

Infusing Innovation into Sustainable & T  
1944 - 2014

# CSIR-IICT

Celebrating Seven Decades of Service to the Nation

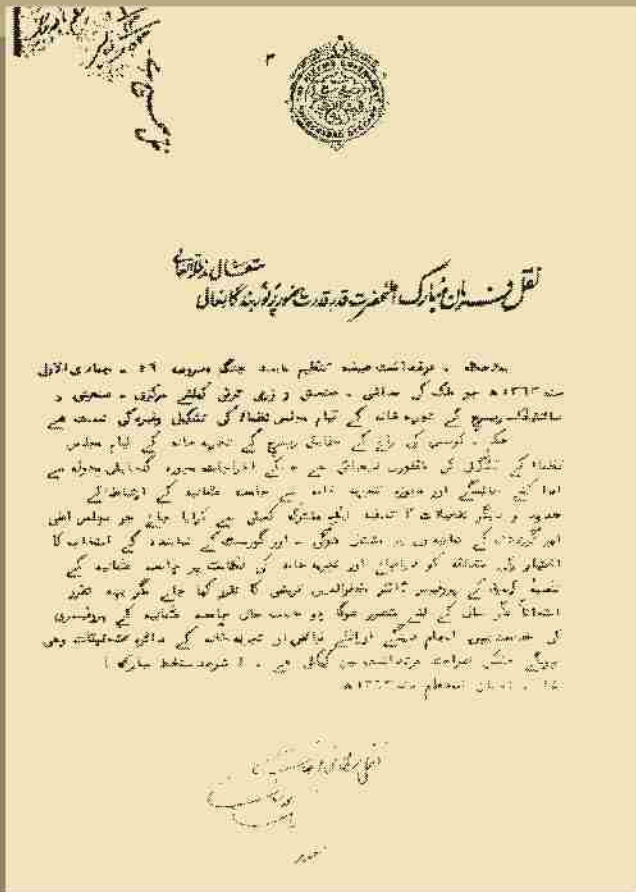


**CSIR-Indian Institute of Chemical Technology**  
(Council of Scientific and Industrial Research)

Hyderabad - 500 007, India



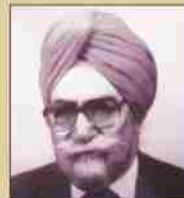
## Firman



Dr M Qureshi 1944



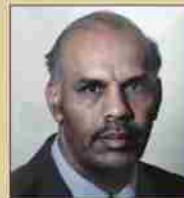
Dr S Hussain Zaheer 1948



Dr G S Sidhu 1963



Dr G Thyagarajan 1981



Dr A V Rama Rao 1985



Dr K V Raghavan 1996



Dr J S Yadav 2003



Dr M Lakshmi Kantam 2013

# Foreword



I consider it a great honor to document some of the most significant contributions of CSIR-IICT through this souvenir “**CSIR-IICT: Celebrating Seven Decades of Service to the Nation**”, which is being released on the closing day ceremony of the CSIR-IICT@70 Celebrations.

During its seven decade journey, the Institute has passed through several challenges on numerous occasions. But the Institute rose against the challenges on every occasion and emerged stronger by calibrating its research focus from time to time. Today, CSIR-IICT is recognized as one of the best organizations in Chemical Sciences research in India because of its significant contributions to the strategic, societal and industrial sectors. This distinction could be achieved only due to the untiring efforts of the CSIR-IICT family and the fore-vision of my predecessors Dr M. Qureshi, Dr S. Hussain Zaheer, Dr G.S. Sidhu, Dr G. Thyagarajan, Dr A.V. Rama Rao, Dr K.V. Raghavan and Dr J.S. Yadav in guiding the institute towards frontier areas of chemical and allied sciences & technology.

During the journey of these seven decades, CSIR-IICT has developed globally competitive and environment-friendly technologies in agrochemicals, pharmaceuticals, homogeneous and heterogeneous catalysts, lipids, coal, ceramics, biofuel, polymers and coatings, fine chemicals, organic intermediates etc. Now CSIR-IICT is one of the best performing institutes of CSIR in terms of different quantifiable parameters like publications in high impact journals, patents, technology transfers and external cash flow. In line with the current decade of innovation, CSIR-IICT has now shifted its focus towards trans-disciplinary research. The Institute is networking with other R&D Organizations and industry to harness the innovation potential of scientists and technologists in trans-disciplinary areas of chemistry, biology and allied sciences. Several programs have been charted out with an aim to develop greener solutions in the areas of health care, agrochemicals, food & nutraceuticals, intermediates, functional materials and renewable energy.

The souvenir “**CSIR-IICT: Celebrating Seven Decades of Service to the Nation**” captures the present strength areas and R&D focus of CSIR-IICT, while chronicling some of the celebrated achievements during its seven decade journey. I thank Hon'ble Minister of Science & Technology and Vice President CSIR Dr Harsh Vardhan, for agreeing to release this souvenir. I take this opportunity to congratulate the entire CSIR-IICT family, both past and present, for their contributions to this great Institute.

*M. Lakshmi Kantam*  
**(M Lakshmi Kantam)**  
Director, CSIR-IICT

## Our Vision

- To become an innovative global R&D organization in the field of chemical sciences and technology with reference to industrial and speciality chemicals
- To be an institution of international excellence in basic research in chemistry and adjacent chemical and engineering sciences.
- To establish balance between innovation and discovery research

## Our Mission

- Provide globally competitive environment friendly technologies
- Achieve world class expertise in the frontier areas of chemical sciences and technology
- Competence to offer knowledge based technological services



# Organising Committee

CSIR-IICT@70 Celebrations

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Dr. Ahmed Kamal

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## Dr. Jitendra Singh


Hon'ble Minister of State for Science and Technology  
Earth Sciences (Independent Charge)  
PMO Personnel, Public Grievances &  
Pensions Department of Atomic Energy  
Department of Space and Vice President, CSIR

## MESSAGE

It gives me immense pleasure to greet CSIR-Indian Institute of Chemical Technology (CSIR-IICT) as it celebrates its seventy years of contribution to chemical sciences research.

I am happy to know that during the seventy year journey, CSIR-IICT has developed several products/processes that benefitted the society. Its contributions in agrochemicals, pharmaceuticals, coal & gas technologies, food & nutraceuticals and several other important technologies have helped the industry in providing low cost solutions aimed at improving the quality of life. I am glad to learn that today this Institute is amongst the top laboratories in Chemical Sciences research in India.

I congratulate Dr. M Lakshmi Kantam, Director CSIR-IICT and her illustrious team on the occasion of completing seventy eventful years. I wish that CSIR-IICT assumes global leadership role in Chemical Sciences research in the years to come.

  
21.8.2014  
(Dr. Jitendra Singh)







## MESSAGE

As CSIR-Indian Institute of Chemical Technology (CSIR-IICT) celebrates its 70th Foundation Day, I am happy to state that CSIR-IICT is now recognized as a global player in chemical science research. During its seven decade history, CSIR-IICT has consciously reoriented its research focus from time to time to always remain cotemporary and relevant. From a humble beginning in the year 1944, as Central laboratories for Scientific and Industrial Research (CLSIR), the Institute has grown from strength to strength, first as the Regional Research Laboratory in 1956 and later as the Indian Institute of Chemical Technology in 1989. CSIR-IICT has also produced several world class leaders in the form of Dr. Hussain Zaheer and Dr. Sidhu, who helped India shape its scientific & industrial policies as Director Generals of CSIR.

CH

In the current decade of innovation, I am glad to note that CSIR-IICT has charted for itself several trans-disciplinary programs by networking with other CSIR labs and industry, in its bid to develop greener solutions in the areas of health care, agrochemicals, food & nutraceuticals, functional materials and renewable energy.

I wish to extend my heartfelt greetings to Team-IICT on this occasion. I also take this opportunity pay homage to the contributions made by the leaders of the past.

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## Dr. G. Thyagarajan

Former Director, IICT, NEIST & CLRI  
Chennai

## MESSAGE

The genesis of the Central Laboratories for Scientific and Industrial Research as an R&D institute in the then Hyderabad State, its incorporation into the CSIR as a national laboratory with a wider mandate and its final arrival as Indian Institute of Chemical Technology is a fascinating story to be read, said or heard.

The charismatic Founder Director Dr. Husain Zaheer inculcated great norms and values in research choices, commercialization of research results, talent spotting securing and sustaining, team working all of which became models for Institutional design and management of later R&D laboratories. On the occasion of the closing ceremony of the Platinum Jubilee of this magnificent institution, it is appropriate to salute all those, and every one of those, who have directly or indirectly contributed to its growth and glory since its inception.

At a personal level my association with this Institution for twenty two fine years is a perennial source of delightful reminiscences.

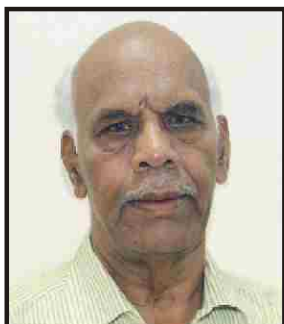
IICT is a jewel in the crown of CSIR and pride of the nation. To Dr M Lakshmi Kantham I give my every good wish in her endeavors to take IICT to greater heights.

A handwritten signature in blue ink, appearing to read 'G. Thyagarajan', with a horizontal line underneath.

**(G. Thyagarajan)**

Former Director, CSIR-IICT





## Dr. A.V. Rama Rao

Ph.D(Tech), D.Sc FNA, FTWAS

Former Director

Indian Institute of Chemical Technology

Charman & Managing Director

AVRA Laboratories Pvt. Ltd.

## MESSAGE

realized the need to strengthen the area of chemical sciences within this organisation and inducted several young talented chemists. We enhanced our external cash flow from various chemical and pharmaceutical industries by way of sponsorship for providing research services. We also strengthened its instrumental facility and inducted new NMR, Mass spectra, X-ray equipment, etc. During this period we were the first in the country to initiate computer aided design for chemical plants. IICT offered technology packages that included pilot scale production with detailed design engineering and our engineers were involved in its implementation.

The institute proved to be a center for excellence in the total synthesis of bioactive molecules. Several of our young colleagues received CSIR young scientist awards year after year since its inception in 1988 till my retirement. The institute also demonstrated its superiority in technology development by way of bagging four technology awards and the 1<sup>st</sup> business development award given by CSIR (cash award) to its scientists.

I would like to congratulate the present Director and the staff of IICT on this special occasion and wish this great institute the very best with the hope that it will continue to excel in creating more knowledge based technologies which are so vital for the growth of our national economy.



(A.V RAMA RAO)





## Dr. K.V. Raghavan

Former Director, IICT &  
INAE Distinguished Professor  
CSIR-IICT, Hyderabad-500 007

## MESSAGE

I am very happy that IICT is celebrating the successful completion of 70 years in August 2014. This is an occasion for all of us to rejoice and rededicate ourselves to further the growth of this institute.

The vision H.E.H the late Nizam of Hyderabad State led to the establishment of a laboratory exclusively for scientific and industrial research in early 1940s. It grew into a Regional Research Laboratory and finally into a National Laboratory of eminence. My association with this Institute dates back to 1964. Its 70 years journey has been full of scientific challenges and outstanding S&T achievement. It has acquired a very good reputation of transforming scientific research ideas into industrially relevant technologies.

