

OVERVIEW

The Council of Scientific and Industrial Research, a multilocational network of national laboratories/institutes, has the mandate to undertake research and development projects in diverse fields of science and technology, with emphasis on applied research and utilization of results thereof. There are at present 38 research establishments including five regional research laboratories. Some of the establishments have also set up experimental, survey field stations to further their research activities and 39 such stations attached to 16 laboratories are functioning at present.

In general, all the laboratories are well equipped for undertaking basic and applied research, including development work. Many of them work on industrial raw materials and have research programmes on their beneficiation, testing and standardization. Many problems of industry, and even of pure science, being multi-disciplinary in character require for their solutions, the knowledge and techniques of more than one branch of science and call for team-work. CSIR laboratories have created facilities for such team-work; the 38 laboratories provide synergistic, discipline specific, research platforms.

During the Tenth Five Year Plan, CSIR has conceptualized network projects involving various CSIR laboratories and other R&D establishments. The results of networking are very encouraging.

The Annual Report 2005-06 presents CSIR's S&T contributions in the sectors such as Aerospace Science & Technology, Biology & Biotechnology, Chemical Science & Technology, Earth Resources & Natural Hazards Assessment, Ecology & Environment, Energy, Food & Food Processing, Health Care, Drugs & Pharmaceuticals, Housing & Construction, Information Dissemination & Products, Leather, and Material, Minerals, Metals & Manufacturing. Various activities related to Central Management and Headquarters are also detailed in the Report. The section on 'Dateline CSIR' lists the significant events that took place at various CSIR constituent laboratories during the year.

Some of the notable achievements of the year 2005-06, as presented in this report, are:

Anti-leukemic compound from *paan* leaves

IICB scientists have isolated from the leaf of the betel plant (*piper betel*) a compound that is able to induce death of cancer cells in chronic myeloid leukemia (CML) — a type of cancer that attacks white blood cells. Locally known as *paan*, the leaf is widely chewed by people in the Indian subcontinent as an aid to digestion. The compound, that has the same structure as chlorogenic acid (*Chl*), kills cancerous CML cell lines without harming normal cells.

New lead molecule for malaria

NIO has reported that the crude extract prepared from a marine organism (mussel) by the enzyme-acid hydrolyzing process shows a potent anti-malarial

activity, when examined for *in-vitro* cultures of *Plasmodium falciparum* in human erythrocytes. The molecular entity responsible for anti-malarial activity was isolated & characterized. These molecules present themselves as promising candidate drugs for malaria and may be used in conjunction with conventional drugs. The active compound is relatively cheap to obtain and can readily be prepared in bulk without killing the mussel. The Mumbai-based company M/s Shreya Life Sciences has been licensed to commercialize the drug.

Oral delivery of insulin & Hepatitis B vaccine

IICT has developed a process for the oral delivery of Insulin and also of Hepatitis B vaccine. This new invention is a boon to the diabetic population showing the reduction of blood glucose levels comparable to that of the injectable insulin. The preclinical toxicity studies have been planned and the clinical trials in India and Europe will be taken up simultaneously later. Similarly, the oral delivery of Hepatitis B vaccine has demonstrated the generation of anti-body titres to a single dose of oral delivery is comparable to that of injectable Hepatitis B vaccine. This technology will deliver Hepatitis B vaccine through oral route. Oral administration of this vaccine provides the easiness in administering the vaccine to the infants and children.

Bioactive integrated orbital implants

CGCRI has designed and fabricated two varieties of porous hydroxyapatite-based orbital implants which have been clinically tried in more than 100 patients at different hospitals in India, as yet with no report of post-operative complications. One of the significant advantages of these Hap implants over the glass/polymeric material is that they become invested with fibro-vascular tissues of the orbit and provide natural movement to the eye. This artificial eye is very light (less than 2 gms) and costs only Rs. 2000/- compared to around Rs. 25000/- for the imported ones. Technology has been transferred to M/s IFGL Bioceramics Ltd., Kolkata.

