

CSIR NEWS

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Team CSIR



IIP signs MoU with M/s Petroleum India International, Mumbai

THE Indian Institute of Petroleum (IIP), Dehra Dun, has signed an MoU with M/s Petroleum India International (PII), Mumbai, to undertake a study on 'Preparation of on-grade fuel oils from pitch samples'. The objective of the study is to prepare on-grade fuel oil (viscosity 370 cSt at 50°C) from the available pitch by blending it with LVGO or other suitable diluents. PII is a consortium of eight top petroleum and petro-chemical industries in India and provides technical, managerial, human resource training, development activities, and information technology solutions to the petroleum industry the world over in upstream as well as downstream sectors.

NAL signs new agreements

- The National Aerospace Laboratories (NAL), Bangalore, and Transpek Industry Ltd, Vadodara, have entered into an agreement for licensing of Aramid Fibre know-how on 1 March 2007
- Heralding the second phase of 'Mesoscale modeling for monsoon related weather predictions' an agreement has been signed between CSIR; NAL; Bangalore Centre of Tata Institute of Fundamental Research, Indian Institute of Technology, Bombay; Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore; and Encore Software Limited, Bangalore; under the NMITLI programme on 14 March 2007
- An MoU has been signed between ISRO Satellite Center and NAL for the Establishment of a New Acoustic Test Facility (ATF) at ISRO Satellite Integration and Test Establishment (ISITE), Bangalore, in March 2007.



NEERI-Zar Portable Instant Water Filter

DEVELOPED by the National Environmental Engineering Research Institute (NEERI), Nagpur, 'NEERI-Zar' is a water purification system suitable for potable water supply particularly under emergency situations with a wide range of flood water quality. The NEERI-Zar meets drinking and cooking water requirements on emergency basis and therefore can be regarded as a disaster management tool for drinking water supply under flood affected situations. A typical unit, with two 100 L vessels, can serve about 20-30 persons, when operated for 10 hours a day, on the basis of 6-10 litres per capita/day for drinking and cooking purposes.

NEERI-Zar brings down the turbidity of filtered water to less than 3 NTU from raw water in the range 100-300 NTU. The operation of the unit includes disinfection by a chemical agent.

A typical unit comprises two plastic containers placed at elevation difference to manage gravity flow. The top container contains raw water. An oxidizing chemical solution is added into the raw water container. The water flows by gravity into the second plastic container with a fixture and sand filter. The filtered water from the tap is collected in the third container. A disinfectant solution is added to this treated water container, once treated water starts accumulating in the container. The container is allowed to fill up to

the capacity. Safe potable water is ready for use after half an hour. The filter needs periodical cleaning. The typical capacity of the unit is 20-30 l/h of treated water.

The unit was tested in NEERI for the treatment of raw water spiked with turbidity, bacteria and zooplankton. The unit produced filtered water with a turbidity in the range 1.1 to 2.8 NTU from the raw water with the turbidity in the range 14 – 300 NTU. Total coliform and *E. coli* counts in the raw water were in the range 6800 – 78300 CFU/100 ml and 100 – 7900 CFU/100 ml respectively, which is usual range for surface water sources or flood waters. The respective counts in the filtered water were 80 – 7900 CFU/100 ml and ND – 150 CFU/100 ml



"NEERI-Zar" Portable Instant Water Filter



Evaluation of NEERI-Zar installed in the flood affected area of Baitu Block of Barmer District, Rajasthan



indicating 90 – 99% reduction in bacterial load. After disinfection total coliforms and *E. coli* counts were nil in the treated water samples. Zooplankton species like *Cyclops*, *Nauplius*, *Daphnia*, *Branchionus* are also removed during filtration.

The novel features of the present invention are:

- Simple to fabricate
- Easy to operate
- Minimum maintenance
- Light weight
- Ease in transportation and installation
- Most reliable for emergency water supply
- Gravity operated
- No power requirement
- Typical capacity 20 l/h.

NEERI has installed 100 units in the flood affected remote areas of Barmer District in October 2006 to convert the turbid and contaminated rainwater into potable water. Performance of these units under field conditions was evaluated and the opinion of the local people was recorded. People were very happy with the quality of water produced by NEERI-Zar units. They expressed their gratitude for timely help provided by NEERI team for the supply of potable water at the time when all their water sources has been either destroyed or contaminated owing to flood; even tanker water supply was not available because of non approachability of the villages. NEERI has submitted a patent application for the portable instant water filter “NEERI-Zar”

CLRI’s Mobile Blast Chilling System for Preservation of Hides and Skins

THE Central Leather Research Institute (CLRI), Chennai’s designed and tested **Mobile Blast Chilling System** is the first of its kind of such systems developed for preservation of hides and skins in India. The chilling and storage at low temperature preservation of hides and skins will lead to green processing, which has tremendous scope to replace the salt preservation technique and thereby reduce the salinity in tannery effluents.

Airlock, hooking arrangement for hides, SS interior lining of container, FRP (FMC) Chequered plate flooring, corrugated CRCA sheets for container, MIG welding for fabrication of container, special anti-corrosive paints, illuminated safety door lock of the door, alarm for



CLRI designed and tested Mobile Blast Chilling System for preservation of hides and skins

indicating entrapment, energy efficient epm motors of refrigeration system, uninterrupted power by generator are special features of this mobile system.

The mobile system received the Special Jury Commendation for Innovative System Design and figured among the 2nd Bry-Air Awards for Excellence in HVAC&R 2006- 2007



Shri R. Thiagu and Shri N.K. Chandrababu, Scientists, CLRI, receiving the Bry-Air Award



Technologies developed/licensed, Sponsored/Consultancy Projects undertaken, and Technical Services rendered by CECRI

THE technologies developed/licensed, sponsored/consultancy projects undertaken, and technical services rendered by the Central Electrochemical Research Institute (CECRI), Karaikudi, during July to December 2006 include:

Technology developed

- Electrochemical de-arsenator for drinking water.

Technologies licensed

- Magnesium silver chloride seawater activated battery (through NRDC) to M/s Tirven Industries, Hyderabad
- Electrolytic defluoridation of drinking water to M/s Sandur Fluid Controls Private Limited, Bangalore

Sponsored projects undertaken

- Fabrication and supply of 10 numbers of Mg-AgCl sea water activated batteries, for ADE, Bangalore
- Installation of solar lighting systems and conducting hands-on training programmes for village youths and women self-help groups, for Aranmanaipatti Panchayat, Attangudi
- Study of atmospheric corrosion of reinforcement of steel at 20 locations, for Ircon Industry, Muthupet
- Development of solid film lubricant coatings, for DRDO,

- Hyderabad
- Study of super ion conducting solid electrolytes and its industrial applications as solid state batteries for DST, New Delhi
- Evaluation of Exide tubular stationary cells as per Exide specifications, for Exide Industries Ltd, Kolkata
- Evaluation of 12V/150Ah tubular battery as per IS: 13369:1992, for Pandy Oxide & Chemicals Ltd, Kanchipuram
- Studies on the development of high durability and multi functional concrete, for Yonsei University, Seoul, South Korea
- Optimization of product design with cured and formed plate morphology, for Amara Raja Batteries Ltd, Karambakudi
- Design and development of cost effective diagnostic kit and exploration on the development of non-invasive diagnostic tools, for Nicholas Piramal India Ltd, Mumbai
- Electroless nickel plating of 12 numbers. of maraging steel slat track components, for ADA, Bangalore
- Study of the causes of corrosion and suggestions regarding remedial measures to control internal corrosion in Petronet UK pipeline, for Petronet UK Ltd, Larur
- Development of magnetron sputtered transition metal nitride coating (CrN, ZrN, AlN) and evaluation of their

structural, mechanical and corrosion properties, for Department of Atomic Energy, BRNS, Mumbai

- Electrolytic preparation of cerium metal by molten salt technique, for IGCAR, Kalpakkam

Consultancy Services undertaken

- Electro-refining of lead from smelted lead/scrap lead acid batteries, for New Metal Refinery (I) P Ltd, Mumbai
- Long term corrosion monitoring of rehabilitated zirconium sponge plant (ZSP) building on installed sensors for Nuclear Fuel Complex, Hyderabad
- Soil resistivity survey and soil analysis for Kingsway Consultants, Chennai

Technical Services rendered

- Evaluation of 'Hi power' LM cells as per IRS S88/04, for Southern Batteries Pvt Ltd, Bangalore
- Failure analysis of VRLA batteries for Vinit Impex, Mumbai
- Testing of non-organo phosphonate samples for NLC Ltd, Neyveli
- Testing of paint sample for VSSC, Thiruvananthapuram
- Testing of paint sample for DRDO, Hyderabad
- Design & Development of membrane electrode assemblies



(MEAs) for operation of polymer electrode fuel cell (PEFC) under dry condition for Columbian Chemicals Company, Georgia, USA

- Determination of capacity at 10h rate of "Arrow" batteries as per IS:13369:1992 for the following cells/batteries: 12V 40Ah10 & 12V 75Ah10 for Arrow International P Ltd, New Delhi
- Evaluation of galvalume sheets for base metal thickness and coating characteristics for NLC Ltd, Neyveli
- Testing of CPCC system for carrying out relevant tests as per CECRI code of practice for Southern Railway, Muvattupuzha

Projects taken up/completed, S&T Services taken up and Training Programmes organized by IIP

THE projects taken up/completed, S&T Services taken up and training programmes organized by the Indian Institute of Petroleum (IIP), Dehra Dun in the recent past include:

Projects taken up

- Feasibility of producing high specification aromatics from straight-run naphtha using IIP's NMP extraction technology
- Study on diesel buses for evaluation of fuel efficiency at different speeds
- Development of methodology for measurement of CNG consumption on-board CNG bus
- Studies on detailed evaluation of OILEX NL, Vadodara's crude oil sample
- Preparation of on-grade fuel oils from pitch samples
- Study on MS stock losses at ROs/COCOs
- Short evaluation studies on four crude oil samples from ONGC, Assam
- Studies on re-refining of used oil through NMP extraction for production of Group II based oils.

Projects completed

- Study of shear stability property of hydraulic oils
- Study of the deposit characteristics of four-stroke two-wheeler engines
- Studies on development of regenerative process for sulphurdioxide removal from lean gas streams
- Short evaluation studies on Assam mix crude oil
- Short evaluation studies on three crude oil samples including one from Digboi.

S&T Services

- Testing of fire resistance properties of plantoflux 68 AT-S(HFD.U type FRHF) for Fuch Lubricants (India) Pvt. Ltd, Mumbai
- Determination of moisture content in furnace oil for Philips Electronics Ltd, Mohali
- Analysis of RFO/HPS for M/s ACE Glass Containers Ltd, Rishikesh
- Determination of sulphur content in resorcinol for M/s Atul Ltd, Gujarat

Training Programmes

- Training programme on 'Petroleum Refining Technology' for the Non-Chemical Engineers of Kochi Refinery Ltd, Ernakulam, 16-27 October 2006
- Training Programme on 'Petroleum Refining Technology' for the Management Trainees of Kochi Refinery Ltd; 30 October-24 November 2006
- Workshop-cum-training Programme on Vehicular Pollution for the Officers of Transport Departments of Different States, 20-24 November 2006. In this programme 28 Road Transport Officers from Arunachal Pradesh, Gujarat, Haryana, Kerala, Maharashtra, New Delhi and Rajasthan participated.
- Training Programme on 'Petroleum Refining Technology' for the Chemical Engineers of HPCL, Mumbai, 11-29 December 2006.