I had the good fortune of leading this great Institute during 1996-2003. The Institute celebrated its Diamond Jubilee years at the end of my tenure. I have witnessed its progress in scientific publications of high impact value, international patents, successful technology transfers to a wide spectrum of Indian chemical industries and international consultancy assignments with global majors in pharmaceutical and specialty chemical sectors.

I am particularly happy that the Institute continued to make its remarkable progress under the eminent leadership of my successors. The major strength of the Institute has always been the depth of scientific and engineering knowledge of scientific and technical staff and good leadership at various levels.

As the former Director of IICT, I offer my best wishes to the Director and Staff of IICT on this happy occasion.

( K.V. RAGHAVAN )  
Former Director, CSIR-IICT







सी एस आई आर - भारतीय रासायनिक प्रौद्योगिकी संस्थान  
वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद  
**CSIR - Indian Institute of Chemical Technology**



Council of Scientific & Industrial Research

उपपल रोड Uppal Road, हैदराबाद Hyderabad - 500 007, भारत India

**Dr. J.S. YADAV**, FNA, FTWAS  
CSIR-Bhatnagar Fellow & J C Bose Fellow  
Former Director, CSIR-IICT

**डॉ. जे. एस. यादव**,  
एफएनए, एफटीडब्ल्यूएस  
सी.एस.आई.आर. - भटनागर फेलो & जे सी बोस फेलो  
पूर्व निदेशक, सी.एस.आई.आर. - आई.आई.सी.टी.



## MESSAGE

It gives me immense pleasure to be the part of the 70 years celebrations of the world renowned and prestigious institute. All the more, it is my proud privilege and honour to lead the institute almost for a decade (2003-2012) for its ultimate glory. Since its inception in 1944, the leaders of the Institute always thrived with a single agenda of involving itself with its strength in science and scientific research for the development of the country. The contributions of IICT in Agrochemicals, Pharmaceuticals, Edible Oil Technology and Human Resources are highly reckoned specially for the societal needs in the country. CSIR-IICT being the jewel in the crown of CSIR has staged a first ever Lady Director in the history of entire CSIR. I believe that she lives up to the reputation of the leadership attire, the institute established so far and take the institute to greater heights. I congratulate the institute on its remarkable and outstanding journey so far and wish resounding success in its future endeavours.

  
(J S YADAV)

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# CSIR-IICT: Chronicling The Seven Decade History

The CSIR-Indian Institute of Chemical Technology (CSIR-IICT) is one of the oldest National Laboratories under the Council of Scientific & Industrial Research (CSIR). It started as the Central Laboratories for Scientific & Industrial Research (CLSIR) by the then princely State of Hyderabad in 1944. CSIR-IICT during its seventy year journey has made its mark as a dynamic, innovative and result oriented R&D organization. The clientele spans all corners of the globe. In India it is the reliable destination of chemical and biotech industries. The reputation that CSIR-IICT could establish amongst the industrial clients as a reliable R&D partner, can be largely attributed to its rich pool of scientists with expertise in broad ranging research areas and simple and effective business development strategies.

## The Transformation from CLSIR to CSIR-IICT

For a laboratory with Global presence, it had a humble beginning when the princely state of Hyderabad was planning to create a research Centre. A first step in the direction of creating applied research appears to have been taken by Hyderabad State when the Industrial Laboratory was set up by the then Government in 1920s which became the forerunner of CLSIR. Its work involved 'scientific help and advice, analytical services, and investigations and research on industrial problems'. The areas of investigation on laboratory scale in 1940s, for example, included: synthesis of known drugs; organic acids from vegetable wastes; denaturants for alcohol used as motor spirit; graphite and mica purification; fire-proof enamels and glass for bangles; and examination of fibers. Similar laboratories were later set up in some British provinces.

**The formative Years:** In 1940, the Imperial India constituted the Board of Scientific & Industrial Research (BSIR) to facilitate industrial research. On the suggestion of the Government of India, a BSIR was also established in Hyderabad in 1942. The CSIR came into existence in 1942 as an autonomous body registered under the Societies Act. With the creation of CSIR in New Delhi, the Government of India requested the British Government for expert advice on the organization of scientific research in India. Accordingly, Professor AV Hill, Secretary of the Royal Society, London visited India in 1943 and interacted with officials concerned and identified Hyderabad as the location for establishing an Industrial research laboratory. Hyderabad being particularly rich in raw materials, especially vegetable oils, coal, various types of clays and a number of minerals, it was decided to create the CLSIR in Hyderabad State.

**Central Laboratories for Scientific and Industrial Research (CLSIR):** A note embodying the proposal to set up the CLSIR was jointly prepared by the Departments of Commerce and Industry, Finance on February 18, 1944. It was vetted by the Nizam's Executive Council on March 20, 1944 and submitted to the Nizam for his approval and orders on May 10, 1944. The note, justifying the need to create the CLSIR, dealt in detail with the efforts needed to set up new industries and to improve the existing ones. To raise the standard of living of the people, it was not only necessary to aid the industries but also to provide additional powers, agricultural assistance, chemical fertilizers and modern agricultural implements. Agricultural and industrial progress was feasible only upon the appropriate utilization of natural resources and that could be brought about only through scientific and industrial research conducted on a continuous basis. The CLSIR is to be established on modern lines which will have separate research divisions concerned with (i) Industrial development, (ii) Agricultural chemicals, (iii) Forest products, and (iv) Drugs.

On the suggestion of the Government of India, a BSIR was also established in Hyderabad in 1942 and two years later CLSIR was created to carry out similar functions in Hyderabad State. By the *Firman* dated August 5, 1944, the Nizam directed the Government to set up the CLSIR at Hyderabad and the appointment of Dr. Muzaffaruddin Qureshi as its first Director. The Government Industrial Laboratory, Hyderabad, which had been functioning for over two decades, was merged with CLSIR. The Hyderabad BSIR too became a part of CLSIR. After Independence, the state of Hyderabad has merged with Independent India, and CLSIR started working closely with CSIR. A pioneering effort to promote research and provide assistance to small industries was made by the Hyderabad Government through the creation of an Industrial Trust Fund. Many of the large pilot plants set up by the CLSIR were financed by the Fund.

Dr. S Hussain Zaheer was appointed as Director of CLSIR on November 28, 1948. On taking over the charge, Dr. Zaheer reoriented the Institute's research focus on Oils & Fats; Coal & Fuels; Heavy Chemicals and Fertilizers; Ceramics; Organic Chemistry, Pharmaceuticals and Drugs; Biochemistry; Physical Chemistry; Chemical Engineering and Operations Research.

**Regional Research Laboratory, Hyderabad (RRL-H):** CLSIR was formally taken over by the CSIR on April 13, 1956 and was renamed the Regional Research Laboratory, Hyderabad. RRL-H has the distinction of becoming the first Regional Research Laboratory to be set up by CSIR. In 1950s through eighties, RRL-H assumed national importance as leading organization in Chemical Sciences and Technology in several areas like coal, oils & fats, paints ceramics, paper, drugs etc. Dr. Hussain Zaheer was appointed as Director General, CSIR in 1964 and Dr. GS Sidhu succeeded him as the Director of RRL-Hyderabad. A major event which brought about structural changes in the Laboratory was the establishment of semi-autonomous "Centre for Cellular and Molecular Biology (CCMB)" on April 1, 1977. The Biochemistry Division of RRL-H formed the nucleus of CCMB and Dr. PM Bhargava as its Head. After being at the helm of affairs for close to two decades as Director RRL, Dr. Sidhu was appointed as Director General CSIR on May 5, 1981. Dr. G Thyagarajan took over as Director of RRL-H on February 2, 1981. On the request of CSIR, Dr. Thyagarajan moved to CLRI, Madras as Director. Dr. AV Rama Rao was appointed as Director RRL-H on July 15, 1985. With a view to bring in cohesion to the R&D activities of RRL-H, the laboratory was reorganized into major divisions and supporting infrastructural groups to cater the emerging needs.

**Indian Institute of Chemical Technology (IICT):** The Prime Minister in his capacity as the President of the CSIR, appointed a committee headed by Shri Abid Hussain in April 1986 to review the functions and structure of CSIR. The Committee submitted its Report on December 31, 1986. One of the recommendations was to reorganize the RRLs to reflect the direction and orientation of the expertise and excellence developed by them. The RRL was rechristened as the Indian Institute of Chemical Technology with effect from April 1, 1989. IICT celebrated its Golden Jubilee in 1994. A monument erected to commemorate IICT's 50 years of fruitful existence was unveiled by the Governor of AP Shri Krishan Kant on August 6, 1994. Shri P V Narasimha Rao, Prime Minister of India graced the Golden Jubilee Function of IICT and inaugurated the Golden Jubilee Block comprising Discovery Laboratory, Natural Products Laboratory and Catalysis Laboratory. Dr. KV Raghavan was appointed as Director of IICT on January 11, 1996. Dr. Raghavan strengthened the chemical process development and design, reaction engineering groups of IICT. Dr. JS Yadav took over as Director of IICT on October 1, 2003. CSIR-IICT celebrated its Diamond Jubilee in August 2004. During the early part of the new millennium, IICT had redrawn its vision with an aim to



emerge as an innovative global R&D organization in the field of chemical sciences & technology. To this end, three National Centres viz. Lipid Research, Semiochemicals and Chemical Biology were created.

**CSIR-Indian Institute of Chemical Technology (CSIR-IICT):** CSIR in its bid to ensure better recognition and visibility, had decided to add the suffix 'CSIR' to all labs during 2010-11. Subsequently, IICT is now referred as CSIR-IICT. Dr. Ahmed Kamal took over as Acting Director after the retirement of Dr. JS Yadav in August 2012. In a major landmark appointment, Dr. M Lakshmi Kantam became the first woman Director of a CSIR lab in the entire seven decade long history of CSIR, when she took over as Director of CSIR-IICT on April 9, 2013. With the present focus on developing green processes relevant to the Industry, several technology transfers are in the pipeline. CSIR-IICT is celebrating the Seven Decade Service to the Nation in August 2014.

### Research Areas

The core strength of CSIR-IICT lies in Organic Chemistry, and it continues to excel in this field for over six decades. The research efforts during these years have resulted in development of several innovative processes for a variety of products necessary for human welfare such as drugs, agrochemicals, food, organic intermediates, adhesives etc. In terms of research outputs, CSIR-IICT has an outstanding record in research publications, patents and technology packages in the CSIR system. A recent study positions CSIR-IICT at number one with respect to number of publications, cumulative impact factor and total number of patents filed. CSIR-IICT is a front runner in the following areas of research.