Collagen-based biomaterials

CLRI has developed Gelatin micro spheres wherein SSD loaded collagen membranes have been evaluated for wound healing. It was found that wound healing is accelerated by ~ 60%. Batch process for soluble collagen and four wound care management products has been standardized.

Fawn birth by artificially insemination

CCMB has achieved successful delivery of a live fawn by artificial insemination of a female deer. This is the first successful artificial non-surgical intra-vaginal insemination in the spotted deer in India, which led to the birth of a fawn. With this, India has joined Australia and United States of America, the only two other countries to achieve this remarkable feat using the same procedure. This success could form the basis for future attempts to increase the numbers of other endangered deer species and other animals in our country.

Control of quiescence in muscle stem cells

CCMB established a culture model of quiescent satellite cells using G₀ synchronized myoblasts. Studies at CCMB suggests that regulation at multiple levels from chromatin modulation of transcription to regulation of cytoskeletal and membrane dynamics, and metabolic controls of nutrition, energy and cellular redox state co-operate to sustain the arrested progenitor cell, prevent precocious differentiation and maintain signal responsiveness.

Arsenic and Iron removal plant

CGCRI has developed technology for arsenic and iron removal based on ceramic membrane technology for the production of safe drinking water from contaminated ground water. The technology has been transferred to industry. CGCRI has installed eight community models of arsenic and iron removal plants of capacity of 2500 litre per day which are operating in West Bengal. Sixteen iron removal plants are under installation in eight North Eastern States. The technology conforms to WHO standards and has led to employment generation.

“CIM-ASVIKA” multi-utility portable distillation unit

CIMAP released a low cost and simple to operate multi-utility portable distillation unit “CIM-ASVIKA” useful for the farmers in rural areas and small scale entrepreneurs. Features include low cost portable type unit specially designed for producing high quality natural rose water. It can also be used for extraction of spices and other aromatic oils. It has pure stainless steel construction with long life, efficiently designed with shell and tube condenser for proper condensation and complete oil recovery. It can be operated with firewood, agro wastes, LPG/kerosene burners. There is no pollution at workplace due to provision of chimney and can be operated even by laypersons.

Synthesis of FEMA GRAS approved flavouring agent: 4-vinylguaiacol

4-Vinylguaiacol and other 4-vinylphenols are the most extensively studied class of natural compounds due to its widespread applications in food and alcoholic beverages, flavouring substances and as intermediates in the preparation of polymers and copolymers useful in coatings, electronic applications, ion exchange resins, photo resists, etc. IHBT has developed a unique and novel process for the synthesis of 4-vinylphenols in microwave curtailing the two step process into a single step in an environment friendly manner. The method developed imbibed the principles of green chemistry and reflects the advantages over the existing protocols. Also, the cost of production is reduced manifold.

PWM amplifier for electromechanical actuator

CEERI has developed integrated position control system for an underwater guided vehicle. It has pulse width modulation scheme for high efficiency bi-directional PWM scheme for improved stiffness, conforms to mil 883 environmental specification with cost and reliability competitive with other international products.

Myoelectric arm

CSIO, in collaboration with CMERI, has developed lab model of myoelectric arm. The prototype was tested on patients at National Institute for Orthopaedically Handicapped (NIOH), Kolkata. The patients were able to perform many mechanical activities with this arm, viz. drinking water, writing, plucking flowers, picking and placing of objects from one place to another.

20KW radio frequency quadruple (RFQ)

CMERI, in collaboration with Variable Energy Cyclotron Centre (VECC), Kolkata has designed, developed and fabricated 20KW Radio Frequency Quadruple (RFQ). The RFQ is operating at 33.7 MHz accelerated 21 KeV 3^{+16}O beam from the ECR up to an energy level close of 500 KeV. The beam achieved a transmission efficiency of almost 100%, a remarkable record in this area of high technology. The unit has been installed at VECC, Kolkata.

Indigenous Molecular Beam Instrument

NCL has developed a simple, compact and economically viable Molecular Beam Instrument (MBI). Catalytic reactions are, in general, too complex and information on the elementary steps is not easily available. MBI enables study of heterogeneous catalytic reactions on active metal surface in a clean environment under vacuum and provides fundamental information about the catalytic reactions, such as, transient kinetics and kinetic parameters. Such vital information helps to derive the mechanistic pathway of complex reactions. With high local coverage on the substrate under clean environment, MBI bridges the pressure gap between the real-world catalysts working at atmospheric or higher pressure and other conventional experiments carried out under high vacuum.

Ultrafiltration membrane-based water purifier

NCL has developed an ultrafiltration membrane with pores too small to permit viruses and bacteria. Special additive used in the dope solution for membrane casting controls membrane porosity and offers membranes with desirable pore size. It operates on normal tap water pressure (0.5 bar) and does not require electricity.

Small tractor

CMERI has developed a 10HP small tractor named as **Krishishakti** to aid farm mechanization. Weighing at 800 kg it has single cylinder, water cooled, 10HP diesel engine and has automatic draught control with lifting capacity of 450 kg.

Long afterglow luminescent powder

NPL has developed long decay phosphor powder which can be processed into many different media and can be used in a variety of applications. The applications include back lighting of liquid crystal displays, bank notes, enamels and ceramic tiles, flexible & rigid plastics for switches and consumer goods, warning signs, accident prevention, etc.

Health assessment of bridges and other structures

SERC has designed fiber optic sensor based structural health monitoring towards predicting the time-dependent losses in prestressing steel and evaluating the stress condition of concrete in the beam. A post-tensioned prestressed concrete I-beam of 5.2m long has been prepared and instrumented with embedment type and surface mounting type EFPI fiber optic sensors at mid span and one quarter span. Adjacent to fiber optic strain sensors, surface mounting type vibrating wire strain gauges were also instrumented to compare the response of fiber optic strain sensors. Strain and temperature values from all the sensors were recorded during prestressing and applied prestressing. Monitoring the performance of the instrumented prestressed concrete I-beam has been carried out over 225 days. Time-dependent prestress losses have been computed from the measured data and these values compare closely with American Concrete Institute (ACI) method.

Dynamic fog forecasting system

C-MMACS has developed and calibrated a visibility model Fog Forecast Engine which is a combination of high performance computing, new generation dynamical meso-scale models, advanced data analysis and informatics. The platform has been tested in an operational setting since November, 2005 for Delhi Airport, with a web-based sales management system. The forecasts for the winter of 2005-06, communicated to a number of scientists for post-forecast validation, have been fairly accurate with only three misses and two (marginal) false warnings. An on-site validation, through a meso-scale observation network is already under implementation.

Recognition of CSIR scientists

Contributions of CSIR scientists are continuously being recognized both at the national and international levels. Dr. R.A. Mashelkar, DG-CSIR has been awarded TWAS medal (2005) by the Academy of Sciences for the Developing World and the Star of Asia Award (2005) of Business Week (USA). Dr. S. Sivaram has been conferred the prestigious Padmshree Award for Science & Engineering. Besides these, CSIR scientists have bagged Shanti Swarup Bhatnagar Award, elected as fellow of Indian Academy of Sciences, Indian National Science Academy, National Academy of Sciences, Indian National Academy of Engineering, etc.

Excelling in scientific & industrial research output

CSIR's basic research contributions scored an all time high in terms of number and international recognition. A total of 3018 basic research papers have been published in internationally peer reviewed journals with an average impact factor per paper of 2.01. CSIR was granted 178 patents abroad while filed 570 patents. It has secured 22 copyrights and 4 trademarks as well.

The year also witnessed an all time high generation of external cash flow of Rs. 341 crore from its contract R&D.