National Botanical Research Laboratory

R&D Highlights: 2005-06

DURING the last five decades, the National Botanical Research Institute (NBRI), Lucknow, has developed capability in several aspects of plant science, specially biodiversity, biotechnology, bioprospecting, environmental sciences, herbal products and IPR. These areas are critical to advancing knowledgebase in plants science and socio-economic development of the country. The laboratory has been involved in 158 multi-disciplinary, externally funded, networked, technology leadership and in-house R&D programmes.

Noteworthy technologies transferred for commercialization during the year 2005-06 pertain to: Bio-diesel from *Jatropha*, Nutra-Diab, *Trichoderma* based bioinoculant, herbal dry colour (gual) and *Bacillus* spp. based biofertilizer. The institute continued with its year round activities of conducting summer training programmes and trainings. Rural development programmes gained further momentum by organizing a number of events for farmers.

R&D Highlights

Plant Biodiversity & Conservation Biology

The Plant Biodiversity and Conservation Biology group worked on both basic and applied projects related to taxonomic revision, biodiversity assessment of lower and

higher groups of plants, ethnobotany, conservation biology, molecular taxonomy, seed biology and palynology studies. Molecular and systematic studies of *Astragalus rhizanthus* complex and *Oxytropis* sp. was initiated to decide the correct identity, taxonomic position and relationship of the species as well as to study their genetic variability.

Studies were continued for the molecular taxonomy and assessment of the genetic diversity in wild species of *Citrus* and *Atalantia* in India. Extensive and intensive germplasm surveys were conducted in various geographical regions of the country.

The extraction methods of fibre from the plants such as, *Cryptolepis buchmanii* and *Marsdenia tenacissima* as used by the tribal people were analyzed. The folk knowledge for conservation and natural association with other plants of above species has been recorded. A study was conducted to know the status of lichen diversity in Jammu and Kashmir and Uttara nch al Himalayas. A total of 279 species belonging to 79 genera and 33

families of lichens were recorded from the State of Jammu & Kashmir. The lichen diversity of certain areas was utilized for monitoring of pollution in these areas.

The Bryology group revealed that two bryophytes species, viz., *Plagiochasma appendiculatum* and *Mnium marginatum* accumulated a fair amount of heavy metals (Pb, Cu, Zn, Ni, and Mn). *Mnium marginatum* has been found to be higher hyperaccumulator as compared to *Plagiochasma appendiculatum*. Studies on the bryoflora of Darjeeling and its neighbouring areas have revealed the occurrence of 267 taxa of



A. Fruit, seeds and fibres of *Cryptolepis buchmanii*; B. Sauria Paharia tribal man holding *Marsdenia tenacissima*; and; C. Extracted fibres from *M. tenacissima*



bryophytes comprising 153 taxa of mosses, 105 liverworts and 9 hornworts.

The surveys were made in the fly-ash contaminated areas of thermal power and coal mine areas of Sonbhadra district of Uttar Pradesh to collect ferns and fern allies. *Christella parasitica* and *Pteris vittata* collected from polluted areas near the dumps of thermal power stations and Hindalco industries, interestingly showed high reproductive capacity. For the conservation of some threatened and economically important ferns, reproductive biology of six threatened, economically important taxa, namely, *Microsorium punctatum*, *M. alternifolia*, *Pityrogramma chrysophylla*, *P. calomelanos*, *Cyathea spinulosa*, and *C. nilgirensis* was studied.

The polluted water bodies of Lucknow, Kanpur and Unnao districts were surveyed and a few members of Chlorophyceae family, viz. *Phacus caudata*, *Euglena* sp., *Spirogyra* sp., *Oedogonium capilliforme*, *Scenedesmus limorphus*, *Chlamydomonas globose* and *Ulothrix* sp and Cynophyceae, viz. *Oscillatoria nigra*, *Phormidium* sp., *Spirulina meneghiniana*, *Lyngbya majuscula* and *Aphanocapsa grevillei* found in these polluted water bodies. Non-heterocystous forms of algae seem to have high degree of pollution tolerance capacity.

A comprehensive palynological analysis of regional honeys originating from Gangetic region was carried out which included identification of predominant,

secondary and important minor pollen types of regional honeys of Gangetic plain along with identification of main honey flow season and lean season of this area. The Seed Biology group continued to study the reproductive biology of *Rauvolfia* species in relation to seed sterility and seed germination for the third consecutive year.

Biomass Biology and Environmental and NBRI Farm Stations

The agrotechniques were developed for cultivation of *Bacopa monnieri* (Brahmi), *Acorus calamus* (Vachh), *Commiphora wightii* (Guggul) and *Chlorophytum borivlianium* (Safed musli). Propagation technique for faster propagation with minimum portion of *Acorus calamus* rhizome was developed. Guggulsterones E and Z concentrations were found to vary greatly among different individuals of guggul germplasm collected from different geographic locations of the country. Various eco-friendly methods, viz., allelopathic effect, integrated approach and by creating competition were successfully applied for the control and management of obnoxious weed, *Parthenium hysterophorus*, which is of concern not only to agriculture, but also to human and animal health.

Molecular characterization of phytochelatin synthase gene from *Ceratophyllum demersum* was performed under the project phytoremediation of toxic metal ions from polluted environment through phytochelatin synthase activity. A full-length gene of 1757 base pair was

cloned, out of which 1503 bp codes for amino acids for PC synthase. In another experiment, rice varieties, viz. Sabha-5204 and Saryu-52 were found suitable for cultivation in FA amended agricultural soils for better crop yields. It was found that plants growing on tannery sludge have accumulated substantial amount of different toxic metals in the order: Fe, Cr, Mn, Pb, Zn, Cu and Ni, which led to reduction in the level of metals from the sludge.

An eco-friendly consortium of compatible strains of *Bacillus subtilis* and *Trichoderma harzianum* was prepared and evaluated in fields to control *Fusarium* wilt of chrysanthemum caused by *Fusarium oxysporum* f. sp. *chrysanthemi*. The effect of consortium on growth promotion in gladiolus was also observed. The results revealed that the consortium was better amongst different treatments under field conditions in controlling the *Fusarium* wilt.

Molecular Biology and Genetic Engineering

Under the project 'Using functional genomics in tea and Mentha for gene expression modulation', a highly expressing 568 bp bidirectional promoter was developed that initiated transcription simultaneously in both the directions. The promoter simultaneously expressed the reporter genes (*gusA* and *gfp*) in both sense and anti-sense directions in transient as well as stable transformations. A patent has been filed for securing rights on the sequence comprising the above bi-



directional promoter. The role of TATA-box in the regulation of gene expression was studied. A thirteen-nucleotide long sequence was identified as an efficient TATA box by computational analysis of gene sequence database.

In order to identify the genes related to ripening, in banana and to understand the complex regulatory mechanism of genes involved in ripening the scientists prepared a PCR select subtractive library using mRNA from unripe and ripe banana fruits. A few novel genes have been identified and can be candidate genes to be used for delaying ripening. Studies were also initiated to understand molecular basis of ripening in mango (*Mangifera indica*, var. *dashehari*).

Three new isolates of Cucumber Mosaic Virus from Chrysanthemum, tomato and banana were identified on molecular basis. These Indian isolates of CMV formed a separate

cluster indicating close relationships with each other. A sensitive nested PCR has been developed for the detection of a phytoplasma associated with yellow leaf symptoms of *Catharanthus roseus*, which will be useful in regenerating phytoplasma-free *C. roseus* plants.

Pharmacognosy & Ethnopharmacology

Based on the concept of traditional ancient texts and pharmacognostical and toxicological studies, an anti-cigarette product was developed using critical effective ingredients of a number of plant species along with the diluents/recipients. The effective composition has been filed for the global patent jointly between NBRI (CSIR) and MIR Holistics. For the development and commercialization of bioactive molecules from plants, 25 plant parts of 17 plants were collected in bulk, 33 parts extracted with alcohol, aqueous alcohol and water. Around

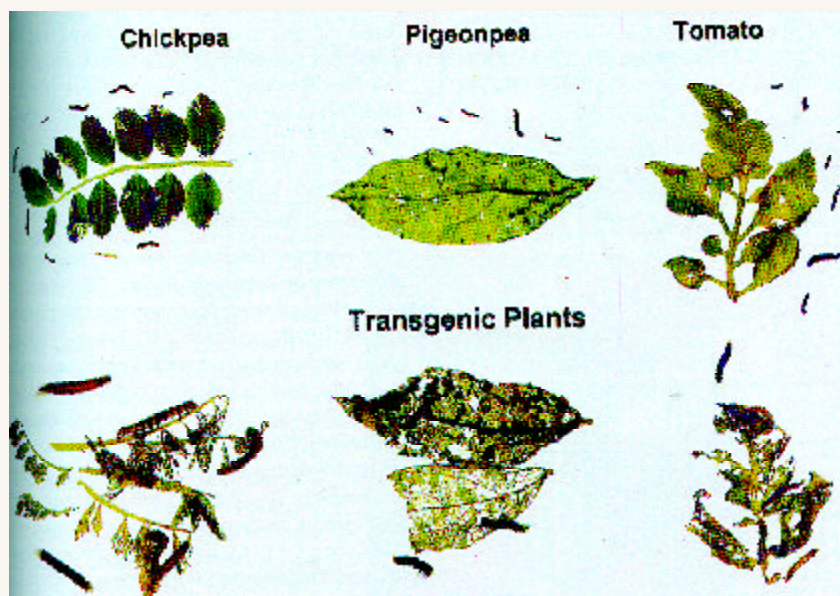
hundred extracts were made and 1620 samples of 70 extracts were sent to different CSIR laboratories for biological screening.

Phytochemistry

In order to identify potential sources of the antioxidants for the development of nutraceutical products, extracts of some medicinal plants were studied by using different methods. Various parts of *Azadirachta indica*, *Cassia fistula*, *Casuarina equisetifolia*, *Indigofera tinctoria*, *Lawsonia inermis* and *Trewia nudiflora*, were found to have high phenols, high AOA, high antiradical power and protection of DNA nicking, indicating very strong free radical scavenging activity of their extracts. The leaves of *Averrhoa carambola* were found potential source of chlorogenic acid; flowers of *Indigofera tinctoria*, leaves and fruits of *Lawsonia inermis* and *Trewia nudiflora* of gallic acid; leaves of *Trewia nudiflora* of quercetin and leaves of *Casuarina equisetifolia* of rutin.

Floriculture, Botanic Garden and Eco-education

The existing germplasm collection of diversified groups of plants is being constantly enriched for the purpose of aesthetic and educative display besides promoting nursery trade of ornamental plants. Two new plant introductions, namely, *Zamia splendens* – a native of Mexico and *Bougainvillea* 'Royal Daupline' have been introduced in the institute's garden from Germany and Thailand, respectively. Two new cultivars of *Gladiolus*, namely 'Urvashi' and 'Neelima', were



Transgenic plants expressing modified Bt-cry1Ac for insect resistance



developed and released for public this year during Annual Rose and Gladiolus show of the institute.

Biotechnology and Plant Physiology

A novel super stable superoxide dismutase (SOD) from the leaves of *Curcuma longa* was extracted and purified. The scavenging activity of



Gladiolus "Neelima"



Gladiolus "Urvashi"



Bougainvillea 'Royal Daupline' - introduced and acclimatized and established by NBRI

this SOD remains intact both in crude and purified forms before and after heating at boiling temperatures (80-100°C) up to 20 minutes, autoclaving and even to microwaving for 5-10 min. This is unique example of a super stable superoxide dismutase from a tropical medicinal plant.

Collaboration has been developed with Balrampur, Haidargarh and Tulsipur sugar mills for studies on sugar industry effluents and wastes under the Task Force Project on 'Industrial minimization and clean up'. The results showed that wastes from sugar industry (pressmud and biocompost derived from PM) can reverse the toxicity caused by cadmium and reverse some of their effects on antioxidant enzyme activities.

An *in vitro* strategy for germplasm preservation of neem regenerant has been developed successfully. For this, differentiation in segments of excised root culture was augmented by supplementing a polyamine. Histological studies revealed the origin of regenerants from Pericycle tissue of root, testifying true-to-type nature of root-generated plants. The scientists of the Betelvine Biotechnology succeeded in growing betelvine in water culture and showed the possibility of promoting it as home scale technology for growing *Piper betle*.

S&T Support Services

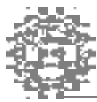
The Bioinformatics Centre continued the development and upgradation of Legume Database of South Asia (LDSA), Reference

Management System (RMS), PLIN-Base for creation of nomenclature database of Plants of India, PLIN-Web for creation of database on Web for Plant diversity of India, Herbnnet for creation and management of database of herbarium specimen and PLIN-UP for creation of database of plant resources of UP. A state-of-the-art TKDL (Traditional Knowledge Digital Library) cell has been fully established at NBRI and information on 1500 names of Ayurvedic plants and 4680 Nomenclature corrections of the 4680 species has also been completed.

The scientists of the Economic Botany Information Service, Information, Liaison and International Scientific Collaboration, Planning and Co-ordination, Report Cell, Technology Transfer and Business Development Group & Training Cell, Patent Cell, SEM and TEM laboratory, Photography and Exposition provided valuable services to scientists of NBRI and other research organizations. Fifteen scientists of the institute were deputed to visit various countries under the bilateral exchange and other programmes to attend conferences, symposia and seminars. A number of distinguished visitors including several foreign scientists visited the institute.

Honours and Awards

Dr Rakesh Tuli, Director, NBRI and his team comprising Drs P.K. Singh, S.V. Sawant, Mithilesh Kumar and C.P. Chaturvedi, were conferred the prestigious CSIR Technology Prize-2005 for



'Development of artificial promoters, novel d-endotoxin coding genes and transgenic cotton lines for resistance to insect pest'.

International Research Society Complementary and Alternative Medicine, Risk Factor Modification Center, St. Michael's Hospital, University of Toronto, Canada, awarded Honorary-Fellow and Life Membership to Dr Rakesh Tuli, Director, NBRI for his outstanding contribution to the area of Molecular Biology and in the promotion of the Natural Health Products at global level.

Dr Samir V. Sawant, has been awarded the prestigious innovative Young Biotechnologists Award 2005 by DBT, New Delhi for his outstanding contribution and innovative approach in Biotechnology. He was also awarded the Young Scientist Award by Indian National Science Academy.

Dr D.K. Upreti, Scientist, Lichenology Laboratory, was awarded prestigious 'Prof. Bashir Ahmad Razi Medal (2006)' of the Association for Plant Taxonomy (APT) for his outstanding contributions to taxonomy.

Dr H.B. Singh, Scientist, Plant Pathology Division, was awarded SOM award as a team member by Essential Oil Association of India, New Delhi.

Dr S.K. Tewari, Scientist, NBRI, was honoured with Rajbhasha Kirty Samman by Bhartiya Rajbhasha Vikas Sansthan, Dehradun.

Publications/Patents/MoUs

A total of 145 research papers were published in various national and international journals.

Nineteen MoU's were with different agencies and parties Thirty patents were filed in India and abroad, while seven patents were awarded during the year.

New Processes/Products from CFTRI

Spray Dried Coconut Milk Powder

COCONUT milk is a white milky produce extracted from the endosperm of coconut and constitutes an emulsion stabilized by proteins. The milk has a characteristic nutty flavour and is known to have many nutritional advantages. It is one of the prime ingredients in the preparation of sweets, confectioneries, vegetable curries, beverages and non-vegetarian dishes. The Central Food Technological Research Institute (CFTRI), Mysore, has developed a process for spray dried coconut milk powder as a value-added product, benefiting a large number of farmers. The process involves dehusking, paring and grating of ripened coconuts. The grated coconut is comminuted and milk which is extracted is homogenized and spray dried under optimum conditions. The dried powder is later packed in the laminated pouches with or without nitrogen. Disintegrator, screw-press, vibrating screen, homogenizer, spray drier, vibro fluidized bed dryer, pasteurizer and oil expeller are the equipment required.

Spouted Coffee Bed Roaster

The spouted bed roaster technique is an alternative to the fluidized bed roaster. Though the areas of application of a spouted bed overlap with those of the fluidized bed, the mechanism of operation is different. The spouted bed roaster technique results in good solid mixing and effective gas particle contacts facilitating high temperature short time (HTST) processing. The importance of the spouted bed roasting is that the heat can be applied quickly resulting in enhanced aroma and flavour, retention of high organoleptic and nutritional attributes in the final product. Since the roasting chamber is transparent, degree of roasting (colour analysis) can be easily regulated. Spouted bed roaster, which works on HTST principle, removes unwanted materials, thereby ensuring the quality product. Also the technique provides higher percentage of soluble solids, swelling ratio and breaking strength compared to that obtained using any commercial drum roaster. The quality of the coffee is excellent. The roaster can also be used for roasting of other food grains like bengal gram, ground nuts, cowpea, cashew and makhana seeds. The resultant product will have better organoleptic properties. The design drawings of the product can be had from the institute.

Conference on Chemical Metrology

THE National Physical Laboratory (NPL) and Metrology Society of India (MSI) organized an International Conference on Advances in Metrology (AdMet-2006) in conjunction with 22nd APMP General Assembly and Related Meetings in India [CSIR News, 57(2007), 62]. As a parallel event, a Conference on Metrology Chemical was also organized in collaboration with Asia Pacific Metrology Program (APMP) and Co-operation on International Traceability in Analytical Chemistry (CITAC) during 11-13 December 2006. Nearly 90 scientists from Australia, Brazil, China, Germany, Hong Kong-China, Indonesia, The Netherlands, New Zealand and India participated in this event. Eminent chemical metrologists delivered 20 invited talks and presented 15 poster papers. The scope of the conference was traceability in chemical measurement, recent scientific/technical advancement to realize the SI unit mole, certified reference materials (CRMs), and regional and international inter-comparison programme.



Dr Robert Kaarls, Secretary, CIPM and Chairman, CCQM, The Netherlands, (extreme left) addressing the participants of the Conference on Chemical Metrology

Secretary, CIPM and Chairman, CCQM, The Netherlands, was one of the key speakers who gave information on the Metre Convention: Establishing Global Comparability of Chemical

Measurements Results. Dr. Lindsey Mackey, Chairperson, CCQM Working Group, Key Comparison, Australia and Dr Ed W.B. de Leer, Chairman CCQM Working Group, Gas Analysis, The Netherlands, delivered lectures on 'Assignment of SI-Traceable Reference Values to Proficiency Testing Schemes for Food Analysis' and 'State of the Art Gas Analysis' respectively. Dr (Ms) Vera Poncano, Chair, CITAC, Brazil and Dr Arun K. Agrawal, Head, CRM

Programme of National Physical Laboratory, India, delivered general lectures on 'Co-operation on International Traceability in Analytical Chemistry (CITAC)' and 'COMAR International Database of



A view of the participants of the Conference on Chemical Metrology Seen in first row from left are: Dr V. Poncano, Brazil; Dr A.K. Agrawal, NPL, India; Dr Ed W.B. de Leer, The Netherlands; S. Mitra, CFRI, India and Dr S.K. Halder, NPL, India.

Dr Robert Kaarls,



Certified Reference Materials' respectively. The other eminent speakers Dr Laly Samuel, New Zealand; Dr Laurie Baseley, Australia; Dr J. Arunachalam, India; Dr V. Balaram, India; Yu Yadong, China; Prabhat K. Gupta, India; Dr Krishan Lal, India; Dr Della Sin, Hong Kong – China covered the topics related to traceability in chemical measurement, mutual recognition arrangement (MRA), certified reference materials (CRMs), SI unit mole, new methods of analysis, uncertainty in chemical measurements and national/regional/international inter-comparison and proficiency testing (PT) programme.

Six CRMs of mono elemental solutions of lead, cadmium, cobalt, zinc, iron, copper and 4 pesticides namely chlorpyrifos, isoproturon, fenvalerate, cypermethrin were also released by Dr Robert Kaarls and Mr G. Gyani, Secretary General, Quality Council of India jointly on 13 December 2006. A special issue of the Journal of Metrology Society of India – MAPAN (MSI-NPL publication) is planned to publish the papers presented in the conference.

Release of New Certified Reference Materials (Bharatiya Nirdeshak Dravyas)



Dr Robert Kaarls, Secretary, Comite International des Poids et Mesures (CIPM) and Chairman, Consultative Committee on Amount of Substance (CCQM) and Mr G.J. Gyani, Secretary General, Quality Council of India, releasing certified reference materials. On their right are Dr A.K. Agrawal, Coordinator, Certified Reference Material Programme and Dr Vikram Kumar, Director, NPL

THE National Physical Laboratory (NPL), New Delhi, is coordinating a multi-laboratory programme on preparation and dissemination of certified reference materials as Task 4 in the CSIR Network project on *Up-gradation of SI Base Units, National Standards of Measurements & Apex Calibration Facilities and Creation of High Quality Network of Testing and Calibration Laboratories and Preparation & Dissemination of Certified Reference Materials (CMM 0024)* to provide the traceability in chemical measurement in the country. It had created a network of 35 reputed laboratories of the country to carry out this work. These laboratories belong to various sectors of the country namely atomic energy, space, power, petroleum, agriculture in addition to scientific and industrial research.

In recent years, the activities under the CRMs programme have been enhanced to meet the requirement of CRMs needed in other S&T sectors. To achieve the set targets, NPL created 10 satellite groups with each having a 'lead laboratory' with long experience in that area. Laboratories designated as 'lead laboratory' are National Geophysical Research Institute, Hyderabad, for Geo-chemicals; Indian Institute of Chemical Technology, Hyderabad, for Fine Chemicals & Pesticides; Central Food Technological Research Institute, Mysore, for Food & Related Pesticides; Indian Institute of Petroleum, Dehradun for petroleum; National Metallurgical Laboratory, Jamshedpur for Spectroscopic Ferrous Alloys; Central Drug Research Institute, Lucknow for Bio, Clinic & Drugs and NPL for Mono & Multi Elemental Solutions, Greenhouse &



Other Gases, XRD Standards and SEM/TEM Gold Resolution Standards. NPL is providing metrological support for certification of the property of CRMs prepared under this programme.

Thirty-five reputed laboratories of the country including those of CSIR, Bhabha Atomic Research Centre, Indian Agricultural Research Institute, R&D Centres of Indian Oil Corporation and National Thermal Power Corporation, etc. are participating in the programme. This year, work on preparation of CRMs in four new sectors, namely Food, Petroleum, Spectroscopy and Geochemicals has been initiated. Scope in the areas where work is already in progress e.g. CRMs of elemental solutions, pesticides, gas mixture and silicon powder for X-ray diffraction, has also been accelerated and several new CRMs are under preparation. Stakeholders of the CRMs prepared under this programme are the laboratories of CSIR ICAR, BIS, NTH, industries, accredited laboratories, atomic and defence sectors..

Dr Robert Kaarls, Secretary, Comite International des Poids et Measures (CIPM) and Chairman Consultative Committee on Amount of Substance (CCQM) and Mr G.J. Gyani, Secretary General, Quality Council of India, released 10 new Certified Reference Materials of two categories on 13 December 2006 in the inaugural symposium of Asian Pacific Metrology Programme (APMP) General Assembly and related meetings. With the release of these, the number of CRMs available at NPL has increased to 32. Details of the CRMs released on 13 December are given in the box.

Dr Vikram Kumar, Director, NPL, welcomed Dr Kaarls and Mr Gyani for releasing the CRMs. They have also expressed their happiness on the release of the CRMs. Calling it as a special day for NPL as these CRMs were being released at an international event, Dr A.K. Agrawal, Head, CRM Programme, NPL, congratulated all the BND team members over their achievements. Later, he also proposed a vote of thanks.

SERC Training Course on 'Computational Methods for Process Simulation and Analysis: Software And Applications' at NCL

THE National Chemical Laboratory (NCL), Pune, jointly with Science and Engineering Research Council (SERC), Department of Science and Technology (DST), Government of India, organized a two-day training course on 'Computational methods for process simulation and analysis: Software and applications' on 1-2 February 2007 at NCL. The course was aimed at introducing the conceptual framework of various computational strategies on (i) phenomenological process modeling including methodologies with a special focus on polymerization reactor engineering and (ii) artificial intelligence, machine learning and wavelet based paradigms comprising major data driven-methods such as artificial neural networks, genetic algorithms, genetic programming, fuzzy logic, wavelets and support vector machines for process engineering applications namely modeling and optimization. Scientists from Chemical Engineering and Process Development Division (CEPD) and Homogeneous Catalysis Division of NCL delivered the talks and

1. Mono Elemental Solutions

- 1.1 Lead Solution (BND 105.01) - concentration 5.01 ± 0.04 mg/L
- 1.2 Cadmium (BND 205.01) - concentration 5.00 ± 0.04 mg/L
- 1.3 Zinc (BND 1205.01) - concentration 5.00 ± 0.04 mg/L
- 1.4 Iron (BND 1305.01) - concentration 5.00 ± 0.04 mg/L
- 1.5 Copper (BND 1405.01) - concentration 5.01 ± 0.04 mg/L
- 1.6 Cobalt (BND 2205.01) - concentration 5.01 ± 0.04 mg/L

2. Pesticides

- 2.1 Chlorpyrifos (BND 1701.02) - Purity $99.08 \pm 1.28\%$
- 2.2 Isoproturon (BND 2001.02) - Purity $99.10 \pm 1.4\%$
- 2.3 Fenvalerate (BND 3101.01) - Purity $99.09 \pm 0.94\%$
- 2.4 Cypermethrin (BND 3201.01) - Purity $99.09 \pm 0.82\%$



conducted hands-on training including the demonstration of software packages in four major sessions. About 35 participants from academia, R & D institutes and industry attended the course.

Dr B.D. Kulkarni, Deputy Director and Head, CEPD, in his opening remarks introduced the central theme of the course and elaborated the relevance of process modeling and optimization to chemical engineering education, research and practice. He stressed that most chemical engineering operations involve a range of length and time scales over which events occur and different types of models are necessary to capture the physico-chemical phenomenon underlying chemical processes. Dr Kulkarni also elaborated the role, scope and appropriateness of phenomenological models and their solution methodologies and wavelet, artificial intelligence and machine learning based modeling and

optimization methods. He introduced the stated formalisms with a view to summarizing and supplementing the more detailed presentations on the respective topics that followed subsequently.

Polymers are one of the most important commodity chemicals, consumption of which is continuously growing. Synthetic polymers are produced using a wide range of technologies. For optimal use of these technologies, it is essential to establish a link between the reactor performance (polymer production, characteristics and particle size distribution) and reactor hardware with operating conditions. A half-day session was, therefore, dedicated to polymer reaction engineering and on **the software tool called PoRE (polymerization reactor engineering tool) developed at NCL**. Dr V.V. Ranade in his talk on polymerization reactor engineering gave a general presentation on reactor, process and

product engineering. He gave a broad overview on computational modeling needs for entire life cycles of chemical processes right from conception to decommissioning. He explained the different ways of computational modeling and related them to different engineering objectives.

Shri R.P. Utikar covered the development of a detailed dynamic model of a fluidized bed polymerization reactor. The model, which is capable of simulating both polymer properties and polymer particle size distribution simultaneously, was explained with adequate detail. The modeling framework is general enough to accommodate multiple monomers and multiple sites and has an ability to simulate any Ziegler-Natta polymerization in fluidized bed. The model also possesses unique capability of simulating super-condensed mode of fluidized bed operations. The model can also be



Group photo of the participants



effectively used to understand the dependency of macroscopic variables such as temperature, monomer conversion, polymer grade transitions and PSD on the catalyst properties. The applications of the computational model were discussed with specific examples. The basic mathematical models are implemented into user-friendly software called PoRE. MSEExcel spreadsheet-based plug in to PoRE was also developed so that PoRE can be seamlessly used within MSEExcel. The next presentation was devoted to explain the user interface and usage of PoRE software. Hands-on session was also arranged on desktop PCs at Digital Information Resource Center where access to PoRE was arranged. Applications of software for other types of polymerization systems and reactors were also discussed. Dr Ranade concluded the session on PoRE by reviewing the session and making general comments about how to use such computational tools for performance enhancement in practice.

In the second session of the day, Dr V. Ravi Kumar conducted an intensive course on "Wavelet transforms and their applications in complex systems analysis." The course was held in two parts. The first part covered aspects related to the principles, description and applications of wavelet transform. It included: (i) Wavelet transforms (WT) by lifting techniques, (ii) Studying complex data by discrete wavelet transform (DWT) and showing its usefulness, (iii) Interpretation of the WT based on Haar and other basis functions, (iv)

Connections between WT and high pass and low pass filter coefficients, (v) Wavelet packet analysis, and (vi) Extension of 1-dimensional WT studies to 2-dimensional WT for studying space-time systems. The course notes describing the general methodology and concepts were distributed among the participants.

The second part of this session laid emphasis on applications of wavelet transforms. Software demonstration with case studies included (i) Analysis of the chaotic dynamics of non-isothermal reactors using WT and its usefulness in studying event detection and safe reactor operation, (ii) resolution of fast and slow time scales in nonlinear dynamical systems, (iii) noise reduction in data monitored from complex processes, (iv) studying hot film anemometry (HFA) turbulent data from a jet reactor, (v) data analysis and Interpretation with wavelet transform for multiphase systems, and (vi) GUI demonstration and description of the developed software with relevant case examples. This part of the course was conducted by Dr Ravi Kumar, Dr Amol Kulkarni and Shri Sagar Deshpande (ICT, Mumbai).

Phenomenological models of chemically reacting systems are capable of providing fundamental understanding of the physico-chemical phenomena underlying the process behaviour. In many instances, they can also be used in the extrapolated regions of the parameter and variable spaces of the model. Notwithstanding these positive features of phenomenological models, their development in most cases of

practical interest is difficult, costly and cumbersome owing to (i) insufficient knowledge of the underlying physico-chemical phenomena, (ii) complex nonlinear behavior exhibited by a large number of chemical processes, and (iii) extensive experimental and computational effort needed to study the factors influencing the process behaviour. In common industrial practice, process related problems require quick solutions and thus solutions based on the phenomenological models may not be feasible.

In the last two decades, artificial intelligence (AI) and machine learning (ML) paradigms have found ever-increasing applications and popularity in process engineering. The AI and ML based paradigms have two major application areas, namely process modelling and process optimization. While methods such as artificial neural networks (ANNs), genetic programming (GP), fuzzy logic (FL) and support vector regression (SVR) are used for modelling, genetic algorithms and evolutionary algorithms are employed for nonlinear optimization. The AI based models are exclusively data-driven and can be built even when adequate knowledge of the physico-chemical phenomena underlying a process does not exist. Once developed properly, the data-driven models can be used for a variety of process engineering tasks involving nonlinear control, identification, fault detection diagnosis, classification and optimization. Dr S. S. Tambe in his lecture on "Process engineering applications of



artificial intelligence paradigms” outlined the basic principles and provided practical guidelines for building data-driven process models using various AI and ML formalisms. A number of ANN architectures along with methods of their training, testing and validation were illustrated through process engineering case studies involving modelling, monitoring, control, identification, classification, input selection and dimensionality reduction. He also illustrated process optimization applications of genetic algorithms (GA) and the novel hybrid modeling and optimization method namely ANN-GA.

NCL has developed a software package for the novel AI-based data-driven formalism namely genetic programming and its efficient variant termed as “memetic programming (MP)”. The novelty of GP and MP formalisms is that they can search and optimize the best fitting multiple input - single output (MISO) type linear/ nonlinear function and all its parameters automatically and exclusively from historical process input-output data. Dr Tambe presented the salient features of GP and MP formalisms and their process engineering applications involving data-driven modeling. Additionally, in the hands-on session, the in-house developed GP-MP software package was demonstrated.

Data-driven models can be employed in situations where there is no substantial understanding of the phenomenology involved. They are more robust to presence of noise and relatively scarce measurements, and are thus becoming more attractive. In recent years a new machine-learning paradigm known as “kernel machines” based on the notion of implementing kernel trick is becoming increasingly popular in different fields. A family of kernel methods mainly includes support vector machines (SVM), kernel principal component analysis (kernel PCA), support vector regression (SVR), support vector domain distribution (SVDD) etc. Apart from data driven modeling these algorithms can be employed to solve a variety of classification and regression tasks in different fields. Dr V. K. Jayaraman provided a lucid introduction on applications of kernel machines to data driven modelling and for solving problems in chemo and bio-informatics. He gave a complete overview of all the methods with a view to make the participants well conversant with these topics. Several case studies regarding applications of the methodologies to process fault detection, gene identification, identification of protein and gene functions and biomedical signals were discussed in detail. Finally, a hand on demonstration session of

the developed software on kernel machines was conducted with a view to illustrating the power, capabilities and usefulness of the developed methodologies to the participants.

In the concluding session, Shri Rajiv Tayal, Convener, Chemical Engineering Sub-Committee of DST, explained the genesis of the workshop and highlighted the role of DST in general and SERC in particular in imparting knowledge to young researchers with a view to enabling them undertake independent research in cutting edge areas of science and engineering.

The elaborate hands-on sessions after each lecture provided interactive discussions, case studies, discussions and software demonstration and training. The course notes for the SERC Workshop were prepared in the form of ‘hand-outs’ for easy reference. The reference material, along with the lectures, hands-on sessions and group discussions provided necessary insights for acquiring knowledge and skills to initiate research and development in various process engineering tasks such as modeling and simulation, process control and optimization, fault detection and diagnosis, monitoring, identification, input selection and dimensionality reduction.