**Drug discovery and development:** During the early years of CSIR-IICT, the generic drug industry depended heavily on CSIR-IICT's expertise and technologies. As the industry grew in size and foreign equity started flowing in, most of the firms ramped up their R&D. Foreseeing the trend, CSIR-IICT began making forays into new drug discovery and began synthesizing new drug molecules. Later when the Abbreviated New Drug Application (ANDA) had come into force, the industry stopped outsourcing R&D for generic drug to research laboratories. By then, CSIR-IICT established itself as a new drug discovery laboratory and had synthesized several new molecules for screening against different targets. The primary lead molecules thus identified were then transferred to industry for further development. Terminal diseases like cancer has been given special attention and several programs are underway for development of new chemical entities as anticancer therapeutics. A number of new molecules are under detailed investigations to be explored as potential cancer therapeutics. Some of the US Patents relating to new molecules have been licensed to the pharmaceutical companies for their development as chemotherapeutics. Work is also underway towards the development of diagnostics and target based molecular medicines against allergy, bronchial asthma and chronic obstructive pulmonary disease. Some of these developments, in years to come, might enable drug manufactures to develop new drugs at affordable price to common man. To screen new chemical entities, target-based biochemical screens and cell-based screens for biological activity against diseases, a dedicated chemical biology facility is necessary. To this end, the Centre for Chemical biology has been established at CSIR-IICT. In the first phase, the centre established facilities in the areas of diabetes, cancer, cardiovascular diseases and CNS disorder. These would be expanded in phased manner to cover other disease areas. CSIR-IICT has also taken a lead in the development of drug delivery systems, especially for anticancer drugs. The institute has also established a mol-bank to store the large number of new chemical entities it synthesizes every year.

**Agrochemicals:** CSIR-IICT has been at the forefront in development of several cost-effective and eco-friendly processes for commercial production of agrochemicals. The agrochemical industry widely acknowledges the fact that it is the technologies developed by CSIR-IICT, which heralded the agrochemical industry in India, with over 50,000 TPA installed capacity. On a conservative estimate the agrochemical industry generates huge revenue with the technologies developed by CSIR-IICT. Some of the processes developed include, chlorpyrifos, monocrotophos, butachlor, trimethyl phosphate, esfenvalerate, carbendazim, glyphosate, quinalphos, diazinon. It can be claimed that about 50 to 60% of the agrochemicals being produced in India have originated from CSIR-IICT technologies.

CSIR-IICT has developed technologies making use of pheromones, (organic substances released by the organisms for communication purpose within their own species) as alternatives to pesticides. The Pheromone Application Technology (PAT), which is associated with species specificity, safety to non-target organisms, ease of use and efficacy in reducing the damage, can manage quite effectively the pests and thereby losses to the farmers. PAT is highly suitable for the control of insect pests that are internal feeders, borers, webbers, miners and storage pests. The Pheromone Group at CSIR-IICT, Hyderabad is leading the way in the development (isolation, identification, synthesis of pheromone components and dispenser development) and implementation (field evaluations and demonstrations of developed pheromones) of PAT for the management of various important crop pests. The Government of Andhra Pradesh has recognized the pheromone technology developed by CSIR-IICT for groundnut crop and is taking necessary measures to popularize this technology.

**Strategically important fluoroorganic chemicals:** With rising global concerns, a blanket ban on the use of freons, halons and several CFC generating substances that deplete the ozone layer was globally imposed in mid nineties. The technology for substitutes like HFCs was not indigenously available and the global players like Dupont and ICI kept the technology a closely guarded secret. To stem the flow of foreign exchange, the Government of India sought help from research institutes to develop the technologies for HF based chemicals. HFS being highly toxic and corrosive, other than CSIR-IICT no other lab came forward to take up the challenging task of developing fluorine based chemicals/ products. CSIR-IICT has developed several such fluoro-organic chemicals. Most notable among them are HFC-134a and FM-200 (a substitute for halons) which are under commercial production. In addition to the development of processes/products that address problems of global environment, CSIR-IICT has also developed fluorine chemicals in applications related to drugs, fine chemicals, polymers etc.

**Lipid research:** CSIR-IICT has been working on oils and fats for well over six decades. Taking the baton forward, CSIR-IICT also started working on lipid research established a Centre for Lipids Research. An environment-friendly enzymatic degumming process was developed to produce high quality rice bran oil (RBO). The RBO produced by this process retains all nutritional components such as oryzanol, tocopherols, tocotrienols etc. in the refined oil. These nutritional components are lost in the traditional alkali refining process. The process developed by CSIR-IICT yields 1-1.5% more oil and 0.3 to 0.6% more fatty acid compared to other processes and yet retains all nutritional values. The consumption of water can be cut down by 50% compared to traditional process and water wash is also not necessary after enzymatic degumming and hence oil loss is less and the process is effluent-free. The technology was transferred to 27 industries across 9 states. CSIR-IICT has launched a project in a major way for development of technologies for synthetic aviation lubricants from indigenous resources in collaboration with five other institutes. Lipids group in



collaboration with several other groups of CSIR-IICT has successfully completed the process development for two aviation lubricants and Indian Air Force has agreed to carry out the flight trails employing these lubricants.

**Coal:** The research in the area of coal R&D occupied centre stage in the institute's R&D profile since the inception of this institute. After renaming as 'Regional Research Laboratory, the institute started with focused work on 'Coal Utilization' and gained significant professional expertise in the area of process development for rational utilization of the locally available low-grade coals. Over a period of time, the Coal Division developed technologies for the Low Temperature Carbonization of Coal (LTC), Coal-tar Distillation, Briquetting of Coal-char fines to Domestic coke, Moving Bed Pressure Gasification of Coals for Power Generation, Atmospheric Fluid Bed Gasification for Fuel Gas production, Hydrogenation of Coal-tar hydrogenation to Middle Distillates, Benzene to Cyclohexane, Hydro-cracking of Coal-tar to Paraffins / Naphthalenes, Extraction of Taracids and Tar-bases, Extraction of phenols from Ammoniacal liquor, Shaped Industrial Fuel, Formed Coke from Coke Breeze, Biomass Briquettes from Coir-pith, Saw dust etc., Impregnating Pitch from High Temperature Coal-tar, Unsymmetric Di-Methyl Hydrazine (UDMH) for Space Applications, Pine Char Carbonization for Rubber Industries, Activated Carbon from Coconut Shells, 3,5-dimethyl phenol from acetone, 2,3,6-Trimethyl phenol from m-cresol alkylation with methanol, Hot Gas Clean up for dust removal & desulphurization of coal-derived fuel gas for IGCC application, etc. and some of which were transferred successfully to the Industry.

**Inorganic and Physical Chemistry:** The Inorganic and Physical Chemistry is one of the major areas of the Institute with multi-disciplinary approach for achieving advancement in both basic and applied industrial research related to catalysis, nanomaterials, and inorganic chemicals. The research focus of this area spans a diverse range, that include catalysis (heterogeneous and homogeneous for bulk and fine chemicals synthesis employed as drugs and drug intermediates), nano-materials development (with applications as sensors, bio-based drug delivery systems, and materials for solar energy conversion), sustainable energy (catalytic biomass conversion into chemicals and fuels, hydrogen production from natural gas), capture and conversion of global warming gases employing mesoporous microporous materials, computational chemistry as well as organometallic and bio-inorganic chemistry.

**Biofuels and biotransformations:** CSIR-CSIR-IICT is leading a US-India Consortium for the Development of Sustainable Advanced Lignocellulosic Biofuel Systems under the Second Generation Biofuels. In this programme, there are eleven partnering institutes including two industries and the University of Florida is leading this programme from the US side. The major goal of this project is to develop and optimize selected non-food biomass (highly yielding biomass and bmr varieties of sorghum, sweet sorghum, pearl millet, bamboo and switch grass)-based advanced biofuels systems and bio-based products like biogas and lignin-based byproducts for the U.S. and India. CSIR-IICT has also developed technologies for the production of biodiesel. The biotransformations group is working in areas related to application of enzymes/microbes for various chemical transformations towards developing clean and green technologies and processes for important compounds of commercial interest.

**Functional materials, organic coatings and polymers:** The functional materials group specializes on research related to electrode materials, sensitizers based on organometallic, organic and tetrapyrrolic compounds, hole transport materials,

redox electrolytes, nanomaterials and their polymer composites for applications in energy devices (excitonic solar cells, OLEDs), coatings, adhesives, composites, construction materials diagnostics and healthcare. The research activities also include renewable/natural resource based monomers/polymers, photo curable polymers, fluoropolymers, hyperbranched polymers, biomaterials, block copolymers, conducting polymers, polymer blends, polymer/oxide/ metal/ fiber composites/nanocomposites.

**Analytical chemistry:** CSIR-IICT has state-of-art analytical facilities to help the scientists in their research. Research activities in the analytical chemistry group encompass spectroscopy (NMR, UV, Mass etc) chromatographic techniques, single crystal & polymorphism studies involving XRD and other areas of analytical chemistry. CSIR-IICT has the capability to analyse the bulk drugs, finished pharmaceutical products, impurity profiling of drugs and pesticides.

**Chemical engineering sciences:** The chemical engineering group of CSIR-IICT has necessary expertise and infrastructure to scale up bench-scale research to pilot and commercial scale. The group researches on experimental evaluation of process routes to design & commission of commercial plants involving scale up studies, kinetic, phenomenological and data-driven models, product modelling & design, new sensor configuration methods, process control & optimization strategies, fault detection & diagnosis, process safety, development of new membranes for different gas separations, dehydration of solvents by membrane distillation and pervaporation, liquidliquid extraction, reactive extraction, hydrodynamic studies, process intensification studies and thermodynamic studies.

**Design & Engineering:** The Design and Engineering Division (D&E), the only one of its kind in CSIR, was established in 1974 with an objective of providing a seamless link to technology transfer. The Division has a unique opportunity to be associated with the chemistry and chemical engineering groups in all the process plant projects right from the process development, through pilot plant studies / scale-up and basic engineering stages, which are the niche areas of expertise of CSIR-IICT. The thrust area of work of the Division is to carry out the engineering of pilot and commercial scale process plants by providing the mechanical designs and detailed engineering information required for construction of the plants, leading to seamless technology transfer. Over the years, the activities of the Division have been expanded to include process safety studies as a major partner in CSIR-IICT's PROSAC group, laboratory and biotech facility design and applied research in areas related to process equipment and piping. The Division has vast experience in the use of latest computer-aided methods in the detailed design of process plants.

**Biosciences:** The Biosciences group works on disease specific target development, screening of molecules to identify potential leads for drugs and pharma industry, cancer biology & research, bioinformatics, development/ application of bioinformatics tools for management of vectors and vector borne diseases, entomology, toxicology, design and synthesis of cationic lipid based novel gene delivery systems, development of cancer targeted liposomal gene and drug delivery systems and development of lipid-based anticancer molecules.

**Environmental sciences & engineering:** The environmental sciences & engineering group specializes on developing waste treatment and utilization technologies for industrial process industries. The group also carries out research in biogas conversion to energy and value-added chemicals, anaerobic and aerobic treatment processes of industrial and organic wastes, waste utilization, zero-discharge processes, generation of value added products and energy from organic wastes.





### Promoting Entrepreneurship Through Public-private Partnership

In addition, CSIR-IICT over the years has built comprehensive experience and expertise in setting up resource platforms to promote entrepreneurship in new and emerging areas.

**Biotechnology Incubation Centre (BTIC):** In association with Government of Andhra Pradesh and Department of Biotechnology, Government of India, the institute has established the Bio-Technology Incubation Centre (BTIC) at Genome Valley, Hyderabad. The BTIC aims to nurture and mentor start-up companies and it provides a resource platform for entrepreneurs to incubate their innovations. The BTIC has fully furnished incubation space for about 12 incubates and is equipped with all necessary analytical & characterization facilities. The Centre also has pilot plant facilities for scale-up studies of bench-scale innovations. The Centre is presently running to its near full capacity. The operation and asset management of the BTIC is outsourced to a private firm, M/s Genome Valley Tech parks and Incubators Private Limited, a subsidiary company of M/s Alexandria Inc marking the establishment of first public private partnership venture in biotechnology. CSIR-IICT as the mentor institute of BTIC, continues to extend its expertise to BTIC in its effort to promote growth in biotech sector.

**CSIR-IICT - Evolva partnership:** CSIR-IICT partnered with M/s Evolva to create a distinct R&D space in Genetic Chemistry Solutions. M/s Evolva incubated its innovations in the lab-space provided by CSIR-IICT, with active cross exchange of expertise in genetics and synthetic organic chemistry, to jointly establish knowledge base in chemical genomics. The expertise of M/s Evolva in employing genetic chemistry technology platforms to replicate the ability of nature to evolve molecules with exquisite design, is complemented by CSIR-IICT expertise in synthesis of designer organic molecules. The research collaboration is presently working towards (i) Synthesis of artificial chromosomes from genes to make new biosynthetic pathways and (ii) Generation of small molecules with 'drug-like' properties.

**CSIR-IICT - Aisin Cosmos partnership:** CSIR-IICT, with its expertise of having developed several new sensitizers based on ruthenium polypyridyl complexes, porphyrins and phthalocyanines, helped M/s Aisin Cosmos R&D Co Ltd, a concern of Toyota Car Company to establish a strong R&D base in India. M/s Aisin Cosmos is presently incubating from within CSIR-IICT campus. Together, the two institutes are collaborating towards developing photo-functional materials for application in sensors, light harvesting units and nanotechnology devices.

**Saarum Sciences - Start-up company:** M/s Saarum Sciences - a start-up company with capabilities in preparing cell lines and stem cells for screening against target diseases, is incubating from within CSIR-IICT campus. M/s Saarum Sciences aims to build a technology platform to enable the discovery & development of novel drugs, targets & biomarkers through the synergistic application of primary human bio-samples, stem cells and advanced biology tools. As an initiative to promote start-up companies, CSIR-IICT is extending its high-throughput screening facilities and providing small molecules to be tested on the stem cell lines prepared by M/s Saarum Sciences.

One of the main strengths of CSIR-IICT is its rich pool of scientists and PhD students numbering over 700. To create right ambience for the young researchers to carry out research. CSIR-IICT has active collaborations with several countries including France, Germany, UK, Switzerland, Italy, USA, Australia, Japan, Korea, China, S. Arabia, etc. and several students have benefitted from various exchange visit and post-doctoral opportunities.

## XII Five Year Plan Projects

CSIR-IICT is very actively participating in several XII Plan Projects funded by CSIR. The projects are listed below.

### CSIR-IICT as Nodal Lab

S.No	Acronym	Project Name
1	BIAGOS	Biocatalysts for the industrial application and Greener Organic Synthesis
2	INSPIRE	Inherently Safer Practices for Industrial Risk Reduction
3	ORIGIN	Organic reactions in generating innovative and natural scaffolds
4	NICE-P	Non-Infringing Chemistry and Engineering for Pharmaceuticals
5	CMET	Lipid profiling & Metabolomics
6	SMILE	Screening Molecules in Lead Exploration
7	PEOPLE HOPE	Development Sustainable Processes for Edible Oils with Health Benefits from Traditional and New Resources
8	SETCA	Sustainable Environmental Technologies for Chemical and Allied Industries
9	INTEL COAT	Intelligent Coatings
10	DITSF	Development of innovative technologies for strategic fluorochemicals
11	DENOVA	Development of Novel Vaccine Adjuvants
12	ACT	Affordable Cancer Therapeutics
13	ADD	Advanced Drug Delivery Systems
14	AARF	Augmentation of analytical research facilities

### CSIR-IICT as a Participating Lab

S.No	Acronym	Project Name
Chemical Science Cluster		
1	MULTI FUN	Multifunctional electrodes & Electrolytes for Future Technologies
2	MATES	Membrane and Adsorbent Technology Platform for Effective Separation of Gases and Liquids
3	BIOEN	Biomass to Energy Products
4	GENLUBE	Development of High Performance Lubricant Base Stocks from Non-edible oils
5	INDUSMAGIC	Innovate, develop and up-scale modular, agile, intensified and continuous processes & plants for specialty chemicals
6	CSC	Catalysts for Specialty Chemicals
7	MSM	A multiscale simulation and modeling approach to designing smart functional materials for use in energy, electrochemistry and bio-mimetics
8	NAPAHA	Isolation, Identification and characterization of new bioactive molecules from Indian Medicinal Plants for Pharmaceutical Applications
9	SURE	Sustainable utility of Rare Earths
10	FUNHEALTH	Development of functional foods and their formulations for potential health benefits of common man
11	M2D	Molecules to Materials to Devices
12	SPECS	Clay Nanocomposite functional materials for multiple applications

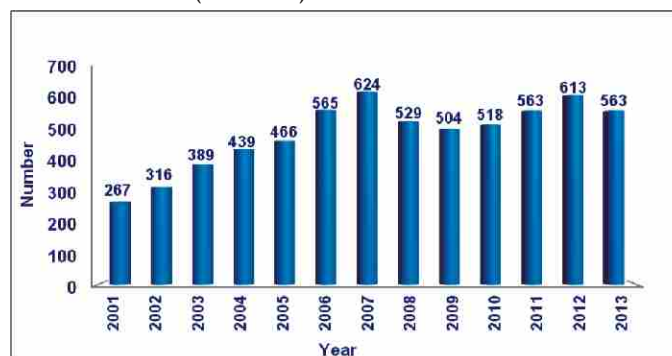


Biological Science Cluster		
13	THUNDER	Towards holistic understanding of complex diseases: unravelling the threads of complex diseases
14	UNDO	New approaches towards understanding of disease dynamics and to accelerate drug discovery
15	NANOSHE	Nano-materials: Applications and Impact on Safety, Health and Environment
16	MIND	Neurodegenerative Diseases: Causes and Corrections
17	TREAT	Therapeutics of chronic obstructive pulmonary disease (COPD) and Related respiratory disorders
18	EPIHED	Epigenetics in Health & Disease
19	GENESIS	Genomics and Informatics Solutions for Integrating Biology
20	GENCODE	Genome dynamics in cellular organization, differentiation and enantiostasis
Information Science Cluster		
21	KNOW GATE	CSIR knowledge gateway and open source private cloud infrastructure
Engineering Science Cluster		
22	WUM	Centre of Excellence: Waste utilization and management

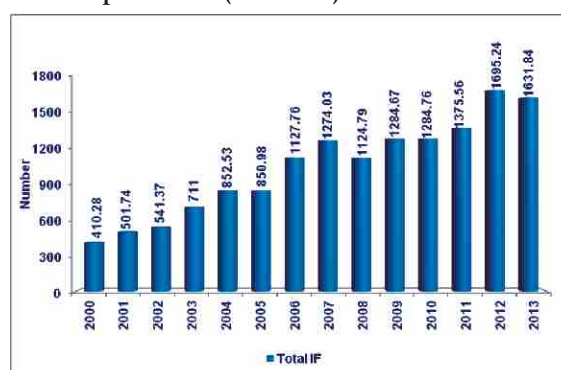
## Research Outputs

**Publications:** CSIR-IICT is one of the leading institute in the country for publications in high impact journals in chemical sciences and related areas. CSIR-IICT has a number of research collaborations with overseas institutes and several publications have resulted from these collaborations.

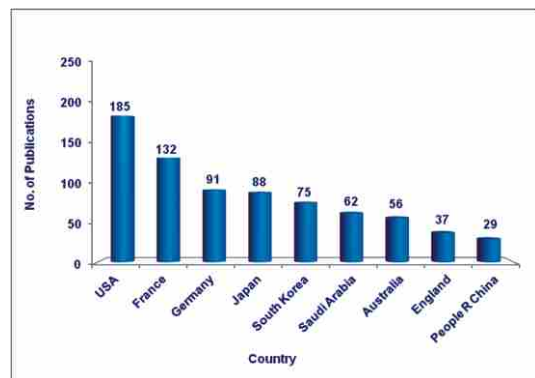
No. of Publications (2000 - 2013)



Total Impact Factor (2000-2013)



#### Publications from International Research Collaborations (2000-2013)



**Patents portfolio of CSIR-IICT:** Although the Institute came into existence in 1944, the Institute's patent cell has been effectively functioning since 1949 under Research Management Division (the then ORTIL Division). The first patent was filed in 1949 on the invention titled " New superheated cylinder oil". The Institute's top priority is to protect inventions that have novelty and commercial application. Since India is a signatory to the World Trade Organization (WTO) and Trade Related aspects of Intellectual Property Rights (TRIPS) agreement that came into effect from January 1995, IICT transformed itself to be equipped to avail the opportunities under new IPR regime. Keeping in mind that the protection of intellectual property is a fundamental step towards economic development and growth, IICT has been vigorously engaged in protecting the Intellectual Property Rights by filing patent applications in India & Abroad for the new and improved processes. Over the years this institute has developed a strong portfolio of patents: 545 Indian patent applications, 1133 Foreign applications, out of which 348 patents have been granted in India and 647 patents granted abroad. These patent applications have been filed in various countries under various conventions viz., PCT, EPC etc. in order to protect intellectual property rights in respect of inventions arising from its R&D work. The majority of the patents filed in the areas are: Medicinal Chemistry & Pharmacology, Inorganic & Physical Chemistry, Lipid Science & Technology, Natural Products Chemistry, Crop Protection Chemicals, Fluoro Organics, Organic & Biomolecular Chemistry, Polymers & Functional Materials, Biology, Bio Engineering & Environmental Sciences, Chemical Engineering etc. IICT has been making lot of efforts in licensing/ commercialising its patented technologies and some of its important patents have already been licensed/commercialized.

#### e-Management/Administration

e-Management was introduced at IICT in a phased manner without disturbing the working environment. Realising the importance of computer literacy, several training programs were conducted for the staff members. These training programs have raised the level of computer literacy to about 90%. The following are some of the prominent e-management tools that are in practice :

**ADMINSALCHEMY:** The ADMINSALCHEMY is the e-management tool introduced at IICT to cover the functions of Administration Departments and this computer programme has been developed in-house. This portal has been developed in-house for the use of administration. This began as a small experiment and earned lot of accolades and now turned out into a daily necessity. The personal profiles/details of all employees are computerised and the employees can track the status of their transactions with various sections of the Administration. The entire



information related to all the staff members is available through intra-net. Each staff member has been assigned a page on the intra-net whereby a staff member not only can log in and see information related to their personal details but can also interact with the administration online. Updated information with regard to the administration i.e., all circulars and daily used forms are available to staff online. It serves as an internal information repository of all the internal decisions taken and communicated to the staff and also the decisions taken by the government on the service conditions of the staff. The Adminsalchemy portal serves as internal electronic notice board. Today's Adminsalchemy is like any other modern website catering to all sections of the laboratory and exhibits the resolve to be a good partner in the laboratories progress.

**ComPASS:** It is a web based application for automating procurement and inventory management. The system is completely workflow based incorporating the purchase and store procedures. This system manages the entire acquisition process, from requisition, to purchase order, to product receipt. Monitoring of existing stock can also be done in case of items available on Rate Contract. ComPASS supports the two way procurement of items involving approval at each and every phase. (PL Approval, COFA Approval, COSP Approval, SPO Approval). The tasks accomplished through this system are: Raise an Indent, Online Approvals, Creation of Stores Issue Voucher, Creating DRR (Daily Receipt Register), Item Acceptance by Indentors. This system makes everything from inputting information to taking inventory easier.

**CAFAS:** The Finance and Accounts Division has computerised the transactions related to various cash transactions, PF/GPF advances through CAFAS. Details related to employee payslip, arrears etc., are made available online, through CAFAS

**RMA NET:** The RMA NET has a centralised database of all information related to various types of projects (GAP, SSP, CLP, TSP etc.), publications, patents, External Cash Flow etc. and has proved to be an efficient tool to monitor the research activities of IICT.

**IICT-CCMB Dispensary:** The IICT-CCMB Dispensary has several facilities including physiotherapy. The Dispensary is also providing specialized treatment and advice by appointing different specialists to dispensary on part time basis in addition to regular Medical Officers. Medicines are also provided to pensioners and their dependents through authorized medical stores on credit basis (cashless). Medicine inventory, medical reports, etc. are computerised to facilitate the smooth functioning of the dispensary. IICT entered into Memorandum of Understanding with 35 CGHS recognized hospitals in and around Hyderabad for Medical Credit Facility to the staff, pensioners & dependents residing at different locations of the city.

### Social/Welfare Activities

**Achievements in sporting events:** Realising the importance of sports in day-to-day life, due encouragement was given to the sporting activities by providing good infrastructure facilities at IICT. They include both outdoor for cricket, volleyball, basketball and tennis and indoor badminton, table tennis, caroms and chess. IICT staff have excelled in SSBM Tournament both in outdoor and indoor events. A state of art gym facility has been created for the utility of staff and their children. Both indoor and outdoor sports always received good patronage from all the CLSIR/RRL/CSIR-IICT Directors and the management of the Institute. The game of cricket in our country attracts huge patronage and it is true when it comes to the

CSIR-IICT cricket team also. The CSIR-IICT Cricket team carved a niche to be recognised as a 'CHAMPION TEAM' by regularly winning the Shanti Swarup Bhatnagar Memorial Cricket Tournament, in turn it also strengthened the All India CSIR Cricket Team by contributing many players to render their service at National Level. Dr. Hafeez-ur-Rehman and Dr. S. Sridhar led the "All India CSIR Cricket Team" to glory with great distinction. The volleyball team led by Mr. S.N.M. Raju and team members played the game with great commitment and were placed in top 4 of many SSBM Tournaments since the year 1980. Mr. S.N.M. Raju had the privilege of leading the CSIR Volley Ball Team to represent in the "Atma Ram Trophy", and National Tournament for Central Government Departments on various occasions. Late Dr. G.S. Sidhu was not only a great scientist and a great human being but was also a true sportsman and a very good Bridge player who excelled in the sport. The game of bridge received a major fillip during his tenure in late 70's and early 80's. Many players like Dr. L.N. Kota, Mr. J.S.R. Krishna Rao, Mr. Y. Nageswar Rao, Mr. Suryanarayana, Dr. Sajid Hussain Dr. K.S. Patil, Dr J Madhusudhana Rao and many others excelled in the sport and were very popular on the national and international tournament circuit. During those days the fort of CSIR-IICT was impregnable in many bridge tournaments. CSIR-IICT has a formidable presence in the men's and women's badminton arena the players represent the Institute in various tournaments like SSBMT, IMD Tournament and A.P. Mitra tournament. CSIR-IICT badminton team lifted the runner's trophy for men singles and winner's trophy in men's doubles in IMD tournament at Ahmedabad (2009). It was quite fruitful for the men's and women's badminton teams in the 42nd SSBMT indoor finals at Jamshedpur (2011). Mr. Ravikiran won the runners trophy in men's singles and Dr. Varsha Ohatker won the coveted women's singles championship and repeated her performance in the 44th SSBMT finals at Roorkee also. The women's doubles team was runners in the same tournament. IICT also excelled in games like Chess, Table Tennis, and Lawn Tennis in many tournaments. Mr. P.S. Prasad and Mr. Bikshapathi won the carrom doubles championship in SSBMT indoor finals held at Tiruvananthapuram in the year 2003.

**Health:** In order to maintain good health for all the staff members of IICT, periodic medical check camps are organised. Procedures were introduced for quick disbursement of reimbursement claims for all the staff. This kind of monitoring not only brought the awareness among the staff about their health condition but also allowed them to take precautionary measures to maintain their good health. This kind of initiative for the benefit of the staff is practiced for the first time at the Institute, may be in all probability in the entire CSIR too.

**Welfare Association:** For the welfare of the staff members and their families residing in different colonies of IICT, a welfare association has been constituted which include the residents, maintenance staff, housewives and children. In order to provide hygienic living conditions, several measures have been taken up and implemented in keeping the entire colony premises very neat and clean.

**IICT Hussain Zaheer Memorial School:** To provide quality education at affordable cost, IICT has established the IICT Hussain Zaheer Memorial School in 1979. New facilities and infrastructure were recently added to the school.

### ERP Implementation at CSIR-IICT

The introduction of ERP One CSIR has a motto of giving Secured Online Operations in CSIR Laboratories Leveraging National Knowledge Network through One CSIR Portal was basically designed and architected by Dr. K. Jayakumar IAS CSIR Joint Secretary (Admn.) and Dr. G. Radhakrishnan Project Leader, Scientist CSIR. In Govt.



Sector the ERP stands as the largest online portal which caters the needs of the employees and it happens to be the major Management tool for retrieving the required information. ONE-CSIR has won the award presented by Computer Society of India in 2010. It has also received the “SKOCH” award for handling highest online transactions provided with 6 different portals launched through ERP. It is dedicated to entire CSIR by Science and Technology Minister, Government of India.



Some of the Benefits of ONE-CSIR are as follows: Easy domain policy management; Easy network management; High bandwidth for data replication between production site and DR sites; Enhanced performance and fast application access, with distributed load and high security Management system.

CSIR-IICT has contributed for the implementation of ERP in CSIR-IICT as per the guidelines given by CSIR. The entire IICT ERP team from RMA, BMA, Administration, Bill, Accounts, Pension, Purchase etc have contributed in giving all pre-requisites. CSIR-IICT received the "Outstanding Achievement Award" for the year 2012-13 from DG CSIR on the CSIR foundation day at New Delhi.



CSIR-IICT Team receiving outstanding achievement award for the implementation of ERP





# CSIR-IICT@70 Celebrations

Several events were organized by CSIR-Indian Institute of Chemical Technology as a part of year long CSIR-IICT@70 years Celebrations. The various events conducted as a part of these celebrations are outlined below:

## 1. Curtain Raiser Function of CSIR-IICT@70 Celebrations

The CSIR-Indian Institute of Chemical Technology (IICT), Hyderabad, with pride and joy launched its Septuagennial year (entering its seventh decade) celebrations "CSIR-IICT@70", on its anniversary, 4th August, 2013. Shri. S. Jaipal Reddy, Hon'ble Minister for Science & Technology and Earth Sciences, and Vice President, CSIR, graced the curtain raiser ceremony as Chief Guest. Welcoming the gathering, CSIR-IICT Director Dr M Lakshmi Kantam, gave a brief account of the research activities of IICT. She acknowledged the contributions of Director General, CSIR and former Directors of IICT and looked forward to their continuing support. Dr Ahmed Kamal, Outstanding Scientist, IICT, recalled the significant contributions of IICT in its 70 years. He highlighted the achievements and expressed gratitude to all those who were a part of it. Dr RBN Prasad, Chief Scientist and Chairman "IICT@70" Celebrations,



briefed on the yearlong events and programs planned for the celebrations. The curtain raiser ceremony commenced with the unveiling of the logo designed for the occasion by the Chief Guest. In his address the Honourable Minister expressed that "Scientific temperament should not be confined to research laboratories but spread far and wide and taken to all corners of the world. Science should be useful to all sections of society". Referring to the thoughts of social reformer Raja Rammohan Roy on science, he emphasised the relevance of not only spreading scientific temper but also promoting philosophical outlook based on science. He further added that, "We need science with a human face. India needs technologies which can be useful to people, especially the poor". Appreciating the contributions being made by IICT in the field of science and technology, he added that the Institute had contributed significantly both to academic endeavor and to Industry over the last 70 years. He assured that the Government would provide adequate resources for technology based science and research projects. The Hon'ble Minister inaugurated the Meteorological Tower of Climate Change on Vector Control Programme and the Cancer Therapeutic Research Laboratory. He also laid the foundation stone of the Centre for Fluorochemicals on the occasion. He released a compendium on CSIR-IICT Competencies and Research Facilities and also presented the CSIR-IICT Foundation Day Awards for 2012-13. Dr. K. Ravikumar, Chief Scientist proposed the vote of thanks to the august gathering.

## 2. International Conference on "Emerging Trends in Oleochemicals & Lipids Expo-2013" - August 8-10, 2013

The International conference on "Emerging Trends in Oleochemicals & Lipids Expo 2013" was jointly organized by CSIR-IICT, Oil Technologists' Association of India

and the American Oil Chemists' Society during August 8-10, 2013 at CSIR-IICT. Euro Fed Lipid, Japan Oil Chemists' Society, International Society for Fat Research and The Solvent Extractors' Association of India supported the event. The conference addressed the global trends in the Oleochemicals R & D and provided an excellent opportunity to bring together the stake-holders in the oleochemical industries and research organizations. The Conference was inaugurated by Dr K V Raghavan, INAE Distinguished Professor & Former Director of CSIR-IICT and Dr M Lakshmi Kantam, Director, CSIR-IICT presided over the Inaugural Function of the Conference. 21 Plenary lectures were delivered by eminent researchers from various part of the world during the technical sessions on Lubricants, Surfactants, Personal and Home Care Products, Eco-green Polymers and Coatings, Newer Oleochemicals, Microbial Conversions and Glycerol and Oilseed Based Products. Dr Sevim Z Erhan of USDA Agricultural Research Service, USA delivered Dr K T Achaya Memorial Award Lecture. The conference was concluded with the valuable remarks made by the expert panelists during the Panel Discussion on the theme of the Conference. Dr BV S K Rao, CSIR-IICT and Mr Brian S Cooke, AOCS were the conveners of the conference.

### **3. International Symposium on "Recent Developments in Dye Sensitized Organic & Hybrid Solar Cells" - August 8-10, 2013**

International Symposium on "Recent Developments in Dye Sensitized, Organic & Hybrid Solar Cells" cum ESCORT Summer School of CSIR-IICT was held during August 8-10, 2013 at CSIR-IICT. Prof H.Segawa was the chief guest of this symposium. Dr Fillipo De Angelis, Coordinator, ESCORT, EU, Dr JS Yadav, Coordinator ESCORT, India, Prof H. Segawa, Chief Guest, University of Tokyo, Japan, Mr M Akakai, President Aisin Cosmos R&D Co. Ltd., Japan, Dr M.K.Nazeruddin, EPFL, Switzerland, Dr PY Reddy, Aisin Cosmos R&D Co.Ltd. attended the inaugural function. Dr M. Lakshmi Kantam, Director, CSIR-IICT and Chairperson of this symposium welcomed the delegates. There were 25 invited lectures and 40 posters were presented in this symposium which has covered various aspects of third generation dye sensitized solar cell, organic and hybrid cells with latest developments such as mass production of DSC, metal & metal-free sensitizers, electrolytes, liquid-based and solid-state DSC, engineered nanostructured electrodes, colloidal nano-oxides with tailored properties, quantum dots, computational chemistry perspective of modeling materials and processes in DSC, new Concepts and design Rules for hybrid nanocomposite solar Cells etc. Dr M. K.Nazeeruddin of EPFL has delivered the keynote address on Mesoscopic solar cells for electricity production from sunlight. The invited lectures were delivered by Prof H. Segawa, University of Tokyo, Japan, Dr Suresh Das, CSIR-NIIST, India, Dr Fillipo De Angelis, CNR Italy, Dr Songyuan Dai, Chinese Academy of Science, Hefei, China, Dr Yun Chi, National University of Taiwan, Prof. Viresh Dutta, IIT, Delhi, Mr Tatsuo Toyoda, Aisin Seiki, Japan, Prof Satoshi Uchida, University of Tokyo, Japan, Dr V K Kaul, CEL, Delhi, Hans De Silvestro & Mervyn D. Borniol DyeSol Ltd, UK, Dr Satish Patil, IISc, Bengaluru, Prof. G D Sharma, Jaipur, Dr Jejungko, Korea University, Prof. Hari M. Upadhyaya, Heriot-Watt University, UK, Dr Michele Munca, IIT, Italy, Dr M. Chandrashekharam, IICT, Hyderabad, Dr Saif Haque, Imperial College London, Dr Justin Thomas, IIT, Roorkee, Dr K. Bhanuprakash, CSIR-IICT, Dr Luisa De Marco, IIT, Italy, Dr VJ Rao, CSIR-IICT, Dr Srikanth V. Joshi, ARCI, Hyderabad and Dr L. Giribabu, CSIR-IICT. An exclusive poster session was conducted for the young budding researchers in this area and three best posters were selected for prizes by the jury for evaluation of posters. A snapshot presentation has been made by the



three best poster award winners. The symposium was concluded with summing up and interactive feedback session.

#### **4. Teacher's Day - September 5, 2013**

Teacher's day was celebrated in association with M/s AVRA Laboratories at CSIR-IICT on September 5, 2013. Dr. Chandrakanta Bandopadhyay, Professor of Organic Chemistry, Ramakrishna Mission, Vivekananda Centenary College, Kolkata has delivered a talk on "Chemistry at its own level" to the students.

#### **5. Hindi Day - September 16, 2013**

HINDI DAY-2013 was celebrated on September 16, 2013 at CSIR-IICT. Prof. Shivgopal Misra of Pradhanmantry Vigyan Parishad Prayag, Allahabad has delivered a lecture on "Hindi and Scientific Communication" at CSIR-IICT.

#### **6. CSIR Foundation Day - September 26, 2013**

71<sup>st</sup> CSIR Foundation day was celebrated on September 26, 2013 at CSIR-IICT. Prof. Ramakrishna Ramaswamy Vice-Chancellor, University of Hyderabad, delivered the 71<sup>st</sup> Foundation Day Lecture on "Cancer Systems biology" The Chief Guest and Dr M Lakshmi Kantam presented mementos to staff completing 25 years of service, CSIR Outstanding Performance Awards to Employees, Merit Awards to Research Fellows, Studentships/ onetime cash award to the meritorious children of IICT Employees.

#### **7. National Symposium on "Advances in Chemical & Material Engineering" - October 1, 2013**

A National Symposium on "Advances in Chemical & Material Engineering" was organized by Chemical Engineering Division of CSIR-IICT in association with Andhra Pradesh Academy of Sciences, Hyderabad and Indian National Academy of Engineers on October 1, 2013 to commemorate the 70<sup>th</sup> birthday of Dr KV Raghavan, INAE Distinguished Professor & Former Director of CSIR-IICT. Dr. M. Lakshmi Kantam Director CSIR-IICT delivered the welcome address. Dr. Ch. Mohan Rao, President A.P. Academy of Sciences & Director, CSIR-CCMB delivered opening remarks. Padma Vibhushan Prof. P Rama Rao Former Secretary, DST, Govt. of India and Former Vice Chancellor, University of Hyderabad inaugurated the Symposium. On this occasion, an Electronic Version of Publication entitled "Industrial Catalysis and Separations: Innovations for Process Intensification" edited by Dr. K. V. Raghavan and Dr. B. M. Reddy was released. The APAS Journal Special Issue on Technology, edited by Dr. K. V. Raghavan was also released by the Chief Guest. Dr. M. O. Garg, Director, CSIR-IIP, Dehradun delivered the Key note address. Dr. G. Thyagarajan, former Director, CSIR-IICT, Dr. B. D. Kulkarni, Distinguished Scientist CSIR-NCL, Pune, G. Sundararajan, Director, ARCI, Hyderabad, Dr. P.G. Rao, former Director, CSIR-NEIST, Jorhat have delivered invited lectures covering a wide spectrum of biodiversity conservation, challenges in technology transfer in material and petrochemical industries, definition of new paradigm in chemical engineering and addressing of audacious tasks through astute chemical engineering. Sri KHV Prasad, Head, Chemical Engineering and Convenor of the Conference proposed vote of thanks

#### **8. Chem Careers Seminar-2013 - October 18, 2013**

CSIR-IICT and Royal Society of Chemistry, London have jointly organized "Chem Careers seminar-2013" on October 18, 2013 at CSIR-IICT in association with RSC-DS, British Council. The seminar mainly focussed on the employment opportunities available in the chemical sciences area for research students. Dr. Ahmed Kamal,

Outstanding Scientist, IICT welcomed the delegates. Mr. Andrew McAllister, British Deputy High Commissioner, Hyderabad inaugurated the Seminar. Ms. Julie Franklin, RSC-UK explained the importance of the Chem Careers Seminar. Eminent experts from academic/research/industry and representative from Deputy High Commission's Office, Hyderabad and Delhi delivered lectures on the topics such as career in agro chemicals, speciality chemicals, biofuels research, and chemistry with computer, development of soft skills covering topics like resume writing and tips on facing interviews etc. About 750 students of Chemistry from various colleges and universities attended the Seminar. The program was coordinated by Dr V Jayathirtha Rao, Chief Scientist and Head, CPC Division of IICT.

### **9. Interactive Meet with Poultry Farmers on "Poultry Litter Biomethanation" - October 24, 2013**

A one day interactive meet with Poultry farmers on "poultry litter biomethanation" was organized by BEEC Division of CSIR-IICT on October 24, 2013. Dr. Y.V Swamy, Chief Scientist & Head of BEEC Division of IICT welcomed the participants. Poultry farmers, technologists, engineers, policy makers, bankers, officials of different government ministries, press and media attended the meet. Dr. M. Lakshmi Kantam, Director, CSIR-IICT has released the brochure "for advocating the technology in the market" developed jointly by CSIR-IICT and M/s Ahuja Engineering Services Pvt. Ltd (AES), Hyderabad. Dr. AG Rao briefed about the technological developmental initiatives taken by CSIR-IICT in the area of high rate biomethanation of poultry for the past eight years. Ms. Shruti Ahuja, Director of M/s Ahuja Engineering Services Pvt. Ltd. presented the commercial aspects of bioethanation of poultry litter. Prof. A. Rajashekara Reddy, Dean of Sri Venkateswara Veterinary University, Hyderabad, emphasized on the usage of biomethanated poultry for farm applications.

### **10. National Seminar on "Food Processing For Sustainable Food Security and Safety" - October 24-25, 2013**

A National Seminar on "Food Processing For Sustainable Food Security and Safety" was organized by Association of Food Scientists and Technologists (India) Hyderabad Chapter in association with CSIR-IICT on October 24-25, 2013 at CSIR-IICT. The Seminar was supported by Ministry of Food Processing Industries, New Delhi and CSIR-Central Food Technological Research Institute, Mysore.

### **11. Third CSIR and Mayo Clinic Alliances Symposium Clinomics: Innovation to Translation - November 9, 2013**

Third CSIR and Mayo Clinic Alliances Symposium Clinomics: Innovation to Translation was organized at CSIR-IICT on November 9, 2013. Prof. Samir K Brahmachari, Director General, CSIR and Secretary DSIR delivered Plenary Lecture on "Crowd Sourcing Big Data to Develop System Biology Platform for Open Source Drug Discovery" and also addressed CSIR-IICT Fraternity. Dr. M. Lakshmi Kantam Director CSIR-IICT, Prof. Eric Wieben, Mayo Clinic, USA, Dr. Jean-Pierre Kocher, Mayo Clinic, Dr. Mitesh Borad, Mayo Clinic, Prof. Siddhartha Roy, Project leader, CSIR and Dr. Edward B. Leof Project leader, Mayo Clinic participated in the seminar.

### **12. IICT Founder's Day Lecture - November 22, 2013**

CSIR-IICT organized IICT Founder's Day Lecture on November 22, 2013. Dr. K. Nagarajan Corporate Advisor, Hikal R&D Centre, Bangalore delivered a lecture on "New Drug Development - The Indian Experience".



### **13. National Seminar on “Emerging Trends in Analytical Sciences” - November 27-28, 2013**

Indian Society of Analytical Scientists (ISAS) Hyderabad Chapter and CSIR-IICT jointly organized National Seminar on “Emerging Trends in Analytical Sciences” during November 27-28, 2013 in IICT Auditorium. Prof. B. Syama Sundar, Vice-Chancellor, Yogi Vemana University Kadapa, AP delivered the Keynote Address. Dr. A. V. Rama Rao, Chairman & Managing Director, AVRA Laboratories Pvt. Ltd., Hyderabad was the Chief Guest and Dr. M. Lakshmi Kantam, Director, CSIR-IICT presided over the Inaugural Function. Dr R Nageswara Rao, Head, Analytical Chemistry Division co-ordinated the seminar.

### **14. Industrial Meet cum One day Interactive Meeting on Recent Trends in Water-based Coatings - December 21, 2013**

Polymers & Functional Materials Division organized Industrial Meet cum One day Interactive Meeting on Recent Trends in Water-based Coatings on December 21, 2013 along with Indian Paint & Coating Association (IPCA). Around 70 delegates from different MSME of paint and raw materials have taken part in this event. Dr. M. Lakshmi Kantam, Director, CSIR-IICT inaugurated the IPCA Chapter. Mr Amit Misra, President IPCA, Mr Sanjeev Gupta, Vice President IPCA, Dr KVSJN Raju, Head PFM, CSIR-IICT, Mr Umesh Gupta and Mr MVN Rao, Mr Jatin Agarwal, Secretary IPCA were present during the inaugural function. IPCA has appreciated the efforts of CSIR-IICT in promoting the R&D activity in the area of coatings and allied materials. Dr Lakshmi Kantam has appreciated the efforts of IPCA for coating sector and emphasized that academia and industry has to come together for developing sustainable products. Dr Raju explained about the various facilities available at IICT and elaborated the steps that can be taken for the promotion of small scale paint industries. Dr Ramanuj Narayan of CSIR-IICT has delivered a interactive invited talk on opportunities and challenges in water based coatings. All the delegates visited the R&D facilities at IICT which was followed with a interactive session with IICT and IPCA team under the panel comprising of DR KVSJN Raju, Dr Ramanuj Narayan and Dr NV Satyanarayana, Head, BMA, CSIR-IICT and Mr VV Puranik.

### **15. 45<sup>th</sup> Shanti Swaroop Bhatnagar Memorial Tournament (Outdoor) Finals - January 7-10, 2014**

The 45<sup>th</sup> SSBMT outdoor finals for Cricket and Volleyball was held at CSIR-Indian Institute of Chemical Technology, Hyderabad from January 8-10, 2014. A total number of 16 teams - 8 for Cricket and 8 for Volleyball vied for the winner and runner spot after qualifying in the zonals held at different laboratories situated all over the country. The following teams participated in Cricket: CSIR-NAL, Bengaluru; CSIR-NPL, New Delhi; CSIR-IHBT, Palampur; CSIR-NBRI, Lucknow; CSIR-IICB, Kolkatta; CSIR-CMERI, Durgapur; CSIR-CSIO, Chandigarh and CSIR-IIP, Dehradun. The following teams participated in Volleyball: CSIR-NAL Bengaluru; CSIR-CFTRI, Mysore; CSIR-CCMB, Hyderabad; CSIR-NGRI, Hyderabad; CSIR-IIP, Dehradun; CSIR-CECRI, Karaikudi; CSIR-NPL, New Delhi; CSIR-IMTECH, Chandigarh. The tournament was inaugurated by Shri. A.K. Khan (I.P.S.) Director General, Anti Corruption Bureau, Government of A.P in a glittering function held at the IICT ZM School grounds on 7th January in the presence of Dr. M. Lakshmi Kantam, Director, CSIR-IICT, Dr. R.B.N. Prasad, Chief Scientist and Chairman of 45<sup>th</sup> SSBMT Organizing Committee, Sports Promotion Board Members, CSIR-New Delhi, Tournament Organising Secretary Mr. L.B. Suryaprakash and Executive Committee

Members of CSIR-IICT Staff Club. The following teams were the Winners and Runners: Cricket Winners: CSIR-National Aerospace Laboratories, Bengaluru; Cricket Runners: CSIR- Indian Institute of Petroleum, Dehradun; Volley Ball Winners: CSIR-National Aerospace Laboratories, Bengaluru; Volley Ball Runners : CSIR- Indian Institute of Petroleum, Dehradun. The valedictory function was held at CSIR-IICT auditorium on 10.01.2014. The Chief Guest of the function Dr. T. Ramasami, DG, CSIR and Secretary, Department of Science and Technology, Government of India, New Delhi distributed the trophies and individual prizes to the winners and runners. A galaxy of dignitaries like Prof. Sourav Pal, Director, CSIR-NCL, Pune, Prof. Budhani, Director, CSIR-NPL and President CSIR-Sports Promotion Board, New Delhi, Dr. M. Lakshmi Kantam, Director, CSIR-IICT, Dr.R.B.N. Prasad, Dr. Daljit Singh Bedi, Secretary, SPB, Dr. Vipin Kumar, central observer and Executive Committee Members of the Sports Promotion Board were present on the dias during the valedictory function. During the event, Dr. AR Prasad and Mr. SN Murthy Raju were felicitated for their contribution in cricket and volleyball. The function ended with a Vote of Thanks to the chair, by Dr. M. Mohan Rao, Vice President CSIR-IICT Staff Club and Member Sports Promotion Board, New Delhi

#### **16. Dr. P. S. Murti Memorial Lecture - January 10, 2014**

The 16<sup>th</sup> Dr. P. S. Murti Memorial lecture was organized at CSIR-IICT on January 10, 2014. Prof. Ravindra D Gudi, Department of Chemical Engineering IIT, Bombay delivered the lecture on "Advances in Batch Process Manufacturing". The lecture was focused on some of the challenges posed by batch processes and recent research efforts to use systems engineering tools such as modeling, optimization, control and performance monitoring, to improve batch productivity and minimize batch-to-batch quality variation and failures were highlighted. Dr M Lakshmi Kantam, Director, IICT delivered the Welcome Address.

#### **17. International Conference on "Chemistry with Computers" January 18-19, 2014**

A two day international conference on "Chemistry with Computers" (CWC-2014) was organized in IICT during January 18-19, 2014. The symposium showcased the principles and applications of current methods like Computational quantum chemistry, Density functional theory, Ab initio calculations, MD simulations, QM/MM calculations, Structure and Ligand-based drug design as well as the state of the art software and hardware solutions. The conference was attended by more than 150 participants including 30 delegates from abroad. Eminent scientist in the field of computational chemistry and biology Prof. E. D. Jemmis, Indian Institute of Science Bangalore was the chief guest.

#### **18. International Conference on Chemical Biology: Disease Mechanisms and Therapeutics - February 6-8, 2014**

CSIR-IICT, in association with the newly formed Chemical Biology Society (CBS) of India organized the first annual meeting of CBS-India "International Conference on Chemical Biology: Disease Mechanisms and Therapeutics (ICCB-2014)" during Feb 6-8, 2014 at CSIR-IICT. The major goals of the symposium were to foster seamless research collaborations among chemists, biologists, clinicians, physicists, mathematicians, and computer scientists with interest at the crossroads of chemistry & biology; to inspire creative young minds in undertaking the unmet global challenges in the emerging interdisciplinary field of chemical biology; and to promote academy-industry research collaborations. More than 400 young and



established chemical biologists from India, United States, Germany, France and Japan enthusiastically participated in this event. Dr. M. Lakshmi Kantam, Director of CSIR-IICT extended her hearty and warm welcome to all the delegates from India and abroad. Professor Santanu Bhattacharya, the Vice-President of CBS-India, Indian Institute of Science, Bangalore, briefly delved into the genesis and mission of the newly born Chemical Biology Society of India. Dr. Arabinda Chaudhuri, Chief Scientist, CSIR-IICT and Convener, ICCB-2014, highlighted the various technical sessions of the symposium and introduced Padmabhushan Professor P. Balaram, the then Director of IISc, Bangalore and the Keynote Speaker of ICCB-2014. The inaugural session ended with the mesmerizing keynote address "Probing Peptide Diversity in Conus Venom" by Professor Balaram. Thereafter, each of the technical sessions of ICCB-2014 covered one plenary lecture, 2-3 invited lectures and few short oral presentations by selected young faculties, students and post-doctoral researchers. An overwhelmingly large number (240) of young doctoral and post-doctoral researchers participated in the poster sessions of ICCB-2014 and multiple best poster awards were sponsored by Journal of Biological Chemistry / American Society of Biochemistry and Molecular Biology. "Journal of Biological Chemistry/ Herbert Tabor Young Investigator Award" (1500 USD plus a Crystal Plaque) was won by Professor Ruma Banerjee, Associate Editor, J. Biol. Chem. The coveted award went to Mr. Gopal Gunanathan Jayaraj from CSIR-Institute of Genomics and Integrative Biology, New Delhi. Professor Siddhartha Roy, Director, CSIR-Indian Institute of Chemical Biology, Kolkata and President, CBS-India, thanked the symposium organizing committee members of ICCB-2014 for their intense efforts. ACS Chem Biol, one of the World's most reputed Journals in the field of Chemical Biology published a full coverage of ICCB-2014 (ACS Chem. Biol. 2014, 9, 1224-1229).

### **19. National Symposium on "Clean Energy from the Coal Resource: Reliability to its Relative Abundance"- February 14, 2014**

In order to encourage and promote the adoption of clean coal technologies nationally, Coal and Gas Technology Division of CSIR-IICT organized a National Symposium on "Clean Energy from the Coal Resource: Reliability linked to its Relative Abundance" on February 14, 2014 at CSIR-IICT. This symposium was aimed at deliberations on various technological options for the efficient and cleaner utilization of coals i.e., the environment-friendly Integrated Gasification Combined Cycle (IGCC) for Clean Power generation, Production of Liquid fuels and chemicals in a sustainable manner either through syngas route or directly from coal, etc. Dr. M. Lakshmi Kantam, Director, CSIR-IICT delivered the Welcome Address. Dr. B. Madhusudhan, Chief Scientist & Head, Coal & Gas Technology Division and Convener, CRESS-2014 had introduced the symposium theme. The Inaugural Address was delivered by Chief Guest Shri Sutirtha Bhattacharya, CMD, M/s Singareni Collieries Co., Ltd. Dr. S. Sekar, Executive Director, BHEL (R&D) and Dr. DK Gupta of Thermax India, Pune spoke on IGCC for Clean Power Generation; Dr. Amitava Banerjee, Tech. Advisor, Air Liquide India Global E&C Solutions spoke on conversion of coal to High Value Products. Dr. Venkata Ramanan, VP (Proj.), spoke on application of British Gas-Lurgi gasification to Ammonia production from coal, while Shri DN Prasad, Advisor (Projects), Ministry of Coal spoke on governmental perspectives related to Coal Policy issues in Clean Technologies Development. Dr. K.V. Raghavan, INAE Distinguished Professor & Former Director of CSIR-IICT had chaired a panel discussion with all the eminent plenary speakers on the panel that discussed 'Clean Energy from the Low-grade Indian Coals: The way Forward' and made the recommendations to the Ministry of Coal.

## **20. Refresher Course on “Processing and Analytical Methodologies of Oils & Fats” - February 24-26, 2014**

The Centre for Lipid Research has organized a three-day refresher course on “Processing and Analytical Methodologies of Oils & Fats” during February 24-26, 2014 at CSIR-IICT. Dr M Lakshmi Kantam, Director, CSIR-IICT inaugurated the refresher course and released the course materials. This course was designed for the representatives of industries and R & D institutions and 50 participants attended this refresher course. This course was divided into lectures on processing and analysis and demonstrations of different spectral and chromatographic analytical techniques related to oils and fats. Dr PP Chakrabarti was the convener of the Refresher Course.

## **21. National Science Day Lecture - February 28, 2014**

CSIR- IICT organized the National Science Day Lecture on February 28, 2014. Dr. Simhadri Chandrasekhar Rao, Former Director & Chief Surgical Oncologist, Indo-American Cancer Institute & Research Centre delivered a talk on “Cancer in Indian Scenario: Early Diagnosis and Prevention”.

## **22. International Symposium on "Nature Inspired Initiatives in Chemical Trends" - March 2-5, 2014**

CSIR-IICT organised an International Symposium on “Nature Inspired Initiatives in Chemical Trends” during March 2-5, 2014 at CSIR-IICT. The symposium was inaugurated by Prof. Goverdhan Mehta, National Professor, University of Hyderabad and presided over by Dr. M. Lakshmi Kantam, Director, CSIR-IICT. The main theme of the symposium centred around the chemistry, biology and applications in human health care of natural products of plants, marine organisms, microbial and other natural sources. About 600 delegates from various countries including USA, France, Germany, Switzerland, Japan, China, South Korea, India were participated. Invited Lectures by 14-international and 22-Indian speakers besides 200-posters, mostly by young researchers and students, with an emphasis on recent developments in natural products chemistry and biology were presented in the symposium. The symposium was an unique opportunity the researchers working in the research and developments of drugs and pharmaceuticals. The symposium brought together the natural product chemists, biologists, young researchers and technologists from industry to know the recent developments and to identify the priority areas to provide affordable drugs for the human health care.

## **23. Business Meet of Centre for Lipid Research**

The Centre for Lipid Research, CSIR-IICT organized a Business Meet on March 15, 2014. In association with The Solvent Extractors' Association of India (SEA), Indian Vanaspati Manufacturers' Association (IVMA) and Indian Vanaspati Producers' Association (IVPA). The main objective of this Meet was to facilitate a common platform for Industry, Regulatory Authorities and R & D Organizations to critically discuss the present regulations on vegetable oils/fats/vanaspati/other allied products and their quality/safety specifications and identify the necessary additions / deletions and also identify technological gaps so as to provide safe, healthier and quality food products to the common man of the country. Dr M Lakshmi Kantam, Director, CSIR-IICT welcomed the delegates and requested the industry to network with CSIR-IICT for enhancing the productivity and quality of oils, fats and allied products. Sri Vijay Data, President, SEA, Shri Prakash Chawla, Chairman, IVMA expressed their wish to strengthen the industry association with CSIR-IICT. A Brochure showcasing the activities and achievements of Centre for Lipid Research of





CSIR-IICT and a R&D Profile with the compilation of technologies developed by the Centre were released. CSIR-IICT showcased the activities related to oils, fats and allied products with presentations and exhibition followed by visit to facilities of Centre for Lipid Research. Around 100 representatives from leading Oils, Fats and Allied Industries participated in this meet. Dr RBN Prasad, Chief Scientist and Head, Centre for Lipid Research and his colleagues described about various commercialized and developed technologies of the Centre. Dr N V Satyanarayana, Head Business Management Area explained IICT's industry-friendly business culture and also explained various project models. During the meet, agreements on technology transfers worth of Rupees fifty lakhs were signed with leading industries like A P Organics, Punjab, Balmer-Lawrie Ltd., Chennai, Advance Enzymes, Mumbai, Kamani Oil Industries, Mumbai, Japro Engineering Pvt. Ltd., Mumbai and R L Agro Solutions Pvt. Ltd., New Delhi. A separate agreement was also signed with the Directorate of Oilseed Research of ICAR for carrying out collaborative research for the development of newer varieties of oilseeds with thrust to higher yields and better nutritional values. The Solvent Extractors' Association of India announced its interest to sign a Memorandum of Understanding with CSIR-IICT to have closer interactions for the benefit of industry and consumers. The final session of the Business Meet was an interactive one dedicated to Regulations chaired by Dr. (Smt.) Meenakshi Singh, Scientist, FSSAI and co-chaired by Dr. A. Madhavan, Asst. Director, DVVOF. Dr. A.R. Sharma, A.P. Organics Ltd., Dhuri, Sri Susheel Goenka, 3F Industries, Hyderabad, Dr B V Mehta, SEA, Dr. V. Sudershan Rao, National Institute of Nutrition, Hyderabad, Dr. K.D. Yadav, Kamani Oil Industries Ltd., Mumbai, Sri Prabodh Halde, Marico Ltd., Mumbai and Dr. R.B.N. Prasad CSIR-IICT, formed the expert panel and based on the discussions a consolidated recommendations were forwarded to FSSAI by IICT to take appropriate action.

#### **24. Popular Lecture on Legal Issues of Employees Behaviour at Workplace - March 20, 2014**

As part of CSIR-IICT @ 70 celebrations, Mrs. S. Sainanda, Advocate, A.P. High Court, Panel Advocate, Bar Council of A.P. delivered a popular lecture on "Legal Issues of employees behavior at work place" at CSIR-IICT on March 20, 2014.

#### **25. S.S. Bhatnagar Memorial Lecture - April 1, 2014**

Prof. C.L. Khetrpal, Distinguished Professor & Vice Chairman, Centre for Biomedical Research Sanjay Gandhi PG Institute of Medical Sciences Lucknow delivered 22<sup>nd</sup> SS Bhatnagar Memorial Lecture on "Molecular basis of diseases, brain function and human behavior and beyond-role of NMR" on April 1, 2014 at CSIR-IICT.

#### **26. Round Table Business Meet of Natural Products Chemistry Division - April 18, 2014**

The organic chemistry group of CSIR-IICT has conducted a round table meet on April 18, 2014 by inviting about thirty pharma industry representatives. The meeting was conducted with a main focus to show case the capabilities of the institute built over the last decade and also to facilitate the sponsorship of projects to IICT by industry. The meet also allowed industry to share the problems they have been encountering especially on adapting newer processes and also the increase in R & D costs. The industry representatives were given opportunity to present their strengths and limitations so that nationally funded laboratories like CSIR-IICT could gear up for future. This meeting enabled CSIR-IICT to build strong relations with small, medium and also large pharma industries and the new collaborations are already

built within a short span of less than six months of this meeting. This meeting was also attended by DSIR representatives who have showcased various govt schemes offered by the Govt. of India to promote pharma industry activities or sustained growth.

### **27. World Earth Day Celebrations - April 22, 2014**

CSIR-IICT celebrated World Earth Day on April 22, 2014 by plantation of trees near Centre for Chemical Biology and Centre for Lipid Research Buildings. Latter one hour Film on environment - "Years of living dangerously" was shown at CSIR-IICT auditorium.

### **28. National Symposium on Polymers & Coatings - April 24-25, 2014**

The Polymers & Functional Materials (PFM) Division has organized 2<sup>nd</sup> National Symposium on Polymers & Coatings (NSPC-2014) during April 25-26, 2014 as part celebration of CSIR-IICT@70. This symposium was supported by CSIR XII Plan project INTELCOAT, OTAI, ISSPA, IPCA and IRMA with Paintindia as the media partner. It was attended by more than 350 delegates. Dr KVSJN Raju, Head, PFM Division was the convener while Dr D.Shailaja of PFM Division and Dr SV Manorama of Materials Research Group (I&PC Div.) were the co-conveners of this symposium. Dr. M. Lakshmi Kantam, Director CSIR-IICT welcomed the delegates while Dr KVSJN Raju has explained about the significance of the event. Dr A.J.V. Prasad, Joint Secretary, Ministry of Chemicals & Fertilizers, Govt. of India and Dr Vijayamohan K. Pillai, Director CSIR-CECRI, Karaikudi were the Chief Guest and Guest of Honor respectively. Mr. Dilip Raghavan, Managing Director, Color Publications Pvt.Ltd, Mumbai delivered the keynote address on "Opportunities for Coating Industry to harness Innovation and R&D". The exhibition organized during this symposium was inaugurated by Dr Vijayamohan K. Pillai. The focal theme of the symposium was nanomaterials, polymers and hybrids for smart and intelligent coatings. The symposium consisted of six technical sessions on Smart & Functional Coatings, Water based Coatings, Water based industrial coatings and Functional materials consisting of 18 Invited lectures, 2 selected oral presentations and 87 posters. The sessions were chaired by Dr B.P.Mallik of Asian Paints Ltd, Mumbai, Mr Vijay Kumar of Kansai Nerolac Ltd, Mumbai, Prof. A.S.Khanna of IIT, Mumbai, Mr D.Satpute of Kansai Paints Co. Ltd., Japan, Dr DJA Raj of NanoTech, Sharajah, UAE and Dr T.Shekharam of CSIR-IICT. The Valedictory function was presided over by Dr KVSJN Raju, the convener of NSPC-2014. The two day symposium provided a common platform for the industry, academia, end users to share their thoughts on science and technology of materials and coatings. The symposium was closed with a promise to meet in future with a motive to connect more the industry and researchers across the country.

### **29. National Seminar on "Recent Trends in Agrochemical Research and Manufacture" - May 5, 2014**

CSIR-IICT along with other CSIR institutions made a pioneering contribution to the development of process technologies for a variety of broad spectrum agrochemicals. This had greatly helped the Indian agrochemicals industry not only to acquire new process capabilities in organophosphorus and synthetic pyrethroid based agrochemicals but also to face the competition from multinational companies very effectively. A one day seminar on "Advances in Agrochemical Research and Manufacture" was organized on 5<sup>th</sup> May 2014 at CSIR-IICT to review the recent advances made in agrochemical science and engineering. This seminar was also organized to commemorate the 80<sup>th</sup> Birth Day of Dr. G. Thyagarajan, former



Director of IICT-Hyderabad, CLRI-Chennai and NEIST-Jorhat. Dr Thyagarajan has made outstanding contributions to the growth of agrochemical research in this country through a unique multi institutional applied research program of CSIR on organophosphorus pesticides during 1965-1985. Dr AB Mandal Director, CLRI, Chennai, Dr D Ramaiah Director, NEIST, Jorhat, Dr V Prakash, Former Director, CFTRI, Mysore, Dr AV Rama Rao, Former Director, IICT, Dr KV Raghavan, Former Director, IICT, Dr JS Yadav, Former Director, IICT and several industrialists, former scientists of Organic Chemistry Division II of IICT and faculty of IICT attended the Seminar. The program ended with felicitation to Dr G Thyagarajan on the occasion of his 80th birth day. Dr V Jayathirtha Rao was the Convener of the Seminar.

### **30. World Environment Day Celebrations - June 5, 2014**

CSIR-IICT celebrated World Environment Day on June 5, 2014 by plantation of trees near Center for Chemical Biology by Dr. Sukumar Devotta, former Director, NEERI, Nagpur, Dr Lakshmi Kantam, Director, CSIR-IICT along with several senior colleagues of CSIR-IICT. Latter Dr. Sukumar Devotta delivered a lecture on "CFCs, HCFCs and HFCs - Where do we go?" at CSIR-IICT.

### **31. National Technology Day Celebrations - June 30, 2014**

National Technology Day Celebration was held on 30<sup>th</sup> June, 2014. Prof. M.K.Bhan, former Secretary, DBT, Ministry of Science & Technology, Govt. of India delivered the "A.V. Rama Rao Technology Award Lecture" on "Development of an Indigenous Rotavirus Vaccine".

### **32. Dr. G. S. Sidhu Science Lecture - July 4, 2014**

CSIR-IICT and Dr. G.S. Sidhu Foundation Trust jointly organized 24<sup>th</sup> Dr. G. S. Sidhu Science Lecture on July 4, 2014 at IICT. Dr. B.V. Rama Rao, Chairman, Dr. Batreddi Hospitals Pvt. Ltd., Hyderabad delivered a lecture on "Chemistry of the Soul and It's Role in Health".

### **33. Workshop on Recent Developments in Extraction and Processing of Vegetable Oils - July 19, 2014**

CSIR-IICT and School of Food Technology, Jawaharlal Nehru Technological University, Kakinada jointly organized a workshop on "Recent Developments in Extraction and Processing of Vegetable Oils" on July 19, 2014 at JNTU-Kakinada to find out the problems of the oil industries in that area and to propagate the technologies developed by Centre for Lipid Research of CSIR-IICT for the benefit of the local industries. Dr G Tulasi Ram Das, the Hon'ble Vice Chancellor of JNTU, Kakinada inaugurated the workshop and expressed his desire to work together with R & D organizations like CSIR-IICT and also with the local industries. Shri O P Goenka, Technical Director, 3F Industries Ltd., Tadepalligudem delivered the key-note address. Eminent speakers from different industries delivered lectures on recent developments on solvent extraction, processing and also on regulatory issues. Dr RBN Prasad, Head, Centre for Lipid Research had delivered a lecture on "Value Addition and New Products" and showcased various technologies developed by CSIR-IICT.

# Glimpses of CSIR-IICT



# Celebrations



Dr M. