this electrode is Defence Laboratory (under Defence Research & Development Organization), Jodhpur.

### ***Supercapacitors***

CECRI has evolved a new preparative approach to configure a supercapacitor electrode by interfacial polymerization leading to carbon-polyaniline nanofibre matrix. This method utilizes the template free generation of polyaniline nanostructures with small diameter (sub 100 nm), which can easily be incorporated into porous carbon matrix of uniform size and also in bulk quantities. The electrodes of this composite matrix displays faster rate of doping-dedoping compared with conventional polyaniline and thus hold a promise as an efficient supercapacitor electrode. Screening of this electrode for capacitive charging-discharging indicates higher order of specific capacitance (over 150 F/g) in comparison to conventional polyaniline electrode. The importance of incorporating polyaniline nanostructures into porous carbon matrix has enabled to realize faster charging-discharging time required for pulse charge storage application. This input has been found to be crucial for supercapacitor cell fabrication and thus provide new understanding in the design of speciality supercapacitor electrodes.

### ***Proton Conducting Polymer Backfill (PCPB)***

CECRI has developed Proton Conducting Polymer Backfill (PCPB)- a new product- customized for use, as corrosion control belt along with a sacrificial anode on concrete structures creating required electrochemical interface. It distributes the current efficiently to the embedded steel reinforcement and thus enables to adequately shift the rebar potential in the cathodic direction and also maintain the requisite cathodic protection criterion as per international standard.

The uniqueness of this PCPB lies in the use of strip type of sacrificial anode arrangement, which can be strapped on to the concrete surface at the designed space intervals. This new type arrangement enables lesser use of sacrificial metal anode and does not need any special equipment/design skill. The maintenance cost is almost insignificant during the design life of anode. It is this aspect, which has made this method of cathodic protection practice for concrete structure different and cost effective from the presently practiced impressed current method of corrosion protection.

A totally new method of practice in the cathodic protection of concrete structures is being introduced into the global market and expected to simplify the corrosion control measures required for both existing and upcoming systems. Added to this, the utility of sacrificial metal has been reduced in this process thereby saving the precious resource.

### ***A novel process developed for preparation of a steroid Testosterone, male sex hormone***

Testosterone is an androgenic hormone primarily responsible for normal growth and development of male sex and reproductive organs. Declining testosterone level play a major role in a broad range of age-associated symptoms including declining sexuality, cardiovascular disease, osteoporosis and prostate hypertrophy. Hormone replacement therapy with testosterone has been rapidly becoming a standard of anti-aging medicine. RRL-Jorhat has developed a process for the production of Testosterone from 4-androst-3, 17-dione at the laboratory scale.

The literature reports for the preparation of Testosterone mostly involved the oxidation of androsten-3, 17-diol requiring two-step synthesis. However, the process developed by RRL-Jorhat is a single-step, stereoselective and cost-effective.

### ***Development of amino-acids racemate resolution membrane***

RRL-Jorhat has made significant experimental and theoretical contributions towards understanding the effect of molecular structure on enantio-selective permeation of amino acids in membranes from condensation products of L/D amino-acids with glutaraldehyde embedded in polysulfone matrix.

Aiming at the development of amino-acids racemate resolution membrane, the study made so far reveals that a unique combination of single amino-acid isomer self-association and diffusion across the membrane can be exploited to achieve the desired resolution. The permeation behaviour expressed in terms of diffusion and partition co-efficient of amino-acids exhibited excellent correlation with their hydrophobicity parameters. The correlations so obtained are qualitatively identical but quantitatively different from the two isomers which indicate enantio-selective permeation and leading to a scientific/technological knowledge-base on development of enantio-selective membrane for amino-acids.

For racemic resolution of other therapeutically important compounds i.e., propranolol, the principle of reactive extraction with a chiral selector namely cholesterol-L-glutamate has been exploited using a hollow fiber membrane device. Appreciable enantioselectivity for D-propranolol in a single step has been obtained. This development has opened up avenues for new and efficient technology development particularly in the field of separation and purification technology that can be applied in various fields such as drugs and pharmaceuticals, wastewater treatment, refining of vegetable oils, etc. The study also led to generation of technological knowledgebase for membrane-based process for racemic resolution of therapeutically important drugs/drug intermediates.

### ***Development of Speciality polymer for use in Petroleum Products***

RRL-Jorhat has prepared & characterized the copolymers poly (acrylamide-co-Na acrylate) [AM-NaAA], poly (acrylamide-co-Na 2-acrylamido-2-methylpropanesulphonate)[AM-NaAMPS], poly (N,N-dimethyl- acrylamid-co-Na acrylate) [NNDAM-NaAA], poly (N,N-dimethylacrylamide-co-Na 2-acrylamido-2-methylpropanesulphonate) [NNDAM-NaAMPS], poly (acrylamide-co-N-vinylpyrrolidone) [AM-NVP] and poly(acrylamide-co-Na-vinylsulphonate) [AM-VSASS]. The cross-linking behaviour of all the samples are studied by varying the polymer and cross-linker concentration, solution pH, temperature and salinity. Cr(III)-acetate is used as the cross-linker. Effect of monomer ratio in the copolymer on cross-linking was also studied for NNDAM-NaAMPS. Solution pH was observed to be the main criteria for controlling the cross-linking behaviour of the copolymers. Presence of high concentration of brine can slow down the gelation process. The cross-linked polymer is observed to be thermally stable at 120°C at least for a period of two months.

Water soluble polymers, especially partially hydrolysed polyacrylamide (PHPA) and polysaccharides like xanthan are commonly used in a number of oil fields for conformance control, sweep efficiency improvement and water as well as gas shut-off treatments. The polymer is injected with the cross-linking agent to the reservoir in the form of aqueous solution to attain the maximum possible uniform distribution throughout the reservoir pores before the formation of gel. Anionic cross-linked polymers of acrylamide are frequently used as water shut off agent in the oil recovery processes. But this polymer degrades at high temperature in presence of multivalent brine. It is observed that cross-linked polymer of N,N-dimethyl acrylamide-sodium salt of acrylamido methyl propane sulphonate is a thermally stable brine compatible. The novelty of the gel polymer is that the copolymer before gelation is also thermally stable and brine compatible. Work is continued to replace inorganic cross linker by environmentally acceptable organic cross linker.

### 1.3.2 HUMAN RESOURCE DEVELOPMENT

#### **CECRI**

Industry oriented Technology Courses

- Water Treatment Technology
- Waste Water Treatment Technology
- Recovery of Silver from Photographic waste
- Lead Acid Battery Technology (2 Module)
- Valve Regulated (MF) Lead Acid Battery
- Corrosion Science & Engineering (6 Modules)
- Industrial Metal Finishing (12 Modules)

The courses are structured as modules each lasting 5-6 days. 186 participants attended the different courses during 2003-2004 Rs. 7,21,500/- has been collected as the course fees.

- Training Programme on “Corrosion Control in Petroleum Refineries “ for Indian Oil Corporation Ltd, New Delhi at CECRI, Karaikudi.
- Special Training Programme on “Plating and Processing “ to Naval Aircraft Yard at Kochi”.
- In-house Training Programme on “Industrial Metal Finishing ,Paint Coatings and Corrosion Control “ for Hindustan Aeronautics Ltd., Bangalore at CECRI, Karaikudi.

#### **CSMCRI**

- Three training programs (both in-house and field) on salt production were organized at Little Rann of Kutch and two at Malia near Morbi.
- An extensive training program related to salt was arranged for the technical staff of M/S IPCL from December 3-5, 2003.

#### **IICT**

- IICT in collaboration with C-DAC and JNTU conducted an advanced course in bioinformatics for four months from 25th June 2003 onwards.
- A training programme on Skill upgradation in financial management systems for finance & accounts personnel of CSIR labs was conducted from 7-11th July 2003 at IICT by HRDC, CSIR, Ghaziabad.



- A training programme for Group-III staff of CSIR labs was conducted from 29th September 2003 to 1st October, 2003 at IICT by HRDC, CSIR, Ghaziabad.
- IICT organised UNESCO regional training workshop on environmental chemistry for 18 teachers from SAARC countries from 10-15th November 2003 at IICT.
- Six day national workshop on Industrial applications of chemo informatics and computer aided drug design held at IICT from 12-17th January, 2004.
- A practical training to IICT staff in safe handling of chlorine cylinders and rescue has been given by officials of M/s Rayalaseema Alkalies and Allied Chemicals, Kurnool, A.P. on 20th February, 2004.

### **IIP**

- Workshop cum Training programme on Vehicular Pollution was organized during 19-23 January, 2004. 22 officers of transport department of various states namely Assam, Chattisgarh, Goa, Maharashtra, Pondichery and Uttaranchal attended the workshop.
- Workshop organized for automotive industry 'Rating of Gear, Bearing and Oil Seal Distresses' on March 6-7, 2003. Delegates from industry such as Telco, Lubrizol India, Eicher Motors, Birla Yamaha, and Yamaha motors attended the seminar and received hands on training on rating of gears, bearing and oil seal etc.
- Workshop on 'Solvent Extraction Technologies in Refineries' jointly organized by IIP and EIL, New Delhi. October 29-31, 2003, participated by Organisation like BPCL, HPCL, CPCL, IOCL and ONGC.
- "Patent awareness programme" was conducted by Delhi Patent Office and NRDC on August 14, 2003 to create Patent awareness amongst Scientists and Engineers.

### **NCL**

- Training programme on materials management to upgrade technical and nontechnical skills of the employees and expose them to up-to-date modern trends in their respective fields. This programme in two batches was conducted by NITIE, Mumbai.
- A two-day training programme on "Patents & Regulatory Issues in Pharmaceutical Industry" was conducted by National Academy of Legal Studies & Research (NALSAR), University of Law, Hyderabad.
- Training programme was conducted for Canteen and Guesthouse personnel by The Maharashtra State Institute of Hotel Management and Catering Technology, Pune.
- NCL conducted a three-day training course on "Rheology of Polymeric and Complex Fluids" for the employees of GE-WTC, Bangalore.
- DST-SERC school on "Modeling and Optimization for Performance Enhancement in Process Engineering".

## **1.3.3 RECOGNITION & AWARDS**

Life Time Achievement Award (2004) by Indian Science Congress Association;

Life Time Achievement Award (2003) by Indian Chemical Society for contributions in advancement for chemical sciences;

World Federation of Engineering Organisations (WFEO) Medal of

<p>Engineering Excellence (2003) by WEFO, Paris  Qimpro Award for Quality Evangelist (2003) by Qimpro Foundation, Mumbai  LakshmiPat Singhania - IIML National Leadership Award (2004) by Indian Institute of Management, Lucknow  Devi Ahilya National Award (2003) by Shri Ahilyotsava Samiti, Indore for contribution towards development in the scientific and industrial fields;  Lal Bahadur Shastri National Award (2002) by Lal Bahadur Shastri Institute of Management for Excellence in Public Administration and Management Sciences.</p>	<p>Dr. R.A. Mashelkar, FRS, DG-CSIR</p>
<p>N. M. Sampath Award 2003</p>	<p>Dr. K.N. Srinivasan, CECRI</p>
<p>Vigyan Ratna Samman for 2002-03 for excellent contributions in S&amp;T from Govt.of Uttar Pradesh, India</p>	<p>Dr.J.S.Yadav, IICT</p>
<p>Chandra Kanta Dandiya National Award for the year 2003 in Pharmacology</p>	<p>Dr.P.V.Diwan, IICT</p>
<p>Dr.S.Hussain Zaheer Award of OTAI for 2002 for outstanding contributions in Lipid chemistry and technology</p>	<p>Dr.R.B.N.Prasad, IICT</p>
<p>Chemical Research Society of India, Bronze Medal.</p>	<p>Dr.V.Jayathirtha Rao, IICT</p>
<p>Amar Dye-chem award for excellence in R&amp;D in membrane technologies</p>	<p>Dr.S.Sridhar, IICT</p>
<p>Technocrat of the Year Award-2003</p>	<p>Shri Sudhir Singhal, IIP</p>
<p>CSIR Technology Award for Chemical Technology for developing a process for manufacture of 1,1',1''-Tris(4'- hydroxyphenyl) ethane (THPE)</p>	<p>Drs. S. Sivaram, C.V. Avadhani, S, Chakrapani, P.P. Wadgaonkar, S. Devotta, V.R. Ranade, G.R Venkitakrishnan, S/Shri S. Gopichand, H.G. Jogelkar, A.R. Joshi, R.S. Karnik, V.G. Kulkarni, Nandkishore, A V. Palghadmal, Drs. M.G. Parande, M.S. Qureshi, Shri M.B. Unde, Dr. J.G. Wadkar, NCL</p>
<p>Vishwakarma Medal (INSA)  Vice-President of the Indian National Science Academy  Chemcon Distinguished Speaker</p> <p>Asian Paints - Dr. R.A Mashelkar Medal and Distinguished Speakership Award for Innovators and Science Leaders, IICHe</p>	<p>Dr. S. Sivaram, NCL</p>

Srinivasa Ramanujan Research Professorship by the Indian National Science Academy	Dr. Paul Ratnasamy, NCL
CSIR Bronze Medal	Dr. K. Vijayamohanan, NCL
Organisation of Pharmaceutical Producers of India (OPPI) Scientist Award	Dr. S.P. Chavan, NCL
Plastic Udyog Ratna Award	Dr. R. P. Singh, NCL
INSA Medal for Prof. T.R. Seshadri 70th Birth Anniversary Commemoration Medal	Dr. Ganesh Pandey, NCL
Vasantrao Naik Social Forestry Award	Dr. (Mrs) Rajani Nadgauda, NCL
Associate Member of IUPAC Division of Organic and Biomolecular Chemistry	Dr. K.N. Ganesh, NCL
IUPAC National Committee	Dr. Murali Sastry, NCL
CSIR Young Scientist Award in Engineering Sciences	Dr. Upendra Natrajan
CSIR Young Scientist Award in Chemical Sciences	Dr. C.V. Ramana

# Engineering Sciences & Technology

## New sensors for trace moisture analyzer

Detection of gaseous moisture in ppmV level is very important in certain industries. CGCRI has developed a device to detect moisture in the range of 0-1000 ppmV based on micro and nano-porous alumina sensors. Important areas of application of these trace moisture analyzers are in measurement of moisture in gases of glove boxes as well as in industrial environment involving high quality welding, nuclear reactors, food packaging, pharmaceuticals, laser marking, submarine periscope purging, etc. Most of the moisture sensors in the trace moisture level have not yet come into commercial production in India. The sensors are being imported at a cost of around £500 for various industrial uses. It is a low-cost indigenous technology for Trace Moisture Analyzer based on new sensors. Indian Institute of Management, Ahmedabad, under their 'National Search for Innovation' scheme, awarded gold medal to CGCRI for developing this technology.



Trace Moisture Analyzer

## Non-Linear junction detector for explosives

A Non-Linear Junction Detector (NLJD) is used for detection of all kinds of non-linear junctions, which may be semiconductor or metallic. The specific function of the system is to detect the electronic devices meant for detonating the Explosive Ordnance Disposal (EOD) and Improvised Explosive Device Disposal (IEDD). Due to global environment of international terrorism, there has been a well-identified requirement for security and specific detection equipments. Regular explosions are posing serious threat to day-to-day life of citizens worldwide. In the recent past, land mines and explosives are detonated with the help of remote control and electronic timers.

CSIO has developed a portable, field operable hand-held NLJD system, which is an advanced detector using the Harmonic Radar principle to aid the security professionals in the search of concealed electronic devices and other similar items such as timers or remote control receivers for detonation of explosive dormant and non-operational devices.

Very few companies are producing these systems worldwide and are selling their products at very exorbitant prices to India and to other countries. CSIO is the first to develop this instrument indigenously.

Devices like Radio Transmitters, Power Amplified Microphones and Electronic Timers etc. contain non-linear junctions and will be detected even if they are embedded in the Cabinets and either in conducting or non-conducting states. NLJD can also be used for scanning the Aircraft and Podium. It is used by para-military forces for scanning the area before Republic Day and Independence Day Parades to detect presence of concealed timers/transmitters. The NLJD fabricated using SMD components has powerful discrimination against false targets.

The instrument has been tested and evaluated in CSIO, New Delhi. The performance of the instrument was demonstrated to external experts from paramilitary forces. The users of this device are various security agencies like, Armed Forces, Paramilitary Forces, State Police Departments, National Security Guards, Special Protection Group, Railway Protection Force, and Many Other Security Agencies.

The know-how of this instrument has been transferred to M/s Astra Microwave Products Ltd., Hyderabad. At present, there is a demand of about 50 units of NLJD by various bomb disposal squads, state police and para-military forces in the country.

## **Highly sensitive explosive detector**

CSIO has developed a highly sensitive explosive detector. The instrument works on the principle of gas chromatography, which separates the mixture of volatile compounds when they flow through the chromatographic column containing a stationary phase, through which the stream of inert gases passes continuously. As different components in the mixture interact differently with the stationary phase they emerge out of the column after different retention times. It is well known that all modern organic- explosives emit organo-nitro compounds to a greater or lesser extent depending on the type of explosives. The detection of explosives is made by utilizing their electron capturing property, common to all organo-nitro compounds.

The instrument utilizes twin chromatographic columns (one empty and other coated with stationary phase) coupled to two independent electron capture detectors. The empty column ECD immediately responds to electron capturing compound whereas coated column ECD responds according to the retention time of compound in coated column.

The explosive detector developed at CSIO detects vapors and particulates of low vapor pressure organic explosives such as TNT, EGDN, NG, PETN, RDX, HMX, RDX+TNT.

The system provides greater selectivity and sensitivity. The option of needle probe permits accurate searching of packages and baggage. The detector is housed in an executive briefcase and is completely self-contained with a rechargeable battery and argon gas cylinder housed within the brief case.



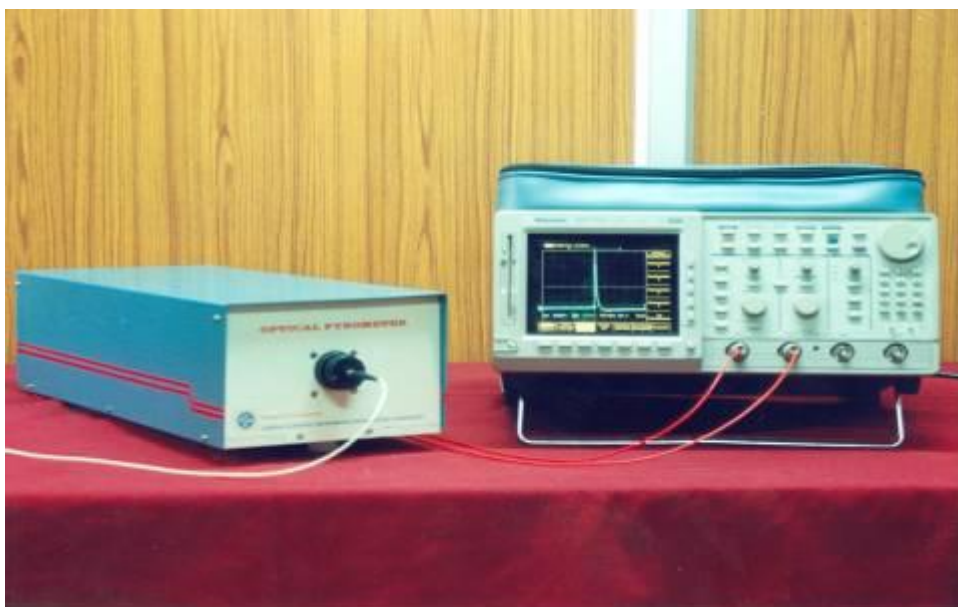
Explosive Detector

### ***Fast optical pyrometer for transient explosion temperature***

CSIO has designed & developed a Fast Optical Pyrometer to measure transient explosion temperature in the range of 1,000-10,000 K where the detonating response time is of the order of 100 nsecs. The instrument consists of focusing optics, fiber optic beam splitter (50/50), interference filters, optical to electrical (O-E) converters and application software.

Light emitted from the transient explosion is collected by the focusing optics, which focuses the light on to the tip of the fiber optic beam splitter. The fiber optic beam splitter (200/230  $\mu\text{m}$ ) splits the light (50/50) into two channels. In each channel, the ends of the fiber optic beam splitter are connected to the collimating optics, which provides the collimated light beam. The collimated beams in each channel are made to pass through the chosen interference filters. After passing through the interference filters, the light is made to fall on the focusing optics, which focuses the light on the tip of the fiber optic cable (200/230  $\mu\text{m}$ ). The other ends of these fiber optic cables are connected to the optical to electrical converters. The output of the optical to electrical converter is then displayed on the oscilloscope that gives the intensities of the signals from both the channels. The values of the signals (in volts) in both the channels correspond to the respective intensities. These intensities,  $N(I_1, T)$  &  $N(I_2, T)$ , are then being used as input values to the software module for temperature calculations.

The software is organized in five sub-modules. Module-1 is used for the selection of the interference filters to be used for the measurement of the required temperature. Module- 2 is used for interpolating the emissivity values w.r.t wavelengths based on a set of standard emissivity values for the detonation material under use. Module-3 is used to generate the emissivity values w.r.t. Temperature. Once these data are available, these are used in Module-4 to calculate the temperature that is directly displayed on the monitor. The instrument is simple to use, highly accurate and modular in approach.



Fast Optical Pyrometer

### ***Clinical chemistry analyser for blood biochemical parameters***

CSIO has developed Clinical Chemistry Analyser, which is a high performance Micro-controller based photometric biochemistry analyzer used to measure various blood biochemical parameters such as Blood Glucose, Urea, Protein, Bilirubin etc. that are associated with various disorders such as diabetes, kidney diseases, liver malfunctions and other metabolic derangements. The quantisation of these parameters is helpful in classifying such diseases and under appropriate circumstances results of the system are used for diagnostic purposes.

System hardware is based on 8031 Micro-controller. This is interfaced with 64 Kbytes of EPROM for monitor and control program and 24 Kbytes of RAM with battery back up for temporary data storing and 24 hour results storage capacity, 12 bit A/D converter for converting analog OD into digital form, I/O devices 8255 are used for interfacing 30 keys keyboard for selecting various functions of the system, Graphical LCD module for displaying various parameters and result of each test, Real Time Clock for displaying date and time on LCD, 40 columns mini printer for hard copy of the results, temperature sensor LM335 and Pettier device for sample heating and cooling, roller type peristaltic pump for sample aspiration and optical module. Menu driven software is written in



C language.  
Clinical Chemistry Analyser

### ***Pneumatically driven anaesthesia ventilator***

CSIO has developed a pneumatically driven Anaesthesia Ventilator, which delivers breaths to supply a specific volume of breathing gas to a patient at a desired breathing rate. It also maintains required duration for inspiration and expiration.

The Ventilator has three basic sub-systems:-

- Bellow system supported by pneumatic driving components.
- Microcontroller based control system for Ventilator parameter control, monitoring and alarms for safety.
- A closed circuit rebreathing circle absorber type patient circuit.

CSIO has fabricated the Ventilator including the sub-systems in-house. For control of the breathing, the three independent control parameters i.e Respiratory Rate, Tidal Volume & Inspiratory Flow are set through the control panel of the instrument where signal processing circuit designed by using a microcontroller has been used. The system has safety features and has several alarms.



Anaesthesia Ventilator

### ***Smart biosensor based on ion-Sensitive field effect transistor (ISFET)***

CEERI has fabricated ISFET biosensor using metal gate NMOS technology with the Glucose Oxidase (GOD) enzyme immobilized over the silicon dioxide-silicon nitride dual-dielectric gate in place of the conventional metal gate electrode. The device has a high aspect ratio (W/L~400) N-channel enhancement mode FET with interdigitated source-drain geometry and the channel length of 12  $\mu\text{m}$ . The ISFET chip has been mounted on ceramic substrate and the wire bonds have been protected with insulating epoxy.

The device has biomedical applications e.g. in clinical pathology and food and beverage industry. Advantages include; small size, instant response, ruggedness, mass scale production, low-cost and reliability. The device has impact on health care and food processing instrumentation.



### **Packaging technology for ISFET bio-sensor**

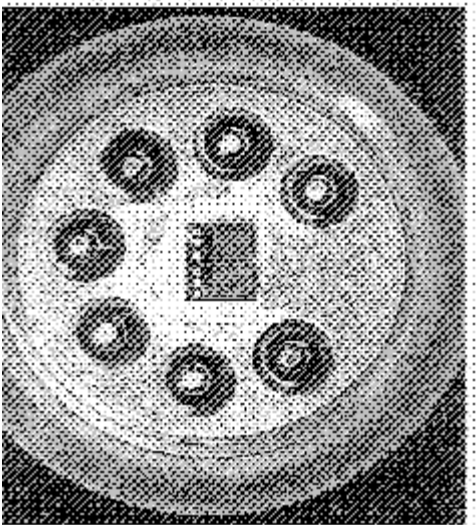
The technology for packaging of ISFET Bio-sensor chip has been developed by CEERI with following specifications: 3mm x 3mm chip having two ISFETs has been packaged on 7.8mm x 8.5mm alumina substrate. The critical problem of encapsulation of selective areas of ISFET chip has been sorted out by developing a special process called "AIR JET TECHNIQUE". After leads attachment, wire bonding, bonded wires and selective area of the chip, except sensing part, have been protected using insulating epoxy. The package has 7 leads with a pitch of 50 mil. The packaged ISFET sensor has been employed in testing of sugar content in a number of fruit juices successfully. This can be used for analyzing glucose, urea, penicillin and acetylcholine in medical reusable applications

### **Micro Electro Mechanical System (MEMS) surface micro-machined capacitive pressure sensor**

CEERI has fabricated high sensitivity, low-cost and surface micromachined capacitive pressure sensors with chip Size – 4 mm x 3.2 mm, chip Thickness – 0.5 mm, configuration – 10 x 10 Arrays, pressure range – 0-700 Psi.

The packaging can be done as per the user demand and is compatible with CMOS VLSI.

These sensors find application in number of strategic areas like space, atomic energy and defense. Industrial applications in automobile, structural health monitoring and process control instrumentation needs a large variety of these sensors in different package configurations. A variety of sensors are also needed in human health related miniaturized diagnostic instruments. The demand of these is expected to grow extremely fast in times to come.



MEMS Pressure sensor

### **Strategic development of Micro-Travelling Wave Tube (TWT) and its sub-assemblies for Microwave Power Module (MPM)**

CEERI has designed, fabricated and tested Electron Guns (2 numbers) for Micro-TWT and Multi Aperture Test Vehicle to get the correct information of beam waist and throw for electron gun trajectory. Also an In-house developed package 'MAGFLD' for Periodic Permanent Magnet (PPM) System design for Micro-TWT with experimentally measured values has been validated.

Microwave Power Module (MPM) is a hybrid super-component, which combines the best attributes of both the vacuum tubes and solid-state devices to provide a high power, high efficiency amplifier in a compact size. This MPM consists of a micro-TWT, a solid-state amplifier, an electronic power conditioner and a power control system packaged into a single compact module. The development of MPM is considered a major technological breakthrough in broadband microwave power amplifiers. The design and development of 6 to 18 GHz, 80 W

(CW) MPM would help the nation in becoming self-reliant in this vital area. This development is of strategic importance since these Micro-TWT and MPMs are available with few companies in the world.

## Fluidized bed separator

Separation of cenospheres is an essential requirement in the area of mineral processing. RRL-Bhopal has developed a Fluidized Bed Separator for the same. Preliminary results indicate that cenospheres coarser than 45 microns can be selectively recovered using this separation system. Further, this size of separation can either be increased or decreased by controlling the process conditions while separation.

The machine is also suitable for different classification and concentration of different minerals, coal, separation of contaminants from the polymer waste products etc. The unit works under the principles of counteracting forces of fluidization water against the setting velocities of particles. Due to inverted conical shape of the separation chamber, a velocity gradient of water (maximum at the bottom and minimum at the top) is generated. This velocity gradient of water segregates relatively coarser particles at smaller heights from the bottom of the separation chamber. This enhances the entrainment of the finer fraction from the coarser material. Similarly, the coarser fractions do not get entrained in the finer fractions because of decreasing velocity zones at increasing heights. Thus the system operates at higher efficiency.



Fluidized Bed Separator

## Process control automation for paper converter machine

CEERI has designed & developed a Distributed Control System (DCS) based Electronic Control System for Online Measurement of coat weight, coat moisture, roughness and sheet temperature to control the paper converter process to improve the quality of the coated paper. Optical sensors have been used to control these parameters. The DCS system has been based on AC-70 process controller. Two scanning frames have been incorporated in the system to measure the coat weight and coat moisture and sheet temperature. Online display control system is used to see the display of real time trend of all parameters at an operator workstation. User-friendly human machine interface software is developed and compatible with Windows NT based operator workstation with 19" color monitor interfaced with DCS system through a Modbus Communication. The system has been successfully installed and commissioned at M/s Rohit Pulp and Paper Mills Ltd., Vapi, Gujarat.

### ***Low cost Cu-conductor process***

CEERI has developed a novel and low-cost Cu-conductor process compatible to thick film technology for handling high current requirement of power hybrids. Novelties of the process include excellent leaching resistance, excellent adherence and low-cost (about 40% less than the conventional metallisation). The improvement lies in higher current carrying capacity i.e. three times that of conventional Pd-Ag thick film conductor. This technology does not require additional expensive equipment and high purity nitrogen. Shelf-life problem associated with other thick film materials and processes has been overcome by using this innovative technique. This process has been used for development of three types of power HMCs namely, Alternator Regulator, Head Light Flasher and Horn Hybrid Module for automotive applications.

### ***Radiation resistant optical components for CCTV nuclear camera developed & fabricated***

CGCRI has developed, fabricated and supplied complete optical system for an indigenous CCTV nuclear camera used for remote viewing of the interior of the reactor coolant tubes. This remote is very important for effective and timely servicing of the nuclear reactors. The system is required for focussing, illumination, mirror rotation, etc. to aid viewing for remotized controls. The device developed at CGCRI replaces the earlier ones, which were being imported and are not readily available.

The optical system has been successfully deployed in the 230/550 MWe Pressurized Heavy Water Reactors (PHWRs) at Kalpakkam and at Kaiga of the Nuclear Power Corporation Ltd.

The optical components have a service life exceeding 100 hours in water-filled environment of 1 M rad/h radiation, pressure of 10 atmospheres at a temperature of 100°C. Components worth Rs. 1.6 million have already been supplied and additional orders are under execution. This work has contributed to self-reliance in a high tech area and resulted in significant cost saving for the users.



Mirrors for video imaging inside a nuclear reactor



High dose radiation resistant optical lenses

### ***New rare earth based glass and glass-ceramic phosphors developed for compact fluorescent lamps and cathode ray tube display screens***

Phosphors are used in lamps for illumination in cathode ray tube (CRT) for visual display. Although total amount of phosphors produced per year in the world is around 25,000 tons, not even a single kilogram of phosphor is produced in India. CGCRI has studied the basic mechanism of luminescence of the various commercially used phosphors and developed indigenous technology for production of these phosphors in the country. Technology

for the preparation of total of five commercially used phosphors namely (Ba, Ca, Mg) $10(P04)6Clz$  : EU+2 (Blue-green luminescence), (Sr,Mg) $3(P04)2$  : Sn +2 (Yellowish red luminescence), Y203 : EU+3 (red luminescence), (Sr, Ca, Ba) $10(P04)6Clz$  : Eu +2 (Blue luminescence) and LaP04 : Ce +3, Tb +3 (green luminescence) have been successfully developed. Out of these five phosphors former two are commercially used in high pressure discharge lamps while latter three are used in tri-band compact fluorescent lamps (CFL). Y203:Eu+3 - phosphor (also used in CRT display screen).

Scientists of CGCRI have also developed a new generation bi-chromatic ceramic phosphor, which emits simultaneously the green and red light. A new theory has been put forward on the mechanism of charge compensation in apatite based phosphors.

### **Novel cellular Silicon Carbide (SiC) based ceramics from plant precursor**

Macro- and microstructure of naturally grown plants realize excellent strength, high stiffness, elasticity, damage tolerance and flexibility. CGCRI's concept explores the intrinsic hierarchic design of structural and anatomical features of plants to develop unique classes of Silicon Carbide (SiC)-based ceramics. To test the concept dense Si-SiC duplex ceramic composites and highly porous SiC ceramics in the image of the morphological features inherent in the caudex stem of a local monocotyledonous plant have been synthesized. The process route involves making of a carbonaceous biopreform and its subsequent reaction with an infiltrating silicon melt to yield the biomorphic Si-SiC ceramic composites. The Si-SiC composites are transformable into porous SiC ceramics with complete preservation of micro cellular anatomy of the parent plant, by depleting residual silicon phase in channel pores through reaction with carbon.

### ***Water filter for removal of Trihalomethanes [THMs]***

In view of health hazards associated with THMs formation on chlorination, NEERI has developed a Water Filter capable of removing chloroform, bromodichloromethane, dibromochloromethane and bromoform at the concentrations of 200 mg L<sup>-1</sup> from tap water supply. The developed system is portable, tap attachable, useful at a household level and easy to operate even by unskilled persons.

### **Rejuvenation of iron, copper and zinc mine spoil dump and mined land productivity through integrated biotechnological approach**

NEERI, under a collaborative effort with Department of Biotechnology (DBT), Govt. of India and Swedish Agency for Research Cooperation with developing countries (SAREC), Sweden, has adopted a two-front Integrated Biotechnological Approach (IBA) for the prevention of heavy metal leaching from overheaps and for rejuvenation of productivity in copper, zinc and iron mine lands and spoil dumps through identification of appropriate blends of organic waste and mine spoil for rhizospheric development.

Three different metal mine sites (5 hectares each) selected were Iron ore open cast mine under Sesa Goa Ltd., Kodli, Goa; Malanjkhanda open cast copper mine under Hindustan Copper Ltd., Malanjkhanda, Madhya Pradesh and Zawar underground zinc mine under Hindustan Zinc Ltd., Udaipur, Rajasthan.

Physico-chemical and microbiological analyses of mine spoil dumps tailings from these sites are carried out. The native flora of all these three sites is surveyed and plants in abundance and maximum frequency of occurrence are selected and planted at these sites. Pot culture studies are also conducted to ascertain the enrichment in spoil quality, growth response of selected plant species and to identify appropriate blends of soil, mine spoil and organic waste.

The studies on metal uptake by pot culture plants shows that addition of biofertilizer and organic amendment decrease the uptake of various heavy metals like Zn, Mn, Fe, Cu, Cd and Ni by plants.

Lysimeters are installed at NEERI to study the effect of organic amendment with Farm Yard Manure (FYM) on leaching properties of different metal mines spoil.



Lysimeters installed at NEERI

Based on the pot culture studies, treatment involving 1 part soil + 4 part spoil + 50 tonnes/hectare FYM + biofertilizers was selected for implementation at field level at all the three mine sites. Local species of plants having high economical and ecological value are planted on an area of 5 hectares each at all the three mine sites. After a periodic interval of six months, spoil/ tailing samples were collected and analyzed to find out the improvements in physico-chemical and microbiological status. Growth performance study of different plants species is also carried out at all the three metal mine spoil dumps.



## Reclaimed sites

Piezometers are installed at iron and zinc mine spoil dump sites and leachate samples are analyzed to study the effect of vegetation and impact of organic material on the mobilization of heavy metal ions from the heaps of metal mine spoil dumps.

The barren iron mine spoil dump at Codli mine under Sesa Goa Limited is revegetated by plantation of 8000 plants of 29 varieties of different plant species locally available nearby the vicinity of mine site. Apart from barren mine spoil dump, tailing site at Hindustan Copper Limited at Malanjkhand is also revegetated by plantation of

10,000 plants of 17 different species on an area of 5 hectares. At Zawar Zinc Mine, Udaipur, multi-species plantation is carried out on an area of 5 hectares of barren tailing site. About 8,000 plants of 30 different species are planted on the tailing site.

## **Surface modified zeolite: a versatile material for Volatile Organic Carbon (VOC) monitoring**

NEERI has used cost effective flyash based zeolites (FAZs), synthesized by its patented process, to resolve serious environmental problems pertaining to indoor air pollution being faced by human beings. Human, which spends more than 80% of the time indoor, their exposure to volatile organic carbon (VOCs) being generated from myriad sources at homes viz. combustion of fuels, paints, varnishes etc. is substantially high. This is being correlated with higher incidences of diseases being reported in rural and urban areas. Accurate identification and quantification of VOCs is required which is not possible with conventional method of monitoring which lacks selectivity and versatility. To overcome this problem a new class of material has been developed as an alternate to conventional adsorbent to help in identifying the various VOCs and in turn help in providing suitable measures to mitigate its health effects on human beings.

### ***Hydrogen sulphide inhibition system***

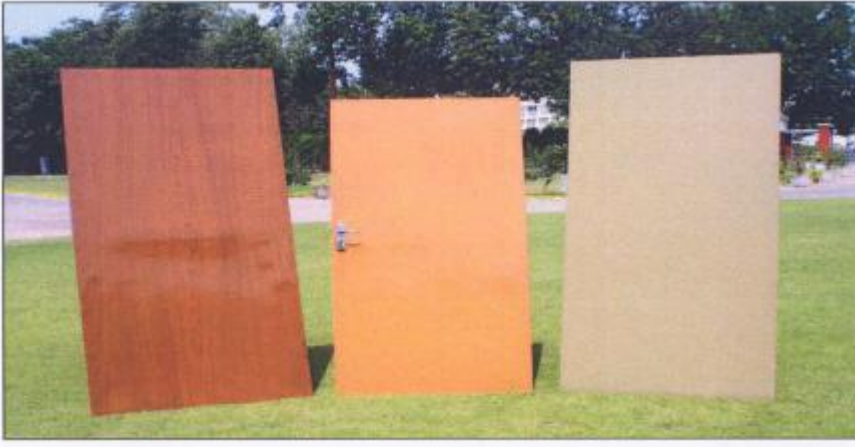
RRL-Trivandrum has invented the hydrogen sulphide inhibition system for anaerobic system of sulphide effluent. Alembic Chemicals Ltd., Vadodara has implemented this system in its effluent treatment plant. The sulphide control process designed for Alembic consists of two stage sparged tanks for hydrogen sulphide removal from anaerobic reactor recirculated liquor by air stripping and gas bio-filtration for off-gas odour control.

## **Natural Fibre Composite Door Shutters**

Viewing the potential of natural fibres, CBRI investigated their rational utilization as reinforcement in unsaturated polyester resin. The selection of sisal/jute fibres is made on the basis of their structure-property relationships. Surface modification on jute/sisal fibres has been done in order to make it more moisture resistant by attaching long chain hydrocarbons onto their surface. Water resistant composites are prepared from these surface modified fibres and unsaturated polyester resin under compression at a pressure of 10-12kg/cm<sup>2</sup> for 1 hour. These composite laminates meet IS:12406-88 in terms of physico-mechanical properties and performance characteristics.

Composite door shutters are prepared by bonding the jute/sisal laminates face with plastics wood slab core. These door shutters conform IS: 4020-98 and exhibit superior performance as experienced in the existing alternatives for conventional doors. The thermal conductivity (U-value) of the door panel was ~ 0.18 kcal/hr/oC/m<sup>2</sup> and its screw withdrawal strength was ~ 1500 N, compared to the typically specified value of >1000 N for wood. The door passes the end immersion test. The weight of door is ~12 kg/m<sup>2</sup>. Fixtures such as handles, locks and hinges can be fixed in the finished door shutters without adding any wooden blocks. The cost of the composite door (30mm thickness) is comparable to the conventional ones.

CBRI has also prepared Techno-economic feasibility report of natural fibre composite door shutter. Commercial trials were also carried out. The know-how on the manufacturing of door shutters has been transferred to M/S Artglas industries, Jhotwara, Jaipur.



Photoview of composite door shutters

### ***Mechanised casting of reinforced concrete cored units for roof/ floor***

Roofing in a building is a major item with respect to construction cost. The reinforced concrete cored unit is a fast growing single item for use as roofing / flooring member. It is a box type structure with circular hollows in the center of the unit throughout its length. The unit is structurally complete in it and does not require any support or propping during placement. The roof slab construction using cored units is upto 30% lighter than a cast in-situ slab.



Mechanised casting of concrete Cored Unit

CBRI, in order to improve the quality of cast cored units, produced by semi- machanised process, designed and fabricated prototype using up-graded technology of casting 300, 600 and 900 mm wide and upto 4.0 m long cored units with a production rate of 20-30 units per day using pressure - vibration technique.

***For casting the concrete cored units in different dimensions i.e. width & length, the mould sides are rigidly connected to the steel pallet through taper pins and wedges.***

The concrete in the mould is fed by the concrete feeder moving on rollers along the length of mould on a channel track. The concrete is poured in the mould in two stages. The pressure plunger is brought downward by operating two hydraulic jacks fitted on the top of the reaction frame. The concrete in the mould is vibrated under pressure (upto 100 gm/cm<sup>2</sup>). The vibrating cores are withdrawn from the concrete by operating a power winch after terminating the vibrations while maintaining the pressure on the concrete.

Followed by a series of various processing steps during 28 days the units become ready for use.



The units produced using the upgraded technology have been tested as per relevant BIS code and found superior in strength and quality.

### ***Structural concretes containing fly ash aggregates***

Environmental considerations are receiving increased attention with regard to industrial by-products, such as fly ash. Since, construction industry forms a very significant segment of national economy, utility of industrial by-products in this sector is going to be one of the important avenues of disposal of the industrial waste products in near future.

SERC has prepared a state-of-the-art report on use of Fly Ash Aggregates (FAA) covering various aspects such as production technology of FAA, characteristics of FAA including mix design and durability aspects. In particular the report mentions the advantages of FAA such as lower thermal conductivity, better fire resistance besides lower density. Laboratory trials were also made to prepare bonded FAAs using the modified concrete drum mixer using locally available fly ash. Test data generated indicate that due to lower self-weight of FAA, the concrete produced is lightweight in nature.

### ***Artificial neural network in structural shape optimization***

Optimal design of structural shapes is an important branch of structural optimization relevant to the fields of mechanical, aeronautical, automotive and civil engineering disciplines. Here the best structural shapes from the point of view of a specific design function is to be obtained in a design environment consulting of other behavioral, geometrical and technological constraints. Shape optimization using gradient less approach is very time consuming because of its slow convergence. To reduce the computational time, RRL-Bhopal has used artificial neural networks. Neural networks are trained based on the results of first few iterations of gradient less method. Trained networks are used to predict the further shape modifications. Four numerical examples, cantilever beam, circular plate with square hole, fixed ends beam and bracket, are successfully optimized using proposed approach. It is interesting to note that upto 67 % computational time can be curtailed by using the proposed approach.

### ***Design of die profile using computer simulation technique***

Optimum design of die profile for extrusion of aluminum tubes is usually carried out using finite element technique. RRL-Bhopal has developed indigenous software for this purpose that has the capabilities to account large strain and large rotation occurring during forming process. Based on the stress, strain and energy distribution

### ***Estimation of seismic vulnerability of buildings in Delhi***

It has been highlighted time and again that Delhi, capital city of India, might face an earthquake of magnitude of 7 on Richter scale in future, based on history of earthquake and the geotechnical setting in the background. Delhi, being the socio-political and economic nerve center of the country, demands much more attention from planners, engineers and decision-makers towards disaster preparedness. CBRI has carried out detailed assessment of seismic vulnerability of existing building stock in Delhi area based on two approaches namely Demand Capacity Ratio (DCR) approach & Rapid Screening Procedure (RSP).

For practical reasons, Delhi is divided into 134 numbers of municipal wards as delineated by Municipal Corporation of Delhi. Based upon the reconnaissance survey of buildings in each ward, 25-30 representative building samples of different building typologies were selected for detailed investigation from each ward. Figure shows the existing building typology in Delhi.

CBRI has prepared GIS based ward wise map of Delhi along with different feature class like road, rail, important structures etc., for portrayal of seismic vulnerability of the region. The primary objective is to build a spatial Database and develop an empowerment tool, viz., Customized GIS Software that enables Criteria Based Analysis of the Scenario and helps in taking effective decision.

These maps act as guidance for future planning, risk reduction and disaster mitigation and management at different levels, by bringing in necessary modifications in the land-use zoning practices, building bye-laws & regulations, and retrofitting of existing structures.

### **Vulnerability Analysis of Framed Structures Against Earthquake**

From the post disaster damage survey carried out by SERC, it has been noticed that a large number of reinforced concrete framed buildings with open storey at ground floor level, suffered extensive damage and in some cases catastrophic collapse during the infamous Bhuj (Gujarat, India) earthquake on January 26, 2001. This has brought into sharp focus the need to carryout systematic studies on the seismic vulnerability of such buildings.

SERC has taken the challenge in the national interest and studied the uncertainty in system parameters on seismic response of reinforced concrete framed structures, stochastic finite element modeling and analysis of a typical reinforced concrete framed structure with open storey. The stochastic dynamic response of reinforced concrete framed structures was characterized with uncertain system parameters subjected to random seismic excitation based on Stochastic Finite Element Method (SFEM) technique.

Based on these studies, SERC has proposed a methodology for generating acceleration response spectrum using fuzzy-random models of earthquake ground motions. The methodology will be useful for developing design response spectrums for the different seismic zones in India for different site conditions.

**The fragility analysis of reinforced concrete framed structures is an essential part in developing a framework for risk analysis due to seismic excitation. Fragility analysis requires the results of reliability analysis for different levels of peak ground accelerations (PGAs). Scientists of SERC have carried out the linear dynamic finite element analysis of typical reinforced concrete framed structure under stochastic seismic loading to estimate the reliabilities. Using the statistical properties of the absolute maximum response and the AFOSM method of reliability analysis, reliability indices are computed and the failure probabilities are determined against different levels of damage state defined in FEMA 302. From the fragility curves developed, the unconditional probability of a specified damage state under a given earthquake loading was determined. Determination of failure probabilities against different damage states will be useful for identifying the vulnerability of the structure and will help in making decisions regarding repair/retrofit measures to be adopted.**

## ***Across-wind response of structures having different cross sectional shapes under atmospheric wind***

Evaluation of dynamic wind loads on cooling towers, tall buildings, chimneys etc. is important for the design of such structures.

A pressure measurement study on a 1:100 scaled building model with cross-section in plan was carried out in the SERC wind tunnel. The model had a plan size of 12cm x 12cm with a height of 48cm. Pressure taps were provided at six different levels and the model was tested under open terrain conditions. Similarly a 1:250 scaled model of a tall building with varying shapes at different levels was also tested for pressure measurements. The height of the model was 95cm. The portion of the model between 46cm and 80cm was provided with pressure taps and manifolds were used to measure area averaged loads. The model was tested for different angles of wind incidence, both in isolated condition and with the presence of a similar interfering structure.

SERC has developed a program, 'ACLOCK', for prediction of across-wind response of a RC chimney that is equally capable for predicting across-wind response of a steel chimney. Applying to a full scale, model steel chimney, validated the method. The analytical predictions of across-wind response of both upstream and down stream chimneys in a tandem arrangement were investigated using ACLOCK program.

Further, SERC has also studied wind tunnel pressure measurement on a rigid model of a cooling tower. The model to a geometric scale of 1:300 has a top diameter of 17.78cm, a throat diameter of 17.23cm, and a base diameter of 31.46cm. The total height of the model is 38.07cm and the height of throat level is 30.45cm. A wooden pattern was initially fabricated using in-house facilities, an acrylic sheet was heated to around 200 oC, and using the wooden pattern, the required cooling tower model was fabricated to 1:300 scales. This technique, attempted first in the laboratory, is found to be practical, as well as resulting in and achieves required profile of the cooling tower model.

## ***Fiber optic sensors applied for health monitoring of civil engineering structures***

Fiber optic sensors are reported to be suitable for health monitoring of concrete structures. Embedding bare fiber optic sensors in concrete structure is not advisable because of their fragility. The process for concrete placing and compacting through vibration exerts severe stress on the bare optical fiber causing damage to the sensor. Hence it is important to develop techniques of embedding fiber optic sensor safely inside the concrete. SERC scientists have evolved procedures for embedding fiber optic sensor in concrete. Performance studies of encapsulated sensor embedded in concrete cylinders indicate that cast epoxy sheets are best suitable as encapsulated material. Experimental studies to assess the performance of epoxy encapsulated fiber optic sensor at high strain ranges have also been carried out.

## **Energy saving potential of tilted glazing in buildings**

The building sector consumes a sizable portion of the total energy produced in the country to provide appropriate indoor thermal and visual comfort levels. Due to prevailing energy crisis, interest in energy conservation in buildings has gained much momentum. Since significant energy is consumed in cooling the indoor environment in buildings, development of energy efficient design by applying common solar sense and taking maximum advantage of climate and surrounding is an approach, which is being advocated by researchers and building designers world over.

CBRI has prepared a scheme for reduction, due to the tilted glazing, in transmitted direct solar radiation through the glazing irrespective of the direction the glazing faces to. The benefit accrued is maximum for glazing oriented towards E, W, SE and SW directions for buildings located at latitudes higher than the tropic of cancer. In case of buildings located at stations below the tropic of cancer, the maximum benefit due to tilting of glazing is achieved for windows facing E, W, NE and NW directions. The reduction in transmitted radiation also increases with increase in the tilt of glazing. Studies reveal that for achieving significant benefit, a 12° tilt in glazing can be easily provided by flushing the bottom and top of glazing with the inner side and outer side respectively of a conventional 23 cms thick brick wall.

## New technique for fire protection- Direct Foam Injection (DFI)

The Direct Foam Injection technique, conceptualised and indigenously developed by CBRI has been patented in India and USA and is now ready for commercialization. Detailed engineering is in progress for technology transfer in the Oil Sector in India with M/s. Engineers India Ltd., New Delhi with statutory approval from Chief Controller of Explosives under Explosives Act 1884.

## Study for formulation of BIS code for 'Use of Glass in Buildings'

CBRI is facilitating the use of glass as an emerging building material adding excellence in building appearance, efficiency in energy performance, acoustical performance and functional performance. Use of glass in buildings has increased many folds and is thus playing an important role as an element composing building spaces of excellence.

India is producing world-class glass with a range of strength & optical properties.

Glass industry, architects, builders and All India Flat Glass Manufacturers Association (AIFGMA) has taken a forward looking role and supported the preparation of guidelines for use of glass in commercial and residential buildings. The commonly used glass types – Normal (Annealed), Laminated, Tempered, Reflective, Insulating and Mirror are covered in this study.

The country does not have any code about 'Use of Glass in Buildings'. The study would form the basis for formulation of a BIS code for 'Use of Glass in Buildings'.

*Studies for aerodynamic stability of cable stayed bridge deck*

CRRI, sponsored by Ministry of Road Transport and Highways, has carried out a planned dynamic study of bridge deck due to turbulent flow of wind on cable supported bridges and developed the state-of-the art methodology for wind tunnel testing of long span cable stayed bridges in India using sectional model investigations. The method is simple and economical which gives reliable results.

The methodology and computer program developed is useful for future wind tunnel studies of bridges in India. As longer span cable stayed bridges are being planned in India, the study would lead to their proper aerodynamic design and ensure safety.

*Monitoring of the long spans of second road bridge (North Carriageway) across Thane Creek, Mumbai, under the known superimposed live loads*

CRRRI has developed a new technology for the health assessment of the Second Thane Creek Road Bridge, Mumbai, using performance monitoring. This technology would help the user agency to plan and execute suitable bridge management policies as per the requirement.

CRRRI and Bharat Petroleum Corporation Limited have jointly developed multigrade bitumen conforming to PG (SHRP) grade specifications.

Two multigrade bitumen conforming to PG-52 and PG-64 have been developed and evaluated for different properties.

Products developed are premium products with reduced temperature susceptibility. It also indicates better adhesion properties than the conventional bitumen. A single grade can be used for the entire country.

## **Preparation of master plan for rural roads in Jharkhand**

CRRRI has prepared, on request from Government of Jharkhand, a district rural road plan and core network for all the districts of Jharkhand. CRRRI has created GIS based database for the entire 212 blocks of the 22 districts of Jharkhand. The available infrastructure and amenities of each habitation have been scrutinized.

### **Assessment of structural health and preparation of rehabilitation scheme for distressed Madhya Ganga Canal bridge on SH-14 near Garh Mukteshwar, UP**

The condition of the super structure of the 3-span simply supported bridge on Madhya Ganga Canal, Garhmukteshwar, built in 1983 is deteriorating very fast. CRRRI has used non-destructive testing methods such as rebound hammer, ultrasonic pulse velocity, crack mapping and structural response of the structure in terms of deflection by load test to assess the damage. Further to this, load tests on span carried out to examine the elastic behaviour under load test, which is lower than to the designed load. CRRRI has adopted the suspension wire method for load testing. Also the crack locations have been mapped and width of cracks are measured in main beams and diaphragms. The studies has helped the bridge to be operational by rehabilitation to meet the requirement of plying traffic of desired load class by using NDT results, lab. test, field investigations and theoretical analysis judiciously.

The study highlights the usefulness of the scheme for rehabilitation/strengthening of the distressed bridges. The suggested strengthening scheme is sufficient to qualify the bridge for 2- lane of IRC class A loading and it is within 20 percent of the cost of replacement of the bridge.

## **Microsurfacing of roads**

The highway professionals consider Microsurfacing as a vital technique for maintenance of roads.

Microsurfacing is a mixture of polymer modified emulsified bitumen, dense graded crushed mineral aggregate, mineral filler, water and chemical additives to facilitate early setting of mix. CRRRI has developed the technology for microsurfacing and could utilize a microsurfacing machine, procured by the Ministry of Road Transport and Highways for Assam PWD (NH Division).

CRRRI has designed & developed job mix for ISSA grading III @12 Kg aggregate/m<sup>2</sup>

10.5% NR latex, modified emulsion, 0.5% cement and 0.25% additive. The machine was calibrated for these deliveries, as the mix is successful. About 7000 sq. m area has already been laid using this technology. The technique has been found to be successful on a number of roads in Delhi also.

## *Evaluation of performance characteristics of road sections constructed using Natural Rubber Modified Bitumen (NRMB)*

CRRI has conducted a detailed study, which shows that incorporation of 2-4% natural rubber in bitumen improve properties of bitumen and bitumen mixes enhance the life of pavement surfacing.

The better performance of test sections with NRMB in bituminous binder courses and wearing courses indicated that performance of roads with NRMB is better with the use of NR in bitumen modification. The use of natural rubber in this diversified application leads to better economic conditions for the rubber growers also.

## **Dissemination of HDM-4 in India and Asia Pacific**

The Asian Development Bank has funded Highway Development and Management Version 4. This is basically a Training and Dissemination Project, which has been developed in response to the needs that have arisen as a result of the introduction of HDM-4 - a replacement for HDM-3. The aim is to develop sustainable capacity in training and dissemination at regional and country level, related to the application of HDM-4 in the development and management of road based infrastructure, with the ultimate goal of achieving significant improvements in the performance of the road sector in member countries.

This is an ongoing process and CRRI is developing manpower especially in India who would be able to use the software in real life situation with clear understanding of different parameters used in HDM-4 so that they could develop rational pavement maintenance management systems. The effort has become by and large successful and CRRI has trained around 100 personnel of different organisations in India and abroad. This programme has brought the Institute in the forefront of HDM-4 dissemination programme all over the world.

## **IMPORTANT VISITS**

### **SERC**

Hon'ble State Minister for Science & Technology, Shri Bachi Singh Rawat, evincing keen interest in the Industry sponsored R&D work in progress.

### **NEW FACILITIES ADDED**

#### **CBRI**

1. Scanning Electronj Microscope
2. X-ray Diffraction equipment
3. Environmental chamber
4. Infra-red Thermography
5. Ground Penetrating Radar
6. Pile Diagnostic system
7. Cyclic Triaxial Accelograph

#### **CEERI**

1. Reliability Test Set-up for Semiconductor Laser and Photodetectors for estimating the life expectancy of laser diodes.
2. Test Set up for pressure sensor performance in the pressure range of 14.7 to 1470 psi (1 to 100 bar) Visual Alignment System for Precision Presco Thick Film Screen Printer for printing on LTCC tape.
3. Step Height Surface Profiler.
4. Laser Beam Profiler.
5. Laser Pattern Generator for Photo mask fabrication.
6. Hydrogen Gas Generating System

7. MEMS Pro CAD tool installed and tested to solve some complex MEMS design problems like Piezoelectric Element, Pressure Sensor based on Piezoresistive Wheat Stone Bridge, Gyroscope System and Accelerometer.
8. 6" dia silicon wafer cleaning set up installed.
9. 2 nos. of class 10 clean air stations procured and installed in Millimeter Wave Device Laboratory
10. LCTF (Liquid Crystal Tunable Filter) with a Colour CCD Camera and Software facility created

## 1.4.2 HUMAN RESOURCE DEVELOPMENT

### CEERI

Provided training to final year BE/B.Tech, MCA/ME/M.Tech/M.Sc./B.Sc.(Hons) students from various academic institutions.

Provided training to final year BE/B.Tech, MCA/ME/M.Tech/M.Sc./B.Sc.(Hons) students from various academic institutions.

<b>Long Term (6 months and above)</b>	
M.Sc. (Tech.)/M.E./M.Tech.	18
B.E./B.Tech.	14
M.Sc./MCA	18
<b>Short Term (2-6 months)</b>	<b>15</b>

### CMERI

1. National Seminar on '**Towards Self Reliance in Power**' (SRP 2003) held during April 18-19 2003. Participants: 200, Papers: **42**.
2. **National Conference on Investment Casting (NCIC 2003)** held during September 22-23 2003. Papers: **33**.
3. International Conference on **Grain Drying in South Asia (GDSA 2003)** held during December 1-2 2003. Papers: **35**.
4. National Conference on **Advanced Manufacturing & Robotics (AMR 2004)** held during January 10-11 2004. Papers: **108**.

### CRRI

- Training Programme for the Engineers of North-Eastern Region for Capacity Building, sponsored by Department of Development of North Eastern Region (DONER), Govt. of India, has been organized.
  1. Ground Improvement Techniques and Landslide Management
  2. Field & Laboratory Testing of Material for Quality Control Aspects of Road works.
  3. Inspection, Maintenance and Rehabilitation of Bridges.
  4. Planning, Design, Construction and Maintenance of Pavements

- Workshop - cum - Training programme on 'Implementation of SKD-6 i.e. Road Construction and Management Planning was organized using HDM-4' during December 22, 2003 to January 2, 2004 at Kathmandu sponsored by Royal Govt. of Nepal which was attended by 25 participating officers.

## CSIO

- 11th Management Development Programme on Operation, Maintenance & Repair of Bio-Medical Equipment organized during 17th September -11th November 2003. (Sponsored by Ministry of External Affairs, Govt. of India under ITEC / SCAAP Programme).
- 4th Management Development Programme on Operation, Maintenance & Repair of Analytical Equipment organized during 14th January 2004– 9th March 2004. (Sponsored by Ministry of External Affairs, Govt. of India under ITEC / SCAAP Programme).
- Training Programmes on Repair & Maintenance of Bio-Medical Instruments for Hospital Technicians/Doctors conducted at different places (Sponsored by Department of Science & Technology, New Delhi)
- Courses Conducted by Indo-Swiss Training Centre (ISTC) of CSIO
  1. Human Resource Development is an ongoing activity of the Institute in the areas of:
    - Instrument Technology
    - Mechatronics & Industrial Automation
    - Die & Mould Making
  2. Short-term courses have been started by ISTC for benefit of persons from industry:

Short-term courses have been started by ISTC for benefit of persons from industry:

Course Name	Course Duration, Importance of Programme & No. of Programmes	Number, Level & Type of Participants	Benefits Derived by the Participants
CNC Milling Part Programming	Two weeks. CNC programming is the new trend in industry No. of Programmes: 4 during 2003-04	[Eight] Diploma/Degree in Engg. Sponsored and Individual	Learned past programming for machining on CNC milling machine along with theoretical inputs
Design of Press Tools	Two weeks. Press Tools Designers are required in the industry No. of Programmes: 1 during 2003-04	[Two] Diploma in Engg Sponsored	Basics of Press Tools Design of various types and hands-on practice

## RRL-Bhopal

- Workshop on "Materials & Technologies For Reducing Corrosion, Maintenance & Cost In Sugar Mills"
- International conference on Water and Environment - 2003 (WE-03).



## RRL-Trivandrum

- Training programme related to sampling and analysis of nutrients in sea water and statistical analysis of

Technical competence to perform specific types of testing, measurement and calibration as per international criteria in diverse fields like electrical, mechanical, thermal and fluid.	CMERI
CSIR Technology Award for the design development of Sonalika Tractor	Hardyal Singh, R. Nigam, M.K. Banerjee, U.S. Karail, H.S.Toor, S.S. Sehmbly, A. Nandy, CMERI
'VIGYAN GAURAV SAMMAN' by the Council of Science & Technology, Department of Science & Technology, Govt. of Uttar Pradesh	Dr. R.P. Bajpai, CSIO
Dr Myung Se Kim Award of Excellence in Hyperthermic Oncology by Indian Association of Hyperthermic Oncology & Medicine	Shri R.N. Sengupta, CSIO
ISO 9001 : 2000 Certification	CSIO
ISO 9001:2000 Certification	CRRRI
Fellow of Maharashtra Academy of Science for the year 2003	Dr.(Mrs.) N.P. Thacker, NEERI
JSPS Invitation Fellowship award (research at AML-NIMS, Tsukuba, Japan)	Dr. Nitin K. Labhsetwar, NEERI
National Technology Award 2003	Dr. C. Arumughan, MM. Sreekumar, B. Sankarikutty, MA. Sumathikutty, K.P. Padmakumari, RRL-Thiruvananthapuram
MRSI Medal	Dr. BC. Pai Dr. CKS. Pillai, RRL-Thiruvananthapuram
CRSI Bronze Medal	Dr. Ajaya Ghosh Dr. D. Ramaiah ,RRL-Thiruvananthapuram

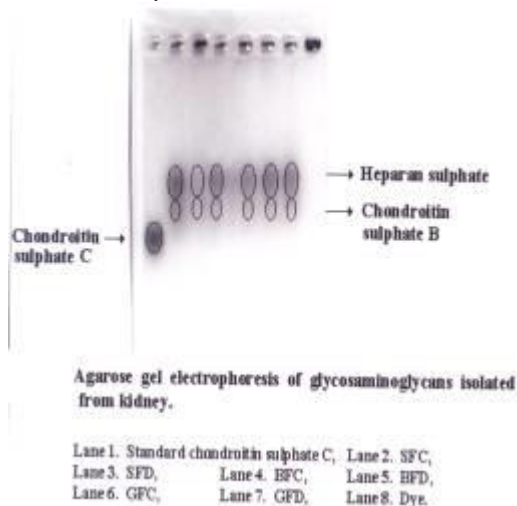
# Food Science & Technology

## Finger millet $\alpha$ -amylases degrade cereal starches and flours

Purified  $\alpha$ -amylases from ragi malt (designated as a-1(b), a-2 and a-3), are found to be completely inactivated below pH 4.0 but found to be comparatively more stable in alkaline pH. These iso-enzymes are inactivated around 70°C. CaCl<sub>2</sub> (5-7 mM) enhances their thermal stability and also found to be an activator. On the other hand citric and oxalic acids inhibit these enzymes completely between 10 and 12.5 mM concentrations, respectively. EDTA is a competitive inhibitor of these enzymes at micro molar concentrations and inhibition is temperature dependent. CFTRI, on the basis of detailed studies, prepared various malto-oligosaccharides which can be used as fat substitutes. Ragi malt  $\alpha$ -amylases have high specific activity and can be utilized in both bread making and brewing industries as cost-effective substitutes for barley malts.

## Beneficial effects of dietary fiber and butyric acid on diabetes and diabetic nephropathy state

CFTRI has carried out a comprehensive study on the effect of dietary fibre (DF) and butyric acid (BA) on diabetes and changes in heparan sulfate. Both wheat bran and guar gum ameliorated diabetic status to a considerable extent. Glycosaminoglycans were isolated from kidneys of different groups and the profile of uronic acids, total sugars, amino sugars and sulfates has been studied. The content of sulfate decreased during diabetes and is ameliorated by DF. Activities of some of the renal enzymes involved in glycoconjugate metabolism - GFAT,  $\beta$ -glucuronidase, and glucosaminidase are examined. The increased activity of these enzymes is prevented by these dietary fibres. CFTRI studies demonstrate that dietary fibres and its fermentation product butyric acid are beneficial in improving diabetic status and minimizing the complications of diabetic nephropathy state with particular emphasis on heparan sulfate. Such studies help in developing foods for diabetic patients.



Agarose gel electrophoresis of glycosaminoglycans isolated from kidney. Lane 1 Standard chondroitin sulfate C, Lane 2 Starch fed control, Lane 3 Starch fed diabetic, Lane 4 Bran fed control, Lane 5 Bran fed diabetic, Lane 6 Guar gum fed control, Lane 7 Guar gum fed diabetic, Lane 8 Dye

## Oryzanol extraction from rice bran oil soapstock

A simple and cost effective process for isolation of oryzanol has been developed by CFTRI. Conventional saponification process is carried out at elevated temperature and for longer duration. The present process is employed at lower temperature and for shorter duration with efficient removal of targeted impurities. The degradation of oryzanol is also minimal and hence the process is simple and easy to scale up with reduction of number and scale of unit operations involved in the overall process. The technology has been patented.

## Blending of oils to enhance nutritional value of edible oils

Naturally occurring edible oils are not wholesome in terms of balanced fatty acid composition and in minor constituents, which have independent health benefits. Efforts have been put towards developing combinations of vegetable oils to provide fatty acid composition in the ratio of approximately 1:1:1 and 1:2:1 for saturated: monounsaturated: polyunsaturated fatty acids for meeting the needs of health conscious individuals.

Combinations have been chosen to provide desired levels minor constituents to act as nutraceuticals. Various oils containing essential fatty acids of w6 and w3 series have been chosen as base oils and blended in appropriate ratios with oils like rice bran oil, red palm oil and sesame oil to provide nutraceuticals like oryzanol, b-carotene, tocotrienols, sesamin and sesamol. After ascertaining quality parameters as well as desired levels of fatty acid composition, six combinations of oils have been selected for large-scale trials. An enriched fraction of b-carotene, to be used as nutraceutical, has been extracted from red palm oil, a rich source, with organic solvents of different polarities.

In order to obtain an oil combination, which not only provides health benefits but also, suitable for use in frying dishes, combinations of oils were prepared at CFTRI. Combination of palm oil or mustard oil along with rice bran oil and sesame oil provided a stable frying oil. Combination of groundnut oil with rice bran oil or red palm oil provided good rheological stability.

## Preparation of nutraceutically enriched traditional candy

India is endowed with a variety of natural ingredients rich in nutraceuticals. In the current study, spices/herbs like ginger and cumin are taken as ingredients to prepare candy based on jaggery. Ginger and cumin are reported to have health benefits. Ginger and cumin in the form of oleoresin as well as a whole spice are used in product preparation. Along with these nutrients, vitamin-C is also incorporated in the product. In addition, jaggery also contributes some micro-nutrients. The product prepared with ginger alone is found to be pungent. On the other hand, the product prepared with ginger and cumin is found to have balanced taste and the proportions of these two are standardized to obtain a product with good acceptability.

CFTRI has standardized the process to retain the natural nutrients present in these raw materials. Also, the product was prepared using black cumin in place of normal cumin (jeera), as black cumin is reported to be nutritionally better than normal jeera. However, the products with black cumin have lower sensory scores compared to that of normal jeera.

## Natural food additives from forest produces

The roots of *Decalepis hamiltonii* and *Hemidesmus indicus* are aromatic and have the characteristic nature of possessing the crystalline compound 2-hydroxy-4-methoxybenzaldehyde as the major compound in their volatile

oils. *D. hamiltoni* root volatiles possess antimicrobial and insecticidal properties. On steam distillation the fresh fleshy roots yielded a volatile oil (0.68%) from which 2-hydroxy – 4-methoxybenzaldehyde crystallized out. GC-MS analysis of the oil shows, the added presence of benzaldehyde, salicylaldehyde, methyl salicylate, benzyl alcohol, 2-phenylethyl alcohol, ethyl salicylate, a p-anisaldehyde, and vanillin – minor but olfactorily and biologically significant components.

## A new process for egg yolk antibodies against an insect specific protein

Insect infestation in stored grains is a universal phenomenon that causes loss to food grain to the tune of 20-30% both in terms of quality and quantity. The method of separating the insect and grain through visual examination is not a very efficient one. CFTRI has developed a process for the production of egg yolk antibodies which have high titer, consistent quality of antibody, easy to produce and non-invasive for an insect specific protein. This is very practical, economical and advantageous, as it gives high yield of antibody (165 mg of antibody/egg). The production of the titer of the antibody remains high for a longer period of time (almost 60 days), thereby providing a continuous supply of consistent quality of antibody.

## Nutrient dense food for infants and children

Weaning stage (6 months to 3 years) is very important in the growth of a child. During this stage the growth of child is very rapid and the child changes his/her nutritional needs from milk to semisolid diet. Besides, the growth of important vital organs is almost complete during this stage. In view of this, providing adequate nutrition with an acceptable food of proper texture is highly desirable. Such food mainly contains pre-gelatinized starch, which absorbs more water and becomes bulky. This high bulk limits the nutrient content of the food per unit feed and this is a major constraint for intake of requisite quantity of energy and protein by younger children. CFTRI has solved this problem by incorporating amylase rich flour particularly from finger millet. A small quantity of malt flour (about 5%) could be mixed with high bulk foods prepared by popping, roller drying or extrusion cooking. By this approach their texture, nutrient density and also bioavailability of the major and minor food constituents could be improved.

## Natural food colors, antioxidants from spent coffee, microbial degradation of caffeine, low grade tea

Natural food colors find a wide variety of uses in food and non-food applications like pharmaceuticals and cosmetics. The major problem encountered with the natural colors is their instability to light. CFTRI has solved this problem by optimizing the use of antioxidants.

The generation of spent coffee in soluble coffee manufacturing industry is enormous in quantity and hence the need to utilize it. Spent coffee contains phenolics and chlorogenic acid which when isolated will serve as good antioxidants. The biotechnological process for degradation of caffeine uses simple substrates for the growth of the microorganisms and simple extraction procedures for the enzyme. The enzyme after immobilization and stabilization can be reused with no change in the final product. The process is safe, eco-friendly and cost effective.

## 1.5.2 HUMAN RESOURCE DEVELOPMENT

### CFTRI

#### ***M.Sc. FOOD TECHNOLOGY***

Duration: 2 Years

The uniqueness of the course is in the fact that the R&D scientists of the various departments of CFTRI impart the training in specialized areas of Food Science and Technology using the state-of-art facilities of the institute.

#### **CERTIFICATE COURSE IN MILLING TECHNOLOGY**

Duration: 12 months

This course is the only one of its kind not only in India but also in whole Asia for the formal training in Flour Milling Technology.

Training of students from other universities and colleges

Duration: 4 weeks to one year

The students from different colleges and Universities are trained in the various frontier areas of food science and technology

## 1.5.3 RECOGNITION & AWARDS

Padma Shri for distinguished services, Fellowship of Royal Society of Chemistry (ERSC), UK, Kashalkar Memorial Award for 2002 by All India Food Processors' Association Fellowship of Royal Society of Chemistry (ESRC), UK	Dr. V. Prakash, CFTRI
APSI Young Scientist Award and Gold Medal –2002 of Academy of Plant Sciences, India Fellowship of Academy of Plant Sciences, India	Dr. P. Giridhar , CFTRI
National Technology Day Award by DST	Dr. S. Rajarathnam, CFTRI
National Technology Day Award by DBT	Dr. G.A. Ravishankar, CFTRI
PB Rama Rao Memorial Award for 2003 excellent contributions to Biomedical Sciences by Society of Biological Chemists (India), Bangalore	Dr. K. Srinivasan, CFTRI

Fellowship of the Association of Food Scientists & Technologists  
(India), Mysore

Dr. S. Divakar, Dr. N.G. Malleshi, CFTRI

# Information Science & Technology

## 1.6.1 SCIENCE, TECHNOLOGY & SERVICE

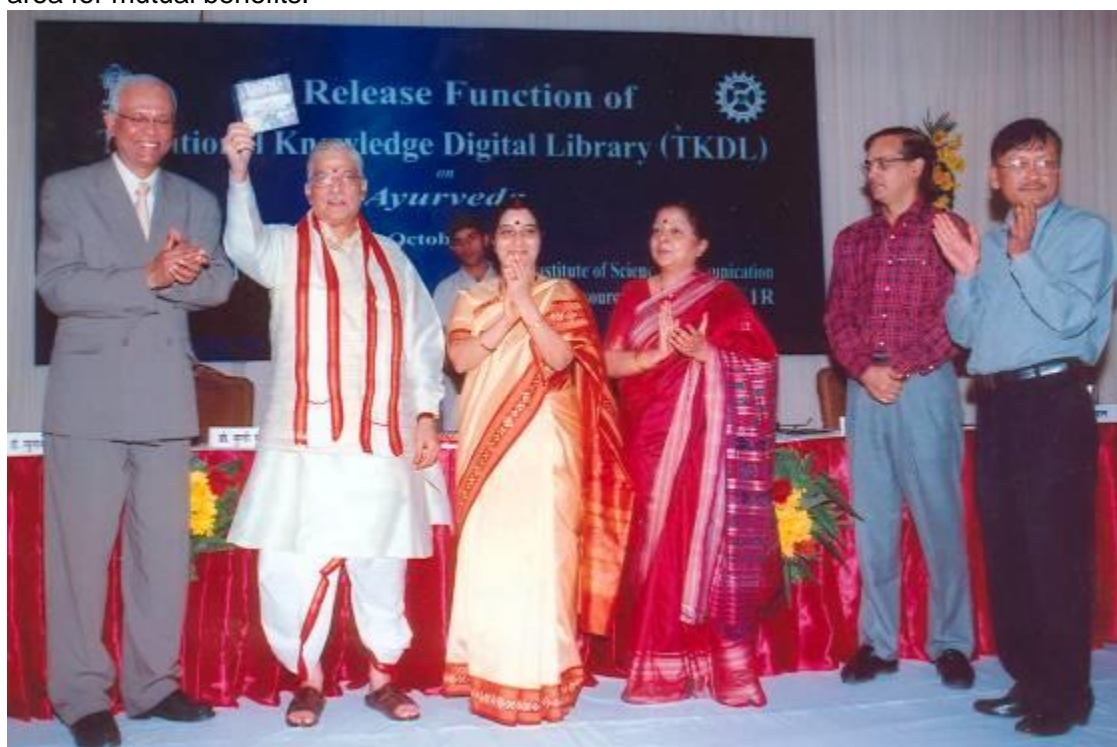
### Traditional Knowledge Digital Library (TKDL) — Ayurveda *Inclusion of 200 Subgroups on Medicinal Plants in IPC*

The concepts of Traditional Knowledge Resource Classification (TKRC) were presented to the experts of International Patent Classification (IPC) Union. The novelty of the classification scheme was well recognised by these experts and the IPC Union constituted a Task Force to further study the possibility of linking and/or integrating TKRC developed by India with IPC. Task Force consisting of United States Patent Office, European Patent Office, China, Japan and India recognised the need of having a more detailed level of classifications relating to medicinal plants and has created approx. 200 subgroups for the classification of medicinal plants in IPC (under a new Group A61K 36/00) instead of the existing single sub-group (A61K 35/78). These will be included in the next edition of IPC to be published in July 2005. It has also been recommended by the IPU Union that the TKRC developed by India and other countries may be linked to the IPC.

#### ***Release of CD containing a sample of 500 Ayurveda formulations***

A CD containing a sample of 500 Ayurveda formulations was released by Hon'ble Minister of Science and Technology, Human Resources Development and Ocean Development, Prof. Murli Manohar Joshi in a function held at NISCAIR on 23rd October, 2003. Hon'ble Minister of Health and Family Welfare and Parliamentary Affairs, Smt. Sushma Swaraj presided over the function. Present on this occasion were Dr. R.A. Mashelkar, FRS, DG-CSIR, Mrs. Malti S. Sinha, the then Secretary, Department of AYUSH, Mrs. Shailaja Chandra, Chief Secretary, Delhi, besides other dignitaries who attended the function.

TKDL has become a model for other countries for protecting their traditional knowledge from misappropriation. A five-member team from South Africa led by Ms. L. Thahane, Dy. Director General, Department of Science & Technology visited NISCAIR in first week of December. Both the organizations have agreed to collaborate in this area for mutual benefits.



Hon'ble Minister of Science and Technology, Human Resources Development and Ocean Development, Prof. Murlu Manohar Joshi releasing CD of ayurveda formulations

### ***Wireless information society***

NISTADS has studied the competition between mobile and fixed telephony for the market share of the subscriber base as well as the revenue earned. Global trends pertaining to the growth of the Wireless Information Society (WIS) were analysed with the help of mathematical models. Future projections have been made for the subscriber base as well as the revenue earned from mobiles and fixed telephones. The study predicts that mobile telephones, equipped with latest communication technology, are likely to be in an advantageous position vis-à-vis fixed telephones and are likely to replace them in the near future. Similarly, revenue generated from mobile sets will be more than that by the fixed telephony. Further, with the technological advances in the field, mobile Internet services will enhance the adoption of mobiles in the society and it is estimated that in the near future more than fifty percent transactions will take the mobile route. It is visualised that there would be more economies with mobiles than that with fixed lines in the near future and it will become the trendsetter for the coming generations.

### ***Software for Poly-olefin reactor simulator***

Gas phase polymerization of olefins is one of the most widely accepted and commercially used processes for manufacturing of poly-olefins. In this process small catalyst particles (20 - 80  $\mu$ m) react with the incoming fluidizing gas to form a broad distribution (100 - 5000  $\mu$ m) of polymer particles. NCL has developed a mathematical model for simulating fluidized bed polyolefin reactors. Unlike available models, this new model is capable of predicting both polymer properties as well as particle size distribution of the product.

The model is based on generalized mixing cell framework. It has the flexibility of specifying the degree of mixing in each (gas/solid) phase. For each mixing cell, dynamic balance equations are written for each component. This dynamic model is coupled with steady state particle population balance model in order to predict the particle size distribution. The model incorporates rigorous Ziegler-Natta type multi-site multi-monomer kinetic scheme. The model is capable of predicting the effects of operating conditions such as superficial gas velocity, temperature, pressure and catalyst feed rate on polymer properties and particle size distribution (PSD) of the product stream. The Software, PoRE (Poly-olefin REactor simulator) incorporates the mathematical model to simulate transient and steady state behaviour of fluidized bed polyolefin reactors. PoRE consists of a kernel and different modules for input, kinetics, output, hydrodynamics, model equations, PSD equations and output. A databank of available hydrodynamic correlations for fluidized beds is incorporated in the hydrodynamics module. Due to its modular design, PoRE can be easily configured to simulate any fluidized bed poly-olefin reactor.

### ***Energy scenario in India and other developing countries***

Energy consumption in any country is directly linked to its industrialization, economic strength and the life-style of its citizens. Although, energy consumption in India has increased several folds in the post independence era, its per capita average energy consumption level is far below that of comparably large developing economies like China and Brazil. During the last sixty years, India, China and Brazil have all made progress in exploitation of their vast natural potential of energy sources, both from fossil fuels and new and renewable sources but still these three countries are way behind the global average in per capita consumption of energy.

NISTADS in its study has attempted to analyze the experience of the three largest developing countries in the world by land area, namely, China, Brazil and India, in energy exploitation. Various limitations of fossil fuels including their adverse effect on the environment and biodiversity have also been discussed. Against this



background, a viable energy scenario for India has been developed, which places paramount importance on self-sufficiency and energy security.

The study discusses the need to develop self-sustaining units of energy, based on local inexhaustible sources, which are available in abundance in our country. This requires emphasis on harnessing solar energy, wind energy, hydropower, etc., which are reliable, plentiful and environmentally friendly. Energy from these sources does not affect biodiversity, marine life and there is no emission of green house gases. As regards transportation fuel, in the long run, it may become necessary to adopt synthetic fuels in place of fossil fuels such as Hydrogen and Fuel cells.

### ***Evaluation of design and technology upgradation scheme for handicrafts***

NISTADS, on instance of Ministry of Textiles (GOI) studied and evaluated the impact of the design and technology upgradation scheme on income enhancement of the artisans, creation of additional employment, increasing exports of handicrafts, and in building the capacity of the artisans in terms of design and technological upgradation, infrastructure creation, etc. The overall findings are that the scheme contributed significantly to the creation of additional employment, boosting exports and domestic product, and in training the artisans for better designs and in the use of improved techniques. It is imperative to note that a further boost in the sector can be given only if greater marketing linkages are provided to the artisans, if a spurt is given in producing professional designers in much greater number, and if common facility Centres with modern machines and tools & processing raw material are established and made accessible to the artisans.

### ***Comparative study on internet diffusion between India and China***

NISTADS has undertaken study to highlight the Internet diffusion patterns in India and China. The major portion of the study is the effort being carried out in the diffusion of Internet in the national economies, the problems being faced, how these two countries are tackling these problems. There is a comparison of future potential of Internet growth in the two countries taking into considerations factors like- number of users, with characteristics and bandwidth availability. The study also tries to look into the factors responsible for the difference in situation in two countries and discusses relative advantages and disadvantages of each country. It concludes with the policy suggestions about what India should do in order to increase Internet penetration.

### ***Journal outreach programme***

NISCAIR has been making a major contribution to Indian science by publishing around nineteen journals covering all the major disciplines of science. A special programme called journal outreach programme was launched not only to maximize the reach of NISCAIR journals but also to increase subscription base and to promote sales.

Through this programme, the subscribers lost over the five years were identified and contacted with a view to win them over, by providing value-added products in future.

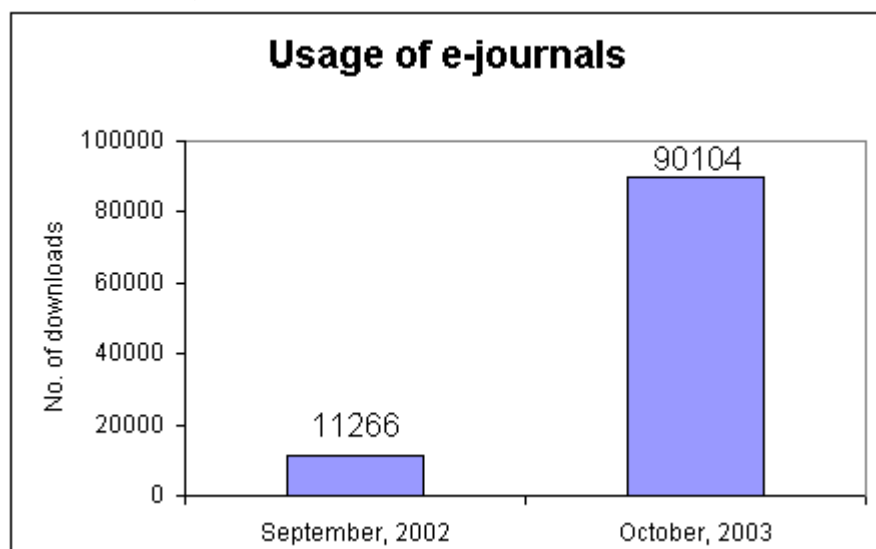
NISCAIR have also made efforts to get new potential subscribers both at national and international level. The impact of the programme is already visible through the facts:

- a. There has been a considerable increase (29%) in circulation figures of journals during January – December 2003 (9053) as against 6993 in same period of last year
- b. Total subscription increased to Rs.77 lakhs

## **CSIR Electronic Journals Consortium**

The CSIR e-Journals Consortium is a Tenth Five-Year Plan project which aims at providing electronic access to nearly 4,500 worldwide S&T periodicals. In June 2002, CSIR entered into an agreement with M/s. Elsevier Science, one of the largest publishers of S&T e-journals for having access to its 1,700 S&T journals among all the laboratories/units/centres of CSIR. NISCAIR (erstwhile INSDOC) is the implementing agency for CSIR e-Journals Consortia by the CSIR.

During the second year of operation of the CSIR e-Journals Consortium, the major activity was to monitor the use of the facility and promote usage among the CSIR laboratories. NISCAIR's continued efforts have enabled significant increase in the usage of e-Journals by CSIR laboratories. There has been 700% increase in usage from July 2002 to October 2003. The total downloads by the laboratories were 11,266 in July 2002 which increased to 90,104 downloads in October 2003.



## **Science Popularisation**

Popularization of science among the masses is a major programme of NISCAIR. For the purpose of spreading awareness about scientific developments and creating a scientific temper among current generation of youth, the Institute publishes three well-circulated popular science journals, Science Reporter (English monthly), Vigyan Pragati (Hindi monthly), and Science ki Duniya (Urdu quarterly) apart from a number of popular science books. The Institute also focuses on the R&D activities of CSIR labs through its newsletters—CSIR News and CSIR Samachar.

## **Books Publisher**

The Institute has brought out more than 60 popular books in English under different series, viz. CSIR Golden Jubilee Series (25), Sci-Fun Series (7), Q-Series (3), Vistas in Biotechnology Series (10) Foundations of Biotechnology Series (6), Others (9), and the encyclopaedic publication Golden Treasury of Science & Technology. Also, 28 books have been brought out in Hindi. All the popular books of NISCAIR have been very well received and several of them had to be reprinted 2-3 times to meet the demand.

The publications brought out by NISCAIR during April 2003 and March 2004 are:

1. A book "Frontier Science and Cutting Edge Technologies—The Road Ahead", was brought out on the occasion of the 90th Session of the Indian Science Congress held at Bangalore during 3-7 January 2003. The book contained overviews of the various sessions as well as interviews of eminent scientists conducted by NISCAIR scientists.
2. NISCAIR has brought a popular science book "Networks Everywhere".

### ***Science Reporter***

Science Reporter, one of the oldest English language popular science monthlies published in India, entered into its 41st year of publication in 2004. The magazine enjoys a wide readership throughout the country. Science Reporter continued with its objective of providing to its readers topical coverage of issues in various fields such as information technology, wildlife, environment, space, nuclear technology, health, and biotechnology as well as light reading material such as humour, amazing scientific facts, profiles of scientists, science projects, inventions and discoveries and much more.

### ***Vigyan Pragati***

Vigyan Pragati is a monthly popular science magazine in Hindi that reaches far and wide in the country. Running in its 53rd year, Vigyan Pragati endeavours to introduce its readers to the important current events/issues in an easy to understand manner. The major issues covered during the year are: Solar Energy, Photonic Crystals, Rare Coins, Indian Roads, Gharat—A Rural Technology (April 03 issue); Petroleum, Diatoms, Coronary Heart Disease (May 03 issue); Chemical & Biological Pollution, Snake, Smokeless Burner (June 03, special issue on Environment); Rose Geranium, Aerosols, Pollution in Sky, Biotechnology (July 03 issue); Mountains, M to M Systems, Mystery of Sunshine, Nutrition (Aug. 03 issue); Aeroplanes affected from Volcanoes, Pollution in Space, Chlorophyll, Mathematical Entertainment, Indian Space Programme (September 03 issue); Endangered Wild Animals, Animalarium (October 03, special issue on Animal Welfare Day); Memorable Moments of Space Visits, Solar System, Inset-3E (Nov. 03 issue); Traditional Knowledge Digital Library, Immunity and Traditional Spices, AIDS, Traditional Crops of Medicinal Values (December 03 issue); Traditional Seeds, DNA Vaccine, Life on Mars, Nanotechnology, Hydrogen as Fuel, Digital Divide, Data Outsourcing, Cactus, Object Monitor (January 04 issue). In addition to all the above, Science Quizzes were included issue wise on different topics as also Pratiyogion Ke Liye. Large number of articles pertaining to issues on health and medicine received appreciation from the readers as reflected by the letters received from time to time. Under the Outreach Programme schools were visited and contacts developed with the science teachers.

### ***Science-ki-Duniya***

Science-ki-Duniya, the quarterly popular science magazine in Urdu, reaches far and wide across the country. One of the most widely read Urdu magazines in the country, it has now entered into its 30th year. During 2003-2004 Science-Ki-Duniya continued to disseminate information on current scientific topics in very easy and attractive manner.

(April-June 2003), Hawai jahaz ki urane kae sau sal--aek jaeza (July-September 2003), Duniya ki Khoobsurat Jheelain aur mahauliyat (October–December 2003). October-December issue was also a special Issue on children containing a number of articles for children like robot doctor ka bharsemand sathi, pai ki kahani (Math Corner), Beaver aek hoshiyar engineer, Namaloom Duniya ki makhlooq (Science Fiction). The forthcoming issue covers story on Biotechnology -- taraqqi ka aham zaria, and the other major article is on Traditional knowledge aur hamara mustaqbil.

Besides these, regular columns on science model, science quiz, miracles and science, science for children and women, health, biography, science news, crime and science, scientific terminology, book reviews, cartoon and science fiction are also being published.

## **CSIR News**

CSIR News, the fortnightly newsletter of Council of Scientific & Industrial Research (ISSN 0409-7467) is intended to serve as a useful link among the various CSIR establishments and to communicate activities/accomplishments of the Council to other R&D organizations, universities, S&T agencies/departments, industry and other users, mass media, etc. It also disseminates information on CSIR to other countries through Indian missions abroad and foreign missions in India.

The 24 issues brought out during 2003-2004 covered news pertaining to R&D accomplishments, technology transfers, marketing, commercialization/utilization, sponsorships, collaborations, IPR, etc. Also covered were new facilities, important conferences, seminars, workshops, training programmes; important events such as foundation day celebrations, lectures, appointment of directors, announcements regarding forthcoming events, etc. Contributions of S.S. Bhatnagar Prize-winners are also published.

The 30 July 2003 issue was a special issue on presentation of Shanti Swarup Bhatnagar Prizes for 2002 by Hon'ble Prime Minister Shri Atal Bihari Vajpayee. The issue published speeches delivered on the occasion by Shri Vajpayee, and Dr. Murli Manohar Joshi, Hon'ble Union Minister for HRD, S&T and Ocean Development. The 15 & 30 October issue was a special issue on CSIR Diamond Jubilee Concluding Function, and release of CD on TKDL Ayurveda by Prof. Murli Manohar Joshi. The article on TKDL CD release function also covered the speeches delivered by Dr. Joshi the Chief Guest, and Smt Sushma Swaraj, Minister for Health & Family Welfare and Parliamentary Affairs, who presided over the function.

***Launched in 1984, CSIR Samachar is now in its 21st year. It is a monthly news bulletin in Hindi, which covers the R&D activities of all the laboratories of CSIR and consequently serves as a useful link. It also disseminates information on various activities of CSIR.***

***November and December '03 issues of CSIR Samachar exclusively covered the closing of CSIR Diamond Jubilee celebrations and release of TKDL CD on Ayurveda. It also included the awards instituted by CSIR, especially Shanti Swarup Bhatnagar Award; Technology Award; Young Scientist Award etc. Raw Materials Herbarium and Museum (RHMD)***

The Herbarium and Museum of Economic Raw Materials was set up in 1978 and the acronym RHMD (Raw Materials Herbarium & Museum, Delhi) was allotted to it by the International Association of Plant Taxonomy, New York in 1984. RHMD houses authentic samples of economically important raw materials of plant, animal and mineral origin of India as a whole, in one place, to cater to the needs of scientists, researchers, industries, students and the public. Presently, it holds 6226 plant specimen; 190 zoological specimen; 207 mineral; and 1600 carpological samples (crude drugs, roots, seeds, bark wood, etc.). The activities of collection, preservation and identification of herbarium specimen and samples to make the herbarium more comprehensive are being continued. The RHMD also acts as a repository of photographs, illustrations and transparencies of economic raw materials. This facility is being used for reproduction of photographs and slides for publication and presentations by NISCAIR staff and also by outsiders against payment. The RHMD presently has 3550 such photographs and 700 negatives.

## **Wealth of India**

Launched in 1942, The Wealth of India — Raw Materials, is an encyclopaedic publication describing the plant, animal and mineral resources of India. It is acclaimed as a reference standard for information on raw materials of India, particularly in the current global trend to incorporate traditional knowledge systems into the proprietary mainstream. Policy-planners use the information to prevent bio-piracy. It has in the recent past, played a major role in India's claim for priority in the US patent case on turmeric.

The A to Z entries of raw materials were covered in 11 volumes (along with two supplements). The initial volumes of the series were taken up for revision and enlargement. A total of three volumes (plus a supplement) of the revised series were published during 1985-1992 covering entries from A to Ci. At this stage, it was decided to go digital and three CD-ROMs were brought out during 1996-1997. All the printed volumes on raw materials went into the first disc while updated information was incorporated in the other two. But CD not being a substitute for the book, particularly for the Indian readership, all the information collected for CD updates, suitably augmented and modified, is being processed to print supplements to the Wealth of India — - Raw Materials Series.

## **1.6.2 HUMAN RESOURCE DEVELOPMENT**

- **NISCAIR**

NISCAIR organises several HRD programmes to train and prepare information, documentation and science communication professionals in meeting the challenges of the changing IT scenario. The following academic and training programmes in the field of information science and technology are conducted.

- **SAARC Documentation Centre(SDC)**

The SAARC Documentation Centre (SDC), set up at NISCAIR (erstwhile INSDOC) for exchanging information among SAARC Member Countries, has been functioning since January 1994. During 2003-04, following activities have been carried out by the Centre:

- **9th Meeting of the Governing Board of SDC**

The decisions of the 9th meeting includes approval of programmes and budget for 2004, conducting of workshop for traditional knowledge experts, workshop on library automation in Maldives, enhancement of linkages between SDC and Member States of SAARC and need for recruitment of full time professionals for SDC.

- **Collection Development**

SDC has a modest collection of reports and documents produced in the region. The Centre has acquired over 600 monographs this year which include reports of various international organizations.

- **Training Courses**

A major activity of the Centre has been to impart training to the library and information professionals in the Member States. The emphasis of all training programmes is effective utilization of information technology in library and information science. The training programmes conducted during this year were

- Short Term Courses on Information technology for information management
- Attachment Training Programmes on Information Management is organized for a period of 3 months.
- Long Term Course
- Associateship in Information Science Course
- Workshop on Library Automation

# Leather Science & Technology

## 1.7.1 SCIENCE, TECHNOLOGY & SERVICE

### Non-zero Discharge Leather Processing

CLRI has developed a three step tanning methodology towards near zero discharge leather processing. Cow hides are dehaired using standard enzyme based dehairing method. The hides are treated with  $\alpha$ -amylase 1% and water 100% for 3 h in a drum. Alternatively, the hides can be treated with 0.9% sodium hydroxide and 350% water in a drum; duration of treatment is one day. A pickle–basification free chrome tanning at pH 5.0 has also been developed with and without masking. The pH of the pelts is kept 5.0 using three different acids namely sulfuric, acetic and oxalic acid without sodium chloride. Speciation studies were carried out during the course of tanning in order to find the mechanistic pathway. A polymeric matrix based on naphthalene sulfonic acid has been prepared using polycarboxylic acid without employing formaldehyde. The product enables pickleless tanning thereby reducing the pollution load in terms of TDS and chlorides. The product not only enables higher exhaustion of chromium but also provides fuller leathers. It is now feasible to avoid Do-Undo process logic and produce Initiatives in polymer technology including synthesis of liquid crystalline polyether urethanes, sulfide copolymers, atom transfer radical polymerization technique for the synthesis of block copolymers.

### Leather Processing Technology

CLRI has developed a database on TDS contribution from their commercial post tanning auxiliaries based on which processes for the production of cow softy upper leather and sheep nappa garment leathers with reduced TDS emission have been standardized.

Presence of Cr (VI) in tannery effluent has been a cause of concern since long. CLRI, an eco-conscious establishment, is making efforts to ensure production of Cr(VI)-free leathers, by avoiding formation of hexavalent chromium in leathers. A process technology for the production of Cr-free sheep gloving leather has been standardized and suitable post-tanning methods have been developed.

Moreover, CLRI has devised innovative strategies to produce low priced garments ranging from 20-35 US\$. The production of such garments will earn India, a share in global middle market segment.

### Leather Product Technology

CLRI has developed material and productivity optimization system and field tested it in a commercial shoe unit. Savings of around 10% in material consumption has been demonstrated resulting in 33% higher production. CLRI has experimented with newer materials in shoe construction. Testing of various parameters has been completed. Wearer trials have been undertaken to assess comfort wear.

Alternatives to leather have been explored due to inelastic supply and unavailability of leather, increasing material requirement for meeting global demand, cost factor and specialized regional craftsmanship. These alternative materials have been assessed for their compatibility to leather in physical properties, workability, changes in design and construction methods. Based on the need for alternative materials and change in production methodologies, new products were developed using rigid materials such as bamboo, mats for flat and

molded products; soft materials like jute and other woven and non-woven materials for bags and garments. Designing of innovative products for aesthetic appeal and cost effectiveness has been initiated using unconventional upgradation techniques. Exclusive and exotic products for home furnishing applications have opened up a new avenue for parchment like material made out of chrome shavings. Many workshops, entrepreneurship training programmes were conducted at different places to disseminate information to the industry on these innovative product ranges. Combination of leather with jute, silk, bamboo and wool has led to innovations in products. Determination of softness (leather), insulation property, productivity enhancement for leather products were studied. Other initiatives include development of low priced garments, development of materials for upholstery, glove making, bullet proof and protective garments.

## Specialized Expert Services

Chemical pollution in leather sector predominantly due to the various processing chemicals used in the tanneries is a major concern. Some of the chemicals which have been banned include certain aryl amines, PCP, Cr (VI), formaldehyde, trace metals viz. Ni, Cd, Hg, As, Sn, phthalates, chlorinated phenols, polychlorinated short chain alkanes and alkyl tins. Taking into consideration the needs of the industry CLRI established a Centre for testing eco sensitivity of chemicals used in leather sector. The Centre offers world class testing services for testing toxicity of chemicals by tracking of PCP, tetrachlorophenols, trichlorophenols, and dichlorophenols.

## Leather biotechnology

Leather industry generates enormous amounts of solid as well as liquid wastes causing ground and water pollution. Dehairing of skins and hides is one of the major sources of pollution. Enzymatic method of dehairing as an alternative to chemical method is gaining worldwide attention. A fungal strain isolated at secreting high levels of alkaline protease in short fermentation cycles was evaluated at CLRI. The dehairing of skins and hides in the absence of sulfide using NCL enzymes has been demonstrated in commercial tanneries. Attempts for transferring the technology are in progress.

Newer sources of proteases and lipases with properties suitable for application under field trials for their application in leather manufacture have been screened. Two proteases have been selected as lead enzymes for further scaling up and large-scale evaluation trials.

## 1.7.2 HUMAN RESOURCE DEVELOPMENT

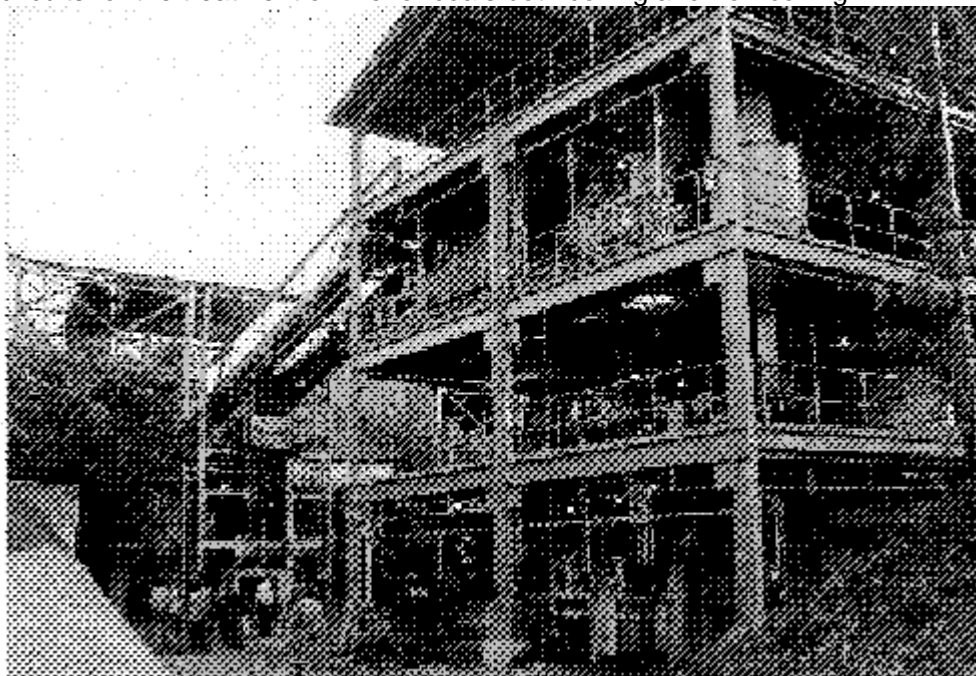
- 23 B.Tech. and 7 M.Tech. students have been trained. Courses have been designed for industry to meet the core competence of the personnel.
- AFPA/AFPIC programmers have been conducted.
- Specialized programmers for executives have been designed.
- International training programmers include leather and leather products training for trainees from Ethiopia, Syria.

# Material Science & Technology

## 1.8.1 SCIENCE, TECHNOLOGY & SERVICE

### Commissioning of Fine Coal Treatment Pilot Plant

CFRI has designed and commissioned the Fine Coal Treatment Pilot Plant (FCTPP) as a low profile building (less than tree height) with state-of-the-art process equipment for carrying out R&D studies on small/fine size coal. The MCC, Control room and the conference room are in a R.C.C. frame building, separated from the steel structure plant by an isolation gap of 50mm, to avoid vibration of the running equipment. The raw coal section of the existing coarse coal washing pilot plant has been enriched with a Batch Rotary Breaker of standard diameter (3.5 m) and a set of online crushers working on different principles like compression, impact, etc. The plant is equipped with secondary crushing house for further size reduction of, either raw coal/deshaled coal/middlings or sinks to finer sizes. FCTPP provides the following beneficiation processes: heavy medium cyclone, spiral, oil agglomeration and flotation. The online sensors and instruments like belt weightometers, load cells for bunkers, weigh feeders, mass flow meters, density gauges, energy meters etc., will help to optimize plant efficiency and economy for achieving desired level of cleaning/beneficiation with maximization of yield. The most important and attractive feature of the plant is that the entire installation including the existing plant can be operated from the control room, through PLC. The instantaneous mass flow of materials may be observed from the control room and its integration is recorded. The dosing/flow of process liquids may be controlled from the control desk as per the requirement of the process. These state-of-the-art facilities may help to develop the optimum beneficiation circuits for the treatment of inferior coals both coking and non-coking.



The FCTP Plant

### Biometric synthesis of inorganic nanoparticles under microgravity

NML has designed and fabricated a biometric reactor to be installed as a payload on the first flight of recoverable space capsule being planned in 2005 by Indian Space Research Organization (ISRO). A conceptual design for Biometric synthesis of inorganic nanoparticles under microgravity has been made and a prototype



reactor has been fabricated. The payload review committee of ISRO has approved this design.

## Diamond reinforced composite (DRC) coating

Diamond and diamond based composite coatings are considered as superhard materials and harder than other materials. Due to their superior tribological properties, these materials are industrially important. It is difficult to make any component only using diamond powder. This has necessitated the growth of composite markets throughout the world. The diamond-reinforced composites have been used for the fabrication of diamond polishing wheel, diamond wafer blade for precision cutting, stone cutting wheel, metal scooping tools etc. Though significant amount of work has been done on the development of diamond-based composites, their processing parameters and tribological behaviour are not studied adequately or reported in the literature. In this project, an attempt has been made to develop a mixed metal powder consisting of C, WC and Cu. The microstructural observations showed a uniform distribution of all the phases and were uniformly distributed. The particles of diamond are in the range of 2-3 microns and WC of 15-20 microns. The flow of the composite coating during the spray deposition appears to be good and coating thickness is uniform. Further, the bonding between the coating and substrate looks good. The coated substrate has been cut into 8 x 40 mm<sup>2</sup> cylindrical in shape and sliding test under 1Kg and 2Kg are conducted. The results shows that due to the presence of hard particles in the mixed metal powder and also having a good bonding among the phases, the coated sample did not worn. In addition, the standard steel disc with hardness 65 Rc has been worn out and during the test the samples gain the weight, instead of loosing the weight that results in negative wear results. The results strongly suggest that the coating can be used for a high wear resistant material.

## Eco-friendly Cokeless Cupola

A gas-based cupola of 3t/hr was engineered and installed in the premises of M/s Goel Engineering Works, Agra in 2001 by M/s Tata Korf Engineering based on NML's know-how and technology. The process parameters for 2t/h cokeless cupola earlier operated at Agra were again examined, analysed and optimised in the scaled up cokeless cupola of 3t/h operation. These trials of 10t to 15t conducted in two phases have now been successfully accomplished. The results and optimized parameters are: temperature from 1380oC to 1420oC without oxygen, good flowability of slag/metal, thin casting ( for pipe & pipefitting) and thick casting (drain cover etc.) of which around 95% are acceptable, depending on requirement temperature is controllable, smooth deslogging, controllable system pressure. The present system indicates that the cupola can be operated on alternate days and the furnace can achieve melting at the rate of 3.8t/hr which is 25% more than its rated capacity at the rate of 3t/h.

Studies on retained austenite in life expired rotary slide valves of centrifugal governor of main fuel pump of R-25 Aeroengine of MIG-21 aircrafts.

NML investigated the fusion of rotary slide valves (RSV) of MIG 21 aircrafts involved in three Cat-I accidents at Jodhpur, Ambala and Jaisalmer. The results indicated that the retained austenite in the material and contaminants in the fuel system are responsible for the fusion of RSV. The contaminant abrasive phases in the fuel system leads to the abrasive wear of governor-end guide-land that generated heat due to friction. It, however, gives rise to increase in temperature upto 500oC-550oC in affected localised circumferential band. The heating is sufficient to transform metastable retained austenite into martensite during cooling. The frictional heating is only caused by larger abrasive contaminants because the smaller size abrasive contaminants easily escaped after forming short wear tracks on the guide land. The generation of frictional heating, therefore, depends on the size of abrasive contaminants. The phase transformation of retained austenite gives rise to local

expansion at the guide land leading to fusion of RSV. During the intervening period, a number of cases of fusion of RSV at test - bed/rig are observed. As the retained austenite is deleterious in a component requiring high dimensional stability therefore, it was decided by Indian Air Force (IAF), Hindustan Aeronautics Limited to quantify the retained austenite in the RSV and find out the critical amount needed for dimensional changes sufficient enough to cause fusion of RSV.

## Roll Rail qualification tests

NML has conducted Roll rail qualifying test for M/s Jindal Steel & Power Ltd., Raigarh. Fracture toughness measurements, fatigue test, inclusion rating and residual stress measurements are carried out as per the IRS T 12-96 standard. Fracture toughness measurements showed crack path was within permissible envelope. The specimens qualify the requirement as per IRS-T-12/1996, clause 22.2.6. Since the IRS-T-12/1996 is not very clear about fatigue test details, it is assumed that the relevant ASTM test standard is E 466 and not E 606. The specimen passes the minimum requirement of 10 million cycles as per IRS-T-12-1996, clause 22.3.3. The inclusions, as analysed by image analysis software package, were observed to be considerably lower than the limits specified by IRS-T-12-1996, clause 22.4.1. The maximum size for both thick and thin series of all A, B, and C and is 0.6, as compared to 2.5 in the specifications. The residual stress measured as per IRS-T-12-1996 (22.1.2) showed all the stresses, except in the centre line of head and foot for samples, are below the limit of 14% UTS of rails. The exceptions mentioned also exceed only by 2%. Such higher stresses in the centre line are commonly found in the literature. Roll rails are found to qualify all the tests according to the specified standards.

An improved method for Underground Extraction of coal from contiguous Seams/Sections

Underground extraction of clean coal from thick and contiguous seams/sections in presence of weak and laminated parting in-between is a major problem of the Indian coal mining industry.

CMRI has conceived an idea of underpinning to facilitate safe and optimal extraction of coal from such seams/sections. The system involves conventional system of development of the sections of the seam/seams along the floor with superimposed pillars and final extraction by splitting and slicing by reinforcing the parting from top of the seam/section working with the application of used wire ropes in galleries/splits/slices.

CMRI found that underpinning consolidates parting stability through reinforcement and provides additional thickness to the critical parting as the roof coal band of the thick bottom sections was stitched together with the parting.

This technology was introduced at Chirimiri colliery of SECL for simultaneous extraction of contiguous sections of zero seam with critical and laminated parting of approx. 3m thick. This method arrested failure/collapse of parting and provided support of high roof during workings of bottom section of approx. 6m thick. This system has successfully been implemented for optimal extraction of 26 panels of the seam. The method has now been accepted as a regular system of extraction for rest portion of the seam.

This method has increased not only the life of the mine but also the mineable property in addition to manpower deployment opportunity. In addition to safety and productivity. Total value of coal of Rs.167 crores would be possible to mine from this seam by the implementation of the method.

## Improved inorganic cement capsule developed for quick setting of bolts

Full column cement grouted roof bolts are gaining immense popularity as a very suitable method of roof supports, as they are economical and effective under Indian strata conditions for underground mines. These bolts provide reliable anchorage by preventing bed separation due to bonding between the strata and the bolt.

CMRI has developed an inorganic composition for grouting the roof bolts. The composition contains all the requisite key features like instant grip, high early and ultimate strength, non-flammable, non-corrosive, non-allergic, and has good self-life and performance of anchorage

The developed grouting mixture has been put under field trial at a colliery of SCCL. The result is satisfactory and it has shown an anchorage strength of 3.0t after 30 min. of grouting and 5.0t and above after one and half hours of grouting. This mixture is expected to be very useful for immediate supporting of freshly exposed roof rock of underground mines.

## **Air Dense Medium Fluidized Bed Separator for Dry Beneficiation of High Ash Non Coking Coal**

Most of the non-coking coal reserves in India contain high ash content ranging from 40-45%. It is necessary to beneficiate these coals before utilization in power generation, sponge iron making, cement manufacture etc. Beneficiation can be carried out by wet or dry methods. The technologies for beneficiation by wet methods are well established but dry techniques are yet to be commercialized. The dry coal beneficiate has become important due to several advantages. With this background, RRL, Bhubaneswar has developed an air dense medium fluidized bed separator to reduce ash from Indian non-coking coals. A prototype set up has been designed, fabricated and tested. In pneumatic dense medium separators, a medium is created by suspending solid particles in an upward airflow. By means of gas-solid two phases pseudo-fluid as beneficiation medium, the light and heavy materials stratify in the fluidized bed according to density. The dynamic stability of the medium plays an important role in the sharpness of the separation and the system should operate under particulate fluidization. Laboratory models of different geometries were used for these studies, where the magnetic powder below 45-micron size was fluidized by compressed air at the different airflow rates to create the dense medium. Based on this basic study, a laboratory model of dense medium fluidized bed separator with capacity of 600 kg/hr was designed and fabricated to carry out the continuous study of the system. Trial runs with different process variables have been conducted. The results show that the ash percentage could be reduced from 40% to 30% with 70% yield.

## **New method to utilize Steel Plant waste economically -Briquetting**

Steel industry generates a lot of waste materials such as iron ore fines, mill scale, coke breeze, flue dust, SMS sludge, stock house dust, lime dust, etc. These wastes are fine in nature. They not only attribute to huge loss of valuable resources but also cause environmental pollution. Hence, recycling of these wastes becomes necessary to solve the above problems. Moreover, reclaiming of iron and carbon units, which have already been paid for, can contribute to lower production cost. Thus, processes to recycle these byproducts/waste materials have been a concern of the iron and steel industry for many years. These wastes being fine in nature cannot be recycled directly. Various agglomeration techniques are adopted for making them suitable for recycling. Among the various agglomeration techniques, the cold briquetting offers greater flexibility for particle size of materials and binders. Hence, RRL-Bhubaneshwar utilized the waste generated in the steel plant, in the form of cold briquettes that are suitable for the blast furnace operation. Laboratory scale studies have been conducted on cold briquetting, using inorganic binders to achieve high green and cold crushing strength. On the basis of the results, large-scale trials on 30 tph capacity have been successfully conducted at the plant site of M/s. Ispat Metallics India Ltd. The briquettes produced during the trial runs have undergone various metallurgical tests such as RDI, Tumbler Index, etc. and found to be suitable for charging to blast furnace.

New technology developed to manufacture DRI blocks by utilizing the Iron bearing fines and coal/char/coke fines for use in steel-making

There has been considerable interaction over the year in finding an efficient process in agglomeration for utilization of ore fines, concentrates, waste and solid fuels for conservations of minerals and recovering energy values from waste fuel fines. Briquetteing technology is efficient process on agglomeration of ore fines.

In metallurgical industries, large quantities of iron ore fines and coal/char/coke fines are also rejected as waste. At present, a part of these solid wastes are sold at a throwaway price resulting substantial financial loss and a bulk of these are stock piled causing waste disposal and environmental problems.

RRL-Bhubaneswar has developed a process to produce composite blocks of iron ore fines and solid waste fines using suitable binder combinations followed by reduction roasting in non-oxidizing/mild reducing condition in a coal fired furnace. These highly metallised DRI blocks can be charged into the induction furnace for steel making. This new technological development consists of (a) utilization of iron oxide bearing fines and coal/char fines in the form of composite blocks, (b) development of thermally stable inorganic binder combination, (c) reduction of iron oxide in composite block in a coal fired furnace keeping reducing/non-oxidizing atmosphere, (d) the technology is less energy consuming and solves the disposal problem of fines with value added product.

This is a new and simple technology for making steel by utilizing waste fines generated in the mines as well as industries and is proposed for the first time in the country.

## **NEW FACILITIES CREATED**

### **NML**

- ZHE Hazardous Waste System
- Siroquant quantitative XRD phase analysis software
- Oscillation stage for Seifert XRD 3003 PTS
- LaboTex-The Texture Analysis Software for Windows-single user License, version 2.1, PC version
- Softwares: NAG Fortran Library, NAG C Library, IRIS Explorer and NAG Graphics Library
- Curing Tank, 1.5M x 0.75M x 0.5M SST 144 curing chamber with accessories
- Abrasion Tester with accessories, Model TR-605
- Dry Abrasion Tester with accessories, Model TR-50
- Atomic Force Microscope
- Lab VIEW Full Development System for Windows 2000/NT/Me/9x
- Laser Flash Thermal Constant Measuring unit with accessories
- Hand Held Thermal Imaging System Agema 550 with accessories
- Leica DMLB HC Transmitted Light Biological Microscope
- Planetary Ball Mill Single Bowl with Agate Bowl 80 ml with Agate Balls
- Bench Top Reactor
- Ultrasonic flaw Detector
- Energy Dispersive X-Ray Spectrometer
- PC Based Ultrasonic Flaw Detector
- Single Disc Polishing Machine with accessories, spares & consumables

- Differential Scanning Calorimeter and Thermogravimetry
- Proof Ring Assembly with contaminant vessel

## 1.8.2 HUMAN RESOURCE DEVELOPMENT

### **CFRI**

- Training programme for the staff of DPL, Durgapur
- CPYLS Programme on 14th -15th January, 2004
- Reorientation programme for the CSIR Diamond Jubilee Interns
- Students Excursion
  - Twenty six (26) students of M.Sc. (Geology) from Jadavpur university, Kolkata visited CFRI on 7 Nov. 2003 and got acquainted with the working of the labs. of Coal Constitution, Research Quality Assessment, Coal Preparation, Coal Petrography and Environment Science.
  - Thirty two students of B.E (Chem. Engg.) from BIT, Sindri visited Coal

### **NML**

- Training on Advanced Mineral Processing Methods imparted

### Training undergone by Scientists/Technical Officers

- ISO Lead Auditor Training (3 scientists received training)
- ISO-9001: 2000 Awareness Training (30 scientists received training)
- Training on R&D Management (1 scientist received training)
- Deputed to undergo training: 10 persons
- Deputation to Seminars/Workshops: 35 scientists/staff
- Training of staff: Training on 'ABAQUS' FEM software package- 15 Scientists
- Training on Management-1.
- Training on Administrative Matters-1.
- Training on Safety-1.

## 1.8.3 RECOGNITION & AWARDS

### 1.8.3 RECOGNITION & AWARDS

NRDC Technology Award	Drs. K. Sen and D.K. Chakraborty, CFRI
IIME Mineral Beneficiation Award - 2004"by Indian Institute of Mineral Engineers, for outstanding professional contribution to Minerals Engineering.	Dr. Vibhuti N Misra, RRL-Bhubaneshwar
"Samanta Chandra Sekhar Award" for the year 2001 in recognition of his significant contribution in Physical Sciences in the State of Orissa by Orissa Bigyan Academy.	Dr. K. M. Parida, RRL-Bhubaneshwar

MECON award by Indian Institute of Metals for the year 2003 NMD, ATM, Kolkata for the design & development of air dense medium fluidized bed separator for beneficiation of non-coking coal.	Dr. S. K. Biswal and Ashok K. Sahu, RRL-Bhubaneswar
Indian Institute of Metal, Bhubaneswar Chapter, Award for the year 2003.	Mr. B. Bhoi, RRL-Bhubaneswar
Fellow of National Academy of Sciences, India	Prof. S.P. Mehrotra, NML
MRSI Medal in the field of Materials Science & Engineering	Dr. Suman Kumari Mishra, NML
Raman Research Fellowship (CSIR), 2004	Dr. K. Venkateswarlu, NML
Boyscast Fellowship (DST)	Dr. Raghuvir Singh, NML
Gold Medal of The Mining, Geological & Metallurgical Institute of India 2002-2003	Shri R.K. Jana , NML
19th IETE Bimal Bose Award, 2002-2003	Dr.S.K. Mandal, NML
Distinguished Services Award	Smt. Savitri Iyer and Sri H.C.Gope, NML

## President's visit to NML

Hon'ble President of India His Excellency Dr. A.P.J. Abdul Kalam visited NML. During his visit he had addressed the gathering and interacted with scientists of the laboratory.



President at NML



Hon'ble President recorded on visitors' book "I am indeed delighted to interact with Scientists and Engineers of National Metallurgical Laboratory. It is a competitive world where in we have to work hard and provide inputs to our production institutions to gain technological advantages in product design and production."

# Physical and Earth Sciences & Technology

## 1.9.1 SCIENCE, TECHNOLOGY & SERVICE

### **Flexible Electro Magnetic Interference (EMI) Shielding Materials**

NPL has designed and developed flexible Electro Magnetic Interference (EMI) shielding materials based on newly emerging technology of conducting polymers and conducting composites with LDPE, HDPE etc. Interest in applications for polyaniline for Electromagnetic interference (EMI) shielding and Electrostatic charge dissipation (ESD) has motivated NPL to set up a pilot plant for the bulk synthesis of polyaniline and its analogues. A stainless steel double walled reactor of 200 liters capacity has been commissioned where the synthesis of polyaniline can be carried out at 0-50°C. A semiautomatic injection moulding machine of 20-60 gms capacity has also been installed where one semiautomatic injection moulding machine of 20-60 gms capacity can make conducting polymer composites of dimensions 6" x 6". Composites of conducting polymers having both electrical and magnetic characteristics have also been prepared at NPL, which has applications in microwave range. Synthesis of conjugated polymers based on aromatic hydrocarbons for organic light emitting diode (OLED) applications have also been carried out. Recent results of NPL have indicated that poly aromatic hydrocarbons are soluble in organic solvents like benzene, chloroform. These polymers are fluorescent and show electro luminescent behaviour.

### **Soft Lithography Techniques for micro and nano-fabrication**

Creation of small structures with feature sizes ranging from a few microns to sub-micron is of great technical relevance to Materials Science, Biological Sciences and Engineering Sciences. Conventional photolithography is used routinely to create structure down to ~0.50 micron features in semiconductor and VLSI devices. However, the facility is prohibitively expensive and poses severe limitations for smaller feature sizes. Moreover, it has very little control over the surface properties of the structures that are very vital for chemical and biological applications. Soft lithographic technique utilizing micro-contact printing (mCP) of self-assembled mono layers (SAM's) has great potential in micro and nano-fabrication and would greatly compliment the existing conventional photolithography technique.

NPL has exploited Micro-patterning using micro contact printing ( $\mu$ CP), one of the variants of soft lithography to fabricate small structures on solid surfaces for micro fabrication, sensors-arrays, MEMS and biological applications. It is an alternate (non-photolithographic) technique to create patterns in metal thin films on a substrate with feature sizes in sub-micron to micron range. It comprises of soft contact printing of SAM precursor solution using an elastomer stamp that contains the relief structures. The SAM solution is transferred to the well-defined regions on substrates having micron and sub-micron sizes. The surfaces derivatized with SAM serves as nano-thick etch resist and the underivatized surface could be etched in standard metal etchants. Micro-contact printing can be used repeatedly without invoking the costly equipment required in photolithography and is experimentally convenient and cost effective. NPL is the first one in country to have initiated work on soft lithography and micro-contact printing.

### **First deterministic seismic hazard map of India and adjacent areas**

CMMACS has prepared a seismic hazard map of the territory of India and adjacent areas using a deterministic approach based on the computation of synthetic seismograms complete with all main phases. The input data set



consists of structural models, seismogenic zones, focal mechanisms and earthquake catalogues. There are few probabilistic hazard maps available for Indian subcontinent, however, this is the first study aimed to produce a deterministic seismic hazard map for the Indian region using realistic strong ground motion modeling with the knowledge of the physical process of earthquake generation, level of seismicity and wave propagation in anelastic media. The synthetic seismograms at a frequency of 1 Hz have been generated at a regular grid of  $0.2^\circ \times 0.2^\circ$  by the modal summation technique. Figure depicts the spatial distribution of the design ground acceleration in g. The estimated values of the peak ground acceleration are in agreement with the observed data available for the Himalayan region. Many parts of the Himalayan region have the DGA values exceeding 0.6 g. The epicentral areas of the great Assam earthquakes of 1897 and 1950 in the north-east India represent the maximum hazard with DGA values reaching 1.2-1.3 g. The peak velocity and displacement in the same region is estimated as 120-177 cm/sec and 60-90 cm respectively.

This is the first deterministic seismic hazard map prepared for India and adjacent areas. The realistic modelling of seismic hazard for the Indian Territory yields meaningful results validated by recent observations made in connection with events that occurred after 1998, the upper time limit of the catalogue we used. It also provides a powerful and economically valid scientific tool for seismic zonation and hazard assessment. The multi-disciplinary approach used in this map will help those earthquake and civil engineers who wish to undertake comprehensive and detailed study of earthquake hazard.

## Signal duration calibrations and local Richter magnitudes for the earthquakes in and around North East India

RRL-Jorhat has established signal duration calibration empirical relations for each of 24 previously operated analog seismic stations (at different gains) while intending to determine duration magnitudes (MD) of the earthquakes in and around North East India during the period 1985-1999. The relations are evaluated by calibrating signal durations with known Local Richter Magnitudes (ML) for each analog station based on models I & II since the stations are operated at different gains. The models are of the form: Model - I:  $MD = C_0 + C_1 \text{Log} (S.D) + C_2 D + C_3 h$ ; Model - II:  $MD = C_0 + C_1 \text{Log} (S.D) + C_2 D + C_3 h + C_4 [\text{Log} (S.D)]^2$ , Where S.D is the signal duration in seconds, D, epicentral distance and h, focal depth are in kilometers. In order to compensate the curvature observed in the relation of  $\text{Log} (S.D)$  versus ML, a fourth variable,  $[\text{Log} (S.D)]^2$  is introduced in model - II. Using these relations and signal durations, duration magnitudes are computed. The models yield magnitudes having standard deviations as low as 0.07 units. Further, network duration magnitudes MD (A) are determined as the arithmetic mean of station magnitudes for each of several earthquakes. Estimates of MD (A) are found to scatter with respect to ML within 0.8 units. In order to attain local magnitudes conformable to ML, scatter of MD (A) needs to be minimized. In this connection, an effort has been made to quantify over - and under - estimations of station magnitudes with respect to ML. MD versus ML plots are obtained for each of 24 stations along with 1:1 lines. With respect to 1:1 line, over - and under - estimations of station magnitudes are computed and applied as corrections to station magnitudes. Using corrected station magnitudes, network duration magnitudes are determined for about 825 earthquakes in and around North East India during the period 1985-1999. These corrected MD (A) estimates are found to scatter within 0.5 units. That is, over - and under - estimations of station magnitudes account 0.3 units out of 0.8 units of scatter of MD (A) versus ML observations. These station factors are applied to station magnitudes yielding that the scatter of MD (A) versus ML reduces by about 0.1 unit. In this way homogenized station magnitudes are obtained conformable to ML within  $\pm 0.2$  units.

## Memory Effect in deformed helix ferroelectric liquid crystals (DHFLC)

NPL has studied the memory effect in deformed helix ferroelectric liquid crystals (DHFLC) material. Its occurrence has been established experimentally for the first time. The memory effect is dependent on the voltage and frequency of the applied pulse and the memory data has been analyzed by optical, electrical, hysteresis and dielectric behaviour. The DHFLC memory effect has also been tested at room temperature in Optically Addressed Spatial Light Modulators (OASLM) using hydrogenated amorphous photoconductor and dielectric mirror coating. It has been observed that the memory in OASLM was stable without any visible decay up to 72 hours by using DHFLC materials.

## Long-range, High-resolution Forecast of Monsoon Rainfall with a Variable Resolution GCM

Efficient use of monsoon rainfall forecasts often requires long-range (such as for crop planning) and high spatial resolution (such as for location-specific sowing schedule); these are also the most challenging issues in contemporary weather prediction. As the monsoon is a large scale system, it is necessary to use a GCM to simulate and forecast monsoon. At the same time, the monsoon dynamics is affected by convective systems, which have scales as small as a few kilometers. CMMACS has presented an GCM configuration that appears to have considerable success in long-range forecasting of monsoon rainfall. The novel feature is the use of a zoom (variable resolution) centered over the monsoon region; this allows high spatial resolution over a domain of interest at a relatively low computational cost. Using climatological fields of monthly SST from AMIP (Atmospheric Model Intercomparison Project) and initial fields from NCEP (National Center for Environmental Prediction), CMMACS presented experimental forecasts for monsoon of 2003 (June –August) in C-MMACS website. The forecast for 2004 are online from 10th April 2004. Thus the lead of the forecast is more than two months for June rainfall and more than four months for August rainfall. While the initial (NCEP) fields are on an approximately 250 km x 250 km grid, the forecast fields, over the monsoon region, are at about 50 km x 50 km in resolution. The reliability of the forecasts is assessed in terms of 15-year model climatology for onset, monthly rainfall fields and inter-annual variability.

## Quality System In NPL Standars

As a part of the WTO agreement all signatory nations are committed to remove barriers including technical barriers to international trade. One of the well identified barriers is in the field of standards and precision measurements. It has been decided that testing and calibration certificates issued by National Metrology Institutes (NMI) like NPL should be acceptable globally. To ensure this, a Mutual Recognition Arrangement (MRA) has been signed by 38 member countries of the 'Meter Convention'. Under this arrangement equivalence of National Standards has to be established. NPL is actively involved in the exercise of carrying out key comparisons to establish equivalence of Indian National Standards with the rest of the world.

Asia Pacific Metrology Programme (APMP) accepts a quality system if it satisfies the following:

- The implementation of a Quality System satisfying ISO/IEC 17025, and
- Technical competence to provide Calibration and Measurement Service that can deliver the claimed uncertainties.

NPL has implemented the Quality System which has undergone peer review of experts from **BIPM France, NIST USA, PTB Germany, and NML Australia**. Our Calibration and Measurement Capabilities are **483** and entered in the **Appendix 'C' of BIPM**.

## Quantum Hall Resistance Standard

Primary DC Standard of resistance based on Quantum Hall Effect (QHE) has been established by NPL to provide a powerful tool for calibration of standard DC resistors with combined uncertainty of 0.08 ppm. It is used worldwide to define, maintain and compare the unit of resistance. The metrological meaning of the QHE lies in the fact that the Quantized Hall Resistance is a function of fundamental constants 'h' and 'e' only and is independent of place and time

## Automatic Optimization of gravity fields

Digitally implemented method for automatic optimization of gravity fields obtained from three-dimensional density interface using depth dependent density is developed by NGRI to interpret the measured gravity fields, wherein the density contrast above the interface is assumed to be varying continuously with depth, a phenomena well observed in many sedimentary basins all over the world. This invention provides means to obtain more accurate depth values of a basement interface and it has remarkable applications in gas and hydrocarbon exploration studies.

## Multibeam echosounding for seafloor studies

Unlike the wide-swath bathymetry data generated by use of multi-beam echosounder, seafloor backscatter signal provides additional fine scale information related to small-scale seafloor roughness. In order to carry out work on angular backscatter signal data, processing of the raw data is essential for data normalization. This processed data is required to utilize for numerical modeling to infer seafloor micro-topographic roughness. Studies based on numerical model, e.g., composite roughness was successful for the purpose of seafloor classification and characterization employing processed multibeam angular backscatter data from manganese-nodules-bearing locations of Central Indian Ocean Basin. However, the composite-roughness model approach is protracted due to the inherent need for raw data processing including system-gain correction etc. In order to establish that tedious processing of raw backscattered values is unessential for efficient classification, hybrid Artificial Neural Network Architecture (ANN) has been developed at NIO. A successful employment of hybrid ANN, i.e., Learning Vector Quantization (LVQ) algorithm for unprocessed (raw) multibeam backscatter data indicates true real-time seafloor classification application.

## Hydrocarbon and Geothermal energy exploration

Regions of thick sediments in three blocks holding promise of hydrocarbon deposits have been demarcated in the Narmada cambay regions on the basis of Magnetotelluric investigations and also integration of other geophysical data by NGRI. The areas have been docketed to NELP for exploration. A major geothermal reservoir, about 5 km thickness, in the west of Sumdo village, Puga valley with anomalous high conductivity (5-10 Ohm-m) has also been delineated by NGRI.

## Hydrothermal hydrocarbons in the sediments

As a follow up to earlier geological and geophysical investigations of tectonically active region of the Andaman Basin (which is a typical back arc basin with strike slip faults and spreading ridge), NIO took up molecular characterization of organic matter in sediments. The characterization provides a clue on the nature and source of the hydrocarbons present and also the processes in play that lead to maturation of organic matter.

The analysis of core samples from representative setting in Andaman Back arc (water depth 2.9 –35 km) indicate that the hydrocarbons found here are of hydrothermal origin and are derived from thermal alteration of sedimentary organic matter, largely marine derived. One of the three core samples from the deep basin and

adjacent to fault, contained more hydrothermal petroleum than those from the topographic high region. It is likely that hydrothermal fluids migrate from deeper strata to the recent sediments near surface and discharged into the water column

## Isotopic evidences of past upwelling intensity in the Arabian Sea

The oceans store more carbon than the atmosphere, thus small changes in oceanic CO<sub>2</sub> may produce large changes in atmospheric CO<sub>2</sub>. Gas exchange between the ocean and the atmosphere is particularly intense in the upwelling regions. Upwelling and its attendant high primary productivity play an important role in the biogeochemical cycling of the oceans. Upwelling regions serve as both sources and sinks for many biologically active elements and the upwelling zones are major sites for sequestering of carbon. In this context it becomes important to identify and understand the history of upwelling as it is recorded in deep-sea sediments. The planktic foraminifera are considered important indicators of climatic changes and ocean history.

NIO has carried out studies on oxygen and isotopic analyses which have been performed on the tests of planktic foraminifer species, *Globigerina bulloides*, *Globigerinoides sacculifer*, *Neogloboquadrina dutertrei* and *Pulleniatina obliquiloculata* to investigate Dd18O and Dd13C of shallow and deeper depth living planktic foraminifer species. High and low Dd18O<sub>obl-bul</sub> and Dd13C<sub>sac-dut</sub> coincide respectively with the low and high flux of *G. bulloides* (established monsoon upwelling index). The tangible relationships between the flux of *G. bulloides* and oxygen and carbon isotope differences between the shallow and deeper depth habitat planktic foraminiferal species appear to suggest that Dd18O and Dd13C of surface and subsurface living foraminifera can be used as isotope indices of upwelling in the Arabian Sea.

## Unusual rise in mercury-resistant bacteria in coastal environs

NIO has found as a part of regular coastal environmental impact assessment surveys, high counts of mercury-resistant bacteria (MRB) at various locations - both non-polluted and polluted, along the Indian coast. The sharp rise in mercury-resistance (even 250 mg concentration of Hg) may be due to substantial physiological changes in bacteria in response to the natural and anthropogenic processes. NIO surveys indicate that Chennai and Mumbai coastal regions receive a wide variety of industrial, urban and shipping related effluents and are among the most pollution affected zones along the Indian coast. Similarly, we do find a noticeable change in the coastal waters off Mangalore due to speedy industrialization and expanded harbour activities. Variety of effluents, some after treatment, reaches the seas. Ratnagiri along the west coast is yet another town receiving large amount of discharges from manufacturing units. The average concentration of Hg in the Indian Ocean environments has been shown to be on increase and is in the range of 44-1390 ng g<sup>-1</sup> dried sediment and 0-2100 ng L<sup>-1</sup> seawater. These maxima are higher than the global oceanic averages. The ecological implications of increased mercury tolerance could mean higher rates of biotransformation of toxic heavy metals, their higher mobilization through the marine food web and increased level of Hg in atmosphere, which may prove deleterious to life systems.

## Novel genes and bioactive molecules from marine organisms

NIO conducted studies on some myctophid fishes, copepods (*Acartia* sp.), green mussel, sea cucumber and reef building corals, to sequence their genes and look for novel biomolecules. The common and abundantly occurring open ocean species of family Myctophidae (lantern fishes) are generally associated with the oxygen minimum layer and are active vertical migrators. Their physiological adaptations allow them to survive in sub-oxic condition even below 1000 m. DNA probing is carried out to locate the genes that encode special functions

enabling myctophids to see in low light intensities, conserve energy for active vertical migration and adapt to low oxygen surroundings. Humans undergo similar stresses on high altitudes and during deep-sea dives. NIO has designed species-specific primers of genes and patent them. The sequences of the rhodopsin gene of this myctophid fish when aligned and compared to that of human being, a notable difference is noticed, possibly a big deletion might have occurred during the evolution.

NIO has developed innovative methods of getting pure coral and zooxanthellae DNA. The collagen peptides that are different in animal kingdom are special for these animals and have greater potential in medical applications, particularly in human bone repairs. DNA fragment of this biomedically important minicollagen gene of reef building corals is sequenced and species-specific primers designed.

NIO has also discovered extra ordinary fluorescent biomolecules from sea cucumber. These fluorescent molecules and fluorescent dyes are patented internationally. They are far superior in quality and stable more than a year even at the room temperature. Novel pharmaceutically important biomolecules are patented from an associated mangrove plant.

## Marine fungus discovered to remove hydrocarbon contaminants

Polycyclic aromatic hydrocarbons (PAHs) are commonly found as contaminants in inland and estuarine water bodies and sediments. They are toxic to diatoms, gastropods, mussels and fish. Several bacteria and a few white rot fungi are reported to metabolize many of the PAHs . NIO used a marine fungal isolate # 312 obtained from decaying seagrass from a coral lagoon for degradation of PAHs such as phenanthrene and chrysenetriol to use this fungus for degradation/removal of PAHs under marine conditions.

## Bioremediation of toxic substances

Mercury has long been recognized as a widely distributed toxicant in the global environment due to its prolonged atmospheric exposure. Strategies for bioremediation of toxic mercury include microbe mediated enzymatic reduction of toxic mercury (inorganic and organic) to volatile elemental mercury. Initial experimentation on bioremediation using marine mercury resistant bacteria have been very promising, not only for dealing with mercury, but also as a host of other highly toxic xenobiotics.

NIO has found that one strain of *Pseudomonas* CH07 is able to degrade a variety of congeners of PCBs. Of the two most toxic coplanar PCBs present in clophen A-50, one congener CB-126 and one toxic sterically hindered congener CB-181 are found to be degraded completely and the other coplanar congener CB-77 was degraded by more than 40% within 40 hours (US patent: grant No. 6544773). This strain is able to remove Cd from growth medium containing 100 ppm of the toxic metal to more than 70%. The same bacterium has also been successfully used in a bioreactor system for the detoxification of toxic mercury wastewater. The usefulness of these natural mercury resistant marine bacteria in bioremediation of toxic waste containing mercury and other pollutants is very promising.

## Study of toxic heavy metals in the soil/water systems in and around Lakwa oil field

The north eastern region of India occupies a prominent position in the history of natural resources and it contributes significant towards the growth of national economy. However, active exploration and exploitation of crude oil causes a large-scale disposal of formation waters, oil contaminated wastewaters and also spillage of crude oil. This complex nature of mechanisms of anthropogenic substances in the environment and its effect on

human system viz. the atmosphere or soil during occupational (work place) or recreational activities assumes a great dimension in the environmental toxicology.

Since 1968, Lakwa became the major oil producing structure of the region with more than 200 oil producing wells. The unattended environmental degradation caused by the oil field developmental activities became a subject of concern.

RRL-Jorhat has studied the soil/water systems around Group Gathering Stations (GGSs) I and III within the Lakwa oil field region both laterally as well as vertically. Texturally sandy-clay-loam (80%) and sand loam (20%) represent the soil of the area. The mean soil background values for Fe, Cu, Cr, Zn, Pb, Ni and Co were found at the higher side within a broad range of fluctuation. The background values of water samples are within the stipulated guideline values of IS(1982) and WHO (1984). The major and trace metals within pond and stagnated water bodies showed marked seasonal variation. The higher values of Na, K, Ca and Mg over the background values can be attributed to the entry of oil-contaminated wastewater from the GGSs, which impart hardness to the water bodies. The heavy metal contents were found to be associated with the clay/silt fractions. The chemical partitioning of metal contents indicate higher association with the residual and Fe-Mn oxide fractions and possess less environmental risk.

## Hydro-Biospheric Processes and Soil Moisture Variability for better crop

Vegetation and surface processes strongly affect evolution of soil moisture, which in turn affects local precipitation and monsoon variability. By using a one dimensional multilayered soil hydrology model CMMACS has investigated and quantified the effects of some of the key vegetation and surface processes on soil moisture dynamics. Effect of initial soil moisture condition and groundwater flux on evaporation processes is also investigated. The simulations clearly brought out the important role of parameters like root zone can play in the evolution of soil moisture. The calibration and evaluation of the model is carried out through a long-period (one year) simulation of soil moisture at select locations. Simulated results have shown profound effect of vegetation on soil moisture evolution as is evident from the figure.

Hydro-biospheric processes encompass a multitude of land surface–atmosphere dynamics at different scales. These processes play crucial roles in the evolution of soil moisture, microclimate, meso-scale circulation, local scale precipitation and regional scale monsoon variability. High initial soil moisture conditions may delay the onset of precipitation but increase its amount and may thus lead to high intensity storm activities. Understanding of hydro-biospheric processes is crucial for reliable monsoon forecast, estimation of regional and global water budget with enormous socio-economic implications.

## Archaeological Explorations along Saurashtra coast

NIO's marine archaeological explorations offshore at Mithi Virdi (Talaja Taluk) and onshore around Porbandar, along the Saurashtra coast brought interesting findings to light. Though stone anchors have been commonly reported from many sites along this coast, the anchors that are found at this particular site were unique and the biggest in the world. It was rather difficult to attribute functional value as these anchors lacked upper hole. Possibly, these resembling Indo-Arabia type were used for mooring.

Onshore remains in and around Porbandar gave clue to the late Harappan settlement here during 16 to 14th Century BC, almost similar to the Bet Dwarka. This also suggests that Harappan legacy of maritime activity continued till late Harappan period along this coast. The discovery of ancient jetties along the creeks here signifies that Porbandar was an active center of maritime activities in the past too.

## 1.9.2 HUMAN RESOURCE DEVELOPMENT

### **C-MMACS**

- Workshop on use of GPS Technology, GPS Data Analysis and Processing
- Indo-US Workshop on "Peer Reviewed Online k-12 (10+2) Science Education (PROKSE): A Feasibility Study"(held at NEERI, Nagpur) Organised by C-MMACS
- Training Course on the use of GPS Technology in Hazard Assessment and GPS Data Processing
- International Conference on Scale Interacting and Variability of Monsoon (SiVOM)
- National Workshop on Science and Technology for Regional Development The Case for the North-East India
- Training Course on Fluid Physics in Geological Environments Jointly Organized by C-MMACS and JNCASR, Bangalore

### **NGRI**

- Training course on MT data interpretation, May 13-17, 2003.
- Training course ICPMS and associated analytical techniques for geochemical, mineral exploration and environmental studies, June 21-25, 2003.
- Training course on Rain water harvesting and artificial recharge.

### **NIO**

- Top rankers of SSC students visited laboratory under CPYLS
- Training for students of BITS, Pilani on "Classification of Satellite Image using PCI Software PCIWORKS Ver 7.0"
- Long Hydrographic Course held for Naval Officers of India, Vietnam, Sri Lanka, Nigeria & Mynamar.
- Workshop on Uncertainty in Measurement at NPL, New Delhi
- Brain Storming session on ultrasonics in healthcare and education

## 1.9.3 RECOGNITION & AWARDS

### 1.9.3 RECOGNITION & AWARDS

National Mineral Award 2003	Dr. C. Manikyamba, NGRI
CSIR Young Scientist Award 2003 for Earth Science	Dr. V.M. Tiwari, NGRI
National Mineral Award, by Ministry of Coal & Mines	Drs. Anil Chaubey & M.V.S. Guptha, NIO
P.R. Pisharoty Memorial Award	Dr. M.R. Ramesh Kumar, NIO

Rajib Goyal Award	Dr. Neeraj Khare, NPL
CSIR Young Scientists Award 2003 for Physical Sciences	Dr. Sushil Kumar, NPL



# Science & Technology for the Society

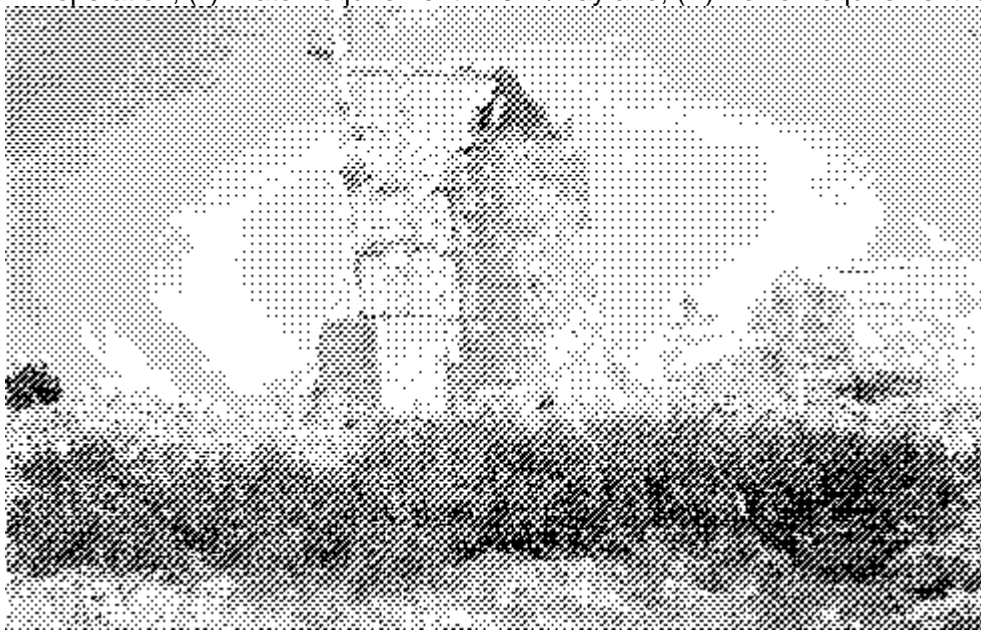
## 1.10.1 SCIENCE, TECHNOLOGY & SERVICE

### Pollution Mitigation For Lime Kilns

Reduction of pollution from the lime burning kilns has been identified as a major concern of the Indian lime industry. CBRI took the challenge for development of an upgraded pollution control system in order to meet the stringent requirements for sensitive areas as well as for clusters of kilns in general and the most commonly used 10 tpd capacity building lime kilns in particular.

A system, which incorporates an improved scrubber with Packed Bed Demister unit, has been evolved in order to control emissions of dust particles and hydrocarbon tarry matter from the limekilns for better separation efficiency.

The salient technical features of the system are: (i) Scrubber with Packed Bed Demister System, (ii) Limestone as reusable packing material, (iii) Suitable for particle sizes less than 10 micron, (iv) Power failure not to affect kiln operation, (v) Water requirement: 4-5 Kl/Day and, (vi) Power requirement: 5 KW.



Pollution Mitigation for a typical Lime Kiln

Kalam- A new Lemongrass for drought prone areas released by RRL, Jammu

A hardy drought tolerant strain CPK-F2-38 rich in citral has been developed through hybridization and rigorous screening of the F2 recombinants of *Cymbopogon pendulus* and *C.khasianus* hybrid. The variety has been named "Kalam". Its performance was evaluated in both irrigated and rainfed areas. The crop is perennial and lasts for five years. The citral percentage ranges from 78-83 and the quality of oil has been evaluated and accepted by the user industry.

On the momentous day of June 26th 2003, during the visit of His Excellency Bharat Ratna Dr. A. P. J. Abdul Kalam, to Regional Research Laboratory, Jammu, a potted plant of this newly named citral rich variety was handed over to the H E the President of the Republic of India by His Excellency Lt. General S. K. Sinha, the Governor of J & K state.

The returns of variety 'Kalam' is two and a half times higher than the traditional crops grown in drought prone areas. However, it gives three times higher yield under irrigated conditions and compares favourably well with the existing varieties.



Release of Variety Kalam

**Tawi Rosa – A new variety of Cymbopogon developed by RRL, Jammu for drought prone areas**

Efforts at RRL Jammu have resulted in the development a hardy drought tolerant strain RLJ-CCI for rainfed areas. The variety has been named "Tawi Rosa". The main feature of this strain is that it can withstand moisture stress level of 15% and contains total alcohol in the range of 80-85%, calculated as geraniol 70-75% and geranyl acetate 10-15%. Apart from the main chemical constituents, it contains 3-5% ocimene which is used in high grade perfumery.

On the momentous day of 26th September, 2003, the CSIR Foundation Day, Professor Amitabh Mattoo, Vice Chancellor, University of Jammu, Jammu released this variety for commercial cultivation.

Under rainfed conditions, this variety in 1st year has a capacity to produce 20 -25 tonnes of fresh herb yielding 80 -85 kg of essential oil. In subsequent years it produces 35-40 tonnes of fresh herbage yielding 150-160 kg /ha essential oil. Essential oil content varies from 0.35 to 0.45% depending upon the harvesting seasons.

CSMCRI has successfully adopted raft cultivation of *Eucheuma*, which has greatly boosted the yield of the seaweed. Farmers are being advised to switch over to this mode of cultivation to increase the returns from cultivation. Fears expressed initially about cultivation of *Eucheuma* in Indian waters have now been allayed and its cultivation has been advocated in Policy Paper 22 published by the National Academy of Agricultural Sciences, India.

Raft Cultivation of *Eucheuma cottonii* in Gulf of Mannar

### **Brackish water desalination plant installed at village Kisari, Rajasthan**

CSMCRI has installed 1200 LPH Brackish water desalination plant in Kisari village of Rajasthan, which was funded by DST, New Delhi. State unit of DST has carried out detailed survey of the plant and interviewed concerned engineers and many people staying in the neighbouring areas. General impression gathered during the survey is that product water of the plant is safe to drink without any further treatment and it eliminates many chronic illnesses. Reverse Osmosis plant removes not only dissolved salt but also reduces fluoride level.

## Electrochemical technology for the removal of arsenic from drinking water

One of the major challenges facing mankind today is to provide clean water to a vast majority of the population around the world. The chronic toxic effects of the excessive intake of arsenic can represent health problems (cancer) for humans. It is found in the aquifers and surface waters in the Bengal Basin. Arsenic exists in two soluble and dangerous oxidation states, known as arsenite and arsenate. Removal of arsenic by electrochemical method is simple and efficient with low capital and operating costs.

The electrochemical technique can be conveniently used in rural areas where electricity is not available, since a solar panel attached to the unit may be sufficient to carry out the process. The commonly used physico-chemical treatment processes are ion-exchange, chemical precipitation, chemical oxidation, carbon adsorption, reverse osmosis and electrodialysis. Low removal efficiency, increase in TDS and addition of anions and cations as coagulants in water are the disadvantages of these techniques.

CECRI has used the electrochemical process for the removal of arsenic, which consists of an electrochemical cell. The soluble anode will generate clean coagulant for the removal of arsenic. So, the electrochemical process avoids uses of chemicals and no possibility of secondary pollution caused by chemical substances added at high concentration as with chemical coagulation.

An electrochemical cell that is capable of reducing the arsenic concentration in drinking water from 3 ppm to 0.05 ppm with current efficiency of 95% is available for demonstration.

## Solid Toughened Paper Board suitable for use in packaging Industry

Packaging with various type of paperboard is becoming popular day by day and now many types of packaging boards are available in the country, the most prominent of which is corrugated paper board and is extensively used in packaging of various goods. The corrugated packaging boards have certain limitations, such as prone to delamination, moisture absorption, fungal growth and non-fire resistant properties. The board does not possess adequate handling and storage properties. As an alternative to corrugated packaging board, RRL-Jorhat has developed speciality board with high physical strength properties imparting special characters like wet strength, resistant to water, oil, fire and grease. This type of solid boards can be used for making cartons and other packaging for scientific storage of food grains, tea, food products, vegetables and fruits, etc. apart from using it for packaging of heavy and sophisticated machine parts.

Utilization of Bast Fibres from wild and cultivated non-conventional plants available in the North Eastern region North Eastern region of India is considered as the storehouse of plant resources. But except bamboo and woods of a few hard wood species, no other plants are utilized in industry particularly in paper industry. Also no commercially feasible process/technology are readily available based on local raw materials. There are various wild and cultivated fibre bearing plant species available in the region and there is a lot of scope for setting up fibre based industry like cordage and textile in cottage and tiny scale sector depending on availability of the raw materials. Some of the common fibre bearing wild plants are *Alpinea allughas* Rosc., *Clynogynal dichotoma*, *Hibiscus abelmoschus*, *Hibiscus sabdariffa*, *Crotolaria juncea*, *Hibiscus esculantus* and *Boehmenia nivea*. The fibres can be extracted by chemical or bio-chemical process and the bleaching and softening of fibres are to be made prior to use for making cordage and yarns. The fibres extracted from bast portion of the cultivated and wild plants can be used as alternative to jute fibres for making cordage and textile yarns. RRL-Jorhat has developed appropriate technology in cottage/tiny scale sector for manufacturing fibre and yarns producing biodegradable items like cordages, carry bags, doormats, rope, twines, hessian cloth and yarns for making cloths.

## Transfer of Technologies in oils and spices (Agroprocessing)

RRL-Trivandrum has transferred the following technologies in oils and spices (Agroprocessing) area

- Processing of Fresh Ginger to make Ginger oil/Ginger Powder (4 parties)
- Red Palmolein (50 TPD) and Zero Trans shortening ( 3 parties)
- Technology on Refining of Rice Bran Oil of 50 TPD (5 parties )

These are being commercialized through project engineering companies.

The technology on processing of fresh ginger to make ginger oil/powder has competitive advantages in that fresh ginger is being processed as compared to dried ginger in the existing technology. This novel process has generated interest among industrialists and entrepreneurs, which has helped in the technology transfer. Also the product profile has marketing advantages on account of the aroma quality.

The red palmolein technology aims at using palm oil high in beta-carotene, which can act as Vitamin-A supplement. Moreover, the zero trans-shortening products obtained by the process have an emerging market in the country.

The technology on refining rice bran oil is based on a novel refining process as compared to the current technology and has technologically commercial attractiveness through the better product profile. India has a potential of 1.5 million metric tones (MMT) rice bran oil per annum and only less than 10% of it is exploited for edible use for want of economical industrial process. Rice bran oil being rich in bio-active micronutrients (oryzanol, tocopherols, sterols, squalene etc.) is considered most healthy edible oil. A novel process for simultaneous degumming and dewaxing was developed to reduce the phosphatide content to less than 5 ppm, a critical parameter for physical refining of rice bran for the first time. The technology was transferred to 5 industries for

commercial production.

Palm oil mill processing plant at Goa

## **Bio-filtration- A superior filter media for sewage water**

A key component of gas bio-filtration technology is the development of bio filter media. RRL-Trivandrum has formulated a superior filter media with very good water retention capacity, porosity, fly ash content, low pressure drop and biological origin.

RRL-Trivandrum has studied environment impact assessment with components like marine study, water and soil quality, traffic, noise and air quality monitoring as sub contracts for other EIA consultants. An on-board sewage facility called Marine Sanitation Device for House Boats (Kettuvallam) has been developed by RRL-Trivandrum. This enables complete treatment of sewage using multiple aerobic and anaerobic processes and constructed from special designed blow moulded plastic tanks. The design is licensed to the manufacturer for installation in house boats on behalf of the Department of Tourism, Kerala Govt.

## **Extraction and refining of micronutrient rich rice bran oil using super**

CO<sub>2</sub> is used to separate high quality edible oil rich in bio-active phytochemicals such as Oryzanol, tocopherols, sterols from rice bran using varying pressure (300 to 500 bar) temperature (50-80°C) mass flow. Analytical results of RRL-Trivandrum indicate the oil obtained is far superior in terms of micronutrients with efficiency comparable with that of conventional industrial process using hexane. A process patent (PCT) has been filed on "Novel Green Technology" approach to combined extraction and refining of micronutrient rich rice bran oil using supercritical CO<sub>2</sub>.

Ma Shakti (STEP) project on cultivation and utilization of aromatic herbal farming

The project aims at imparting training to 10,000 women on cultivation and utilization of aromatic grasses for income and employment generation. RRL, Jammu is providing technical guidance and consultancy services to

the project sanctioned by Dept. of Women and Child Development, Ministry of Human Resources Development, Govt. of India and is being implemented through an NGO, J&K Ex-services League. RRL, Jammu imparted training and 15 demonstrations were given in the field to the beneficiaries in different blocks of Jammu district. Planting material of 47 lakh slips to cover 500 hectares are also supplied. Four distillation units are set up in the field and assisted the NGO in selling 490 liters of essential oil worth of Rs. 2 lakh.

## **Biodegradable polymers from Sugarcane bagasse developed**

Agriculture byproducts constitute one of the most important classes of renewable and sustainable feedstock for the production of polymeric materials. In spite of world-wide attention being paid to the area of sustainability in the production and consumption of materials, polymeric materials derived from agricultural products are not yet commercially competitive with petrochemical based polymers. The most significant reasons for this are the relatively poor energy efficiency of bioconversion processes, distributed availability of agricultural byproducts and their cost of transportation, technology limitations in bioconversions and ability to tailor a wide range of material properties from a single polymer derived from renewable source. This has inhibited growth of large volume polymer industry based on renewable resources.

NCL has emphasized on fractionation of agricultural biomass like sugarcane bagasse to yield major component polymers like cellulose, hemicellulose, and lignin using "green technology" of aqueous auto-hydrolysis by high pressure steam and thereby avoiding chemicals. The bagasse fractionation is successfully accomplished. Further, value-added derivatives like cellulose acetate (biodegradable plastics) is synthesized from the bagasse derived cellulose, and liginosulfonate is synthesized from bagasse derived lignin. This has made the economics of the process even more attractive.

## **Improving quality and storage stability of Neera**

Fresh Neera is traditionally drunk in several Indian coastal states. Due to a large microbial population (bacteria and yeast), it starts fermenting within an hour of its collection. The fermented product, known as Toddy (tadi) is a pungent sour smelling liquid containing ~5.0 per cent alcohol. Unless stored under chilled conditions, it deteriorates within 5-8 hours after collection.

NCL has developed a laboratory scale membrane filtration technique for removal of bacteria. The technique is demonstrated to Khadi and Village Industry Commission (KVIC) and the Commission is planning to put up a pilot plant at its Neera Processing Center at Dahanu. By using NCL technique, the shelf life of the packaged product can be extended to 10-15 days without affecting the stability, taste and nutrient profile of Neera.

## **Single step preparation of p-Aminophenol- an intermediate for paracetamol**

p-Aminophenol is an intermediate for making paracetamol, a widely used antipyretic and analgesic drug.

Conventional method of preparation of paminophenol involves Fe/HCl reduction of p-nitrophenol, which poses a serious effluent problem, due to generation of large amount of Fe-FeO sludge. NCL has developed a non-corrosive solid acid catalyst and a bench scale process for preparation of p-aminophenol.

Under the process optimization work the p-aminophenol selectivity has been enhanced from 58 to 70 per cent by pretreatment of the catalyst and modifying the work up procedure. A successful bench scale demonstration is given (2 liter and 300 ml scales) to the sponsor. Based on the NCL bench scale process, a Basic Engineering Package (BEP) for pilot plant (100 liter vol. reactor) has been prepared and given to the client.

## **Conversion of flyash into eco-friendly catalysts**

Flyash, a by-product of coal burning, contains mostly aluminosilicates. NCL has developed a process to convert environmentally detrimental flyash into a crystalline and pure zeolite beta, an industrially important catalyst. This may partly eliminate the flyash disposal problem and also turn an otherwise waste material into a useful, most-effective and eco-friendly zeolite catalyst. The flyash collected from the Thermal Power Station, Parali (Maharashtra) is used.

## Biofinishing of denims

The traditional use of pumice stone in a water-loaded tumbling machine produces severe wear and loss of tensile strength of the fabric when used to achieve high degree of indigo fading. In addition, use of pumice stones causes clogging of outlet of the machine. Thus, introduction of cellulase enzymes to create the required effect without the use of stones and increasing their compatibility with other chemical processes is one of the thrust areas of research in textile industry. The basis for the application of cellulases in biofinishing of denims is the action of cellulases, specifically endoglucanases on cellulose fibers. NCL has identified a novel alkalothermophilic *Thermomonospora* producing alkali and thermostable cellulase. The cellulase from *Thermomonospora* is evaluated for biofinishing of denims. The cellulase is found to be highly effective with respect to reducing hairiness, total weight loss, impartation of softness, washdown effect, back staining, colour contrast and seam puckering in biofinishing of denim in textile industry.

## An automatic compact model of pulse thresher-cum-winnower developed

RRL-Bhubaneswar is working in Agro-engineering sector too. To serve farmers this laboratory has developed an automatic compact model of pulse thresher-cum-winnower. This is a small machine, which uses a 3 hp electric motor or fuel engine. It threshes & winnows in one go of the crops of pulses. One need not thresh & winnowing separately. The machine is used for efficient threshing and winnowing of grains from the ripe crop of different pulses, such as green gram, black gram, arhar, horse gram, lentil etc. irrespective of shape & size of plants and grains. The machine requires 2 hp to 3 hp electric motor or fuel operated engine. It crushes the crop residue into small sizes during threshing, which is suitable for animal feed. As the grain loss in crop residue is almost nil, and rate of harvesting is 2 to 3 times over traditional methods, 50% harvesting cost is reduced and 10% yield is increased as compared to traditional methods. Pulse thresher-cum-winnower is a vertical flow type. The dry crops flow vertically inside the machine. There are fixed and moving beaters, which open the pods and crush the crop residues. Just below the beater, a reciprocating screen along with air blower is fitted, which separates and clean the crop residues & grains. Grains are collected at the bottom chute of the machine. Threshing & winnowing capacity is 600 kg/hr dry crops. Three small scale units in Orissa have taken manufacturing and marketing license of this machine. Government of Orissa has declared subsidy for mitigation of this machine among farmers in the state of Orissa. The machine would increase the yield of production by 10% over traditional harvesting.

## Sustainable ceramic clusters development in the State of Gujarat

In order to ensure survival of small and medium ceramic manufacturers against the steep competition owing to globalisation in the domestic and international market, the Central and State governments along with various developmental agencies have urged to initiate programmes on cluster development.

Although the worldwide technological innovations in traditional ceramics have taken place through extensive mechanisation and automation, CGCRI's Cluster Development (since 2001) programme for modernisation of Indian ceramic industry, vastly dominated by small and medium enterprises (SMEs), includes (a) consideration

of the prevailing socio-economic conditions and making use of the vast resources of low grade raw materials by way of its upgradation/beneficiation; (b) Optimum use of the indigenously available equipment and machinery and the available large skilled/unskilled labour force in the country and (c) utilisation of indigenous technology and know-how. Till today, 418 ceramic units of Thangadh, Morbi-Wankaner, Himatnagar and Ahmedabad of Gujarat have been remarkably benefited in their productions with the able guidance of CGCRI by way of implementation of appropriate technologies developed at the Institute for these SMES.

# CSIR Society

## 2.1 CSIR SOCIETY

The meeting of the CSIR Society was held on 10th April 2003 at 7, Race Course, New Delhi. The following items were adopted by the society

- Confirmation of the Proceedings of the Meeting of CSIR Society held on 27.03.2002,
- Consideration and Adoption of the Annual Accounts of CSIR for the year 2001-2002, the Audit report and CSIR's comments thereon, and
- Adoption of CSIR Annual Report 2001-2002.

The proceedings of the meeting are as under:

At the outset Prof. Murli Manohar Joshi, Vice President, CSIR and Hon'ble Minister of Science & Technology, Human Resource Development and Ocean Development welcomed the Hon'ble Prime Minister Shri Atal Bihari Vajpayee and members of the CSIR Society to the AGM. He thanked the Prime Minister for his sustained support to the cause of science and his generous gesture of announcing the "Indian Science Award" carrying a cash prize of Rs.25 lakh at the Indian Science Congress. Prof. Joshi pointed out that for several years till 1998 the Government investments and allocation for S&T were stagnant, but since then, the allocations had increased significantly. The Government was committed to ensure that the National expenditure on R&D increased to 2% of GDP within the next five years. Another significant initiative taken by the Government, Prof. Joshi said, was the enunciation of an integrated Science and Technology Policy, which hitherto were separate policies. He then dilated some of the more significant aspects of the new Policy. Prof. Joshi then turned to the need to incorporate modern science in validating and enhancing the value of India's rich traditional knowledge. A Traditional Knowledge Digital Library had been established for the purpose, he explained. Indian tradition was to freely share the knowledge with all and therefore, whenever, new knowledge was developed, it was dispersed to all. But, preaching to Scientists now was to seek monopoly patents for the new knowledge developed by them. However, an Inter-Ministerial Group had been set up to consider the diverse issues involved in introducing a strong intellectual property rights regime in the country, he said.

Prof. Joshi mentioned that hitherto the Scientists were accustomed to working individually but now team work and networking were being encouraged as demonstrated by the mounting of 21 Jai Vigyan Missions nationally and the 55 Networked Programmes taken up by CSIR in the Tenth Five Year Plan. Prof. Joshi pointed out that hitherto the tendency was to follow the west in technology development and whatever technologies were developed there, were adopted in India by incorporating some minor modifications only. The relevance and rationale was not questioned. But in the last five years, he said Indian S& T had established a distinct identity where Indian relevance was being kept in view. To support this statement, he cited the case of development of a 'Simputer' a simple personal computer which was relevant for the rural population and cost effective at the same time.

In regard to Human Resource Development, Prof. Joshi mentioned the schemes initiated to attract young talent to science. He informed the Hon'ble Prime Minister that Shyama Prasad Mukherjee Fellowship had been initiated by CSIR for recognizing the creative talent of young science scholar. Another initiative, the invention awards scheme for school children had also been recently taken up. He went on to explain that even women were being encouraged to pursue research as a career by providing them flexibility in their conditions of service. The Government, he said, had also set up a National Innovation Foundation (NIF) to promote grass root



innovation in the informal sector. He then gave examples of inventions supported by NIF that had been licensed to an American company and exported to South Africa. Prof. Joshi then invited Dr. R.A. Mashelkar, Director General, CSIR to present the achievements of CSIR in the last one year to the Hon'ble Prime Minister and the Members of the CSIR Society.

Dr. Mashelkar welcomed the Hon'ble Prime Minister to the meeting of the Society and thanked him for sparing time to preside over the meeting. He mentioned that during the Diamond Jubilee Celebrations CSIR had come up with a new mantra "India matters to CSIR, CSIR matters to India". Dr. Mashelkar then dwelt on the contributions of CSIR for economic growth, human welfare, strategic needs and advancement of technology. In the sphere of economic development he cited the innovative NTGG process developed by CSIR and patented in USA, used by GAIL to put up a pilot plant at Vaghodia, Gujarat. NALCO, another PSU, had put up one of the largest plants in the world to manufacture eco-friendly detergent grade zeolite based on CSMCRI technology. At the other end of the spectrum were the small capacity palm oil processing mills established in Goa, Gujrat, Orissa and Tamilnadu, based on technology from RRL, Trivandrum. On the agro side he highlighted the continuous advancement in mechanization commencing from Swaraj tractors in the seventies to the Sonalika tractor in the new Millennium.

Talking of the constant endeavour of 'Team CSIR' to pioneer new opportunity areas for Indian industry, he proudly presented the progress on development of SARAS aircraft. He said, starting a decade ago with HANSA - a two seater aircraft, today the country had the privilege of having its own state-of-art multipurpose, short haul 14 seater aircraft to cater to the varied domestic needs. He said it was a proud day for CSIR when HANSA was showcased in the Republic Day parade this year followed thereafter, in early February, by the Rollout of the fully equipped SARAS. Dr. Mashelkar said that CSIR's imprint on the aerospace sector was wide and deep ranging from HUD, landing gear, carbon fibre wings, composite fin and rudder for the LCA.

Dr. Mashelkar then dilated on the diverse initiatives taken for societal welfare. He said the 'value creation' programmes of CSIR for rural areas, especially for the herbal products were already yielding results. Dr. Mashelkar then referred to the several therapeutics developed within the country based on CSIR inputs. These had worldwide impact through the lowering of the prices and wider availability. He referred to the 'STPase', the indigenous streptokinase clot buster (licensed to Cadila) and the leads obtained on antifilarial, antifungal, antibacterial, antiarthritic, antiulcer, anticancer, and immuno modulators/memory enhancers.

In regard to advancement of knowledge, Dr. Mashelkar informed that CSIR was contributing about 15% of the total publications contributed in reputed scientific & technical journals. The quality of science in CSIR had improved considerably, as well as, the number of publications had gone up. The average Impact Factor of contributions from CSIR had jumped from 0.89 in 1995 to 1.67 in 2002; Whereas the comparable figures for even Indian Institute of Science, Bangalore were 1.83 and 2.19 respectively.

He once again stressed the need for aggressively protecting Indian inventions & discoveries through a strong IPR protection regime. He pointed out that during the last Society meeting, the Hon'ble Prime Minister had exhorted CSIR to lead and occupy the No 1 position for PCT patent filing among all developed countries and CSIR had taken the motivation and challenge in earnest. The year 2002, he said, saw CSIR being declared as No.1 in PCT applications from all developing countries, besides CSIR's share was nearly 40% of all US patents granted to Indians in 2002, a no mean achievement.

Thereafter, Dr. Mashelkar dwelt on initiatives taken by CSIR to promote awareness and popularize science among young students. He specifically talked about the efforts of Master Madhav, a class X student of Jabalpur who had been awarded the first prize in the competition for inventions of school children inventing a new font for Braille system for the visually handicapped. CSIR had filed a patent on the young boy's behalf and CSIO was

now designing & fabricating this new generation Braille device. He said the New Millennium Indian Technology Leadership Initiative (NMITLI) of putting together the consortia of the 'best' Indian academic / R&D and industrial partners, was yielding promising outcome. He gave a glimpse of progress made in some of the NMITLI programmes -especially in the development of Biosuite a software for Bio-Informatics and the discovery of a new anti-TB molecule.

He elaborated on the achievements of the 'Bioactive Network Programme' – an initiative launched by CSIR only five years ago, to synergise contemporary Science & Technology with the rich heritage of Indian medical remedies. This he said was an area of opportunity for India and CSIR had taken the lead in this endeavour. The programme had, already lead to the design of a new anti-ulcer formulation, chromatographic imaging methodology for herbal drug finger printing as well as newer animal substitute models for screening of cancer drugs.

He also referred to the Indian initiative in February 2001, through the CSIR at international fora for inclusion of traditional knowledge under International Patent Classifications System. It was to India's credit, that in less than two years time, traditional knowledge was being recognized as a distinct discipline in patent search. He then concluded by giving a brief insight of CSIR's forays into futuristic Technologies like fuel cells for rural electrification, hydrogen from Biomass/LPG etc.

The members appreciated the success of CSIR in increasing its filing of foreign patents. In the ensuing of discussions valuable suggestions were made as follows' (i) modernizing of the 'patent office' and its manning by Scientists/ Technologists, (ii) the need for Scientists to prioritize on filing patents instead of publishing papers,' (iii) seeking a leadership position in technology for titanium, (iv) taking up a programme on development of nano-technology, (v) creating facilities for indigenous certification of plant materials, (vi) development of auto-fuels and (vii) tools and machinery for a modern 'bamboo' industry to create employment.

Prof. Joshi informed the members about the steps already initiated by the Ministry of Science and Technology, DBT, CSIR and others in the Government on some of their' suggestions. He assured the Members that their valuable suggestions would be carefully considered.

The Hon'ble Minister (S&T) then requested the Hon'ble Prime Minister for his guidance and advice. .

The Hon'ble Prime Minister expressed his happiness to participate in the meeting of the Society of Council of Scientific & Industrial Research. He said:

"I would like to begin by congratulating CSIR for the excellent progress it has made during its diamond jubilee year. I recall that during last year's Society meeting, I had said that I would like to see CSIR become a real technology powerhouse. It should make a greater contribution to nation building. It should earn a higher reputation globally. I am happy to see that CSIR is moving in the right direction to make that happen.

One sign of the global recognition is that advanced countries recognize the novelty of Indian innovations by granting it patent rights in their own country. CSIR today is getting that global recognition due to its aggressive intellectual property policy. At the last meeting of the Society, I had congratulated CSIR on its securing the second ranking as per the Patent Cooperation Treaty but had exhorted it to strive to achieve the number one position soon. I am happy to note that CSIR has done India proud by attaining the number one position in 2002. I am also happy to note that CSIR has been granted 145 US patents, almost 40% of the total patents granted to India. My congratulations! .

I have two points to make. Firstly, I note that CSIR shares the number one pedestal with a Korean firm -next year, I want CSIR to be the undisputed first ranker -head & shoulders above the number two. Secondly, I am rather disappointed to see very few of the Indian firms filing patents. The Indian industry needs to realise that to win the wars in the emerging knowledge based economy, they need to be strong in patenting. I hope the Indian

industry and also the Indian institutions will emulate CSIR. It is only by fostering a strong public-private partnership that India can achieve a leadership position in technology. New Millennium Indian Technology Leadership Programme (NMITLI) that we launched in the year 2000 was a step in that direction. I am happy to hear that more than 50 private sector companies and 120 public institutions have been networked together in a 'Team India' fashion to create India's largest knowledge network. Last month, the Cabinet has formally approved the NMITLI programme for the 10th Plan with an investment from the Government of Rs. 205 Crores. We have offered very soft loan conditions to the private sector. I hope our industry will take full advantage of this initiative by the Government.

We have also gone ahead in other specific areas, where public-private partnership can make a difference. My friends in the pharma industry had been a little impatient with the government for a delay in implementing the Mashelkar Committee recommendations on R&D in the pharma sector. I am happy to say today that we have included in this year's budget an allocation of RS.150 crore for Department of Science and Technology to mount this programme. I hope this will help our pharma industry in sustaining the competitive advantage. We are going beyond merely providing funding. The pharma industry has been accorded the same benefits and facilities as afforded to the IT industry. CSIR, DBT and DST have also dovetailed their schemes and competencies to give a technological edge to our pharma industry. We are thus going all out to promote and support the pharma industry to emerge as a global player.

The Finance Minister this year has assigned to the CSIR the task of developing such networking in another area of concern to us, namely energy - especially solar, wind and hydrogen based by making a special allocation of Rs. 20 crores. India's energy security will crucially depend upon such initiatives. I would like to see the CSIR leverage its seed allocation of Rs. 20 crore with other to take up daring technological innovations. I have been voicing my concern on the declining interest in science as a career amongst our youth. I have been urging that some schemes be drawn to nurture young persons to take up R&D as a career. I must thank Prof. Murlidhar Manohar Joshi for directing CSIR to evolve and mount a path setting Diamond Jubilee Research Interns Awards Scheme that seeks to tap and develop local scientific talent for R&D. We must continue to take more such initiatives.

CSIR must reach out to the young. I understand that each CSIR laboratory is seeking to 'adopt' a school and a college in its catchment area to bring in the much needed 'excellence and excitement' in science. I would strongly urge CSIR to take advantage of its nationwide presence from Kashmir to Kanyakumari to fire the imagination of the young.

I have noted with appreciation CSIR's initiatives to kindle the spirit of inventiveness amongst our school children through the 'Young Innovators Awards'. With changing demography in the world, India has a unique advantage of being a relatively young and large nation. If the spirit of innovation is stirred among the youth, then this Indian Yuvashakti will create a great nation.

Finally, I want to express my happiness that after a gap of 20 years, we have launched the Science and Technology Policy - 2003 at the Indian Science Congress in Bangalore. As we will remember so far, the Scientific Policy Resolution of 1958 and the Technology Policy Statement of 1983 were the two policy pronouncements that inspired and guided the nation's programmes and initiatives in S & T. The new policy integrates both Science and Technology in a symbiotic and holistic manner. This policy heralds us in the future realm of science and technology with our feet firmly rooted in our rich culture and heritage. A mere policy is not enough -it needs to be quickly and carefully implemented. We must expeditiously move forward to put together the instruments and mechanisms for its implementation. Concluding, my congratulations to CSIR for an eventful and purposeful year and we look forward to CSIR scaling still greater heights".

Prof. Joshi assured Hon'ble Prime Minister that CSIR would continue to strive for scaling still greater heights. The Annual Accounts and Audit Reports for the year 2001-2002 were also adopted.

# Governing Body

## 2.2 GOVERNING BODY (GB)

The Governing Body of CSIR met five times during the year i.e. on 10th April, 2003, 16th July, 2003, 21st October, 2003, 4th February, 2004 and 15th March, 2004. The GB in its meetings deliberated on several crucial subjects and gave directions on these issues:

- On 10th April, 2003 in its 157th meeting, the GB approved; the financial support for establishment of a Centre of Interdisciplinary Studies in Bio-medical & Social Sciences, for the study of brain, Psychological Processes and Human behaviour to be set up at Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGI), Lucknow; Approval by Cabinet Committee on Economic Affairs (CCEA) for guidelines for NMITLI scheme; Tenth Five Year Plan (TFYP) proposals under the ongoing schemes 'National Laboratories'.
- On 16th July, 2003, in its 158th meeting, the GB approved: CSIR technology Awards-2003; institution of CSIR Diamond Jubilee Technology Award, amendment to foreign deputation guidelines, 1996- Provision for deputation of Scientists for appearing in interview for prestigious fellowships; amendment to CSIR Scientists Recruitment and Assessment Promotion Rules, 2001; amendment to CSIR service Rules, 1994 for recruitment of scientific, technical and support staff; revised estimate of construction of laboratory building block – A at CSMCRI, Bhavnagar; revision of emoluments of scientist fellow appointed under Quick Hire Scheme; Discovery Genomics block of IGIB, rationalization of Administrative Cadres and amendment to CSIR Administrative Services Rules; enhancement of SPM Fellowship; review of NMITLI projects scheduled for completion by April 2003 and also Tenth five Year Plan proposals under the ongoing scheme "National Laboratories".
- In 159th meeting on 21st October, 2003, GB approved: revision of annual financial ceiling for reimbursement/payment of subscription fee for becoming members of professional societies/bodies; CSIR Diamond Jubilee Prize for in-house excellence in sports, extension of the benefit of Non-Practicing Allowance to candidates appointed as Directors of CSIR Labs./Instts.
- In 160th meeting of 4th February, 2004, GB took up the issues of: extension of benefit of Assessment Promotion to S&T staff who left CSIR service to join new Organization/Central Govt., State Govt./Autonomous Body; Financial assistance from CSIR Welfare Fund for meeting Medical Expenses for treatment of major diseases in private recognized hospitals.
- On 15th March, 2004, in its 161st meeting, the GB took up the issues of: merger of New Research Initiatives in Energy with NMITLI scheme; project proposals taken up by NMITLI; modification in terms and conditions of Bhatnagar Fellowship Award Scheme and continuation of the scheme for engagement of consultants for Business Development.

# Research Council

## **2.3 RESEARCH COUNCIL (RC)**

The Research Council is a high level think tank for the laboratory that provides it with the best of direction and vision and helps it to design a road map to achieve it. The Research Councils for the 38 laboratories/institutes were reconstituted with effect from 1st January, 2004 for a period of 3 years with its mandate to advise on the formulation of R&D programmes and future directions of activities of the laboratory keeping in view the Five Year Plans, national priorities and opportunity areas, suggest networking with other CSIR National Laboratories on programmes of mutual interest, review R&D activities and research programmes and advise on future directions, advise on fostering linkages between the laboratory, industry and potential clients, constitute panel of experts for selection of Scientific (Group IV) staff, any other functions as may be assigned by Director General/Governing Body. Each RC comprises between 10 to 12 high-level eminent scientists and technologists

# Department Related Parliamentary Committee

## 2.4 DEPARTMENTAL RELATED PARLIAMENTARY COMMITTEE

The Department Related Parliamentary Standing Committee on Science & Technology, Environment & Forests examines and recommends the demands for grants of DSIR including CSIR. A background note was prepared highlighting activities, programmes and financial summary. Some major recommendations/ observations of the Committee were:

- Appreciated for carrying out research in many frontier areas of Science & Technology. Efforts should be made to raise funds from industry by successful transfer of technologies and wider dissemination of the same.
- Commends for emerging as a pioneering institute to achieve number one position in Indian & Foreign Patent filing. CSIR to remain vigilant to safeguard age-old indisputable rights to our traditional knowledge.
- An agreement to be reached with various financial institutions for providing loans to those research scholars who wants to set up their own enterprises.
- Closer co-ordination among research laboratories should be obtained for producing better products, which would eventually reach the end users of such products.
- Need to create awareness about the symptoms of the disease for early detection and cure. Research efforts should focus on the medicines that are affordable to all classes in society. The publicity of medicines already discovered by the CSIR is grossly inadequate, special attention needs to be focused on allergic asthmas.
- Develop fuels from waste matter and other non-biodegradable substances, which otherwise cause environmental degradations.
- Commends the challenging vision to set up a world-class drug research centre. It directs that new institute should go for manpower training and research to help pharmaceutical companies to improve the quality of their formulations.
- New storage and handling facilities should be of the world class standard. The committee hopes that facility would also conduct basic research for controlling infectious diseases to reduce the risk of morbidity. The committee also emphasized the periodic review of such facilities.
- Develop new building construction materials, which should be less energy intensive for building economical dwelling units.
- High-speed internet access facility is established as vast amount of scientific data is available on the internet.

# CSIR Foundation Day

## 2.5 CSIR FOUNDATION DAY: Diamond Jubilee Concluding Function

The CSIR Diamond Jubilee celebrations concluded on 26 September 2003, after the year-long celebrations. The main function was held in the NPL Auditorium in New Delhi. Shri K.C. Pant, Deputy Chairman, Planning Commission, was the Chief Guest and Shri Bachi Singh Rawat, Hon'ble Minister of State for Science and Technology, was the Guest of Honour. The unique feature of the function was felicitation of former CSIR Director Generals – Dr. A. Ramachandran, Prof. M.G.K. Menon, Dr. S. Varadarajan, Dr. A.P. Mitra and Dr. S.K. Joshi. (Dr. Ramachandran could not attend as he had gone abroad) and their addresses – 'Looking back and looking forward'.

The function began with the visit to the CSIR Diamond Jubilee Exhibition, which had been organized at NPL, by Shri Pant, Shri Rawat, former CSIR Director Generals, a large number of distinguished scientists and the media personnel.

Dr. R.A. Mashelkar, Director General, CSIR extended hearty and warm welcome to Shri Bachi Singh Rawat, Hon'ble Minister of State for Science and Technology, Shri K.C. Pant and a large number of distinguished scientists and technologists present at the Foundation Day Function. Dr. Mashelkar then announced the winners of CSIR Diamond Jubilee Technology Award, Shanti Swarup Bhatnagar Prizes and the CSIR Diamond Jubilee Invention Awards for school children for 2003. The first CSIR Diamond Jubilee Technology Award has been given to Tata Motors for design, development, manufacturing and commercialization of Indica and Indigo cars. Dr. Mashelkar added that one hundred and sixteen applications had been received for CSIR Diamond Jubilee Technology Award, which carries the cash award of Rs.10 lakh. A book, 'Rang Vigyan Ke Rangeen Duniya' (authored by Shri S.S. Sharma and Shri T.P. Pathak) and Journal of Rural Technology were released on the occasion.

Dr. Mashelkar in his welcome address said that the presence of Shri Pant is gracious and special to CSIR. A great philosopher, Shri Pant has been a Vice President, a Guru and Guide of CSIR, Shri Bachi Singh Rawat is providing an able leadership to CSIR. We very much miss Dr. Murli Manohar Joshi, Hon'ble Minister for Human Resource Development, Science and Technology and Ocean Development and Vice President of CSIR, who could not be present at today's function. We express our gratitude to him for the way he has been providing leadership to Indian science and technology.

The past year, Dr. Mashelkar said, has been a very special year for CSIR – It was Council's Diamond Jubilee Year. The celebrations, which started on 26 September 2002, are concluding today. Mentioning about the CSIR Diamond Jubilee Exhibition, he said, CSIR, over the past 61 years, has made remarkable contributions. Whether it is Saheli – the non-steroidal oral contraceptive, which a large number of women take; E-mal – which the doctors prescribe for the treatment of P. falciparum and its complications like cerebral malaria; Asmon – the popular anti-asthmatic, the famous handpump Mark-II, the Sonalika tractor and so many others, the people do not know that these are CSIR technologies. The exhibition has been serving to fill the gap between people and scientists. Depicting 60 major accomplishments of CSIR, this exhibition has gone not only to major cities like Chennai, Bangalore, Delhi and Mumbai, but also to smaller cities/remote corners of the country like Karaikudi, Kurukshetra, Gangtok, Amritsar, Bilaspur, Imphal, Shillong, Patna, Pondichery, and so many other places, making a significant impact.



Dr. Mashelkar mentioned about the various initiatives taken by CSIR during its Diamond Jubilee Year. These include the institution of 'Diamond Jubilee Invention Awards for School Children', 'Diamond Jubilee Technology Awards', and 'Diamond Jubilee CSIR Internship Awards' (with CSIR's own money). Stating that CSIR today is the leader in patents filing, Dr. Mashelkar said that it attained the number one position in patent filing in 2002 among the developing countries. He also made a mention of the New Millennium Indian Technology Leadership Initiative (NMITLI) under which a no. of network projects are being pursued. Reiterating the CSIR's commitment for overall progress of the country, Dr Mashelkar recalled the Bangalore Declaration: "India matters to us and we want to matter to India – more and more".

The announcement of the Diamond Jubilee Technology Award was followed by warm felicitations to the former Director Generals of CSIR. The felicitations included a shawl, a memento and a citation. The citations were: Dr. A. Ramachandran- "brought clarity to CSIR system", Prof. M.G.K. Menon- "brought human bonding and Self confidence" and showed CSIR "cares for its people", Dr. Varadarajan- "great leadership, human qualities and for bringing system's approach, Dr. A.P. Mitra- "an evergreen scientist" and Dr S.K. Joshi "made CSIR to face the challenges very efficiently".

Dr. Mashelkar then requested Shri Rawat to address the gathering:

"Respected Shri Pant ji, Dr. Mashelkar, Dr. Vikram Kumar, distinguished invitees and friends,

May I begin by wishing the entire CSIR family, spread throughout the country, 'many happy returns of the day'. May CSIR continue to have still more laurels and achieve even more successes in the service of the nation. CSIR has many firsts to its credit in science, technology, extramural human resource development and even in management of R&D. It has pioneered and spearheaded many new initiatives – like it is presently spearheading the creation of a civilian aircraft manufacturing industry in the country on one hand and leading the intellectual property movement, not only in India but even internationally, on the other. The result is the design, development and fabrication of a 14 seater 'SARAS' aircraft ready to begin flight-testing before the close of the year and the setting up of the Traditional Knowledge Digital Library (TKDL) to protect our traditional knowledge from being misappropriated. There are many other contributions of CSIR that are intangible, like enhancing the 'national innovation capacity' by skills formation. It is these very intangibles that help create an enabling environment in which tangibles can be delivered by other constituents'.

I see that in its characteristic style, CSIR has mounted two path setting initiatives in its Diamond Jubilee year, the first being the institution of the Diamond Jubilee Invention Awards for School Children and the other, the Diamond Jubilee Technology Award for Innovation that has done the nation proud. Through these initiatives, CSIR is seeking to reach out and help create a 'national innovation climate' that would enhance our ability to move forward and derive the benefits of a knowledge society.

I applaud the Young Scientist Awardees who have excelled themselves in research; I know their work is of a high order. While CSIR has done well in recent years in terms of quality and quantity of its scientific output, the national output in science has somewhat stagnated over a decade. This is in spite of the increasing investments and manpower engaged in R&D. It reflects on our psyche, that we, as a nation, do not seem to have the 'leadership instinct' – we are content to be mere followers. We need consciously to break away from this follower syndrome and set the mind of our youth free to think non-linearly and out-of-the-box. Indian science in times to come should be based on daring and creativity. It is only then that the quality of Indian science will rise commensurate with our aspirations of being a significant contributor to the global knowledge society. The Bhatnagar awards for the year 2003 that were announced today by Dr. Mashelkar represent the very best of science. I will like to congratulate them heartily.

Our economy is on the upswing, especially on the industrial front. We see a great upsurge in select sectors such as pharma, automotive and IT. The innovation in the pharma sector was inevitable due to the modifications and changes anticipated in the Indian Patents Act as a consequence of TRIPS. But, the development in the automotive sector has been truly self-driven. We see for the first time a confidence of Indian automotive industry to invest in their own development – a feature that was hitherto generally found missing in the Indian industry. Thus, wide ranging innovations are now visible in the automotive sector in the two-wheelers, four-wheelers and even heavy vehicles – practically the entire range of on-the-road vehicles.

I am thus heartened to see that Tata Motors has bagged the first ever CSIR Diamond Jubilee Technology Award for its pioneering development of Indica and Indigo cars. This paradigm has given confidence and fillip to other Indian players to venture out, to innovate and to invest. In short, it shows that one needs to be daring and prepared to take risks. Such successes will instill the needed confidence in the other Indian industry players to chart out and move on to the untrodden and rewarding path of innovation.

*I note that in order to help Indian industry adopt a new syndrome of leadership, CSIR has initiated a New Millennium Indian Technology Leadership Initiative (NMITLI) that seeks to capture for the Indian industry a global leadership position through public-private partnership. In the NMITLI endeavour, Government is firmly convinced that it must be a patron and partner of the industrial and technology systems to ensure an advantage for the nation in the global arena. We only seek to optimize the returns from the limited national resources by fostering synergy between all the key constituents in the techno-commercial game. I am happy to know that the initiative has already started bearing fruits. Dr Mashelkar has just told us that Tata Consultancy Services is launching a 'lead-of-the-art' software for bio-informatics. This augurs well for the nation. I am sure there will be many other successes to follow..*

Dr. Mashelkar requested Shri Pant to address the distinguished audience.

Shri Pant,"It gives me great pleasure to be here amongst this galaxy of scientists and technologists on the occasion of the concluding function of CSIR Diamond Jubilee year. The Council of Scientific & Industrial Research is perhaps among the world's largest publicly funded R&D organizations, and is the most visible star that adorns the Indian S&T firmament. A sapling was planted with the establishment of the 'Board of Scientific & Industrial Research' (BSIR) in April; 1940 as a result of the untiring efforts of Sir A. Ramaswami Mudaliar, an outstanding visionary of his times, and eminent scientists like Dr. S.S. Bhatnagar and Dr. M.N. Saha. This has now grown into a big tree. The dedicated efforts of Dr. S.S. Bhatnagar and the continued support provided by the Government of India to nurturing and strengthening scientific and industrial research resulted in the rapid expansion of national laboratories up to the mid-1950s and in building up a wide spectrum of competencies in CSIR. Today CSIR has a network of 38 world class R&D establishments and 47 field stations spread across the country, which are manned by nearly 10,000 highly qualified scientists and technologists besides 13,000 auxiliary and other staff. Its scientific manpower, expertise, and well developed network of facilities, enables it to undertake a variety of tasks and services, as well as to visualize, develop and validate need-based technological solutions.

CSIR has many attainments and achievements that the nation is proud of and its activities cover practically the entire range of industrial R&D, from aerospace to mining to micro-electronics to metallurgy and so on. CSIR, today, is not only the major technology source for an array of industries, offering both technologies and also specific technological solutions on demand, but also a global R&D resource. Its patrons and partners hail from over 50 countries. The world knows that India possesses very deep and wide technological expertise and

capabilities of a standard that can compete internationally. The image projected by the CSIR goes to confirm this impression.

At the dawn of the new millennium the world is becoming increasingly integrated in terms of information, R&D trade, investments, manufacturing and services. Comparative advantage is shifting away from physical endowments to those with brainpower to absorb, assimilate and adopt the spectacular developments in science and technology. There has been a sea change in the economic, political and technological environment world over. Age-old attitudes and mindsets are being discarded everywhere. India has been no exception; its economy has been unshackled and the forces of competition have been unleashed. A new vision of India as a major player in the global setting has been articulated. The wave of change sweeping the country and the world has thrown open vast opportunities, and at the same time posed daunting challenges for all sections of Indian society. Liberalisation and globalisation have opened new dimensions to our R&D community especially in the context of WTO and the TRIPS agreement. The aftermath of recent nuclear tests by India has also thrown up additional challenges for Indian science. Advanced commercial and strategic technologies acquired by the developed world are zealously guarded, and unless India has the ability to create its own base of autonomous technology and innovations, it cannot be the master of its own destiny.

India is a large country, facing formidable challenges in development as well as security, and its technology requirements also span a correspondingly wide range. It has to continue to develop strategic technologies relating to nuclear, space and defence applications, combined with information security and development of technologies denied to India under the so called technology control regimes. It must be remembered that nation development and national security are two sides of the same coin.

Under the WTO regime, the main challenges are in the areas of knowledge and technology, and these could be addressed by enhancing the protection of Intellectual Property Rights. While major efforts have been made to create awareness amongst the scientists and technologists of the country through the Patent Facilitating Centre, which provides assistance in patenting innovations emanating from university-funded and Government-funded research programmes; the institutional structure seems to be preventing others from securing Intellectual Property Rights on Indian products and traditional knowledge. Therefore, a proactive approach to encourage patenting is urgently called for.

Throughout its history, Indian society has demonstrated its, innate ability to develop, absorb and use innovative products and services. We may have lost this edge over the years, but I believe that India can once again attain competitive advantage in the global market place on the strength of its S&T intellectual capital and skill base. The scientific exploration and technological exploitation of our vast natural resources, such as our biodiversity, our traditional and community knowledgebase, our long coastal zones and oceans, our mineral wealth etc., need to be accelerated to derive the fullest benefit from them for the nation. We should take note of the global developments that have resulted in increasing outsourcing of R&D, and growing willingness towards global S&T collaboration. CSIR needs to leverage its advantages to explore global opportunities to the fullest extent, while continuing to solve local problems and harnessing endogenous resources for generating economic wealth.

Some of the newly industrialized countries have been successful in achieving technological advancement and economic growth by dovetailing technology imports with domestic R&D endeavours. In India, till recently, the two main players in the innovation chain, viz., the R&D system and industry enterprises lacked the spirit of

partnership in achieving the common objective of national development. The domestic R&D system, which is mainly confined to publicly funded Government owned institutions, has thus far done rather well in strategic and noncompetitive areas of R&D and technological development, such as aerospace, atomic energy and agriculture, but its impact on the commercially-oriented industry and services sector has been minimal. However, the shift towards a networked knowledge economy has given rise to the necessity of collective effort by industry, the R&D establishment, academia and the government through formal as well as informal cooperation among the constituents. The process of globalisation is compelling both the publicly funded R&D establishment and industry to enter into a dialogue and work together to mutual advantage. Our R&D priorities must match our technology goals except perhaps in basic research, which requires a high degree of intellectual freedom. In order to prevent technology domination by the developed world, India must develop self-reliance in all technology fields, much in the same way as it has done in the field of nuclear and space sciences. Today, India need not view self-reliance narrowly as we had done in the past by equating it with self-sufficiency. We can and must go in for international scientific and technological cooperation. But this cooperation must be as between equal partners, not donors and recipients.

It is matter of great satisfaction for all of us to learn that CSIR, having realized the urgency and the needs of the changed circumstances in the wake of global developments, has reoriented its activities to explore global opportunities. It has carried out a Strength, Weakness, Opportunities and Threat (SWOT) analysis for each laboratory and also for each sector. This has led to the formulation of focused programmes for undertaking innovative research, application and development of technology, commercialization of technology and technology transfer, especially to Small and Medium Enterprises (SMEs). As a result, CSIR has achieved resounding success in the IPR domain, from the battle of turmeric to the adoption of Traditional Knowledge Digital Library (TKDL) in the international patent search, but the road ahead is uneven and uncertain. The global IPR regime is presently in a state of flux and there are major issues of traditional knowledge, genomic sequences, copyright, etc. that need to be taken up rationally. The stakes are high and CSIR has to play a key role in securing the interests of this country in the unfolding scenario.

The unprecedented success achieved by CSIR through its New Millennium Indian Technology Leadership Initiative to bring about public private partnership is praise worthy. This has now to be replicated on a much wider canvas if the country is to make a durable impact. Further, recognizing the changing context of scientific enterprise and national needs in the new era of globalisation, it must be ensured that the message of science reaches every citizen of India, man and woman, young and old, so that we emerge as a progressive and enlightened society. The acquisition of a scientific temper will make it possible for all our people to participate fully in the development of science and technology and its application for human welfare.

On this concluding day of the Diamond Jubilee Year of CSIR, I recall the following words of Dr. Shanti Swarup Bhatnagar, the founder Director of CSIR and one of the outstanding personalities in Indian science.

“We can see today the dim lights of a new dawn in the distant horizon of Indian progress. These faint radiations are not the vanishing streaks of our glorious past; they are the sure signs of a new birth full of promise and glory for the future. This dawn represents the birth of the industrial movement in India”.

The dim lights and faint radiations seen by Dr. Bhatnagar in 1938 are no longer dim or faint. With outstanding achievements to its credit, Indian science and technology has dazzled the world in many areas and will continue to do so in the days to come. Whether the industrial sector in India will attain the full vigour of adulthood or will continue to require sustenance from public support systems will depend largely upon the extent to which it internalizes the responsibility for technological development.

Dr. Bhatnagar was an outstanding scientist-administrator and educationist, whose life and work is a shining example of what human effort is capable of achieving. He rose from a very humble beginning to occupy some of the highest scientific posts in the country and left behind a truly remarkable record of achievements. He not only earned an international reputation by his valuable work in various branches of science, which contributed substantially to the industrial development of India, but was also responsible for fulfilling the vision of Pt. Jawahar Lal Nehru, the then Prime Minister of India – by putting India on the scientific map of the world. He had the quality of translating all odds into opportunities, Behind the realization of his dream of creating a strong scientific and industrial R&D system in the country lay the restless energy, drive and single-mindedness of a practical visionary, Dr. Bhatnagar was also instrumental in the setting up of the Indian Standards Institution and the Indian National Scientific Documentation Centre (INSDOC) with technical assistance from UNESCO. A National Register was also started which contained full particulars in respect of the qualifications and experience of Indian scientists in India and abroad. He took personal interest in promoting the activities of scientific organizations in India and was closely associated with the Atomic Energy Commission as Member Secretary and also with the University Grants Commission as its Chairman. I knew Dr. Bhatnagar and will never forget his kindness and encouragement. I pay my respectful tribute to a nation-builder for his outstanding contribution to the advancement of Science in India and the growth of CSIR to its present status.

*In the end, I would like to thank DG, CSIR for inviting me to participate in an epochal event and to felicitate the award winners.*

*I am sure that in the years ahead, CSIR can and will reach still higher pinnacles of attainments. On this concluding function of the Diamond Jubilee celebrations, my best wishes to CSIR for a still more glorious path ahead. Jai Hind. Jai Vigyan”.*

Dr. Vikram Kumar, Director, National Physical Laboratory, New Delhi, proposed a vote of thanks.

# Shanti Swarup Bhatnagar Prize Presentation Ceremony

## 2.6 SHANTI SWARUP BHATNAGAR PRIZES PRESENTATION CEREMONY

Shanti Swarup Bhatnagar Prizes for 2002 were presented by the Hon'ble Prime Minister Shri Atal Bihari Vajpayee at a glittering ceremony held on 12th July, 2003 at Vigyan Bhavan. The function was presided over by Prof. Murli Manohar Joshi, Hon'ble Minister for Human Resource Development, S&T and Ocean Development and Vice President of CSIR. Shri Bachi Singh Rawat, Hon'ble Minister of State for Science & Technology also graced the function. The function was attended by a large number of dignitaries and distinguished scientists. Hon'ble Prime Minister Shri Atal Bihari Vajpayee presented the Bhatnagar Prizes for the year 2002. The Awards presented were: Prize for Biological Sciences – Dr. Raghavan Varadarajan and Dr. Amitabha Mukhopadhyay; Prize for Chemical Sciences – Dr. Tushar Kanti Chakraborty and Dr. Murali Sastry; Prize for Earth, Atmosphere, Ocean and Planetary Sciences – Dr. Ganapati Shankar Bhat and Dr. Sankar Kumar Nath; Prize for Engineering Sciences – Dr. Ashutosh Sharma; Prize for Mathematical Sciences – Dr. Dipendra Prasad and Dr. Sundaram Thangavelu; Prize for Medical Sciences – Dr. Sunil Pradhan; Prize for Physical Sciences – Dr. Avinash Anant Deshpande and Dr. Mohit Randeria. Dr. Mashelkar then invited Prof. Joshi to address. In his address, Dr. Joshi said, "Hon'ble Prime Minister of India, Shri Atal Bihari Vajpayee ji; my colleague, Minister of State for Science & Technology, Shri Bachi Singh Rawat ji; Dr. Mashelkar; Dr. Brahmachari; the proud Shanti Swarup Bhatnagar Prizewinners and their equally proud family members; young research students who are attending the Bhatnagar Prize function in such large numbers for the first time; distinguished invitees; ladies and gentlemen:

Let me begin by welcoming all of you to this 29th Bhatnagar Prize function. I am especially happy to welcome our Prime Minister, who has set up, as was told earlier, a record. No Prime Minister of India has given away the Bhatnagar prizes for the fifth time in a row. Our Prime Minister has done it. This reflects the deep commitment that our Prime Minister has in Indian science and also his total faith in the Indian scientists.

His abiding faith has been reflected repeatedly over the last five years through what he has said and what he has done. He not only gave his famous and inspiring slogan of 'Jai Jawan, Jai Kisan and Jai Vigyan' but also followed this up with several determined actions. His pronouncement during the Pune Science Congress to raise the level of expenditure in Indian Science & Technology to 2% of India's GDP, was followed up with concrete action. Indeed, the last two years have seen a record increase in the budgetary support for science and technology over the previous years, dare I say, the highest in post-independent India! We thank you Hon'ble Prime Minister for this unstinted support, and assure you that we are determined to use Indian S&T as the most powerful tool for the socio- economic transformation of India so that your dream of 'twenty-first century being India's century' will come true.

Let me begin by congratulating all the Bhatnagar Prize winners. This prize continues to remain the most prestigious prize today that an Indian can get. What is very satisfying for me is that you have committed yourself to do science in India rather than some distant land of promise, and this prize comes to you for the work done primarily in India. I am sure this award, which is a recognition of the outstanding scientific research that you have done, will spur you to go on further and higher, bringing all the glory to Indian science.

I was very keen to organise something very special this time that has not been done before. Apart from the actual awards function, there is a Bhatnagar Laureate (2002) Symposium to follow. In this, each one of the Bhatnagar Laureates will present the gist of the work that got him this prestigious prize. The young researchers will get a glimpse of the best in science that India has to offer. They should be inspired by the presentations of

the Bhatnagar Laureates. I am sure this event will make the young scientists present here the aspirants for this prestigious prize in the future. We will continue this practice of holding the Bhatnagar Laureate symposia from now onwards for all future Bhatnagar Prize functions to follow.

The Bhatnagar Prize has been given primarily for the work done in basic science. Today, I want to spend some time on responding to a question that is often asked — Can a poor country like India afford to spend its scarce financial resource in basic scientific research? Should it not just use the scarce funds wisely and just concentrate on converting the currently available knowledge into something useful for the nation? I even heard recently that in a meeting organized abroad, one of the speakers said that scientists working in developing world should forget about Nobel Prizes. Instead they should just work on improving their lot by using known pool of scientific knowledge. I beg to differ completely. Basic research is a foundation. This foundation for Indian science must be strong. Then only can we build a strong edifice of cutting edge technology. There is no high technology without high science.

Let me begin by quoting what Sir C.V. Raman had said once:

**"Unless the real importance of pure science is recognized and its fundamental influence in the advancement of all knowledge is realized and acted upon, India cannot make headway in any direction and attain her place among the nations of the world. There is only one solution for India's economic problems and that is science and more science and still more science."**

Coming from a scientist, his craving for more and more pure science need not come as a surprise. But let me turn to Homi Bhabha. Not only was he a great scientist himself but he was a great science administrator too. Based on his quarter of a century of experience in India, he was categorical in what he said about the importance of basic scientific research for India. In January 1966, in the last speech that he gave in his life, addressing the International Council of Scientific Unions in Bombay, he remarked:

"What the developed countries have and the underdeveloped lack is modern science and an economy based on modern technology. The problem of developing the underdeveloped countries is therefore the problem of establishing modern science in them and transforming their economy to one based on modern science and technology. An important question, which we must consider is whether it is possible to transform the economy of a country to one based on modern technology developed elsewhere without at the same time establishing modern science in the country as a live and vital force. If the answer to this important question is in the negative — and I believe our experience will show that it is — then the problem of establishing science as a live and vital force in society is an inseparable part of the problem of transforming an industrially underdeveloped to a developed country."

The Government is fully committed to supporting basic science as well as honouring great achievers in basic science in the best possible way that the nation can. That is why during the Science Congress held earlier this year in Bangalore, I requested our respected Prime Minister to announce the Indian Science Prize of Rs. 25 lakh. The Prime Minister graciously agreed and announced it. This will be the highest ever prize in science and I want it to grow in status over the years. Mind you, Rs. 25 lakh is not a small sum. If one looks at the purchasing power parity, then this is equivalent to over Rs. 2 crore in Europe or USA. So this is a large prize, which we want, to give to our large achievers. And mind you, the recently set up CSIR Diamond Jubilee Prize for Technology, which is again the highest in India, is Rs. 10 lakh. Clearly, there is a message here about how deeply we value breakthroughs in fundamental science in India.

My friends, the Government is striving very hard during the last five years to make India a science & technology superpower. It is true that in recent years we have seen that the best of minds do not turn to science. Those who do unfortunately do not stay in science. Therefore, apart from increase in funding, we have launched several

schemes to attract young people to science. These include DST's Kishore Vaigyanik Protsahan Yojana, CSIR's Programme on Youth for Leadership in Science, and several others. We have set up Shyama Prasad Mukherjee Fellowships for the most exceptional young research scientists. We also have Swarna Jayanti Fellowships for the most talented of our scientists and engineers.

We perfectly realize that the real fountainheads of new scientific knowledge are universities. Furthermore, mere teaching without research is sterile. Therefore, we have a scheme to identify our best universities with potential for excellence and support them enthusiastically. DST has created the FIST programme for supporting basic research in universities. UGC is also launching Centres for Studies in Integrative Sciences where integrated 5 year M.Sc. will be offered with a unique course content, which will create budding researchers of the highest quality.

I am happy to see that a lot of efforts that the government has put in over the past five years is beginning to pay a dividend. We had the disappointing news that our basic research output in terms of the papers published in Science Citation Index (SCI) journals had remained almost constant at around 13,000 during two decades, i.e. during 1980 to 2000. This is in spite of the fact that the number of universities more than doubled during that period and the investment in science and technology went up by a factor of 15 in real terms. We inherited this legacy of the past. On this backdrop of our past, I am beginning at last to see the silver lining already. I understand that the cut-off percentage for admission to science courses in Delhi has gone up by about 5% this year, which was steadily declining so far. This is a good sign. I am told that India's rank of SCI papers was constant at the 15th position during the four years period i.e. 1998 to 2001. In 2002, however, we have moved up to the 14th position by displacing Switzerland to the 15th. We, of course, need to go up much higher, but I believe a good beginning of the reversal of the trend has taken place. Recently, while I was in Mumbai, I met an industrialist. She had just returned from Stanford. She told me as to how she met many Indian young scientists, who felt so positive about India and who were wanting to come back to India. Although these are small signs of change, they are, to me, very satisfying signals of the direction in which we are moving.

In Bhatnagar Prize winners, we have the best in science in India. I want the aspirations of our scientists to rise higher and higher. At the end of the day, one must recognize that in science only those are remembered who say either the first word or the last word. For this, we require daring innovation and creativity. We require self-confidence. Let us not forget that this country has a great heritage of courageous scientists, who accomplished magnificently in science. We cannot think of better examples of men of science than Ramanujan, Raman and S.N. Bose. Raman was sure that he would win a Nobel Prize when he discovered the Raman effect. He even booked his voyage for the Nobel Prize function. Such shows his confidence. S.N. Bose, shortly after his post-graduate studies, had the courage to send his research results to none other than Einstein for review. It needed tremendous confidence to feel that the work he had done deserved the highest recognition. Einstein, being what he was, recognized the genius of Bose rightaway. Much earlier to this, Ramanujan did something similar.

Working as a clerk in a port trust, with no one to help and without a college education, Ramanujan felt that he had discovered something new working on "Orders of Infinity" and sent the result to Prof. Hardy at Cambridge. This led to a new era in Mathematics. My young friends, this is the Indian legacy. You are proud inheritors of this legacy. Feel inspired by this legacy and march on. Glory will come to you and Indian science automatically.

I want to emphasize that basic research must form an integral part of every research body. I have very often emphasized that in the case of CSIR, which is the Council of Scientific and Industrial Research, the word "scientific" precedes the word "industrial"; and in fact the organization can be effective in industrial research only if this is based on strong scientific research. This is equally true in areas of agriculture, in medicine, in defence and so on.



I have often said that science cannot be left to the market forces. Strangely, this is something that even the Europeans had recognized, when they were competing with the Americans. As a physicist, I recollect what Cecil Powell said when he was arguing in the early 1950s assuring for support for basic research in Europe. United States was then vigorously moving into the field of high energy elementary particle physics. European physicists were trying to obtain support for a common European accelerator. European Council for Nuclear Research (CERN) did not exist then. Cecil Powell then said: "In the long run, it is most painful, and very expensive, to have only a derivative culture and not one's own, with all that it implies in independence in thought, self-confidence and technical mastery. If we left the development of science in the world to the free play of economic factors alone, there would inevitably result most undesirable concentration of science and scientists in too few centers, those rich in science becoming even richer, and those poor, relatively poorer". This is precisely what has happened today. The gap between the developing and the developed nations has increased enormously. We cannot afford to have such a gap. India simply cannot lag behind. It must surge ahead and be a leader in science.

Finally, let me again congratulate all the Bhatnagar Prize winners once again. Let your work bring a great fame to Indian science. I want to extend my very best wishes to you for your journey up that limitless ladder of excellence.

I am extremely grateful to the Prime Minister for his total support to the development of Science and Technology for then only he has been able to spare so much of time for us out of his busy schedule.

Prof. Joshi requested then Hon'ble Prime Minister to deliver the address.

Dr. Murli Manohar Joshi, Shri Bachi Singh Rawat, Dr. Mashelkar, Dr. Brahmachari, Bhatnagar, Laureates, my young scientist friends and other distinguished guests.

This is the fifth Bhatnagar Awards function that I have the privilege to address. It is always heartening to be in the company of the most outstanding among our country's scientists. But today, I have an additional reason to be pleased. For I see in front of me hundreds of young science scholars, who are participating for the first time in the Bhatnagar Awards function.

I must congratulate the CSIR for the 'innovation' it has introduced in this event by holding the Bhatnagar Laureates Symposium. This will give the young minds present here an opportunity to interact with the brightest among Indian scientists. I would like to congratulate the Bhatnagar awardees, who have excelled in their respective areas of research. I am happy to note that most of the Bhatnagar awardees of yesteryears have continued to remain and work in India. They have over the years pioneered new schools of thought, spawned new paradigms for technology, established centers of excellence and won many laurels.

To the new Awardees, I would like to say, *"You now have an onerous responsibility. You are the role model for young scientists. You have to set an example to them by your continued pursuit of excellence in science, high levels of ethics in your work, and the larger vision of nation-building that ought to guide the work of scientists as well as all the rest of us in our respective professions."*

Today as I pay tribute to the achievers — both past and present — in Indian science and technology, I naturally think of those of our compatriots who have gone abroad and whose superior research capabilities are now acknowledged all over the world.

While speaking to DRDO scientists on this year's Technology Day, I had said that we are proud of the fact that tens of thousands of Indian scientists and engineers around the world are making valuable contributions to the areas of their specialization and to economies of their countries of domicile. Many Heads of State, including those of industrialized nations, have spoken to me praising their contribution.

This gives us the hope and confidence that by creating the right environment for learning, teaching and working here in India, our talented scientists and engineers can produce path breaking discoveries and inventions in our own country.

Here I am reminded of the words of an immigrant scientist in the United States who went on to win a Nobel Prize. "A scientist is like a painter. Michael Angelo became a great artist because he had been given a wall to paint. My wall was given to me by the United States."

So, the first thing all of us should together resolve — those of us in Government as well as those of you in Science & Technology institutions — is to provide a big enough canvas to our researchers right here in India. We should further improve the environment for research and development in India. I am told that much improvement has taken place in recent years, especially in areas such as information technology, biotechnology and pharmaceuticals. But we need to accomplish much more.

The Bhatnagar prize is a national honour. But your ambition should be to benchmark your research with the best in the world and win prestigious international honours. I am happy to see that this year, as many as seven Indians have won the honours of getting elected to the US National Academies of Science & Engineering. What gladdens me especially is the fact that, although five of them have won the honours for work done in USA, the remaining two — Dr. Obaid Siddiqi and Dr. Raghunath Mashelkar have done their entire work in India. I would like to congratulate them heartily.

What does their success mean? It means that you can indeed do world class research in our own laboratories in India, provided you dare to dream, and provided your efforts match your dreams and your ambitions.

Apart from prestigious international honours, the other criterion to judge the quality of output of India's S&T establishment is the number of research papers published in reputed international journals. Perhaps this is an area that has not received adequate attention.

There seems to be an apparent disconnect between our proven technological capability to harness existing knowledge and unsatisfactory contribution to new knowledge. After all, India has made notable progress in the past two decades in agriculture, space, nuclear energy, and several manufacturing sectors. However, this progress is not matched by globally recognized original research in India.

It should be the endeavour of our scientists and researchers in CSIR laboratories, universities, IITs, ICMR, ICAR and other organizations to significantly increase their output of globally recognized research papers.

As history tells us, a nation can progress economically in the short term based on 'existing knowledge', but such progress is not sustainable in the long run — especially in today's competitive conditions in the absence of creation of 'new knowledge'. Thus, we have to be equally adept at both generating new knowledge and applying it to our various national needs.

On this occasion I cannot help reiterate my concern over the declining interest in science among students. In 1950s and '60's, the best students chose to go for science education. Today's bright students seem to be shying away from science. As a result, in few years' time, all our top research organizations would face a shortage of good science graduates. This issue needs to be addressed effectively, imaginatively and comprehensively.

I am happy that Dr Joshiji has initiated several good measures in this regard, both in respect of technology education and science education. However, it is not enough to attract the best and brightest students to science education. It is equally important to create sufficient employment opportunities for them in our country.

I would like the S&T establishment, public and private sector industry, as well as the concerned Government agencies to collectively address this issue. Some international firms have started to set up their R&D centers in India, employing large numbers of PhDs. This trend can be broadened by actively encouraging location in India of R&D activities of big and small corporations abroad. Our aim should be to make India a global R&D hub.

We should also seek the involvement of our Diasporic community in this endeavour. I am told that one of the issues that were discussed at the first Pravasi Bharatiya Sammelan early this year was how to synergise India's scientific talent at home and abroad. I would like this effort to be further strengthened.

Friends, I have always looked forward to the Bhatnagar Awards function to share with you my ideas on some of the priorities in India's socio-economic development and how the S&T establishment can help in meeting these challenges. Today the Nation expects your valuable inputs in many critical areas of development. For example, yesterday the Planning Commission presented to me two excellent reports on promotion of bio-fuels and bamboo.

These subjects may sound unglamorous to some, but both have an immense potential to generate productive employment, help millions of artisans and farmers to be liberated from poverty, achieve significant import substitution and earn considerable export revenue. To achieve these goals, we need critical R&D inputs from agriculture scientists, energy scientists, and technologists of various disciplines.

Let me mention another issue of overriding national importance — namely, water conservation. India is blessed by nature with bountiful water — it is amongst the 'wettest' countries in the world, yet 'desert like' conditions are now prevalent in many parts of the country. We are fast plunging into a water emergency era.

Although many parts of India have received timely rains this year, I have appealed to all our citizens and all institutional users of water to conserve every drop of available water. Among other things, this requires low-cost water saving, water recycling, and water treatment technologies. Our kisans need to know effective techniques of recharging the sources of ground water.

Thus you, my scientist friends, have a great responsibility to contribute to making, India water secure'. Let us remember that 'Water sustains life, and it is now our duty to sustain all sources of water'. I have given only a few illustrative examples. But they show how scientists and technologists can become crucial partners in the Nation's development efforts. You are already playing this role in diverse fields, and I commend you for your valuable contribution. But a much bigger challenge awaits you. I have full confidence in your ability as well as in your readiness to meet this challenge.

Prof. S.K. Brahmachari, Director, Institute of Genomics and Integrative Biology, Delhi, proposed a vote of thanks.

Announcing the winners of Invention Awards for School Children, Dr. Mashelkar said, it is unbelievable the tremendous learning capacity the school children have got. If India has to become 'innovative', it has to start right from these children. The Invention Awards for School children, he said, have been instituted with the aim to encourage the innovative spirit of these children. The first prize is Rs.50,000 (one), Second prize Rs.25,000 (two), third prize – Rs.15,000 (three), fourth prize – Rs.10,000 (three) and fifth prize – Rs.5,000 (five). This year, Dr. Mashelkar continued, 83 applications were received for this award. First prize has not been given to any one. Only one second prize has been given and this went to Bhushan Prakash Mahadik from a school in Navi Mumbai, for developing a process for preparation of carbon nanotubes using plant oils. Two third prize have been given: one to D. Prabhu Hari from Chennai for neo-fertilization-target ovum, and another to Purushottam Bohra from Madhya Pradesh, for developing a process for the preparation of curd powder from curd. Dr. Mashelkar had a special word of praise for Madhav Pathak from Jabalpur, Madhya Pradesh, who had won the first prize last year for developing the front fact braille writer, which makes writing much easier for the blind. This year also Madhav Pathak won a prize – fourth prize for developing a device for preventing soiling of railway tracks at the platform. The other fourth prize has been given to a team comprising Rucha Vinay Joshi, Priyanka Holambe, Divya Patil and Abha Biyani from Nanded, Maharashtra, for developing a process for the preparation of biscuits using banana peel pulp. Three fifth prizes have been given. One to Rupinder Singh from Bhatinda,

Punjab, for developing a novel machine useful for conversion of sea-wave energy to potential energy. The second to Jaydeep Mandal from the Murshidabad Distt. West Bengal, for developing a device useful for lifting the surface water of the river. The third prize has gone to T. Sri Ram Kumar from Coimbatore, for a slope-measuring instrument named as 'Universal spirit level'.

Intended to propel technology innovation in industry, the first CSIR Diamond Jubilee Technology Award, Dr. Mashelkar announced, has been given to Tata Motors design, development, manufacturing and commercialization of Indica and Indigo cars. Ratan Tata was allowed to make the cars in 1993. So far over 300,000 Indica/Indigo have been sold. Indica, a 'B' segment hatch back and Indigo, a 'C' segment sedan have been primarily designed to suit Indian driving cycle and space, and the fuel economy needs, yet conforming to stringent global environmental norms. It is providing direct employment to 4000 employees and indirect employment to 25,000 people.

The cars have not only successfully competed against some well known and established brands in the country but are also making inroads in the competitive export market, as Indica is going to be introduced in UK under the brand name of 'City Rovers' by M.G. Rovers. British Morris came to India as 'Ambassador' and now with the introduction of Indica in UK as 'City Rovers', the circle has been completed.

# R&D Planning Division (RDPD)

## 3.1 R&D PLANNING DIVISION (RDPD)

### Tenth Five Year Plan & Annual Plan 2004-05

The Division formulated the Tenth Five Year Plan (TFYP) and the Annual Plan 2004-05 with the background of 8% growth rate envisaged by the Planning Commission. In TFYP, the R&D activities under the scheme 'National Laboratories' are focused under 57 networked projects. These are in three categories namely, Steering Committee identified mission mode programme; CSIR Working Group identified mission mode programmes; and Core Network programmes. Planning Commission, in principle approved 43 network projects in this particular year.

A substantial period has been spent in formulating the proposals and seeking in principle approval from the Planning Commission. The approved Tenth Plan allocation to CSIR is Rs.2430 crore as against a request of Rs.4545 crore. The Annual Plan allocation for 2004-05 under National Laboratories scheme is placed at Rs.650 crore.

### Network Projects

In the Tenth Five Year Plan, CSIR has taken the R&D activities in networked fashion. The R&D projects are networked across the organization as well as for building capabilities and facilities that contribute to a vibrant innovation system consciously. Most of the programmes for the TFYP are formulated with the emphasis on networking of resources and capabilities to achieve better output in shorter time frame. CSIR has endeavoured to carve out a niche for itself through these areas. These R&D activities are multidisciplinary, competitive and knowledge driven and have been taken up as they are higher in value chain.

Network programmes on R&D activities are already started showing positive results. Few of them are Exploration and Exploitation of Microbial Wealth of India for novel compounds, Asthmatic and Allergic Disorders Mitigation Mission, Cell & Tissue Engineering, Special Electron Tube Technology, Green technologies for Organic chemicals, Ion sensitive Field Effect Transistor, Identification of Genes and Populations, New Building Construction Materials, Custom Tailored Special Materials, Development of Bio-chips for Identification of Foodborne Pathogens and other diseases, and Microbial conversion of Cholesterol, Development of Novel Polymeric Materials.

### CSIR Technology Awards 2003

Nomination for the CSIR Technology Awards were invited and processed by the Division for the consideration of the Technology Awards Selection Committee. The criteria for the awards was visible and sustained impact of a high order on the industrial/economic/societal activity. Only four out of the seven Technology Awards could be awarded. These were in: Biological Sciences & Technology to CCMB, Hyderabad – for A novel in vivo assay system for screening and validation of drugs; Prize for Chemical Technology to NCL, Pune – for 1,1,1'-Tris (4-hydroxy-phenyl) ethane (THPE); Prize for Engineering Technology to CMERI, Durgapur – for 35 HP Tractor; and Shield for Engineering Technology to NAL, Bangalore – for Integrated flight mechanics and control technology for aerospace vehicles.

### Interministerial Linkages

The Division represented CSIR on various committees of the Govt. of India, namely Ministries of Chemical and Petrochemicals, Petroleum & Natural Gas, Environment & Forest, Health & Family etc. and Department of Biotechnology, Indian System of Medicines, Science & Technology, Scientific and Industrial Research etc. Programme on "Discovery, Development & Commercialisation of New Bioactives and Traditional Preparations"

The massive CSIR coordinated networked programme on discovery of Bioactive molecules and traditional preparations involving 20 CSIR labs, 14 University/ Departments, few hospitals and three systems medicine i.e. Ayurveda, Siddha & Unani completed the first phase in March 2003. The progress of the programme was reviewed by the High Powered Committee constituted by DG-CSIR with the members of Governing Body, Advisory Board and Secretaries of the concerned departments.

The Committee appreciated progress made in a short period of three years in terms of obtaining 52 leads for diversified diseases of national and international relevance. It also recommended the continuation of the programme as leads are at different developmental stages so that the objective of the programme for new INDs/ new herbal formulations be achieved. Accordingly an EFC document was prepared. This was extensively discussed in the Apex Committee meeting before submitting to the Planning Commission for in- principle approval for an amount of Rs. 39.60 crore during 2004-07. The proposal accorded in-principle approval by Planning Commission.

The programme advanced forward in terms of achievements in plant collection, extraction, bioevaluation, creation of facilities and mechanism studies. Sixty leads have been obtained, out of which eight are at single molecule stage, twenty two are at formulation stage and thirty at fraction stage. Some are at advanced stage of development for diseases like cancer and ulcer. Two entirely new anti-cancer preparations in the area of women's cancer are being developed further with an Indian firm. Also short term toxicity of two entirely new anti-ulcer: preparations have been completed and clinical trials protocols have been worked out.

The programme has resulted in discovery of few new chemical entities as well as new herbal preparations. A few of them have been licensed to Indian firms.

### **R&D Management Conference 2003**

CSIR (RDPD) organized the fifth R&D Management Conference with the theme "Managing Knowledge Markets in a Global Economy: The Indian Context" during Dec. 6-7, 2003 in Delhi. Over the years this platform has gained national recognition. These conferences have been organized as a self sustaining event. About 60 abstracts were received out of which 40 were selected for presentation in the Conference.

There were 8 sessions namely; Knowledge leadership (4 papers), Knowledge Development (6 papers), Knowledge Management (6 papers), Knowledge Products and Intellectual Property (6 papers), knowledge Marketing (5 papers), Knowledge Mapping/ HR and Human Resource management (4 papers), Strategies and Implementation (4 papers) and lastly Panel Discussion on India's preparedness and role of public and private sector R&D organizations.

About 150 participants attended the conference. The participants comprised of representatives of academia, industry- private as well as public, government S&T departments, research institutions, faculty and students from IIMs and other reputed management schools in the country. The event provided the delegates a platform for cross-fertilization of ideas besides the intermingling of bright minds.

### **Annual Meet**

In the Tenth Five Year Plan, the R&D activities of National Laboratories are being pursued through fifty-seven networked projects. The objective of Annual Meet was to leverage enhanced performance from the networked projects, and to identify and address those issues, which could enhance the performance of networked projects. For the first time there has been a paradigm shift in the approach of the Tenth Plan through organizational networking. The aim of organizational networking was to maximize gain by synergising the strength available at various levels of CSIR. In order to facilitate speedy clearance on common matters of networking from CSIR Hqrs., it requires effective co-ordination between the participants and the nodal labs. It was also recommended that a Group be formed by DG, CSIR as an aid to CSIR for and to formulate guidelines governing the

implementation of network projects with a view to utilize resource optimally and to provide information to the management to monitor the pace of technical/physical and financial progress. These guidelines covering the entire Resource Management would help CSIR for better management in planning, monitoring and reviewing of the programmes, projects and the activity of the laboratories.

RDPD and Finance Group of CSIR Hqrs., jointly organized a two-day meet of Chairmen and Coordinators of Networked Projects and Planning & Finance officials at IICT, Hyderabad on 23-24th January 2004.

27 Chairmen of the networked projects along with their respective coordinators attended the meeting. Besides, Head of Planning Group and FAOs from different laboratories also participated. Altogether around 150 delegates participated in the Meet.

## **Rural Development Programme**

An Advisory and Monitoring Committee was constituted by DG-CSIR with the objectives, to advise on policy guidelines, to identify the key result projects, to recommend linkages & leveraging and to monitor the performance and progress of CSIR's Rural Development Programme & Activities.

A Rural Action Plan was brought out by the committee to provide a new orientation of CSIR on Rural Development Programme towards some identified areas. Key activities of this plan are; special allocations to CSIR laboratories launch of a quarterly publication entitled 'Journal of Rural Technology' which is available to NGOs/Voluntary Organizations etc. at subsidized rates; and in future setting up galleries at few centers depicting success stories of CSIR in the area of rural development. During the year 5 project proposals have been approved for development and dissemination of technologies relevant to rural areas and weaker sections of the society.

The Division has also brought out the current version of the publication 'Technologies for the Rural Sector'. Information Technology has given a special place. Now the users can have a wider choice to adopt appropriate rural technologies for societal benefits

## **Technology Mission on Oilseeds, Pulses & Maize (TMOP&M)**

The Division is designated as the nodal agency for Mini Mission-II related to R&D on Post Harvest and Processing Technologies on Oilseeds, Pulses and Maize. The Division facilitated establishment of following demonstration commercial units based upon technology packages from CSIR national laboratories:

- Two Palm Oil Mills of 2.5 T FFB/hr expandable to 5.0 T FFB/hr capacities based upon technology package developed by Regional Research Laboratory – Thiruvananthapuram (RRL-T) in Goa and Tamilnadu.
- Three Red Palmolein and Zero Transfatty-acid Esterified Fat manufacturing units based upon technology package from Regional Research Laboratory – Thiruvananthapuram (RRL-T) in Andhra Pradesh, Tamil Nadu and Uttar Pradesh.
- Five Rice Bran Oil Refining Units of 50 TPD capacity based upon Simultaneous Degumming and Dewaxing technology package developed by Regional Research Laboratory – Thiruvananthapuram (RRL-T) in Punjab, Haryana, Rajasthan and Andhra Pradesh.
- Ten Rice Bran Oil Refining Units of 50 TPD capacity based upon Enzymatic Degumming technology package developed by Indian Institute of Chemical Technology (IICT) in A.P., Karnataka, Punjab, Chattisgarh, Maharashtra, Tamil Nadu and West Bengal.
- One hundred units of Modern Oil Expeller of 1 TPD capacity for production of pungent mustard oil based upon technology package of Mechanical Engineering Research & Development Organisation (MERADO) in Assam, Manipur, Punjab, Haryana, U.P., M.P.

- Two versatile Dhal Milling units based upon technology developed by Central Food Technological Research Institute – Mysore (CFTRI) in U.P. and Kerala
- Two units of Goat Separator based upon technology developed by Central Food Technological Research Institute – Mysore (CFTRI) in Karnataka and Tamil Nadu.

The Division facilitated extra budgetary resources to the tune of Rs. 450 lakh for the R&D programmes undertaken in CSIR national laboratories and other academic institutions. In addition, the Division organised review of the R&D programmes by Expert Committee comprising detailed presentations and discussions with PIs.



# International S&T Affairs Directorate (ISTAD)

## 3.2 INTERNATIONAL S&T AFFAIRS DIRECTORATE (ISTAD)

ISTAD continued its mandate of identifying, facilitating and promoting international co-operation between India and other countries in the areas of Science & Technology. The major activities of ISTADs during the year includes following:

### Bilateral Co-operation

#### **Australia**

Indo-Australian Joint Workshop on Bioremediation:- Four CSIR scientists participated in a joint workshop on 'bioremediation' organized by CSIRO, Australia in Melbourne, during the year. The purpose of the workshop was to identify common interests and launch a collaborative research in this area.

As a follow up of the Bioremediation workshop in Melbourne, CSIRO officials also visited CSIR, for further discussions on possible co-operation.

#### **Belarus**

Indo-Belarus S&T Co-operation:- A research project on "Synthesis of Carbon Nano-tubes and their applications in Composites and hydrogen storage" between NPL and Heat & Mass Transfer Institute (HMTI), National Academy of Sciences, Belarus has been approved by DST for support under Indo-Belarus S&T Programme of Cooperation in S&T.

A research project on "Development of novel biopesticides based on fungi/bacteria – insect pests" of NCL has been approved by DBT for support under its bilateral programme with Belarus.

#### **China**

Indo-China Joint workshop:- The first Joint workshop on Quality Control and Standardisation of Herbal Drugs – under the bilateral collaboration of Council of Scientific & Industrial Research (CSIR), India and National Natural Science Foundation China (NSFC) was organized at NBRI during the year. 15 experts from China and 22 from India from the area of herbal drug research and manufacturing firms including leading industries like Zandu, Ranbaxy & Vaidyanath participated in the workshop.

#### **France**

Indo-French JSTC:- CSIR participated in the Indo-French S&T Joint Committee held in France. Five projects were approved for funding by the Indo-French Centre for the Promotion of Advanced Research. The cooperation also had a number of exchange of scientists between India and France under the ongoing projects.

#### **Germany**

CSIR-FZJ Cooperation Science programme:- Under this programme five projects have been successfully completed. Presently 6 joint projects in the areas of Electronic Science & Engineering, Chemical Sciences (NCL and IICT), Bioactive molecules, Earth Sciences (NGRI) are under implementation. Three more projects have been approved by CSIR and are awaiting approval from Germany.

SERC, in collaboration with Central Institute for Applied Mathematics, Germany, has successfully completed a project on development of efficient methodologies and techniques for error analysis, and adaptive refinement of FEM, and implementation of these developments in a parallel computing environment.

- CSIR-Humboldt Reciprocity Award:- The nominations of German experts for the CSIR-Humboldt Reciprocity Research Award were invited from CSIR and also select non-CSIR institutions. CSIR has approved to award the first CSIR-Humboldt Reciprocity Research Award for 2004 to Professor Geerd HF Diercksen, Max Plank Institute of Astrophysics, Garching, Germany. The Alexander Von Humboldt Foundation has endorsed the decision. The Award has been exempted from income tax in India upto 2006.

- CSIR-DAAD Exchange Programme: 6 senior CSIR and 5 German scientists visited their counterpart institutions in Germany and India, respectively. Nominations of 7 scientists each from CSIR and Germany were short listed for visits under project mode. In addition four 4 scientists from both the sides were nominated for exploratory visits.
- DST-DAAD PPP Projects: Three projects are ongoing under the DST's Project Based Exchange of Personnel Programme with DAAD.  
Project supported under DBT-FzJ Cooperation: A research project on "Molecular cloning and gene expression studies of the putative members of allatostatin A and C type and of allatotropin from the non mulberry silkworms *Antheraea assama* and *Philosamia ricini* between RRL-Jorhat and University of Bayreuth, Germany has been approved by DBT for support under DBT's Programme of Cooperation with Germany.
- NAL-RWTH Aachen Cooperation: A project entitled "Investigative Studies on Casing Treatment Techniques in Axial Flow Compressors" has been approved for support by DFG (German Research Foundation) and NAL. DFG shall give grant of Rs.18.67 lakhs to NAL in the form of equipment, 2 NAL scientists have visited Germany to work on the project.
- NAL-DLR Cooperation: A two member delegation visited Germany during the year to visit (a) DLR Research Centre in Goettingen, Braunschweig and Cologne to review the ongoing joint cooperation of NAL in the field of aeronautics and to explore possibility of cooperation in the area of aerospace structures and propulsion (b) University of Aachen to review the ongoing bilateral cooperation between NAL and University of Aachen, and (c) Facilities at M/s Thielert Aircraft Engines GmbH, Lichtenstein, Germany.

#### ***Inter Institutional Cooperation***

Out of 8 ongoing projects, three have been completed. These joint projects were funded by Volkswagen Foundation with a total grant of DM 401520/-.

Special Bilateral Projects: CSMCRI has signed a collaborative project between Hohenheim University, Daimler Chrysler, Germany (DCAG), and Daimler Chrysler, India (DC India) on "Biofuels from Eroded Soils in India using *Jatropha* Plant" during the year. The first phase of the project is expected to complete by December 31, 2004.

Visit of CSIR delegation to Germany: A CSIR delegation visited Germany during Sep 14-20, 2003 to review the existing cooperation of CSIR with Germany, identify the gap areas, suggest measures for strengthening the cooperation further, market S&T capabilities of CSIR and set direction for future co-operation. The delegation visited the bilateral partners of CSIR and research institutions which include the German Ministry of Education and Research (BMBF), German Academic Exchange Service (DAAD), University of Bonn at Bonn, Forschungszentrum, Juelich; German Research Centre for Environment and Health (GSF) at Munich and Institute of Applied Chemistry (ACA) and Technology Park "WISTA", Adlershof, Berlin. New areas of cooperation were identified and measures were suggested to bring visibility to the programme.

#### ***Hungary***

CSIR labs have a number of collaborative projects with their Hungarian counterparts under the Indo-Hungarian Inter-Governmental S&T cooperation. 5 scientists from CSIR labs, 2 from NCL and one each from IIP, IICT, CSMCRI participated in the Intergovernmental Conference on "Surface Chemistry and Catalysis on nano-particles" held in Budapest, Hungary.

#### ***Myanmar***

Indo-Myanmar JSTC:- The third meeting of the Joint Indo-Myanmar Working Group for Scientific and Technological Cooperation was held at Yangon, Myanmar during the year. Among the activities agreed for S&T

Co-operation between India & Myanmar for next three years 2003 –2006 were training, in various areas at CSIR labs. Repair and Maintenance of Instruments (CSIO), Food Technology (CFTRI), & Leather processing technology (CLRI)/

It was also proposed to hold joint workshops & projects. The area of Metrology, Food technology, Medical Biotechnology and Traditional Medicinal Research (Malaria). A PoC in S&T for 2003-2006 was also signed at the meeting.

#### ***Nepal***

Five Nepalese Scientists from Department of Plant Resources, Nepal visited NBRI & CIMAP, Lucknow for an exploratory visit in the area of Aromatic Plants under the PoC on S&T between the two countries. Students from Nepal Engineering College, Kathmandu undertook training Courses in Instrumentation at CSIO, Chandigarh.

#### ***Portugal***

Three new projects of NIO have been included under the Inter-governmental S&T cooperation with Portugal.

#### ***Russia***

CSIR-ILTP (Integrated Long Term Programme of Cooperation between India and Russia) Projects

Twenty eight projects are ongoing in the areas of Engineering & Electronic Materials; Laser Science & Technology; Catalysis; Accelerators; Water Technology; Oceanology & Oceanic Resources; Engineering Sciences; Earth Sciences; Chemical Sciences, Life Sciences at various CSIR Laboratories. Out of these 5 projects in the areas of Catalysis, Engg. Sciences, Earth Sciences and Life Sciences were approved by DST for implementation under ILTP during the period of report. 11 projects in the areas of Laser, Catalysis, Water Technology, Earth Sciences and Ecology & Environment Protection have been successfully completed.

Nine Indian scientists visited Russia under the joint projects. Five Russian scientists from EDBOE, Russian Academy of Sciences, Moscow visiting India during October 2003 to deploy the Ocean Bottom Observatory (GEODROME) in Bay of Bengal to carry out experiments on board ORV 'Sagar Kanya'.

#### ***Indo-Russian Sub-Working Group on Oceanology***

A delegation comprising three Scientists of National Institute of Oceanology, Goa, visited Russia to attend the 5th meeting of the Indo-Russian Sub-Working Group on Oceanology and explore new areas for cooperation. The delegation visited several Russian Research Institutes in the area of oceanography.

The CSIR delegation received abstracts of five new project proposals in the area of geology, geophysics and ocean remote sensing for consideration of the working sub-group. 5 Indian and 8 Russian scientists visited the partner countries during the year.

#### ***Saudi Arabia***

A three member CSIR delegation visited Riyadh, Saudi Arabia to review and renew the programme of co-operation with the Saudi Arabian Standards Organization (SASO) for the period 2003-05.

#### ***South Africa***

A team of researchers from the Department of Science & Technology, South Africa, visited NISCAIR, New Delhi during the year to participate in collaborative workshops with the Traditional Knowledge Digital Library (TKDL) Team at NISCAIR.

#### ***Thailand***

Indo-Thailand JSTC: The First meeting of Indo-Thailand JSTC was held at Bangkok, Thailand. The broad areas identified for cooperation under POC:- Advanced Materials; Biotechnology; Natural Rubber Products; Environment; Non-Conventional Energy Sources; Technology Transfer and Seismology & Earthquake Engineering. Two joint proposals from NCL & NAL in the area of Material were approved.

## **Ukraine**

A high level delegation led by Dr. VS Stogniy, Dy Minister for Education and Science of Ukraine visited CSIR and met DG, CSIR to explore the possibility of cooperation between CSIR institutes and their Ukrainian partner institutes.

## **Vietnam**

Indo-Vietnam JCS&T: An Indo-Vietnam Joint Workshop on Science, Technology and Innovation Policies was held at Hanoi, Vietnam. Two CSIR Scientists attended the workshop. The objective of the workshop was to discuss emerging issues on Science & Technology and Innovation Policies with a view to enhancing globalization and trade liberalization. In addition exchange visits from both sides were made under the ongoing projects under the intergovernmental programme.

## **MULTILATERAL CO-OPERATION**

### **European Union**

CSIR has actively participated in Indo-EU S&T cooperation discussions to promote greater cooperation under the newly signed Indo-EU S&T Agreement. CSIR submitted two pre-proposals for discussions towards holding thematic workshops:

- Targeted drugs for HIV, Tuberculosis and malaria: cellular, molecular and biochemical studies in search of new targets and generation of novel lead molecules – CDRI, CIMAP, IICT, CCMB and IGIB
- Studies on method validation, formation, toxicity and biochemical aspects of acrylamide in traditions foods – CFTRI and ITRC

### **GLOBAL BIODIVERSITY INFORMATION FACILITY (GBIF)**

The National Botanical Research Institute (NBRI), Lucknow has been assigned the lead role as the Indian National node of the GBIF, as an Associate Member of GBIF, NBRI will be in touch with our other bio labs and other institutions in India and will hoist biodiversity data available on the public domain on the node.

### **EXPERT GROUP**

One Scientist from NCL participated in the International Centre for Science and High Technology of UNIDO, Trieste, Italy's Expert Group Meeting on "Combinational Chemistry, Molecular Design and Promotion of related Projects".

### **TRAINING**

The Indian Institute of Chemical Biology (IICB), Calcutta has been recognized as one of the training centres of the European Graduate School of Neuro Science, University of Masstricht, the Netherlands.

### **FELLOWSHIPS**

CSIR-DAAD Fellowship:- 6 CSIR scientists have been awarded the Fellowship during 2004-05.

Raman Research Fellowship:- 6 Raman Research Fellows of CSIR visited the host countries. 7 CSIR scientists were awarded with Raman Research Fellowship.

CFTRI-UNU: CFTRI is an associated institute of UNU since 1976, which impart training to the foreign nationals from developing countries selected by UNU, Japan in the area of Food Science and Technology UNU meets international travel and insurance of candidates and provides financial support to CFTRI @ US \$ 417 per fellowship man month to defray part of the training costs, CSIR pays fellowship stipend @ Rs.12,000/- per month per fellow. During the year 2 candidates from the University of Khartoum, Sudan have joined CFTRI for training.

CSIR-TWAS Fellowships: CSIR and the Third World Academy of Sciences (TWAS), Italy have jointly instituted Postgraduate and Postdoctoral fellowship for scientists of proven ability from developing countries who wish to pursue advanced research in newly emerging areas in science and technology in the CSIR Laboratories/Institutes. The principle aim of the programme is to promote scientific capacity and excellence for sustainable development in the South. During the year 9 scientists from Nigeria, Egypt and Tanzania have joined CFTRI, CIMAP, C-

MMACS, IICB, IMT and RRL, Tvm for Postgraduate Fellowship and 6 from Nigeria have joined CDRI ,CRRl, CIMAP, IICB, ITRC and NGRI under Postdoctoral Fellowship.

#### **WebISTAD**

ISTAD's website, WebISTAD along with an innovative software for e-clearance of deputation proposal was developed as a collaborative effort between ISTAD and NAL. The first WebISTAD Group Training workshop for the labs situated in South was organized jointly by ISTAD and NAL at Bangalore for two days. These include CLRI, RRLTrv, CFTRI, CECRI, NGRI, CCMB and IICT. In addition, NCL and NIO were also been included for formal training and necessary interaction. This group-training workshop was followed by similar training workshops in Delhi and Kolkata. With these training workshops, all CSIR labs have now been covered in the net of e-clearance. In this e-clearance module all CSIR scientists can have their deputation proposals processed through e-clearance mode.

Simultaneously with accumulated experience on e-clearance through the WebISTAD Version 1, the planning an conceptualization for the advanced Version 2.0 has already been initiated.

#### **HRD effort:**

- During the year, ISTAD facilitated foreign deputation of nearly 713 CSIR scientists. Of these, 372 were deputed for participation in international conferences/seminars, 55 for training, 13 for Cruise, 146 under bilateral exchange programmes, 117 under Fellowships, Leaves & EOL, 4 for Business Development and 6 as experts. Partial financial assistance was approved for about 199 non-CSIR scientists for participation in international conferences/symposia/seminars of relevance to CSIR.
- Indo-German Workshop:- SERC organized a joint Indo-German Workshop on "Finite Element Analysis of Structures – FEADS '03" to highlight the joint efforts made in the CSIR-FzJ project and to share latest advances in R&D work and applications relating to finite element analysis of structures covering error estimation, adaptive refinement and parallel processing, methodologies. A total of 35 experts participated in the event.
- CECRI conducted a seminar on "Eco-Friendly Technology for Metal Finishing Industries Effluent Treatment" at Madurai during the year. The seminar was funded by GTZ-AEM, New Delhi
- 31 CSIR scientists and 15 German scientists visited partner countries under various programme.

# Intellectual Property Management Division (IPMD)

## 3.3 INTELLECTUAL PROPERTY MANAGEMENT DIVISION

(IPMD)

The Division continued efforts for enhancing the value and volume of IP. As a result CSIR continued to maintain its dominant position in IP arena by filing 495 foreign and 406 Indian patent applications during the year.

International Seminar on 'International Enactments and Practices on Intellectual Property Rights' CSIR in collaboration with the Institute of Intellectual Property Research and Practice (IIPRP), Gurgaon organized a three day international seminar on 'International Enactments and Practices on Intellectual Property Rights' at New Delhi. About 60 representatives from private and public sector Industries, the Government., R&D Institutes, Law firms, and IP Professionals attended the Seminar.

A team of internationally renowned experts Patent County Court, UK, European Patent Office and Patent Attorneys of leading IPR firms from USA, UK and Japan were invited. To expose the participants to the world's current practices on IPR and to enable them to plan their strategies in the new IPR regime, the joint effort brought together a team of internationally renowned experts.

The seminar focused on a) ethical issues in Patent Law and International Patent prosecution; b) recent development in Chemical, Biotech Practices and Pharmaceutical Chemistry in USA, Japan and Europe; c) trends of international growth of Pharmaceutical industry and its commercialization in a new patent regime, with particular reference to the developments in USA and India; d) general examination procedure at USPTO, JPO and EPO, covering various critical aspects with practical example; e) patenting of engineering inventions, software and business method, and their scope of protection in USA and Japan; f) doctrine of equivalent after Festo and its current implications; g) copyright in digital world; h) protection of trademark and present business ethics on infringement and litigation.

### PCT USERS' MEET

For the first time in the country, CSIR organized a PCT Users' Meet in New Delhi on March 24, 2004 bringing together users, stake holders and administrators of PCT on a single platform. The participants included representatives from Ministry of Science and Technology, R&D Institutions, IP Law firms, Industry, Patent Office and representatives of International Bureau, PCT division of WIPO, Geneva. During the meeting, it was discussed and debated as to how users of PCT from developing countries can make the best use of PCT system in a cost effective manner.

# Technology Networking & Business Development

## Division(TNBD)

### **3.4 TECHNOLOGY NETWORKING & BUSINESS DEVELOPMENT DIVISION (TNBD)**

TNBD, carved out of R&D Planning & Business Development Division, has been mandated to support projects under NMITLI and Energy scheme besides liaison, interaction and dealings with and of industry, financial, banking, commerce, trade, science & technology associations, bodies and all dealings of laboratories with commercial entities, to facilitate functioning of two CSIR units namely Unit for Research & Development of Information Products (URDIP), Customer Satisfaction Evaluation Unit (CSEU) and Diamond Jubilee Technology Award.

In the first year of its inception, the division provided support for 25 ongoing NMITLI projects. The on-going projects cover diverse areas. Notable ones are liquid crystals to decentralized power packs; functionalisation of alkane to advanced nano-materials and composites; defunctionalisation of carbohydrates to biodegradable plastics; and new targets and markers for cancer to advanced drug delivery systems. As a result of this one Oral herbal formulation for the treatment of psoriasis has been developed jointly with M/s Lupin Laboratories and an Investigational New Drug (IND) application has been filed for the first time in the country. A simple and cost-effective office-computing platform, SofComp, has been successfully completed and is now ready for soft-launch. On the business development front, measures were taken to further sharpen and deepen CSIR's skill base for knowledge marketing.

#### **Global Research Alliance (GRA)**

The division provides support to GRA activity. The area in which support shall be provided have been identified by nine leading R&D global organizations viz. CSIR-India, Battelle, USA; CSIR, South Africa; CSIR, Australia; DTI, Denmark; FhG, Germany; SIRIM, Malaysia; TNO, Netherlands and VTT, Finland. These are Water, Health, Transportation, Energy and Digital Divide.

#### **Business Development and Marketing of Knowledge**

One of the tasks of the division is providing assistance to laboratories for business development and marketing of knowledgebase in diverse fields in order to maintain organic linkage with national level industry associations and other stakeholders.

#### **Annual Business Meet (ABM)**

The ABM 2004 along with a workshop entitled "Strategies for Marketing CSIR Knowledgebase" was organized at NCL, Pune during 20-21st February 2004 wherein scientists responsible for business development activities and several Directors of the laboratories participated. The ABM is a forum for discussing issues relative to common / generic business difficulties. TNBD shall review the guidelines on "Technology transfer and utilization of knowledgebase" with a committee constituted under the Chairmanship of Dr. S. Sivaram, Director, NCL.

#### **Kelkar Committee**

TNBD provided secretarial support to Kelkar committee constituted by DGCSIR. The committee was set up to assess and value the socio-economic-environmental benefits arising from CSIR's R&D outcomes and S&T activities.

## Diamond Jubilee Technology Award

In order to reorganize and honour the outstanding technical innovation that has contributed greatly to enhancement of national prestige. During Diamond jubilee year CSIR initiated Diamond Jubilee Technology Award 2003 after completing its glorious existence of 60 years. The award, first of its kind, seeks to recognize and honour the outstanding technological innovation that has contributed greatly to enhancement of national prestige. The award carries a plaque and citation alongwith cash prize of Rs. 10 lakh. During the year CSIR received 116 nominations cutting across diverse industry segments. "TATA Motors" stood out in the scrutiny for their spectacular contributions in the domain of design, development, manufacturing and successful marketing of Indica and Indigo cars. TNBD coordinated the efforts

## Unit for Research & Development of Information Products (URDIP)

Continuing its endeavours for developing value added IT products benefiting professionals, academicians and industry, URDIP during the year developed/ added in the series a number of information products. These included:

Health Heritage, which, incorporated both traditional knowledge from Sanskrit classics, referred to by practitioners of Ayurveda and the modern information made available through systematic research during the past 40 years on diverse medicinal plants used in the Indian system of medicine. Summarily the database developed provides the information on chemical studies of plants and biological evaluation on total extracts and fractions there from. It also provides all the pharmacological, biological and clinical work done on pure constituents obtained from plants and gives the complete structures of new substances obtained. A third CD ROM in the series containing information on 50 plants was released during the year.

PAMEP is a database of Patents on Aromatic, Medicinal and Economic Plants. The database has many unique features and covers patents granted on about 300 such plants. The database is in web-enabled format. The work was sponsored by Department of Biotechnology (DBT).

Ayuta Index's second volume in the series named as Hetu-Koshah was prepared and released in CD-ROM format. The work was undertaken in collaboration with Tilak Maharashtra Vidyapeeth, Pune. It integrates widely scattered and distributed references from Ayurveda classics on symptoms, causes and treatments in a retrievable form.

Patestate is a full text database of all the Indian and foreign patents that have been granted to CSIR. A fifth volume containing database and full text of patents granted during the period 1976-1980 was released during the year. This completes the digitization of all the patents granted to CSIR from 1976 to 2000.

Anusandhan ([www.anusandhan.net](http://www.anusandhan.net)), a prototype of a science and technology portal that will act as a single window of information on Indian science and technology was developed. It covers the research activities of all the publicly funded R&D institutions funded by Central and State Governments as well as academic institutions. It is also proposed to cover privately funded industrial R&D units. The project is supported by DSIR.

Explorations ([www.csirexplorations.com](http://www.csirexplorations.com)) is prototype of a basic research portal that includes a digital library of Ph.D. theses of CSIR research fellows at national laboratories and other academic institutions. It will also include reports of extra mural projects supported by CSIR to universities and papers published by CSIR scientists.

## Patinformatics

The discipline of patinformatics encompasses patent intelligence, patent mapping and patent citation analysis with a view to carry out technology competition analysis, new venture evaluation, R&D management and product area surveillance. URDIP completed a number of studies in the area of drug delivery systems, fermentation



technologies, biotechnology, medicinal diagnostics and electronic materials. These studies were basically done for NMITLI projects.

## 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, about sixty such proposals were processed. Some of the clientele covering these proposals included DuPont, Procter and Gamble, Glaxo-Smith-Kline, D&O Pharmaceuticals, Daimler Chrysler, Fritz – Haber Institute (Germany) etc.

# Human Resource Development Group (HRDG)

## 3.5 HUMAN RESOURCE DEVELOPMENT GROUP (HRDG)

The HRDG has been contributing significantly to the development and nurturing of highly qualified S&T manpower at the national level in the age group of 16 to 65. It has the mandate to find new mechanisms to promote development of human resource in basic sciences. It also promotes, guides and co-ordinates scientific & industrial research through funding of research projects at the national level.

The Activities of the HRD Group include: Award of Shanti Swarup Bhatnagar Prizes (SSB); Young Scientist Awards (YSA); Selection of Junior Research Fellows (JRF) through National Eligibility Test (NET); Selection of Senior Research Fellows (SRF), SRF Extended and Research Associates (RA); Selection of Senior Research Associates (SRA); Funding of Extra Mural Research (EMR) schemes at universities/ R&D organizations; Visiting Associateship Scheme; Travel / Conference / Symposium grants; CSIR Program on Youth for Leadership in Science (CPYLS); Selection of Shyama Prasad Mukherjee Fellows (SPMF).

### Shanti Swarup Bhatnagar Prize and Young Scientist Award 2003

Thirteen (13) scientists were selected for SSB Prize during the year 2003 making a total of 388 awards till date. The awards were announced on 26th September 2003, the Foundation Day of CSIR. Six scientists were selected for the 2003 Young Scientist Awards. The Awards were presented on 26th September 2003 at the CSIR Diamond Jubilee celebration concluding function.

### Junior Research Fellowship (JRF)

CSIR conducts JRF-NET examination twice a year for the selection of Junior Research Fellows. 1,23,660 applications were received during the year 2003-04, out of which 91,025 candidates appeared for the examination. A total of 2711 candidates were selected for JRF and 2563 were declared eligible for lectureship.

### Shyama Prasad Mukherji Fellowship (SPMF)

The SPM Fellowship scheme was started in the year 2001-02 selected JRF-NET scholars, who qualify a written test especially designed for the purpose, followed by an interview. In the year 2003-04, six candidates were selected for the fellowship, two each in physics and chemistry and one each in life science and mathematics.

### Senior Research Fellowship (SRF), SRF Extended and Research Associateship (RA)

Applications are invited on all India basis for SRFs, SRF (Ext) and RAs. Selections are based on the interview through an Expert Selection Committee. During 2003-04 a total of 3235 applications were received in 15 disciplines of science and technology. A total of 437 candidates were selected in 15 disciplines of science & technology.

### Junior Research Fellowship for GATE qualified engineering graduates (JRF-GATE)

CSIR has introduced a new research fellowship in 2002 for the GATE qualified candidates with B.E., B.Tech, B.Arch, B.Pharm degree to pursue research leading to Ph.D. This is known as the GATE qualified Junior Research Fellowship (JRF-GATE). JRFs selected under this scheme get excellent opportunity to work with the CSIR scientists with state-of-art R&D facility and obtain Ph.D. degree. The fellowships under this scheme are tenable only at CSIR laboratories. Each laboratory can have 10 JRF-GATE fellows except for engineering

laboratories, which can have a maximum of 15 fellows. Around 120 JRF-GATE Fellows are working in different laboratories of CSIR in the year 2003-04.

#### Senior Research Associateship (SRA)

The Senior Research Associateship (SRA) is primarily meant to provide temporary placement to highly qualified Indian scientists, engineers, technologists, and medical personnel returning from foreign countries and also to those who are not in regular employment in the country. The data of the last three years of the scheme is presented below

#### Senior Research Associateship (SRA)

Year	No of SRA Selected	No. of SRA Joined
2001-02	134	94
2002-03	134	93
2003-04	82	88

#### Extra Mural Research Schemes and Special Support Programs

CSIR promotes research in Science and Technology including Agriculture, Engineering and Medicine through award of research grants to Professors/ Scientists in regular employment in Universities/ Academic Institutes/ IITs etc. The number of research schemes recommended during the year alongwith the last two years is given below:

#### Extra Mural Research Schemes and Special Support Programs

Year	No of Proposals received	Recommended
2001-02	500	220
2002-03	555	223
2003-04	576	179

Under the Emeritus Scientists scheme, financial assistance was provided to 23 outstanding superannuated scientists out of a total of 137 proposals received and 97 renewals were made during the year. In the sponsored scheme category 12 schemes were sanctioned out of the 24 proposals received and 37 ongoing schemes were renewed. Under the one time grant category, out of 19 proposals received 2 were granted.

#### Travel / Conference Grants

Travel grant is provided by CSIR to young researchers for presenting research papers at the International Conferences held abroad. The travel grant committee considered a total of 678 applications out of which 380 cases were recommended. The same committee considered 532 proposals from scientific societies/ institutes etc for organizing national / international conference/ symposium/ workshops, etc. and recommended 468 cases for organizing these events.

## CSIR Program on Youth for Leadership in Science (CPYLS)

The CPYLS scheme is a unique 'hand holding' program started for school children at secondary level. The scheme was started to attract the meritorious young school children towards science. About 150 students are invited from each state to participate in two open days program at CSIR Labs. About 1000 students have participated in the two open days programme organized by most of the CSIR Laboratories.

## NEW HRD INITIATIVES:

### ***CSIR Diamond Jubilee Research Interns Award Scheme***

The CSIR Diamond Jubilee Research Interns Award Scheme was announced by Hon'ble Minister for Science and Technology on the occasion of Diamond Jubilee Celebrations of CSIR on 26th September 2002. It is a preparative scheme through which young interns shall be trained in the tools, techniques and art of research under the supervision of experienced scientists in CSIR. The scheme has taken off and some of the labs have already taken interns. Amongst the 17 labs including Headquarters, which responded to our query, a total of 102 candidates have joined in 8 laboratories.

### ***Entrepreneurship support to Research Scholars***

The objective of this program is to broad base the perspective of the research scholars so that they can make linkages of their scientific and technical knowledge to the buoyant world of business and industry and thus over a period of time become effective wealth creators for their organizations and the nation.

The first training program was organized (as a pilot exercise) at NCL, Pune from 28th March to 29th April 2004. About 19 research scholars participated in the month long exercise.

# Human Resource Development Centre (HRDC)

## **3.6 HUMAN RESOURCE DEVELOPMENT CENTER (HRDC)**

The modern Training cum Residential infrastructural facilities of Human Resource Development Center is fast coming up at Ghaziabad in the campus of erstwhile SERC. The facilities are likely to be operationalized by middle of next year 2004-05. In the meantime, the Centre has commenced off campus training programmes for CSIR staff at the sister CSIR laboratories. The Center is organizing programmes in accordance with its mandate decided by Governing Body, of offering regular structured and customized training and skills upgradation programmes in the broad areas of management of R&D, intellectual property, material procurement & storage, business development and supporting functions besides personal skills upgradation programmes such as leadership, team building, communication, presentation etc. The Centre designed the programme modules & the contents thereof based on the training needs assessed internally and out sourced the faculty/experts for the same.

The Centre, during the year 2003-04, has conducted more than 20 training programmes for different categories of CSIR staff viz. scientific & technical, administrative, finance and purchase staff. The Centre has also initiated a pilot study to assess the training needs. The results of the pilot study will be extended globally to CSIR.

One of the major initiatives by the Centre during the year has been on ISO accreditation of laboratories in a bid towards quality improvement & transparency in working. The Centre conducted two training programmes on general awareness on ISO accreditation for the laboratories that has not yet acquired it and for the various divisions of the Headquarters. A number of these laboratories participated in the programmes. Some of these laboratories have since then initiated actions for acquiring ISO accreditation.

## Recruitment & Assessment Board (RAB)

### **3.7 RECRUITMENT & ASSESSMENT BOARD (RAB)**

The mandate for RAB is to carry out recruitment and assessments of all Gr. IV scientists as per "CSIR Scientists Recruitment & Assessment Promotion Rules - 2001". While assessment promotion interviews are conducted centrally following a suitably structured standardized framework, recruitments are made jointly by the Board and the respective labs, adequately ensuring uniformity in the process. The Board maintains a panel of Co-chairpersons approved by VP, CSIR and a pool of Departmental Core Members approved by DG, CSIR. They are appropriately briefed and trained as per the provisions of the new Rule and after having optimally scheduled various assessment committees at different locations, assessment promotion interviews are conducted by the Board.

During the period 2003-04 the Board carried out assessments of about 750 scientists at 15 locations, by engaging 16 Co-chairpersons, 43 Departmental Core Members and approximately 600 external experts.

The Board also handled recruitment in nineteen labs for the positions of nearly 300 scientists at different levels.

# Unit for Science Dissemination (USD)

## 3.8 UNIT FOR SCIENCE DISSEMINATION

The Unit for Science Dissemination is fully responsible for furthering favourable public image of CSIR as a whole. The unit is the hub center for the large number of activities aimed at creating Brand CSIR during the CSIR Diamond Jubilee year. Effective media relations helped in furthering result-oriented relationship with the key press persons covering science in their respective dailies. Several features/ stories were published with the support of inputs provided by this Unit. Press coverage was successfully organized during important CSIR events. This support was also extended to the other CSIR labs. Press releases were prepared and disseminated on several occasions and their coverage monitored for effectiveness. The Unit also co-ordinated in publishing of corporate advertisements in the nationwide media for the entire Ministry of Science & Technology and Department of Ocean Development and released four special advertisement campaigns exclusively on CSIR events. The Unit successfully coordinated the preparation of a film on the concluding function of the CSIR Diamond Jubilee. A large number of copies of this film were made for wider dissemination. The Unit also catalysed short films on CSIR technologies for Turning Point Programme on Doordarshan.

CSIR participated in the various national/international exhibitions and other related events with two main objectives: Creating awareness about CSIR and its achievements, and supporting its business development efforts. The Unit organized CSIR pavilion in the following events: Technology Pavilion, India International Trade Fair, ITPO, New Delhi (Won an Award); National Technology Day, DST, Delhi; Pharma Expo, 2003, FICCI, Chennai; Infra Education 2003, FePP, Delhi; Indian Science Congress, 2004, MMAActive, Chandigarh; NEARID, CARD, Guwahati; Swadeshi Vigyan Mela; Swadeshi Jagaran, Allahabad; First Nutraceuticals Summit, MMAActive, Mumbai; India Composites 2003, nCT, Hyderabad; Global Advances in Tea Science, ISTS, Kolkatta: The Unit also participated in the international exhibition in Beijing, as a part of the TEDO pavilion organized by CII and DSIR.

The CSIR Diamond Jubilee Exhibition was organized across the country, on the directions of the Hon'ble Minister of Science & Technology. During the year, the Diamond Jubilee Exhibition was organized in about 48 places. Special efforts were made to organize publicity at the local level everywhere to ensure maximum participation of the local people. Shri KC Pant, Dy Chairman, Planning Commission inaugurated the final display of this exhibition, organized on concluding function of CSIR Diamond Jubilee

CSIR Participation in Vigyan Rail Exhibition: This Unit coordinated at the central level, the display of CSIR show case in the Vigyan Rail Exhibition coordinated by the DST. A large number of displays including models and audiovisual presentation were fabricated and displayed aesthetically for effective dissemination to the visitors at 56 railway stations across the nation

# Dateline CSIR

## 4.0 DATELINE CSIR

### 4.0 DATELINE CSIR

<b>April,2003</b>	
10th	<p>Meeting of the CSIR Society was held. Hon'ble Prime Minister and President, CSIR Shri Atal Bihari Vajpayee presided over the meeting. Prof. Murli Manohar Joshi, Hon'ble Union Minister of HRD, S&amp;T and Ocean Development and Vice President, CSIR and distinguished members of the Society also graced the occasion.</p> <p>157th meeting of GB was held. It approved the financial support for establishment of a Centre of Interdisciplinary Studies in Biomedical &amp; Social sciences for the study of brain, psychological processes and human behaviour to be set up at SGPGI, Lucknow; CCEA approval for guidelines for NMITLI scheme, TFYP proposals under the ongoing schemes 'National Laboratories'.</p>
17th	<p>Prof. M. K. Chandrashekar, AstraZeneca Professor &amp; Chairman, Evolutionary &amp; Organization Biology. JCAR, Bangalore delivered the CSIR Diamond Jubilee Lecture on "Biological Clocks in Bats, Mice and Humans" at CDRI</p>
22nd	<p>CFRI celebrated its foundation day. Dr. H.S. Maiti, Director, CGCRI delivered lecture on "Fuel Cell- an ecofriendly power generating device". Prof. B.B. Bhattacharya, Director, ISM also graced the occasion.</p>
23rd	<p>Third CEERI Golden Jubilee lecture was delivered by Prof. Ashok Chandra, Chairman, ECIL on 'Technology Imperatives of socio-economic development.'</p>
29th-May 3rd	<p>CSIR Diamond Jubilee exhibition was organized at Guwahati by RRL-Jorhat and was inaugurated by Dr. P. C. Choudhury, Member, APSC, Govt of Assam.</p>
<b>May, 2003</b>	
3rd	<p>PLHOSTFA, the first bio-informatics software developed by IGIB was launched by DG,CSIR. Three copies of the academic version have been licensed to educational organizations in India. The marketing rights have been assigned to M/S Jalaja Technologies, Hyderabad.</p>
9th	<p>CSIO-Industry Get-Together was organized to commemorate the Silver Jubilee Year of the Die &amp; Mould Making Section of Indo-Swiss Training Centre of CSIO. Prof. D.N. Tiwari, Member, Planning Commission was the chief guest.</p>
9th-13th	<p>CSIR Diamond Jubilee exhibition was organized at Shillong by RRL-Jorhat and was inaugurated by Mr Mukul Sangma, Minister of Information Technology, Govt of Meghalaya.</p>
10th	<p>CMRI celebrated its 48th foundation day in a befitting manner. The Chief Guest Shri Rabindra Sharma, DG, DGMS, Dhanbad delivered the foundation day lecture entitled 'Safety in Beach Placer Mining'.</p>



11th	<p>CSIR constituent laboratories celebrated National Technology Day:</p> <p>CDRI: Dr. V.P. Kamboj, Ex. Director, CDRI, delivered lecture on “Excitement in Life Sciences”.</p> <p>CIMAP: Four special awards ‘Sathi’, ‘Udyami’, ‘Khoj’ and ‘Unnati’ were presented to 15 farmers for outstanding contribution in the cultivation and processing of medicinal and aromatic plants. Several school children visited various laboratories.</p> <p>CSIO: Prof. Roddam Narasimha, FRS, Director, National Institute of Advanced Studies, Bangalore delivered a lecture entitled ‘The Soaring Promise of Indian Aerospace’.</p> <p>IICB: A seminar on ‘Industry-Institute Synergy: a requirement for global technology challenge’ was organized.</p> <p>IIP: Dr. Debabrata Ray, Executive Director-Head, KDMIPE, ONGC, Dehradun, delivered a Lecture entitled ‘Oil Exploration by ONGC, Role of Institutes and Technical Advancement’. A Seminar on ‘Increasing Road Accidents: Causes and Remedies’, was jointly organized with Technocrat Welfare Society of India (TWSI). Hon’ble Minister for Transport, Technical Education, Labour &amp; Employment, Planning &amp; Training, Uttaranchal State, Mr. Hira Singh Bisht, was the chief guest.</p> <p>NAL: HANSA-3 (VT-HNW) aircraft handed over to Trivandrum Flying Club through DGCA.</p> <p>NCL: Prof. M.S. Swaminathan, FRS, UNESCO Cousteau Chair in Ecotechnology &amp; Chairman, M.S. Swaminathan Research Foundation delivered the Prof. B.D. Tilak memorial lecture entitled ‘Science and sustained agriculture progress.’</p> <p>&gt;RRL, Jammu: launched Maa Shakti Project under Ministry of HRD scheme of support to training and employment programme for women in collaboration with J&amp;K Ex-service League.</p>
13th-17th	<p>CSIR Diamond Jubilee Exhibition was organized at University of Jammu. Prof. A.R. Kidwai, Hon’ble MP inaugurated the event.</p>
20th	<p>Fifth CEERI Golden Jubilee Lecture was delivered by Dr. Anil Kakodkar, Chairman, Atomic Energy Commission and Secretary, Department of Atomic Energy, on ‘National Energy Security: A Nuclear Perspective and Related Issues’.</p>
21st- 25th	<p>CSIR Diamond Jubilee Exhibition was organised at RRL, Branch Laboratory Srinagar. Prof. Anwar Alam, V C, SUKAST inaugurated the event.</p>
22nd-26th	<p>CSIR Diamond Jubilee exhibition was organized at Agartala, Tripura by RRL-Jorhat and was inaugurated by Sri Manik Sarkar, Chief Minister of Tripura.</p>
26th	<p>Commonwealth West African Education Delegation consisting of ten delegates from Nigeria and Ghana visited NISCAIR for the inauguration of the Regional Seminar, and for the invited lecture from Director, NISCAIR on “Innovation scouting and protection mechanisms for traditional knowledge” and for the live demonstration to TKDL.</p>

28th-29th	A two-day Hindi workshop was organized by CFRI. Shri Shrinath Singh, BCCL, Dhanbad, Shailabh and G.K. Prasad delivered the lectures.
<b>June, 2003</b>	
2nd	Prof. P. Ramachandra Rao, Vice-Chancellor, Banaras Hindu University, Varanasi, delivered sixth CEERI Golden Jubilee Lecture on 'Bio-mimetics'.
2nd-5th	First National Conference of Botanic Gardens of India was held at NBRI. More than 30 delegates attended the Conference from all over the country.
4th-6th	CSIR Diamond Jubilee exhibition was organized at Aizwal, Mizoram by RRL-Jorhat and was inaugurated by Sri Zoramthangsa, Chief Minister of Mizoram.
5th	World Environment Day was celebrated at NEERI. Dr. D.N. Tewari, Member, Planning Commission, Govt. of India, delivered a lecture on 'Biofuel Mission, Bamboo Mission and Herbal Medicine Mission'.
10th	One day NBRI Golden Jubilee conference on 'Control and regulation of ground water extraction' was organized in collaboration with UP Ground Water Officers' Association to celebrate the Ground Water Day. Notable water activist and Magasaysay award winner Shri Rajendra Singh was the chief guest. Padamshri Dr. S.C. Roy, Mayor of Lucknow chaired the concluding session.
14th	The Apex Committee of CSIR on 'Biomolecules' met at IHBT to review of the progress of the project.
17th-21st	CSIR Diamond Jubilee exhibition was organized at Imphal, Manipur by RRL-Jorhat and was inaugurated by Sri Ibobi Singh, Chief Minister of Manipur.
18th	His Excellency Hon'ble Prime Minister of Lao People's Democratic Republic Sri. Bonnhang Vorachit visited CCMB.
26th	His Excellency Hon'ble Dr. A. P. J. Abdul Kalam, President of India visited RRL, Jammu. In his honour a drought resistant variety of an aromatic grass developed at the laboratory was named as 'Kalam'. Dr. R. A. Mashelkar, DG, CSIR. inaugurated the New Pharmacology Laboratory at RRL, Jammu.
27th	Parliamentary Standing Committee on Science & Technology and Environment & Forests visited IIP.  Work Automation Management System ( WAMS) was formally launched in RRL, Jammu by Dr. R. A. Mashelkar, D G, CSIR. He also inaugurated the new building of Quality Control & Assurance Unit at the institute.
<b>July, 2003</b>	

3rd - 4th	A two-day International Conference entitled 'Quantitative Approaches in Mineral Processing' was organized by RRL, Bhubaneswar.
3rd - 5th	First zonal match of Shanti Swarup Bhatnagar Memorial Tournament (Indoor) was organized by IHBT.
3rd-6th	CSIR Diamond Jubilee exhibition was organized at Naharlagun, Arunachal Pradesh by RRL-Jorhat and was inaugurated by Sri Mukut Mithi, Chief Minister of Arunachal Pradesh.
9th	Seventh CEERI Golden Jubilee Lecture was delivered by Prof. MM Sharma, Kothari Research Professor, Jawaharlal Nehru Centre for Advance Scientific Research, Bangalore, entitled 'Wonder World of Chemistry'.
10th-14th	CSIR Diamond Jubilee exhibition was organized at Kohima, Nagaland by RRL-Jorhat and was inaugurated by His Excellency Sri Shyamal Dutta, Governor of Nagaland.
16th	<p>Three-member team of Parliament Second Sub-committee on Official Language visited CFRI. The team was headed by Hon'ble MP, Shri Bal Kavi Bairagi and other members of the team were Hon'ble MPs, Shri Tilak Dhari Singh and Shri Kuwar Sarbraj Singh reviewed the progress of the Institute with regard to implementation programmes of official languages in day to day official work.</p> <p>158th meeting of GB,CSIR was held. It approved the CSIR Technology Awards-2003,institution of CSIR Diamond Jubilee Technology Award, amendment to foreign deputation guidelines, enhancement of SPM fellowship etc.</p>
22-25	Workshop on quality management of ayurvedic drugs.
24th-27th	CSIR Diamond Jubilee exhibition was organized at RRL Jorhat and was inaugurated by Sri Tarun Gogoi, Chief Minister of Assam
29th	His Excellency Yusuf Bin Alawi Abdullah, Foreign Affairs Minister of Sultanate of Oman and Prof. Waheed visited CCMB.
<b>August, 2003</b>	
4th	<p>Dr. John A Haines (Senior Special Fellow) United Nations Institute for Training and Research, MIE, Switzerland visited CCMB.</p> <p>Dr. Eugene Lottering, Executive Director, Innovation Fund, South Africa, Ms. Bhavini Kalan, Innovation Fund Manager and IP Policy &amp; Strategy Specialist, National Research Foundation, Department of Science and Technology, South Africa, Mr. Reinhardt Deysel, First Secretary, South African High Commission, New Delhi.</p>
5th	Curtain raiser for 'IICT Diamond Jubilee Celebrations' was held and released a Diamond Jubilee logo. Dr. Masami Inada, President, M/s Aisin Cosmos, Japan was the chief guest.

7th-8th	CSIR Diamond Jubilee Symposium on “Rasanya Drug Therapy” was organized at CDRI. Dr. G.V. Satyawati, Former DG-ICMR was the Keynote speaker and Dr. D.N. Tiwari, Member, Planning Commission has delivered the valedictory address.
11th	<p>CIMAP celebrated Silver Jubilee day. His Excellency Hon’ble Dr APJ Abdul Kalam, President of India graced the function. Hon’ble Governor of Uttar Pradesh Shri Vishnu Kant Shastri, the then Chief Minister of Uttar Pradesh Ms Mayawati and Lucknow Mayor Dr. SC Rai also adorned the function. Hon’ble President visited exhibition and interacted with children and research scholars. He lauded the efforts of CIMAP. His message contained a clear advice on shaping into a Centre of Excellence for integrated herbal products. Dr. Kalam released various CIMAP publications and CD on the occasion.</p> <p>A delegation from Tehran Dr. Nasser Naghdi, MD, Iran Pharmaceutical Development &amp; Investment Co., Shri. Monir Sadar Haerian QC Expert, Min. of Health and Medical Education, Tehran and team visited CCMB.</p>
11th – 13th	CFTRI, Mysore and IMTECH, Chandigarh jointly organized a three-day International Workshop on Biosensors, under the auspices of the Indo-Swiss Collaboration Programme on Biotechnology, a synergy programme supported by Department of Biotechnology, New Delhi; and the SDC, Switzerland, and involving the E’Cole Federale de Lousanne, Lousanne, Switzerland.
15th –17th	Second zonal match of Shanti Swarup Bhatnagar Memorial Tournament (Indoor) was organized at CSMCRI.
19th	Prof. Goverdhan Mehta, Director, Indian Institute of Science, Bangalore delivered the second Prof. K. Venkataraman Memorial Lecture on “Design of new molecular objects: art & logic in organic synthesis”.
28-29	National conference on biological treatment on wastewater and waste air
<b>September, 2003</b>	
12th-14th	Third zonal match of Shanti Swarup Bhatnagar Memorial Tournament (Indoor) was organized at RRL, Bhubaneswar.
15th-30th	<p>Hindi Pakhwara was celebrated by several laboratories.</p> <p>NCL released a Hindi annual bulletin NCL-Aloj.</p>
17th-19th	CSIR Diamond Jubilee exhibition was organized at Gangtok, Sikkim by RRL-Jorhat and was inaugurated by Sri D D Bhutia, Minister of Science & Technology, Health, Family Welfare and Cultural Development, Govt of Sikkim.
19th-20th	IICT in collaboration with IGNA, Hyderabad organized an inter- national seminar entitled ‘ Global scenario of Herbal Medicine’.

20th-22nd	CEERI celebrated its Golden Jubilee Foundation Day. Prof. N. Balakrishnan, IISc., Bangalore delivered lecture on 'Trends in Information and Communication Technology'.
21st	Dr. R.A.Mashelkar, DG,CSIR launched the 'IICT Diamond Jubilee Initiatives' Prof. R. Kumar, RC Chairman, IICT presided.
21st-23rd	Fourth zonal match of Shanti Swarup Bhatnagar Memorial Tournament (Indoor) was organized at NGRI.
26th	<p>CSIR Foundation Day- Diamond Jubilee concluding function. Shri Bachi Singh Rawat, Hon'ble Minister of State for Science &amp; Technology presented the 2003 CSIR Young Scientist Awards, CSIR Technology Awards. Bhatnagar Awards were announced. Shri K.C. Pant, Deputy Chairman, Planning Commission was the Chief Guest. The unique feature of the function was the felicitation of former Directors Generals. The day was celebrated with great enthusiasm. Some important events in the laboratories were:</p> <p>CCMB: Open Day was observed wherein 8247 visitors including students visited.</p> <p>IHBT: Prof. R. Kumar, Fellow, IISc delivered a lecture entitled 'Future Evolution of Ayurvedic Products'. Shri Rajesh Jain, MD, M/s. Panacea Biotec Ltd., presided over the function. Prof. R. Kumar also released a CD on the history of IHBT.</p> <p>RRL,Jammu: Prof. Amitabh Mattoo, VC, University of Jammu delivered a lecture on 'Science, Scientists and International relations'. He released Tawi-Rosa- a geraniol rich, drought resistant variety of Cymbopogon commutatus.</p> <p>CSIO : Dr. B.D. Gupta, Emeritus Professor, PGIMER, Chandigarh delivered a lecture on 'Technology Development in Health Care and Emergence of Nano Technology in Medical Practice.</p>
27th	Prof. S.K. Joshi, former DG,CSIR delivered CSIR foundation day lecture entitled 'CSIR: 60 Years Behind and 60 Years Ahead' at NCL.
<b>October, 2003</b>	
1st	The Parliament Standing Committee on S&T, Environment and Forests visited RRL, Bhopal. The hon'ble committee members were apprised of the ongoing activities. The members appreciated RRL's role in building materials, rural technology outreach & watershed management etc. Mrs. Margaret Alva, Hon'ble MP was the Chairperson of the Committee.
7th	Third Prof. J.W. McBain memorial lecture on 'Carbon nanotubes:paradigm for new science & technology' was delivered by Prof. Ajay Sood, IISc at NCL.
7th-9th	Three days International Seminar on Downsizing Technology for Rural Development (ISDTRD-2003) was held at RRL, Bhubaneswar.

8th-10th	CFTRI conducted 1st Nutraceutical Summit and Expo at Mumbai. Hon'ble. Minister of Health & Family Welfare Smt. Sushma Swaraj gave the inaugural address. The key note address was delivered by Dr. R.A. Mashelkar, DG,CSIR.
17th	H. E the President of Republic of South Africa Sri. Thabo Mbeki visited CCMB. He was apprised of the achievements of the laboratory.
21st	159th meeting of GB was held. It approved the revision of annual financial ceiling for reimbursement/ payment of subscription fees for becoming members of professional societies/ bodies; CSIR Diamond Jubilee Prize for in-house excellence in sports etc.
23rd	A CD containing a sample of 500 Ayurveda formulations was released by Hon'ble Minister of Science and Technology, Human Resource Development and Ocean Development, Prof. Murli Manohar Joshi in a function held at NISCAIR. Hon'ble Minister of Health and Family Welfare and Parliamentary Affairs, Smt. Sushma Swaraj presided over the function. Present on this occasion were Dr. R. A. Mashelkar, D,G CSIR, Mrs. Malti S. Sinha, the then Secretary, Department of AYUSH, Mrs. Shailaja Chandra, Chief Secretary, Delhi, besides other dignitaries.
29th	H.E Shri Kidar Nath Sahani, Governor of Goa, released a book titled" Sagar Bodh" at a function held at NIO. The book, fourth one in Hindi, published contains 25 articles on different aspects of ocean research such as advancements in gene research, bio-invasion, polymetallic nodules, gas hydrates-a new alternative source of hydrocarbon fuel and hydrothermal processes.
30th	First Engine run on SARAS aircraft at NAL.  CSIO celebrated its Foundation Day. Prof. R.S. Sirohi, Director, IIT-Delhi delivered a lecture on 'Technology and Nature'.
<b>November, 2003</b>	
3rd	NCL organised a one day international symposium on 'Recent Developments in Organic Chemistry'.
6th –7th	CSIR Programme on Youth for Leadership in Science (CPYLS) was organised by CSMCRI. Dr. Arun Dave, VC, Gujarat Vidyapeeth was the chief guest. Around 72 students participated.
11th –13th	Three days National Seminar on 'New Millennium Strategies for Quality, Safety and GMP's of Herbal Drugs Products' was organised by NBRI. Hon'ble Minister of State for Science and Technology Shri Bachhi Singh Rawat, inaugurated the seminar H.E Shri Vishnu Kant Shastri was the Chief Guest. More than 250 delegates from allover the country attended the seminar.  CPYLS: NCL being a coordinating laboratory to implement CSIR Programme on CPYLS in Maharashtra

	organised a two-day a counseling session and lectures. About 100 meritorious students accompanied with their teachers and parents participated in the programme.
11th-14 th	Four days Thacker Memorial Lawn Tennis Tournament was organized at CFTRI.
12th –14th	CGCRI organized three days Atma Ram Memorial Volleyball Tournament.
19th-20th	CSIR Programme on Youth for Leadership in Science (CPYLS) was organized at RRL Jorhat. Dr K V Raghavan, Former Director, IICT-Hyderabad was the Chief Guest. Around 51 students participated.
20th	A Mauritius delegation led by H.E. Prime Minister Shri Raymond Berenger visited NIO. He was apprised of NIO's programmes carried out in various areas of ocean research.  'The Cardium' the plush new auditorium of NIO inaugurated by H.E Shri Kidar Nath Sahani, Governor of Goa. Dr. RA Mashelkar, DG, CSIR delivered the inaugural lecture entitled "India on the March".
26th	CCMB celebrated its foundation day. Prof. William J Rutter – President, Synergenics, LLC, USA delivered the foundation day lecture.
27th–29th	A three-day National Conference on Radio Science in India (INCURSI – 2003) was held at NPL.
28th-30th	Final of Shanti Swarup Bhatnagar Memorial Tournament (Indoor) was organized at RRL, Trivandrum. DG,CSIR distributed the prizes to the winners.
<b>December, 2003</b>	
1st	RRL, Jammu celebrated its foundation day. Padma Vibhushan Prof. M. M. Sharma, FRS, Ex- Director, UICT, Mumbai delivered lecture entitled 'Symphony of Chemistry and Chemical Engineering for Pharmaceuticals'.
3rd	NAL successfully underwent ISO-9001-2000 quality systems Audit by Lyold's Register Quality Assurance (LRQA) and received certification.
5th-6th	IGIB organized a two day International Symposium on Genomics Analysis.
5th-8th	The fifth International Food Convention Meet-IFCON-2003 was organized by CFTRI in association with the Association of Food Scientists and Technologists (India) and Defence Food Research Laboratory. The meet was inaugurated by Prof. M.S. Swaminathan, Chairman, M.S. Swaminathan Research Foundation. A Food exhibition was inaugurated by Shri H. Vishwanath, Hon'ble Minister for Co-operation, Govt. of Karnataka. About 2000 delegates took part in the deliberations of the convention. Shri N.T. Shanmugam, Hon'ble Minister of State for Food Processing Industries delivered the valedictory address.  Four days Anusandhan Basket Ball Tournament was organized at NAL.

6th-7th	Chrysanthemum and Coleus show was organized by NBRI. 103 exhibitors participated in the show by sending 804 entries. In all 359 prizes besides 23 running challenge cups, shields and trophies were awarded. Prof. R.K. Pathak, Director, Central Institute for Sub Tropical Horticultural, Lucknow was the chief guest.
12th-14th	Nayudamma Memorial Cricket Tournament was held at IICT. Shri C.V. Anand,IPS, President HCA was the chief guest.
15th-18th	RRL, Bhopal organized an International Conference on Water and Environment in collaboration with US Army Standardization Group, London; ACC Limited, India; University of Western Sydney, Australia and Louisiana State University, USA.
18th	The 1st Indian International Conference on Artificial Intelligence held at IICT.
19th-22nd	Four days Indian Chemical Engineering Congress-2003 (CHEMCON-2003) was organized at RRL, Bhubaneswar.
22nd-23rd	Conference-cum-Exposition on "Leadership in Pharma R&D: Co-operation, collaboration and capitalization of synergy" was organized at CDRI.
27th-28th	NCL organized 69th Anniversary of Indian National Science Academy (INSA). Dr R.A. Mashelkar, DG, CSIR launched e-Journal portal of the INSA.
<b>January, 2004</b>	
3rd	Hon'ble Prime Minister and President, CSIR Shri Atal Bihari Vajpayee lauds CSIR by securing, under Patents Co-operation Treaty, No. 1 position as highest filer of patents from all developing countries on the occasion of 91st session of Indian Science Congress.  A mega-event 'Science for School Children' was organized by IMTECH concurrent with the 91st Session of the Indian Science Congress.
3rd –7th	IMTECH in association with Punjab University, Chandigarh hosted the 91st session of the Indian Science Congress. Hon'ble Union Minister for Human Resource Development Dr. Murli Manohar Joshi, inaugurated the Congress.
5th	Hon'ble President of India Dr. A.P.J. Abdul Kalam addressed the scientists attending the Congress and called upon them to work towards realising his dream of making India a developed nation by 2020.
5th –7th	Third international symposium on recent trends in photochemical sciences
8th –10th	Workshop on "Flow cytometry: Applications in drug development" was organized at CDRI.  NCL hosted the XXXIII National Seminar on Crystallography. Professor Hartmut Michel, Nobel Laureate,



	Max-Planck Institute for Biophysik, Germany delivered the keynote address entitled "Crystallization and Structure Determination of Membrane Proteins: Routes and Achievements".
9th	Hon'ble Union Minister for Human Resource Development, Science & Technology and Ocean Development Prof. Murli Manohar Joshi visited CFTRI to dedicate the National Codex Food Laboratory to the Nation.
10th	CFTRI signed an MoU on Traditional foods with Academy of Sanskrit Research (Melkote) in the presence of Prof. Murli Manohar Joshi, Hon'ble Union Minister for Human Resource Development, Science & Technology and Ocean Development and Shri T.N. Chaturvedi, Hon'ble Governor of Karnataka.
15th-16th	NML organized a two day programme on CPYLS. Around 50 students and their teachers from Bihar and Jharkhand participated.
16th	Visit to CRRRI of Parliamentary Rajbhasha Committee - second sub-meeting held at Sanchar Sadan, CGO Complex, New Delhi.
16th-18th	IICB participated in the International Seminar 'Life, mind and consciousness' in the Ramakrishan Mission Institute of Culture. Prof. M.M. Joshi, Hon'ble Union Minister of HRD, S&T and Ocean Development was the chief guest.
17th-18th	NBRI organized annual rose and gladiolus show. 56 exhibitors participated by sending 593 entries. In all 294 prizes beside 25 running challenge cups, shields and trophies were awarded.
20th	Prof. Vingron, from Max Planck Institute for Molecular Genetics, Berlin, Germany visited IGIB. He was apprised of the achievements of the laboratory.
27th	Prof. Philip Cohen, FRS, FRSE, Director of Medical Research Council, Wellcome Trust Biocentre and School of Life Sciences, University of Dundee, Scotland (UK) delivered a talk on 'Kinase inhibitors: Drugs for 21st Century' at NCL.
29th	CIMAP organised 'Harit-CIM-Utsav' with Kisan Mela. More than 1200 farmers and entrepreneurs from different parts of UP, Uttaranchal and other states participated in the Mela. The participants were apprised of the latest varieties, technologies of MAPs besides quality control measures and marketing. Hon'ble Governor of UP Acharya Vishnu Kant Shastri inaugurated 'Manav Upvan' based on the concept of 'green intellectual wealth' Mayor Shri S.C. Rai delivered a lecture on 'Harit Utsav'.
<b>February, 2004</b>	
4th	160th meeting of GB was held. It took up the issues of extension of benefit of assessment promotion to S&T staff who left CSIR service to join new organization, financial assistance from CSIR welfare fund for meeting medical expenses for treatment of major diseases in private recognized hospitals etc.

11th	Hon'ble State Minister for Science & Technology, Shri Bachi Singh Rawat visited SERC. The Hon'ble Minister appreciated the contributions of SERC to the national economy and development through its high quality R&D and industry interaction projects.
12th	National Seminar on Membrane Science & Technology :Challenges and Opportunities was organized by RRL, Jorhat.
13th	President of India, His Excellency, Dr.A.P.J Abdul Kalam visited NML.
14th	Meeting of Himalayan Phytochemical and Grower Association (HIMPA) was held at IHBT. The meet was inaugurated by Shri B.B.L Butail, Hon'ble Minister for Revenue,H.P. About 30 participants attended the programme.
17th	CDRI celebrated its foundation day. The 29th Mellanby Memorial Lecture was delivered by Dr.G. Mehta, Director, I.I.Sc., Bangalore.  Professor Frederick J. Krambeck, Johns Hopkins University, Whiting School of Engineering, USA delivered Prof. L.K. Doraiswamy (former Director of NCL) Lecture in Chemical Engineering on "Glycosylation Reaction Kinetics" at NCL.
19th-21st	A three days International seminar on `Mineral Processing Technology was organized at RRL, Bhubaneswar.
25th-26th	NIO in collaboration with International Water Association, UK, organised a two day International Workshop on "Marine Pollution and Ecotoxicology". Over 80 researchers from India and abroad participated. Dr. Robin Sen Gupta, former Dy. Director, NIO inaugurated the workshop. Dr. Lee R. Shugart, Editor-in-chief, Ecotoxicology, USA, was the Guest of Honour.
27th	CRRI in association with Institute for Road Traffic Education (IRTE) and World Road Safety Network (WRSN) organized a workshop on "Accident Investigation and Analysis for Road Safety Engineering Solutions" - Peter ter Meulen and Shri Erik Donkers from WRSN made the presentations.
28th	CSIR laboratories observed the National Science Day in commemoration of the outstanding discovery of Raman Effect by Nobel Laureate Sir (Prof) C.V. Raman.  CFRI: A lecture was delivered by Dr. Ashish Sarkar, ISM on `FLYASH:Waste of Wealth'.  CIMAP: Opened to all sections of the society. Dr. P.K. Seth, CEO, Biotech Park, Lucknow delivered a lecture on `Biotech Park Lucknow-the Science Hub of the Region.'  CSIO: Prof. Y.S. Rajan, VC, Punjab Technical University and Scientific Adviser to Govt. of Punjab delivered a lecture entitled `Science, Economics and Value Systems.'  NCL: A lecture was delivered by Prof. Ashoke Sen, FRS, Harish Chandra Institute, Allahabad on `Search for a Unified Theory'. About 150 posters were displayed by the research students.

<b>March, 2004</b>	
4th	A delegation comprising Prof. Peter I Folb and Dr Niresh Bhagwandin from the Technology and Business Development Directorate of the Medical Research Council (MRC), South Africa, visited NISCAIR, to explore the possibility of a collaborative initiative in the areas of mutual interest of the two organizations.
5th	Ms.Elizabeth V Cardoza, Assistant Director General, Legal Policy and International Affairs Group, IPOS visited the TKDL Project to discuss the potential for collaboration in the areas of (i) patent examination and searches (ii) use of TKDL database by IPO, Singapore under the usual non-disclosure agreement clauses and (iii) training of persons from Singapore in the IPR-related activities.
8th –10th	International conference on `Woman in science: is the glass ceiling disappearing' was organised by NISTADS.
10th	NCL observed National Safety Day. A special talk by Dr. T. Rajagopal, Corporate Medical Adviser, Hindustan Lever Ltd on `Occupational health, safety & environment management in a chemical laboratory was organized.
11th	Prof Wolfgang F. Holderich, Director, Chemical Technology and Heterogeneous Catalysis, University of Technology, RWTH Aachen, Germany delivered the first Dow Endowment lecture in honour of Dr Paul Ratnasamy, former Director of NCL. Prof. Holderich spoke on "New Heterogeneously Catalyzed Processes for Environmentally Benign and Sustainable Chemical Production".
15th	161st meeting of GB was held. The GB in its meeting deliberated on several crucial subjects and gave directions on merger of New Research Initiatives in Energy with NMITLI scheme; modification in terms and conditions of Bhatnagar Fellowship Award Scheme and continuation of the scheme for engagement of consultants for Business Development.
30th	A Colloquium on Plant proteins and National Nutrition Security was organized by CFTRI in association with Solae Company, India. Prof. MS Swaminathan, Chairman, MSSRF, Chennai delivered the keynote address.

# Intellectual Property from CSIR

## ANNEXURE-I

### INTELLECTUAL PROPERTY FROM CSIR DURING 2003-04

ANNEXURE-I					
Lab	Patents			Copyrights	
	India		Foreign		
	Filed	Granted	Filed	Granted	Filed
CBRI	-	1	-	-	-
CCMB	3	1	6	1	-
CDRI	15	7	14	5	-
CECRI	12	16	-	-	-
CEERI	-	2	-	-	-
CFRI	2	3	18	4	-
CFTRI	104	29	66	13	-
CGCRI	14	8	8	3	-
CIMAP	11	7	10	29	-
CLRI	20	7	12	3	-
CMERI	4	2	-	-	2
CMRI	9	14	-	1	3
CRRI	2	1	-	-	-
CSIO	6	-	18	2	-
CSIR(SCH)	13	6	12	6	-
CSMCRI	15	4	25	2	-

IGIB	7	4	22	8	1
IHBT	4	-	8	21	-
IICB	6	4	11	5	-
IICT	17	24	58	39	-
IIP	11	20	2	3	-
IMT	4	2	7	4	8
ITRC	1	2	-	-	-
NAL	4	1	1	-	1
NBRI	7	-	20	3	-
NCL	59	53	111	19	-
NEERI	1	9	2	-	2
NGRI	-	-	-	1	-
NIO	9	-	34	12	-
NML	12	6	2	2	1
NPL	4	4	-	5	-
RRL (Bhu)	9	5	2	-	-
RRL (Bp)	0	1	-	-	-
RRL (Jm)	10	3	8	12	-
RRL (Jt)	4	24	1	-	-
RRL (Tvm)	7	3	18	9	-
SERC (G)	-	1	-	-	-

SERC (M)	-	1	-	-	-
HRDG	-	-	-	-	1
Total	406	275	495	212	19

# Foreign Patents Granted

## ANNEXURE-IA

### FOREIGN PATENTS GRANTED – 2003-04

ANNEXURE-IA		
CDRI Method of treating hyperlipidemic and hyperglycemic conditions in mammals using pregnadienols and pregnadienones	Pratap Ram Gupta, Ram Chandra, Chander Ramesh Khanna, Ashok Kumar Srivastava, Arvind Kumar Raina, Deepak Singh, Satyavan Srivastava, Savita Rastogi, Anil Kumar Asthana, Omkar Prasad, Nityanand Swarn, Anand; Nitya; Ghatak; Ashim; Kapoor; Narinder Kumar; Dev; Sukh	US 6579862
A process for the synthesis of 1-[4-aryl]piperazin-1-yl]-3-[2-oxopyrrolidin/piperidin-1-yl] propanes used as potential therapeutic agents for hypertension, ischemia, cardiovascular and other adrenergic receptors related disorders	Neelima Sinha, Sanjay Jain, Anil Kumar Saxena, Nitya Anand, Ram Mohan Saxena, Mangal Prasad Dubey, Gyanendra Kumar Patnaik	AU 762684
A process for the synthesis of 1- [4-aryl]piperazin -1-yl]-3- [2-oxopiperidin -1-yl] propanes from 1-[4-aryl]piperazin-1-yl]-3-chloropropane and 2-piperidone useful as potential hypotensive agents	Neelima Sinha, Sanjay Jain, Anil Kumar Saxena, Nitya Anand, Ram Mohan Saxena, Mangal Prasad Dubey, Madhur Ray, Gyanendra K. Patnaik, Deceased	AU 755526
Process for the preparation of diaryl naphthyl methanes	Neeta Srivastava, Arvinder Grover	US 6610705
CDRI+CIMAP Intramuscular formulation of an antimalarial dihydroartemisinin for the control of multidrug resistant and severe complicated malaria	Dharam Chand Jain, Rajendra Singh Bhakuni, Ram Prakash Sharma, Sushil Kumar, Guru Prakash Dutta	AU 763680
CFRI A process for the production of low ash fuel using calcined petroleum coke and low ash fuel prepared thereby	Paras Nath Sinha, Partha Sengupta, Kali Sankar Bhattacharya	FR 2822840
Process for the production of fly ash slurry	Sukuru Ramakrishna Rao, Swapan Kumar Ghosh, Sibendra Kumar Basu, Barun Kumar Mall, Shreekanth Verma, Gulab Singh, Satinath Mazumdar	US

		6702890
Process for the upgradation of the petroleum residue	Suhas Ranjan Gun, Priya Bandhu Chowdhury, Kashi Nath Bhattacharya, Achinta Kumar Roy, Umanand Sharma, Swapan Kumar Ghosh, Awadhesh Kumar Sinha, Santosh Kumar Chanda, Sukumar Mandal, Sanjay Kumar Ray, Asit Kumar Das, Satish Makhija, Sobhan Ghosh, Akhilesh Kumar Bhatnagar	US 6540904
CFTRI Oligonucleotide primers for phosphotidyl inositol in bacillus cereus	BP Padmapriya, A Ramesh, A Chandrashekar, K Nireshwalia, MC Varadaraj	US 6713620
Process for preparation of protein-hydrolysate from milk protein	Bhagya Swamylingappa, Johny Joseph, Kowsalya Shankara Murthy, Vishweshwariah Prakash, Mysore Cheluvarya Shamanthaka Sastry, Tirumakudalu Chikkaraja Sindhu Kanya	US 6589574
A parotta of improved quality multi-layered parotta of specific physical and sensory characteristics and a method thereof.	Indrani Dasappa, Rajiv Jyotsna, Pichan Prabhasankar, Ragu Sai Manohar, Gandham Venkateswara Rao	LN 6694
Primers for identifying aflatoxinogenic aspergilli and an improved method thereof	Haravey Krishnan Manonmani, Arun Chandrashekar, Eddiya Rati Rao	US 6623932 B1
Cholesterol lowering structured lipids containing omega 3 polyunsaturated fatty acids and their process there of	Reena Rao, Kari Rao, Belur Ramaswamy Lokesh	US 6608223 B2
A process for the preservation of coconut sap (NEERA)	Ramalakshmi Kulathooran, Ramesh Nagarajao, Bashyam Raghavan, Vishweshwaraiah Prakash	LK 13037
An improved process for the production of oryzanol enriched fraction from rice brain oil soapstock	Tyakal Nanjundiah Indira, Rajendrakumar Suresh Barhate	LK 13039



A process for the preparation of colorant from oleoresin	Jarapla Pura Naik, Sathyagalam Ranganatha Desikacharya Sampathu, Madeneni Madhava Naidu, Halagur Bogegowda Sowbhagya	LK 13038
An improved process for preparation of proteolytic activity rich spice powder and its application for tenderization of meat	B Narayan, SN Manjabhatta, MN Subbanna, SP Zituji, NR Dittakavi	BD 1003855
CGCRI Process useful for making in-situ silicon carbide in the form of particulate, whiskers and fibres in an inorganic composite matrix	Kalyan Kumar Phani; Asok Kumar De, Nripati Ranjan Bose, Sankar Ghatak	US 6696514
A process for making porous ceramics for pressure filtration	SN Roy, S Bandyopadhyay, BP Ghosh, HS Maiti	TW 189596
Composition useful for making insitu silicon carbide whiskers and fibres	Kalyan Kumar Phani, Asok Kumar De, Nripti Ranjan Bose, Sankar Ghatak	US 6548586
CIMAP Peppermint plant named `pranjal`	Samresh Dwivedi, Maneesha Singh, Ajay Pratap Singh, Vandana Singh, Suman Preet Singh Khanuja, Ali Arif Naqvi, Sushil Kumar	US PP14090
Use of the root extract of <i>Vetiveria zizanioides</i> in curing fluoroquinolone and multi drug resistant bacterial infections	Suman Preet Singh Khanuja, Suchi Srivastava, Tiruppadiripuliyur Ranganathan Santha Kumar, Madan Mohan Gupta, Arvind Kumar Tripathy, Bahl Singh Monika; Raj Janak, Raj Kishori Lal, Mahendra Pandurang Darokar, Ajit Kumar Shasany, Sushil Kumar	US 6676974 B2
An improved process for the preparation of vasicine	SK Chattopadhyay, GD Bagchi, PD Dwivedi, s Srivastava	US 6676976
Method of treatment for fungal infections with a synergistic formulation of antifungal agents	Suman Preet Singh Khanuja, Puspalata Chatruvedi; Krishna Kumar Agarwal, Atique Ahmad, Tiruppadiripuliyur Ranganathan Santha Kumar, Mahendra Pandurang Darokar, Ajit Kumar Shasany, Jai Shankar Arya, Sushil Kumar	US 6660761

Mosquito repellent composition and process for preparation of the same	Dinesh Kumar, Yogendra Nath Shukla, Shikha Tiwari, Ravi Prakash Bansal, Sushil Kumar	PK 137725
Bio-reactor for enhancing the biomass yield of plant organs	Suchitra Banerjee, Arun Kumar Kukreja, Praveen Chandra Verma, Atul Prakash Kahol, Sushil Kumar	US 6589780
A novel formulation useful as nitrification and urease inhibitor	Dharani Dhar Patra, Usha Kiran, Mohammed Anwar, Sukhmal Chand, Sushil Kumar	BD 1003610
Development of a stable high ginsenoside yielding callus line of <i>Panax quinquefolium</i> (American ginseng) and a method for developing such stable high ginsenoside yielding callus line	Archana Mathur, Ajay Kumar Mathur, Girish Chandra Uniyal, Mahesh Paul, Rajendra Singh Sangawan	KO 0404314
Streptomyces strain with potential anti-microbial activity against phytopathogenic fungi	Mansoor Alam, Abdul Sattar, Sushil Kumar, Abdul Samad, Om Prakash Dhawan, Suman Preet Singh Khanuja, Ajit Kumar Shasany, Seema Singh, Poovappallivadakethil Viswanathan Nair Ajaya Kumar, Abdul Khaliq, Mohammad Zaim, Saba Shahabuddin, Mala Trivedi	US 6558940
'Dhawal', a high alkaloid producing periwinkle plant	Raghavendra Narayan Rao Kulkarni, Kuppusamy Baskaran, Ravoor Shankara Rao Chandrashekara, Suman Preet Singh Khanuja, Mahendra Panduranga Darokar, Ajit Kumar Shasany, Girish Chandra Uniyal, Madan Mohan Gupta, Sushil Kumar	US 6548746
Process for the production of a biologically active phenolic compound(+) catechin	Sunil Kumar Chattopadhyay, Suchitra Banerjee, Shipra Agarwal, Manish Kulshreshtha, Ram Prakash Sharma, Vijay Kumar Mehta, Sushil Kumar	US 6620599 B1
Mint plant named `sambhav`	Suman Preet Singh Khanuja, Ajit Kumar Shasany, Sunita Dhawan, Mahendra Pandurang Darokar, Sarita Satapathy, Tiruppadiripuliyur Ranganathan Santha Kumar, Dharmendra Saikia, Nirmal Kumar Patra, Janak Raj Bahl, Arun Kumar Tripathy, Sushil Kumar	US PP14538

A process for the preparation of novel biologically active synthetic molecule 4-(p-methoxyphenyl)- 2 -amino butane	Sunil Kumar Chattopadhyay, Koneeni Venkata Sashidhara, Vinayak Tripathi, Arun Kumar Tripathi, Veena Prajapati, Sushil Kumar	EP 1138666
Use of <i>Drosophila melanogaster</i> as a model for screening of psychostimulant plant materials	Abhay Sharma, Amaresh Pandey, Subhash Singh, Sushil Kumar	US 6617491
Rose scented geranium <i>Pelargonium graveolens</i> plant `safal`	Sushil Kumar, Ritika Gupta, Kakaraparthi Pandu Sastry, Suchitra Banerjee, Gopal Rao Mallavarapu, Ramesh; Srinivas Iyer ; Shasany; Ajit Kumar ; Darokar; Mahendra Pandurang, Suman Preet Singh Khanuja	US PP14400
A method for screening of central nervous system	Abhay Sharma, Sushil Kumar	US 6541193 B2
A process for the preparation of 4-aryl-2-butanols from <i>Taxus wallichina</i>	Sunil Kumar Chattopadhyay, Sushil Kumar, Ram Prakash Sharma	GB 2349881
Process for insecticidal formulation effective in controlling malarial vector, mosquitoes	Arun Kumar Tripathi, Veena Prajapati, Suman Preet Singh Khanuja	US 6623766 B1
Process for the induction of normal roots on nodes and internodes of stem segments without using hormone and/or chemical treatments in <i>Mentha</i> species	Rajender Singh Sangwan, Neelam Singh Sangwan, Sushil Kumar	US 6586248
Process for one pot conversion of artemisinin into artesunic acid.	Rajendra Singh Bhakuni, Atul Kahol Singh Prakash; Tarun, Singh, Suman Preet Khanuja	US 6677463
Single pot conversion of artemisinin into artemether	RS Bhakuni , T Singh, AP Kahol, A Tiwari, S Tandon, SPS Khanuja	US 6683193

Herbal disinfectant compositions	SPS Khanuja, MP Darokar, TRS Kumar, AK Shasany, KK Aggarwal, A Ahmed, P Chaturvedi, VK Gupta, A Krishna, AK Singh, JR Bahl, RP Bansal, D Kumar	BD 1003853
Use of phyllocladane diterpenoids for plant growth promotion and alleviation of growth retardant allelochemicals, and method therefor	Anil Kumar Singh, Guru Das Bagchi, Sarita Singh, Prem Dutt Dwivedi, Anil Kumar Gupta, Suman Preet Singh Khanuja	US 6673749
Process for isolating artemisinin from <i>Artemisia annua</i>	Sushil Kumar, Shiv Kumar Gupta, Digvijay Singh, Madan Mohan Gupta, Dharam Chand Jain, Atul Prakash Kahol, Suman Preet Singh Khanuja, Govind Ram	US 6685972
CLRI 2-dimentional stress relaxation testing	Sanjeevi Ramaswamy, Naresh Mandyam Deivasigamani, Arumugam Viswanathan, Somanathan Narayana Sasthri, Muthukrishnan Subramaniam, Kalaiarasu Krishnaswamy	GB GB2345970
Ecofriendly bio-process for leather processing	Palanisamy Rao Thanikaivelan, Jonnalagadda Raghava Nair, Unni Balachandran, Thirumalachari Ramasami	US 6708531
A device for excitation and detection of magnetic resonance	Chandrakumar Narayan	EP EP0797102 B1
CMRI An improved equipment for short wall mining useful for extraction of pillars in underground coal mines	S Maity, BB Dhar	EP 795680
CSIO Multi-fiber optic 2d-array device for sensing and localizing environment perturbation using speckle image processing	Harish Kumar Sardana, Jagdish Kumar Chhabra, Somnath Bandyopadhyaya, Pramod Kumar Goel	US 6590194
An improved antiglare device for automobile useful during night driving	DS Chhabra, PK Rao, BD Sharma, SK Gupta, DS Dodd, V Singh, S Sharma	US 6674587 B2

CSIR(SCH)	Subramanian Angaiah, Vasudevan Thiagarajan, Gangadharan Ramaiyer	US
Process for the preparation of libf4e		6623717 B2
Process for the preparation of diorganotrисуlfide	Pradipta Sinha, Sujit Roy	US
		6555712
Process for the preparation of lithium metaphosphate	Subramanian Angaiah, Vasudevan Thiagarajan, Gnagadharan Ramaiyer, Raghavan Meenakshisundaram	US
		6656441 B2
Composition and method for maintaining blood glucose level	Sanju Dhawan, Anil Kumar Singla	US
		6703045
Process for the preparation of lithium hexafluoroarsenate	Subramanian Angaiah, Vasudevan Thiagarajan, Gnagadharan Ramaiyer, Raghavan Meenakshisundaram	US
		6682712
CSIR+AIIMS	Ranju Ralhan	US
Method for detecting a single nucleotide polymorphism in p21 waf1/cip1 gene as an indicator of risk of esophageal cancer		6627401 B2
CSMCRI	Jince Sebastian, Raksh Vir Jasra	US
Process for the preparation of a molecular sieve adsorbent for selective adsorption of nitrogen and argon		6572838
An improved process for the cultivation of algae	Radhakrishn Chennur Reddy, Om Prakash Mairh, Guru Rajakrishna Kumar, Eswaran Kuruppanan, Subba Rao Peddi Venkata, Kalpana Haresh Mody, Pushpito Kumar Ghosh	TZ
		T2/T/02/00047
IGIB	Pradeep Kumar, Kailash Chand Gupta	EP
A universal polymer support for the synthesis of oligoribonucleotides		EP1006121 B1

Process for the preparation of cell beads bod sensor useful for instant bod estimation	R Kumar, S Rastogi, A Sharma, TK Saxena	US 6709853
Antifungal molecule 2-(3,4-dimethyl-2,5-dihydro-1h-pyrrol-2-yl)-1-methylethyl pentanoate	GI Sharma, Ali M Rajesh	US 6713504
A process for the preparation of immobilized microbial composition for use as seed inoculum in the bod test	Rita Kumar, Anil Kumar, Alka Sharma, Sharadvishwanath Gangal, Santosh Daya Ram Makhijani	GB 2386124
Method of detection of allelic variants of sca2 gene	Samir Kumar Brahmachari, Shweta Choudhry, Mitali Mukerji, Satish Jain	US 6623927 B1
Microbial composition and its use in the neutralisation of alkaline waste waters	Rita Kumar, Anil Kumar, Alka Sharma, Sharad V Gangal, Santosh D Makhijani	GB GB2342924
IHBT  A convenient and versatile, compact, portable, light weight, low power consuming sterile laminar air flow system	Rajesh Thakur, Anil Sood, Paramvir Singh Ahuja	ZA 2003/2363
Process for the preparation of substituted trans-cinnamaldehyde, a natural yellow dye, from phenylpropane derivatives	Arun Kumar Sinha, Bhupendra Prasad Joshi, Ruchi Dogra	US 6566557
Sterile laminar airflow device	Rajesh Thakur, Anil Sood, Paramvir Singh Ahuja	US 6623538 B2
Gladiolus hybrid plant named 'tushar mauli'	Devashish Mukherjee, Devendra Dhayani, Jaichand Rana	US PP13710 P3

Microwave assisted rapid and economical process for the preparation of substituted phenylaldehydes from trans and cis-phenypropenes: a commercial utilisation of toxic cis-isomer	Arun Kumar Sinha,Ruchi Dogra,Bhupendra Prasad Joshi	US 6544390
Process for the preparation of pharmacologically active .alpha.-asarone from toxic .beta.-asarone rich acorus calamus oil	Arun Kumar Sinha, Bhupendra Prasad Joshi, Ruchi Acharya	US 6590127
Method for producing chiral dihydrotagetone, and its conversion to chiral 5-isobutyl-3-methyl-4,5-dihydro-2(3h)-furanone	Arun Kumar Sinha, Bhupendra Prasad Joshi, Ruchi Dogra	US 6579992
Processess for preparing 5-isobutyl -3-methyl-4, 5-dihydro-2(3h)- furanone from dihydrotagetone and its use as a flavousing agent	Arun K Sinha, Bhupendra P Joshi, Ruchi Dogra	GB GB2374594
A novel method for converting dihydrotagetone, a bifunctional acyclic monoterpene, isolated from the plant species of tagetes	Arun K Sinha, Bhupendra P Joshi, Ruchi Dogra	GB GB2375535
Method for microproduction of tea plants from leaf explants	Indra Sandal, Amita Bhattacharya, Madhu Sharma, PS Ahuja	US 6599743
Efficient method of protoplast culture	Pratap Kumar Pati, Madhu Sharma, Paramvir Singh Ahuja	US 6569680
Species specific genomic dna sequence for identification of anacardium occidantale and the method for its utilisation in detection of cashew husk in made tea sample	Mahipal Singh, Bandana Dhiman	US 6541624
An efficient method for micropropagation of tea (camellia sinensis) plants using leaf explants	Indra Sandal, Amita Battacharya, Madhu Sharma, P S Ahuja	SL 12368

One step process for the preparation of substituted transcinamaldehyde, a natural yellow dye, from phenylpropane derivative.	Arun Kumar Sinha, Bhupendra Prasad Joshi, Ruchi Dogra	PK 137766
Gladiolus plant named "palampur princess"	Devashish Mukherjee, Devendra Dhayani, Jaichand Rana	US PP14435
One step method for micro - production of tea leaves	Indra Sandal, Amita Bhattacharya, Madhu Sharma, Paramvir Singh Ahuja,	US 6548300
IICB  A process for the preparation of a biomarker specific for o-acetylated sialic acid useful for the diagnosis, monitoring outcome of treatment and prediction of relapse of lymphoblastic leukaemia	Mandal Chitra, Pal Santanu, Chatterjee Mitali	US 6693177
Coelomic fluid extract from pheretima posthuma for providing sperm immotility	Mohua Mukherjee, Shampa Biswas, Malabika Datta, Samir Bhattacharye, Ranjan Bhadra, Alok Pal	US 6569464
Process for the purification of a new motility-promoting protein from buffalo serum: a slaughter house waste	Gopal Chandra Majumder, Mahitosh Mandal, Saswati Banerjee	US 6613737
Anti-leishmanial activity of betel leaf extract	Santu Bandyopadhyay, Bikash Pal, Samir Bhattacharya, Mitali Ray, Keshab Chandra Roy	US 6610332 B2
Process for the production of an enzyme preparation containing xylanase and carboxymethyl cellulase useful for the treatment of textile, agro-products and plant biomass	Subhabrata Sengupta, Anil Kumar Ghosh, Mohanlal Jana, Amal Kumar Naskar	US 6569646
IICT	Kaimal, NB Thengumpillil, Kanjilal; Sanjit ; Prasad; BN Raghapudi.	US



Enzymatic process for preparing reduced-calorie fats containing behenic acid		6617141
Process for the synthesis of highly active modified carbon supported palladium catalyst	Janmanchi K Murthy, Sridara C Shekar, Kamaraju S Ramarao, Burri D Raju, Kondapuram V Raghavan	US 6624109
Process for simultaneous alkyl esterification of oil and regeneration of spent oil purification medium	Thengumpillil Narayana Balagopala Kaimal, Penumarthy Vijayalakshmi, Ayyagari Ananta Laxmi, Bandi Ramalinga	US 6635595
Process for the preparation of n-(2,3-dihydrobenzo[1,4]dioxin-2-carbonyl)piperazine	Malladi Pardhasaradhi, Gullapalli Kumaraswamy, Arun Kanti Das, Nivedita Jena, Chembumkulam Kamalakshyamma Snehalatha Nair, Mudiganti Naga Venkata Sastry	US 6608200
Substituted calix (4) pyrroles and process for the synthesis of calix (4) pyrroles over molecular sieve catalysts	Kondapuram Vijaya Raghavan, Shivanand Janardan Kulkarni, Motkuri Radha Kishan, Nagabandi Srinivas	US 6605194 B2
Supported osmates, process for preparation thereof, and a process for the preparation of chiral vicinal diols using supported osmate catalyst	Boyapati Manoranjan Choudary, Naidu Sreenivasa Chowdari, Mannepalli Lakshmi Kantam, Kondapuram Vijaya Raghavan	US 6646168
Process for the separation of racemic mixtures	Boyapati Manoranjan Choudary, Kalluri Venkata Sri Ranganath, Mannepalli Lakshmi Kantam	US 6709597
Herbal cream formulation	Prakash Vaman Rao Diwan, Bhamidipalli Subrahmanya Sitaramam, Sistla Ramakrishna, Kondapuram Vijaya Raghavan	EP 0923937 B1
Process for the preparation of 2-methyl 1,4-naphtho quinone	Narayanan Sankarasubbier, Katravulapalli Vvsbs Murthy, Kongara Madhusudan Reddy, Premchendar Nandhikonda	US 6579994
Process for the preparation of supported osmates	Boyapati M Choudary, Naidu S Chowdari, Mannepalli L Kantam, Kondapuram V Raghavan	US

		6703531
Uresae inhibitor pct national phase an improved process for the preparation of acylferrocenes	Boyapati Manoranjan Choudhary, Konatham Saidi Reddy, Mannepilli Lakshmi, Kondapuram Vijaya Raghavan	KR 0406289
A pesticidal dry powder formulation enriched in azadirachtin upto 88%, an emulsifiable concentrate enriched upto 30% of azadirachtin and a process for preparing such formulation and concentrate from neem seed/kernel	AVB Sankaram, M Marthandamurthy, AD Manohar, M Subramanyam, VSSR Gopal, V Srihari	CA 2188110
Process for the enhancement of cycle-life of the zinc chromium based catalyst used in the synthesis of 2-methylpyrazine	Sai Prasad Potharaju Seetharamanjaneya, Kondupuram Vijaya Raghavan, Panja Kanta Rao, Shivanand Janardan Kulkarni, Katabathini Narasimha Rao, Rajesh Gopinath, Suresh Farsinavis, Harshadas Mitaram Meshram	US 6566292
Pyrimidine linked pyrrolo[2,1-c][1,4]benzodiazepines as potential antitumour agents	Ahmed Kamal, Karnati Laxma Reddy	US 6683073
Process for the preparation of rice bran oil low in phosphorous content	Narayana Balagopala Kaimal Thengumpillil; Rajamma Ongole, Satya Bhaskar Potula	US 6706299
Process for preparing taxol side chain using heterogeneous trifunctional catalyst	Boyapati M Choudary, Naidu S Chowdari, Sateesh Madhi, Lakshmi K Mannepilli, Jyothi Karangula	US 6706901
Alkylxanthates and use of alkylxanthates in the integrated pest management	Janapala Venkateshwara Rao, Yenamandra Venkateswaralu, Kondapuram Vijaya Raghavan	US 6583175
Method of processing of hydrogen for reductive acylation of nitro, azido and cyano arenes	Boyapati Manoranjan Choudary, Venkati Sri Ranganath Kalluri, Lakshmi Kantam Mannepilli	US 6673967

Process for the preparation of a polyaniline salt	Sirnivasan Palaniappan	US 6586565
(+)-Cycloolivil as antioxidant obtained from natural source namely stereospermum personatum	Janaswamy Madhusudana Rao, Ashok Kumar Tiwari, Upparapalli Sampath Kumar, Jhillu Singh Yadav, Kondapuram Vijaya Raghavan	US 6562381
(-)-Olivil as antioxidant which is obtained from a new natural source namely stereospermum personatum	Janaswamu Madhusudan Rao, Ashok Kumar Tiwari, Upparapalli Sampath Kumar, Jhillu Singh Yadav, Kondapuram Vijaya Raghavan	US 6592911 B2
Preparation of alkylated aromatic amines	Bankupalli Satyavathi, Akash Patwari, Uday T Bhalerao	EP 1002789 B1
Process for the preparation of hydroxylated lecithin from crude soybean lecithin	V Vandana, MSL Karuna, PSS Prasad, RBN Prasad	US 6638544 B2
Process for the preparation of nitrotoluenes	Boyapati Manoranjan Choudary, Mannepalli Lakshmi Kantam, Kompella Vishweshwar Ramprasad	US v 6620981
A process for preparation of esters using polyaniline salts as novel catalysts	Palaniappan S, Sairam M	FR 2822823
1-(2-chloro-5-methyl-3-pyridylmethyl)-2-nitroiminoimidazolidine and process for the preparation thereof	Chinaraju Bhimapaka, Vaidya Jayathirtha Rao	US 6566528
Process for preparation of supported osmates	Boyapati M Choudary, Naidu S Chowdri, Mannepalli L Kantam, Kondapuram V Raghavan	US 6552234
Process for the preparation of polyaniline salts	Srinivasan Palaniappan, Anbalagan Amarnath Chellachamy	US 6630567 B1

A process for the preparation of acyl hetro aromatic compounds from hetroaromatic compounds by metal ion exchange clays	Boyapati Manoranjan Choudary, Mutyala Sateesh, Mannepalli Lakshmi Kantam, Kondapuram Vijaya Raghaven	EP 1138681
Process for the preparation of diazonaphthoquininesulfonyl chlorides using diphosgene and triphosgene	Vummadi Venkat Reddy, Maruthi Janaki Ram Reddy, Vaidya Jayathirtha Rao	US 6559291
Process for the preparation of ethyl 2,3-dihydrobenzo [1,4] dioxin -2- carboxylate	Malladi Pardhasaradhi, Gullapalli Kumaraswamy, Arun Kanti Das, Nivedita Jena, Chembukulam Kamalakshyamma Snehalatha Nair	US 6555695
An improved process for the preparation for the acyl naphthyl ethers	Lakshmi Mannepalli Kantam, Mutyala Sateesh, Boyapati Manoranjan Choudary, Sri Kalluri Venkata Ranganath, Kondapuram Vijaya Raghavan	EP EP1149819 B1
Process for the nitration of xylene isomers using zeolite beta catalyst	Boyapati Manoranjan Choudary, Mannepalli Lakshmi Kantam, Nadakuditi Sailendra Kumar, Kompella Vishweshwara Ram Prasad, Kondapuram Vijaya Raghavan	US 6703532
Process for the preparation of amine oxides	Boyapati Manoranjan Choudary, Chinta Reddy Venkat Reddy, Billakanti Veda Prakash, Balagam Bharathi, Mannepalli Lakshmi Kantam	US 6617454
Method for the synthesis and evaluation of porphyrins, calix (4) pyrroles and allied macrocycles	PS Devi, KV Raghvan, SJ Kulkarni, MR Kishan, VR Rani, MRVS Murthy	US 6712972
IICT+CCMB Process for novel cationic amphiphiles containing n-hydroxyalkyl group for intracellular delivery of biologically active molecules	Rajkumar Banerjee, Prasanta Kumar Das, Gollapudi Venkata Srilakshmi, Nalam Madhusudhana Rao, Arabinda Chaudhuri	US 6541649
IICT+RRL(Jam) Herbal chemical composition for the treatment of cancer	Janaswamy Madhusudana Rao, Pullela Venkata Srinivas, Jhillu Singh Yadav, Kondapuram Vijaya Raghavan, Ajit Kumar Saxena, Mutiah Shanmugavek, Himani Kampasi, Gulam Nabi Qazi	US 6649650 B2
IIP Process for the preparation of a novel catalyst useful for sweetening of sour petroleum distillates	Brij Bahadur Agrawal, Som Nath Puri, Gautam Das, Bir Sain, Bhagwati Prasad Balodi, Sunil Kumar, Anil Kumar, Pushpa Gupta, Jai Prakash, Onkar Singh Tyagi, Turuga Sundara Rama Prasada Rao, Gur Pratap Rai	US 6696381

Process for sweetening of LPG, light petroleum distillates by liquid-liquid extraction using metal phthalocyanine sulphonamide catalyst	Bir Sain, Som Nath Puri, Gautam Das, Bhagwati Prasad Balodi, Sunil Kumar, Anil Kumar, Virendra Kumar Kapoor, Virendra Kumar Bhatia, Turuga Sundara Rama Prasada Rao, Gur Pratap Rai	US 6565740
An improved process for preparation of carboxylic acids by one step oxidation of hydrocarbons	N Girindra, P Kulsrestha, Mahendra Saxena, Ashok K Gupta, Hari B. Goyal, Rameshwar Prasad, SR Turuga, Prasada Rao, Prakash D. Patel	CA 2142792
IMT  Reporter gene based method for the screening of anti-tuberculosis drugs by using essential and regulatory genes of mycobacteria as drug target	Vishal Soni, Lakshami Pathi Khandrika, Pushpa Agrawal	US 6645505 B2
The vaccine for the treatment of tubercullosis and other intracellular infectious diseases	JN Agrewala, N Sharma	ZA 2002/2511
The vaccine for the treatment of tubercullosis and other intracellular infectious diseases	JN Agrewala, N Sharma	BD 1003852
Novel strains of yeast of genus-saccharomyces species-cerevisiae and a process for the preparation of such strains of yeast	Alok Kumar Mondal, Grandham Satyanarayana Chandigargh, Tapan Chakrabarti	EP EP0798382 B1
NBRI  Fermented herbal health drink from plant andrographis	Palpu Pushpangadan, Shanta Mehrotra, Ajay Kumar Singh Rawat, Sayyada Khatoon, Sharad Kumar Srivastava, Subha Rastogi, Manjoosha Chaubay, Adarsh Kumar Agnihotri	US 6616950
Chemically synthesized artificial promoter for high level expression of transgenes	Rakesh Tuli, Samir V Sawant, Pradhyumna K Singh, Shiv K Gupta	US 6639065
A composition useful for qualitative screening of phasphate solubilising microorganisms and a qualitative method for screening microorganisms	Chandra Shekhar Nautiyal, Sangeeta Mehta, Palpu Pushpangadan	US 6638730 B2

NCL Process for preparing enantiomerically pure (s)-3-hydroxy-gamma-butyrolactone	Mukund Keshao Gurjar, Pradeep Kumar, Anis Naim Deshmukh, Rajesh Kumar Upadhyay, Puspesh Kumar Upadhyay	US 6713639
Process for the preparation of substituted aromatic compound employing friedel-crafts reaction using a reusable basic anionic clay catalyst	Vasant Ramchandra Choudhary, Suman Kumar Jana	US 6548722
Process for preparation of a lactone from a cyclic ketone	Deendayal Mandal, Absar Ahmad, Mohammed Islam Khan, Rajiv Kumar	US 6559322
Process for the preparation of 2-methyl-2-propene-1-sulfonic acid, sodium salt	Prashant Purushottam Barve, Sunil Shankar Joshi, Ravindra William Shinde, Shrikant Madhukar Ghike, Milind Yashwant Gupte, Chandrashekhar Narayan Joshi, Raghavendra Venkatrao Naik	US 6660882
Process for the preparation of 2-aryl propionic acids	Raghunath Vitthal Chaudhari, Jayasree Seayad, Abdul Seayad	US 6660883
Thermoprecipitating polymer containing enzyme specific ligands, process for the preparation thereof, and use thereof for the separation of enzymes	Alankar Arun Vaidya, Bhalchandra Shripad Lele, Mohan Gopalkrishna Kulkarni, Raghunath Anant Mashelkar	US 6605714
Process for the production of aromatic carboxylic acids	D Srinivas, SA Chavan, P Ratnasamy	US 6649791 B2
Process for the preparation of phenyl ketones	Mandan Chidambaram, Chithravel Venkatesan, Anand Pal Singh, Arumugamangalam Venkataraman Ramaswamy	US 6593499
A process for the production of polyhydroxyoctanoate by streptomyces lividans	Gyanendra Tripathi, Lata Hanamantrao Mahishi, Turaga Venkata Naga Ramachander, Shuban Kishen Rawal	US 6692945
Process for making s(-) amlodipine salts	Rohini Ramesh Joshi, Ramesh Anna Joshi, Mukund Keshav Gurjar	US 6608206

Noble metal containing hydrogenation catalyst for selective hydrogenation of 1, 4 butynediol to 1, 4 butenediol, and a process for the preparation thereof	Raghunath Vitthal Chaudhari, Chandrashekhar Vasant Rode, Rengaswamy Jaganathan, Manisha Madhukar Telkar, Vilas Hari Rane	US 6660675
A process for the preparation of poly (ester-carbonate)s	SB Hait, S Sivaram	EP 908483
Tinuvin P-hundred amine light stabilizer and derivatives thereof	Shroj Al Mohitkumar Desai, Raj Pal Singh	US 6610856 B2
Process for the preparation of alkyl 4[2-(phthalimido)ethoxy]-acetoacetate	Rohini Ramesh Joshi, Ramesh Anna Joshi, Ravindranathan Thottappillil	US 6562983
Process for treatment of mixture of spent wash from distillery and black liquor from pulp and paper industry	Pramod Prabhakar Moghe, Vinita Vinay Panchanadikar, Ashwini Vinayak Pol, Ajit Ramesh Joshi, Prakash Kondiba Bahirat, Priyadarshini Kudlu, Shekhar Prakash Bahirat	US 6589427
Process for the synthesis of a photo-stabilizer	Shroj Al Mohitkumar Desai, Raj Pal Singh	US 6559311
Composition for hybrid seed production, process for the preparation of such composition and use thereof	V Mahajan, S Nagarajan, VH Deshpande, RG Kelkar, RJ Lahoti, S Ramalingam, VJ Bulbule	US 6645917 B2
Process for the preparation of thermoprecipitating affinity polymers	Alankar Arun Vaidya, Bhalchandra Shripad Lele, Mohan Gopalkrishna Kulkarni, Raghunath Anant Mashelkar	US 6689836
Process for the preparation of thiourea	Balakrishnan Srinivasa, Mahajan Shankar Shivram, Chaphekar Gopal Moreshwar, Gupte Milind Yeshwant, Parshuram Kulkarni Mohan, Bandarupalli Radha Krishna Murthy	US 6657082
NGRI  Digitally implemented method for automatic optimization of gravity fields obtained from three-dimensional density interfaces using depth dependent density	Vishnubhotla Chakravarthi	US 6615139 B1

NIO  A natural nonpolar fluorescent dye from a non-bioluminescent marine invertebrate, compositions containing the said dye and its uses	U Goswami, A Ganguly	US  6689391 B2
A process for the isolation of 2-deoxy ecdysterone from zoanthus sp.	Cynthia Olimpia Lydia Gonsalves, Perunninakulath Parameswaran Subrayan, Chandrakant Govind Naik, Chittur Thelakkat Achuthankutty	EP  EP 1138690 B1
Method for extraction and purification of biologically useful molecules from a mangrove plant salvadora persica l	Usha Goswami, Nazarine Fernandes	US  6586021
Pressure housing for in-water pressure based systems	Ehrlich Desa, Gajanan Purushottam Naik, Antony Joseph, Elgar Stephen Desa, Prakash Mehra, Vijay Kumar, Shivanand Prabhu Desai, Surekha Mahesh Nagvekar	US  6568266
Simultaneous decolorization and detoxification of molasses spent wash using novel white rot-lignin-modifying fungus flavodon flavus	Chandralata Raghukumar, Mysore Srinivasamurthy Shailaja	US  6613559 B2
Method for determining seafloor roughness using a multibeam echosounder	Bishxajit Chakraborty, Vijay N Kodagali	US  6549853
Composition comprising zoanthus sp. Extract with anti-fouling activity and a method thereof	Cynthia Olimpia Lydia Gonsalves, Chittur Thelakkat Achuthankutty, Perunninakulath Parameswaran V, Chandrakant Govind Naik	US  6667062
Method of use for 2-deoxy ecdysterone	Cynthia Olimpia Lydia Gonsalves, Perunninakulath Parameswaran Subrayan, Chandrakant Govind Naik, Chittur Thelakkat Achuthankutty	US  6617319 B2
Process for the preparation of an extract with carotenoids, uv absorption, antibacterial and ph indicating properties from a deep-sea bacterium	Ponnapakkam Adikesavan Loka Bharathi, Shanta Nair, Dorairajasingham Chandramohan	US  6669944
Bioactivity of methyl palminate obtained from a mangrove plant salvadora persica l	Usha Goswami, Nazarine Fernandes	US  6638546 B2



Microbial process for degradation of pcbs in clophen a-50 using a novel marine microorganism, pseudomonas CH07	Sarkar; Anupam ; De; Jaysankar ; Nagappa; Ramaiah	US 6544773
Natural fluorescent dye obtained from a marine invertebrate, compositions containing the said dye and their uses	Usha Goswami, Anush Ganguly	US 6582730
NML Process for the recovery of gold and silver from used refractory bricks	Daita S R Murthy, Vinod Kumar	US 6602319
NML+DST Sensing device for the non-destructive evaluation of steel structures or components	Amitava Mitra, Sarmistha Palit Sagar, Dipak Kumar Bhattacharya	US 6617847 B2
NPL A reusable heat pack	CP Sharma, RK Sharma, C Kant, AK Sarkar	RU 2223071
Formulation for iron chelation, a process for preparing the formulation and a method of treating thalassemia	SA Kumar, K Sudarshan, P Harsh, KS Rattan, D Ghansham	CN ZL 96119785.4
A simulation circuit layout design for low voltage, low power and high performance type ii current conveyor for analog signal processing applications	SS Rajput, SS Jamur	SP 94796
RRL(Jam) Glucopyranoside and process of isolation thereof from pterocarpus marsupium pharmaceutical composition containing the same and use thereof	Rakesh Maurya, Sukhdev Swami Handa, Rajinder Singh	US 6617313
Novel chemo-enzymatic synthesis of optically enriched rose-oxides	SC Taneja, VK Sethi, S Koul, SS Andotra, GN Qazi	US 6692944

Anti-diabetic agent obtained from the plant <i>humboldtia decurrens</i> and a process for preparing the same	Janaswamy Madhusudana Rao, Mangattu Achutankunju Sumathykutty, Gopalan Vijay Nair, Alathur Damodaran Damodaran, Kodandaraman Rathinam, Rajagopal Sivakumar, Kottilil Mohan Das, Narayanapillai Viswanathan Nair	US 6610330
Glucopyranoside, process for isolation thereof, pharmaceutical composition containing same and use thereof	Rakesh Maurya, Deepa Singh, Asha Bhagat, Om Parkash Gupta, Sukhdev Swami Handa	US 6562791
Synergistic composition of bioactive fraction isolated from <i>barleria prionitis</i> linn and a method of treatment for hepatotoxicity, immuno-deficiency and fatigue and a process thereof	JL Suri, SK Banerjee, Subhash Chandra Taneja, AS Anand, Anil Prabhakar, Bupinder Singh Jaggi, AK Saxena, Bal Krishan Chandan, Sukhdev Swami Handa	US 6664236 B2
A novel composition for early and profuse sporulation in fungi and a method thereof	Rajinder Kumar Khajuria, Ram Vilas Parsad Sinha, Vijeshwar Verma, Ghulam Nabi Qazi, Sukhdev Swami Handa	US 6593127 B1
Process for preparing topotecan from 10-hydroxy-4-(s) camptothecin	Satish Chander Puri, Geeta Handa, Kanaya Lal Dhar, Om Parkash Suri, Ghulam Nabi Qazi	US 6660861
Hepatoprotective activity of an extract and fraction from <i>cryptolepis buchanani</i>		US 6686375 B2
) Pharmaceutical composition comprising extract from plant <i>cryptolepis buchanani</i> for treating immunodeficiency	Rakesh Maurya, Anupurna Kaul, Sarang Bani, Usha Zutshi, Anamika Khajuria, Ajit Kumar Saxena, Lila Ram Manahas, Ashwani Kumar, Bal Krishnan Kapahi, Om Prakash Suri, Gulam Nabi Qazi	US 6548086
Bioprocess for the kinetic resolution of (±) - 6-methoxy -α- methyl-2-naphthalene acetic acid using a strain of <i>trichosporon</i> species	QN Qazi, R Parshad, RJ Kotru, S Koul, SC Taneja, KL Dhar	EP EP 0952227 A1 B

RRL(J)+DBT A novel oligospirostanoside from asperagus racemosur	Sukhdev Swami Handa, Om Prakash Suri, Vishwa Nath Gupta, Krishan Avtar Suri, Naresh Kumar Satti, Vikram Bhardwaj, Kasturi Lal Bedi, Anamika Khajuria, Anpurna Kaul, Girish G Parikh, Prabhakar Kulhar, Ulhas Salunkhe, Raman Krishnamurthy	US 6649745 B2
RRL(J)+DST Process for the isolation of novel oligospirostanoside	Sukhdev Swami Handa, Om Prakash Suri, Vishwa Nath Gupta, Krishan Avtar Suri, Naresh Kumar Satti, Vikram Bhardwaj, Kasturi Lal Bedi, Anamika Khajuria, Anpurna Kaul, Girish G Parikh, Prabhakar Kulhar, Ulhas Salunkhe, Raman Krishnamurthy	US 6670459
RRL(T) Biological filter for the purification of waste gases	Ajit Haridas, Swachchha Majumdar	US 6696284
Process for the preparation of novel ceramic substrate ba <sub>2</sub> dymo <sub>5.5</sub> (m=Zr, Sn and Hf), for bi-cuprate superconductors and a process for the preparation of phase pure superconducting Bi(2223) and Bi(2223)-Ag thick films on these newly developed substrates	Jacob Koshy, Jose Kurian, Poo Kodan Sajith, Krishnan Sudersan Kumar, Rajan Jose, Asha Mary John, Alathur Damodaran Damodaran	EP 844677
Method of purification of wastewater and 'rflr' device for performing the same	Ajit Haridas, Swachchha Majumdar	US 6544421
Viologen linked acridine based molecule and process for the preparation thereof	Ramaiah Danaboyina, Varghese Eldho Nadukkudy, Joseph Joshy	US 6630481 B2
An improved process for the preparation of high grade synthetic rutile from ilmenites	Pawvathu Narayanan Nair Mohan Das, Karval Karikrishna Bhat, Melay Eriyat Kochu Janaki, Sreedharan Sasibhusan, Parsarathi Mukherjee, Bishnu Charan Rabindra Mhanty, Hem Shanker Ray	NO 316320
Melt or solution processable highly conducting polyanilin and process for preparation thereof with pvc and eva	Raji Kannaparampil Paul, Chennakkattu Krishna, Sadasivan Pillai	US 6552107

Device for treatment of wastewater	Ajit Haridas	US 6592751
A process for the preparation of melt / solution processable highly conducting polyanilin and its blends with pvc & eva	Raji Kannaparampil Paul, Chennakkattu Krishna, Sadasivan Pillai	JP 3400404
A process for the preparation of melt / solution processable highly conducting polyanilin and its blends with PVC & EVA	Raji Kannaparampil Paul, Chennakkattu Krishna Sadasivan Pillai	GB GB2360524

# Top papers published by CSIR

## ANNEXURE-II

### TOP PAPERS PUBLISHED BY CSIR

#### TOP PAPERS PUBLISHED BY CSIR

TITLE / AUTHOR	JOURNAL AFFL	IF	LAB
Genomic databses illed novel bioplastic producers : Kalia-VC Chauhan-A Bhattacharyya-G Rashmi	NATURE BIOTECHNOLOGY, 2003, Vol 21, Issue 8, pp 845-46	12.822	IGIB
Lamin A/C Speckles Mediate Spatial-Organization of Splicing Factor Compartments and RNA-Polymerase-II Transcription : Kumaran-RI Muralikrishna-B Parnaik-VK	JOURNAL OF CELL BIOLOGY, 2002, Vol 159, Issue 5, pp 783-793	12.522	CCMB
Ethnic India - A Genomic View, with Special-Reference to Peopling and Structure : Basu-A Mukherjee-N Roy-S Sengupta-S Banerjee-S Chakraborty-M Dey-B Roy-M Roy-B Bhattacharyya-NP Roychoudhury-S Majumder-PP	GENOME RESEARCH, 2003, Vol 13, Issue 10, pp 2277-2290	9.863	IICB
Single-Strand-Specific Nucleases : Desai-NA Shankar-V	FEMS MICROBIOLOGY REVIEWS, 2003, Vol 26, Issue 5, pp 457-491	9.597	NCL
Ping-Pong Interactions Between Mitochondrial Transfer-RNA Import Receptors Within a Multiprotein Complex : Bhattacharyya-SN Chatterjee-S Goswami-S Tripathi-G Dey-SN Adhya-S	MOLECULAR AND CELLULAR BIOLOGY, 2003, Vol 23, Issue 15, pp 5217-5224	8.840	IICB
Regulation of Wingless and Vestigial Expression in Wing and Haltere Discs of Drosophila : Mohit-P Bajpai-R Shashidhara-LS	DEVELOPMENT, 2003, Vol 130, Issue 8, pp 1537-1547	7.883	CCMB

Aspartic Peptidase Inhibitors - Implications in Drug Development : Dash-C Kulkarni-A Dunn-B Rao-M	CRITICAL REVIEWS IN BIOCHEMISTRY AND MOLECULAR BIOLOGY, 2003, Vol 38, Issue 2, pp 89-119	7.783	NCL
DNA Electronics : Bhalla-V Bajpai-RP Bharadwaj-LM	EMBO REPORTS, 2003, Vol 4, Issue 5, pp 442-445	7.698	CSIO
Identification and Characterization of Leishmania-Donovani Stage-Specific Genes Using Genomic Microarray : Goyal-N Duncan-R Salotra-P Akopyant-N Klutch-M Rastogi-A Beverly-S Nakhasi-H	MOLECULAR BIOLOGY OF THE CELL, 2002, Vol 13, Issue NOV, pp 2937-2937	7.599	CDRI
Chemical-Composition of Garden Cress Seeds and Its Use as a Functional Ingredient : Gokavi-S Malleshi-N Guo-M	FASEB JOURNAL, 2003, Vol 17, Issue 5, pp A763-A763	7.252	CFTRI
Polyamine-Assisted Rapid and Clean Cleavage of Oligonucleotides from Cis-Diol Bearing Universal Support - Art. No. E130 : Kumar-P Dhawan-G Chandra-R Gupta-KC	NUCLEIC ACIDS RESEARCH, 2002, Vol 30, Issue 23, pp E130-E130	7.051	IGIB
Allosteric Regulation of Transfer-RNA Import - Interactions Between Transfer-RNA Domains at the Inner Membrane of Leishmania Mitochondria : Goswami-S Chatterjee-S Bhattacharyya-SN Basu-S Adhya-S	NUCLEIC ACIDS RESEARCH, 2003, Vol 31, Issue 19, pp 5552-5559	7.051	IICB
Functional Dissociation of the C-Terminal Domain of Type-II DNA Topoisomerase from the Kinetoplastid Hemoflagellate Leishmania-Donovani : Sengupta-T Mukherjee-M Mandal-C Das-A Majumder-HK	NUCLEIC ACIDS RESEARCH, 2003, Vol 31, Issue 18, pp 5305-5316	7.051	IICB
Cloure - Clustal Output Reformatter, a Program for Reformatting Clustalx/Clustalw Outputs for Snp Analysis and	NUCLEIC ACIDS RESEARCH, 2003, Vol 31, Issue 13, pp 3501-3502	7.051	IMTECH

Molecular Systematics : Kohli-DK Bachhawat-AK			
Dendritic Cell-Based Immunotherapy Combined with Antimony-Based Chemotherapy Cures Established Murine Visceral Leishmaniasis : Ghosh-M Pal-C Ray- M Maitra-S Mandal-L Bandyopadhyay-S	JOURNAL OF IMMUNOLOGY, 2003, Vol 170, Issue 11, pp 5625-5629	7.014	IICB
Genetic Affinities of the Andaman Islanders, a Vanishing Human- Population : Thangaraj-K Singh-L Reddy-AG Rao-VR Sehgal-SC Underhill-PA Pierson-M Frame-IG Hagelberg-E	CURRENT BIOLOGY, 2003, Vol 13, Issue 2, pp 86-93	7.007	CCMB
Susceptibility to Anthrax Lethal Toxin Is Controlled by 3 Linked Quantitative Trait Loci : Mcallister- RD Singh-Y Dubois-WD Potter-M Boehm-T Meeker-ND Fillmore-PD Anderson-LM Poynter-ME Teuscher-C	AMERICAN JOURNAL OF PATHOLOGY, 2003, Vol 163, Issue 5, pp 1735-1741	6.750	IGIB
Palmitoylated Peptides from the Cysteine-Rich Domain of Snap-23 Cause Membrane-Fusion Depending on Peptide Length, Position of Cysteines, and Extent of Palmitoylation : Pallavi-B Nagaraj-R	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 15, pp 12737-12744	6.696	CCMB
Role of the Conserved Srlfdqffg Region of Alpha-Crystallin, a Small Heat-Shock-Protein - Effect on Oligomeric Size, Subunit Exchange, and Chaperone-Like Activity : Pasta-SY Raman-B Ramakrishna-T Rao-CM	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 51, pp 51159-51166	6.696	CCMB
Streptococcus-Pneumoniae Hyaluronate Lyase Contains 2 Noncooperative Independent Folding/Unfolding Structural Domains - Characterization of	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 28, pp 25509-25516	6.696	CDRI

Functional Domain and Inhibitors of Enzyme : Akhtar-MS Bhakuni-V			
Identification and Characterization of an Amphipathic Leucine Zipper-Like Motif in Escherichia-Coli Toxin Hemolysin-E - Plausible Role in the Assembly and Membrane Destabilization : Yadav-SP Kundu-B Ghosh-JK	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 51, pp 51023-51034	6.696	CDRI
Unusual Structural, Functional, and Stability Properties of Serine Hydroxymethyltransferase from Mycobacterium-Tuberculosis : Chaturvedi-S Bhakuni-V	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 42, pp 40793-40805	6.696	CDRI
Thermal Inactivation of Glucose-Oxidase - Mechanism and Stabilization Using Additives : Gouda-MD Singh-SA Rao-AGA Thakur-MS Karanth-NG	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 27, pp 24324-24333	6.696	CFTRI
Alanine-Scanning Mutations in Domain-4 of Anthrax Toxin Protective Antigen Reveal Residues Important for Binding to the Cellular Receptor and to a Neutralizing Monoclonal-Antibody : Rosovitz-MJ Schuck-P Varughese-M Chopra-AP Mehra-V Singh-Y Mcginnis-LM Leppla-SH	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 33, pp 30936-30944	6.696	IGIB
Whole Genome Expression Profiles of Yeast RNA-Polymerase-II Core Subunit, Rpb4, in Stress and Nonstress Conditions : Pillai-B Verma-J Abraham-A Francis-P Kumar-Y Tatu-U Brahmachari-SK Sadhale-PP	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 5, pp 3339-3346	6.696	IGIB
A Single-Domain Cyclophilin from Leishmania-Donovani Reactivates Soluble Aggregates of Adenosine Kinase by Isomerase-Independent Chaperone Function : Chakraborty-A Das-I Datta-R Sen-B	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 277, Issue 49, pp 47451-47460	6.696	IICB



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A Novel Antioxidant and Antiapoptotic Role of Omeprazole to Block Gastric-Ulcer Through Scavenging of Hydroxyl Radical : Biswas-K Bandyopadhyay-U Chattopadhyay-I Varadaraj-A Ali-E Banerjee-RK	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 13, pp 10993-11001	6.696	IICB
Identification of Uhp1, a Ubiquitinated Histone-Like Protein, as a Target/Mediator of Rhp6 in Mating-Type Silencing in Flssueion Yeast : Naresh-A Saini-S Singh-J	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 11, pp 9185-9194	6.696	IMTECH
Domain Truncation Studies Reveal That the Streptokinase-Plasmin Activator Complex Utilizes Long-Range Protein-Protein Interactions with Macromolecular Substrate to Maximize Catalytic Turnover : Sundram-V Nanda-JS Rajagopal-K Dhar-J Chaudhary-A Sahni-G	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 33, pp 30569-30577	6.696	IMTECH
A Backbone-Reversed Form of an All-Beta Alpha-Crystallin Domain from a Small Heat-Shock-Protein (Retro-Hsp12.6) Folds and Assembles into Structured Multimers : Shukla-A Raje-M Guptasarma-P	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 29, pp 26505-26510	6.696	IMTECH
Slow Tight-Binding Inhibition of Proteinase-K by a Proteinaceous Inhibitor - Conformational Alterations Responsible for Conferring Irreversibility to the Enzyme-Inhibitor Complex : Pandhare-J Dash-C Rao-M Deshpande-V	JOURNAL OF BIOLOGICAL CHEMISTRY, 2003, Vol 278, Issue 49, pp 48735-48744	6.696	NCL
Mining genomic databases for searching novel hydrogen	TRENDS IN BIOTECHNOLOGY, 2003, Vol 21, Issue 4, pp 152-156	6.291	IGIB

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Association of Polymorphisms in the Collagen Region of Sp-A2 with Increased Levels of Total IgE Antibodies and Eosinophilia in Patients with Allergic Bronchopulmonary Aspergillosis : Saxena-S Madan-T Shah-A Muralidhar-K Sarma-PU	JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY, 2003, Vol 111, Issue 5, pp 1001-1007	6.282	IGIB
Essential Polyunsaturated Fatty-Acid and Lipid Peroxide Levels in Never-Medicated and Medicated Schizophrenia-Patients : Arvindakshan-M Sitasawad-S Debsikdar-V Ghate-M Evans-D Horrobin-DF Bennett-C Ranjekar-PK Mahadik-SP	BIOLOGICAL PSYCHIATRY, 2003, Vol 53, Issue 1, pp 56-64	5.915	NCL
Disruption of Mptpb Impairs the Ability of Mycobacterium-Tuberculosis to Survive in Guinea-Pigs : Singh-R Rao-V Shakila-H Gupta-R Khera-A Dhar-N Singh-A Koul-A Singh-Y Naseema-M Narayanan-PR Paramasivan-CN Ramanathan-VD Tyagi-AK	MOLECULAR MICROBIOLOGY, 2003, Vol 50, Issue 3, pp 751-762	5.832	IGIB
The Polycotyledon Mutant of Tomato Shows Enhanced Polar Auxin Transport : Alhammadi-ASA Sreelakshmi-Y Negi-S Siddiqi-I Sharma-R	PLANT PHYSIOLOGY, 2003, Vol 133, Issue 1, pp 113-125	5.800	CCMB
Single Histidine Residue in Headgroup Region Is Sufficient to Impart Remarkable Gene Transfection Properties to Cationic Lipids - Evidence for Histidine-Mediated Membrane-Fusion at Acidic pH : Kumar-VV Pichon-C Refregiers-M Guerin-B Midoux-P Chaudhuri-A	GENE THERAPY, 2003, Vol 10, Issue 15, pp 1206-1215	5.616	IICT

Protection Conferred by Bcl-2 Expression Involves Reduced Oxidative Stress and Increased Glutathione Production During Hypothermia-Induced Apoptosis in Ak-5 Tumor-Cells : Khar-A Pardhasaradhi-BVV Ali-AM Kumari-AL	FREE RADICAL BIOLOGY AND MEDICINE, 2003, Vol 35, Issue 8, pp 949-957	5.533	CCMB
Chromium(III)-Induced Apoptosis of Lymphocytes - Death Decision by Ros and SRC-Family Tyrosine Kinases : Balamurugan-K Rajaram-R Ramasami-T Narayanan-S	FREE RADICAL BIOLOGY AND MEDICINE, 2002, Vol 33, Issue 12, pp 1622-1640	5.533	CLRI
Apoptosis of Lymphocytes Induced by Chromium(VI/V) Is Through Ros-Mediated Activation of SRC-Family Kinases and Caspase-3 : Vasant-C Rajaram-R Ramasami-T	FREE RADICAL BIOLOGY AND MEDICINE, 2003, Vol 35, Issue 9, pp 1082-1100	5.533	CLRI
Effectiveness of different types of insole for diabetic neuropathy foot: a follow up study : Saraswathy G, Gopalakrishna G, Das BN, Vishwanathan V, Ramachandran A, Sivagami M, Seena Rajasekhar	DIABETES CARE, 2003, pp 0000-	5.477	CLRI
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Nonrandom Distribution of Alu Elements in Genes of Various Functional Categories - Insight from Analysis of Human Chromosome-21 and Chromosome-22 : Grover-D Majumder-PP Rao-CB Brahmachari-SK Mukerji-M	MOLECULAR BIOLOGY AND EVOLUTION, 2003, Vol 20, Issue 9, pp 1420-24	5.271	IGIB

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An Umbraviral Protein, Involved in Long-Distance RNA Movement, Binds Viral-RNA and Forms Unique, Protective Ribonucleoprotein Complexes : Taliansky-M Roberts-IM Kalinina-N Ryabov-EV Raj-SK Robinson-DJ Oparka-KJ	JOURNAL OF VIROLOGY, 2003, Vol 77, Issue 5, pp 3031-3040	5.241	NBRI
Modulation of Apoptosis at the Molecular-Level by Tumor Suppressors - Possible Targets for Cancer Prevention : Gupta-KP	CANCER EPIDEMIOLOGY BIOMARKERS & PREVENTION, 2002, Vol 11, Issue 10, pp C326-C326	5.140	ITRC
Modulation of Different Stages of Skin Tumor-Development by the Inhibitor of Beta-Glucuronidase, Calcium Glucarate : Gupta-K	CANCER EPIDEMIOLOGY BIOMARKERS & PREVENTION, 2003, Vol 12, Issue 11, pp S1320-S1320	5.140	ITRC
A New Cell Secreting Insulin : Roy-SS Mukherjee-M Bhattacharya-S Mandal-CN Kumar-LR Dasgupta-S Bandyopadhyay-I Wakabayashi-K	ENDOCRINOLOGY, 2003, Vol 144, Issue 4, pp 1585-1593	5.095	IICB

# Know-how licensed for the first time

## Annexure III

### KNOWHOW LICENSED FOR THE FIRST TIME

#### KNOWHOW LICENSED FOR THE FIRST TIME

KNOWHOW/ TECHNOLOGY (LAB)	LICENSEE
<b>CHEMICAL &amp; ALLIED PRODUCTS</b>	
Electrochemical colouring of titanium (CECRI)	General Surgical Company P.Ltd., Chennai
Aqueous cleaning solution for removing oil and grease from steel components (CECRI)	Kalinga Woodlands, Karaikudi Sree Kapragamoorthy Chemicals, Karaikudi
Corrosion resistance thermal coating for hydroclave (CECRI)	Godrej & Boyce Mfg. Company, Mumbai
Low temperature manganese phosphating (CECRI)	Ganapath Chemicals, Chennai
Low sodium salt from bittern (CSMCRI)	Hindustan Lever Ltd., Mumbai
4,4'-methylene bis ( Cyclohexylisocyanate) from 4,4' methylene-dianiline (IICT)	VSSC, Thiruvananthapuram
4-vinyl aniline (IICT)	Anu's Laboratories Ltd., Hyderabad
Alcohol production using free yeast and yeast crystals in modified bioreactor (IICT)	The Godavari Sugar Mills Ltd., Sameerwadi
N-butyrophenone (IICT)	Vinati Organics Ltd., Mumbai
Pheromone chemicals used in sugarcane crop pest (IICT)	Rajshree Sugars & Chemicals Ltd., Coimbatore
Hydrogenation of crude rice bran wax (IICT)	Shri Arihant Petrochem P.Ltd., Bangalore
HFC-134a (Hydrofluorocarbons) (IICT)	SRF Ltd., New Delhi
Bioconversion of Nicotinic acid to 6-hydroxy nicotinic acid (RRL,Jt)	Jubilant Organosis Ltd., Bhartigram
Process for the preparation of p-chlorotoluene	Aarti Industries Ltd., Vapi
<b>DRUGS &amp; PHARMACEUTICALS</b>	

CONSAP(Spermicidal) (CDRI)	Hindustan Latex Ltd, Thiruvananthapuram
Herbal formulation for treatment & prevention of cerebral stroke (CDRI)	Themis Medicare Ltd., Mumbai
<i>FOOD &amp; BEVERAGES</i>	
Jamun fruit products (CFTRI)	Crystal Engineers, Pune J.J.Agro Farms Company, Maharashtra
Dosa batter (CFTRI)	Lakshmi Distributors, Bangalore
Maize chips (CFTRI)	Max Foods, Mumbai
Canned vegetable curries (CFTRI)	Orient Spice Company, Kottayam
Herbal health protective nutraceutical formulations for diabetics (Nutra-diab) (NBRI)	Shivalik Herbs & Neutraceuticals, Lucknow
Fruit based herbal health drink from Tinospora (Herbal beer) (NBRI)	ANJS, Kanpur
Ginger oil/ ginger powder from fresh ginger (RRL,Tvm)	Jindal Extracts and Foods, Roorkee NERAMAC, Guwahati
<b>ELECTRONICS &amp; INSTRUMENTS</b>	
Explosive detector (CSIO)	Security Defence Systems, Chandigarh
Non-linear junction detector (CSIO)	Astra Microwave Products Ltd., Hyderabad
Clinical chemistry analyzer (CSIO)	Rohini Micro Systems, Mohali
Electronic stethoscope (CSIO)	Rotax Electronics P. Ltd., New Delhi
Multi-fibre intrusion detection system (CSIO)	Security Defence Systems, Chandigarh
Dispergraph for measuring and analyzing carbon black dispersion in rubber (CSIO)	Optomech Engineers P.Ltd.,Hyderabad
Digital cereal/ grain analyzer (CSIO)	Vaiseshika Electron Devices, Ambala Cantt.
Belt discharge type vacuum drum filter (CFRI)	Multi Tech Engineers, New Delhi

Hot air tunnel dryer (CFTRI)	R. Lalmalsawma, Aizwal
Hot air popping machine (CFTRI)	Sheetal Arch Restaurant P.Ltd, Mumbai
Axle mounted system for road roughness (CRRRI)	Scientific & Technological Equipment Corpn.,Delhi
Tea leaf pre-conditioning machine for withering (IHBT)	MESCO Equipments P. Ltd., Kolkata
<b>OTHERS</b>	
Poultry intestine silage (CFTRI)	Ratnagiri Zilha Kukkut Palan Sahakari Sangh, Saward
Computer based method identifying conserved invariant peptide motifs (IGIB)	Forjalaja Tech, Hyderabad
Eco-friendly,health protective herbal colours and aroma for cosmaceutical applications (Herbal lipstick) (NBRI)	Ayur Herbal, Alwar
Transgenic new lines of Bt cotton for insect resistance (NBRI)	Swarnabharat Biotechnics P. Ltd., Hyderabad
Relief & Clip software (NML)	CMERI, Durgapur
Bio filter technology (RRL,Tvm)	Envirochem Laboratories P. Ltd.,Trissur

# Members of CSIR Society (including Members of CSIR Governing Body)

## **Annexure-IV** **MEMBERS OF THE CSIR SOCIETY** *(Including members of CSIR Governing Body)*

### MEMBERS OF THE CSIR SOCIETY

1.	Shri Atal Bihari Vajpayee  Prime Minister, Govt. of India	President
2.	Dr. M.M. Joshi  Minister for Human Resource Development and  Science & Technology  Anusandhan Bhavan  Rafi Marg, New Delhi - 110 001	Vice-President
3.	Shri Jaswant Singh  Minister of Finance  Government of India  North Block, New Delhi - 110 001	Member
4.	Shri Arun Jaitley  Minister of Industry  Government of India  Udyog Bhavan  New Delhi - 110 001	Member
5.	Prof. Goverdhan Mehta	Member



	<p>(Chairman, CSIR Advisory Board)</p> <p>Director</p> <p>Indian Institute of Science</p> <p>Bangalore - 560 012</p>	
6.	<p>Shri B. Muthuraman</p> <p>Managing Director</p> <p>Tata Iron &amp; Steel Co. Limited (TISCO)</p> <p>Bombay House, 24 Homi Mody Street</p> <p>Mumbai - 4 00001</p>	Member
7.	<p>Shri Mukesh Ambani</p> <p>Chairman &amp; Managing Director</p> <p>Reliance Industries Limited</p> <p>Maker Chamber-V, 222</p> <p>Nariman Point</p> <p>Mumbai - 400 021</p>	Member
8.	<p>Dr. S.Z. Qasim</p> <p>Vice-Chairman</p> <p>Society for Indian Ocean Studies</p> <p>Secular House</p> <p>1, Aruna Asaf Ali Marg</p> <p>New Delhi - 110 067</p>	Member

9.	<p>Dr. Arun Nigvekar</p> <p>Chairman</p> <p>University Grants Commission</p> <p>Bahadur Shah Zafar Marg</p> <p>New Delhi 110 002</p>	Member
10.	<p>Dr. D.N. Tewari</p> <p>Member</p> <p>Planning Commission</p> <p>Yojana Bhavan, Sansad Marg</p> <p>New Delhi - 110 001</p>	Member
11.	<p>Shri Sirajuddin Qureshi</p> <p>Managing Director</p> <p>Hind Agro Industries Ltd.</p> <p>B-3, Friends Colony (West)</p> <p>Main Mathura Road</p> <p>New Delhi - 110 065</p>	Member
12.	<p>Dr. R. Chidambaram</p> <p>Principal Scientific Adviser to the Govt. of India</p> <p>319, Vigyan Bhavan Annexe</p> <p>Near Vigyan Bhavan</p> <p>Maulana Azad Road</p> <p>New Delhi - 110 001</p>	Member

13.	<p>Shri Ashok Soota</p> <p>President</p> <p>Confederation of Indian Industry (CII)</p> <p>23-26, Institutional Area</p> <p>Lodi Road</p> <p>New Delhi - 110 003</p>	Member
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15.	<p>Shri Mahendra Nahata</p> <p>Chairman</p> <p>Himachal Futuristic Communications Limited</p> <p>8, Commercial Complex, Masjid Moth</p> <p>Greater Kailash – II</p> <p>New Delhi - 110 048</p>	Member
16.	<p>Shri K.V. Kamath</p> <p>Managing Director &amp; CEO</p> <p>Industrial Credit &amp; Investment Corporation of India Ltd.</p> <p>ICICI Tower</p> <p>Bandra, Kuria Complex</p>	Member

	Mumbai - 400 051	
17.	<p>Dr. (Mrs.) Swati A. Piramal</p> <p>Chief Scientific Officer</p> <p>Nicholas Piramal India Ltd.</p> <p>100, Centre Point</p> <p>Dr. Baba Saheb Ambedkar Road</p> <p>Parel, P.O. Box No.6011</p> <p>Mumbai - 400 012</p>	Member
18.	<p>Shri M. Shankar</p> <p>Secretary</p> <p>Department of Rural Development</p> <p>Krishi Bhavan</p> <p>Dr. Rajendra Prasad Road</p> <p>New Delhi - 110 001</p>	Member
19.	<p>Shri R.R. Shah</p> <p>Secretary</p> <p>Ministry of Information Technology</p> <p>Electronics Niketan</p> <p>6, CGO Complex, Lodi Road</p> <p>New Delhi - 110 003</p>	Member

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22.	<p>Dr. R.A. Mashelkar, FRS</p> <p>Director-General</p> <p>Council of Scientific &amp; Industrial Research</p> <p>Anusandhan Bhavan</p> <p>Rafi Marg</p> <p>New Delhi - 110 001</p>	Ex-officio Secretary
23.	<p>Shri D.C. Gupta</p> <p>Secretary (Expenditure)</p>	Member*

	<p>Ministry of Finance</p> <p>Government of India</p> <p>North Block, New Delhi - 110 001</p>	
24.	<p>Dr. T. Ramasami</p> <p>Director</p> <p>Central Leather Research Institute</p> <p>Adyar</p> <p>Chennai - 600 020</p>	Member*
25.	<p>Prof. S.K. Brahmachari</p> <p>Director</p> <p>Institute of Genomics &amp; Integrative Biology</p> <p>Near Jubilee Hall, University Campus</p> <p>Mall Road, Delhi - 110 007</p>	Member*
26.	<p>Shri H.S. Singhania</p> <p>President</p> <p>J.K. Organisation</p> <p>Nehru House</p> <p>4, Bahadur Shah Zafar Marg</p> <p>New Delhi - 110 002</p>	Member*

27.	<p>Shri Vivek Singhal</p> <p>24, Palam Marg</p> <p>Vasant Vihar</p> <p>New Delhi 110 057</p>	Member*
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30.	<p>Prof. R. Kumar</p> <p>Fellow</p> <p>Jawaharlal Nehru Centre for Advanced</p> <p>Scientific Research</p>	Member*

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32.	<p>Dr. R. Katoch</p> <p>Adviser (S&amp;T)</p> <p>Planning Commission</p> <p>Yojana Bhavan</p> <p>Sansad Marg</p> <p>New Delhi - 110 001</p>	Member*



# Members of the Advisory Body

## **ANNEXURE-V**

### MEMBERS OF ADVISORY BOARD

#### MEMBERS OF ADVISORY BOARD

1.	<p>Prof. Goverdhan Mehta</p> <p>Director</p> <p>Indian Institute of Science</p> <p>Bangalore – 560 012</p>
2.	<p>Dr. R.A. Mashelkar</p> <p>Director General, CSIR</p>
3.	<p>Dr. H.S. Singhanian</p> <p>President</p> <p>JK Organisation, Nehru House</p> <p>4, Bahadurshah Zafar Marg</p> <p>New Delhi – 110 002</p>
4.	<p>Dr. Raju D. Shroff</p> <p>Chairman and Managing Director</p> <p>United Phosphorus, Uniplus House</p> <p>Mumbai – 400 052</p>
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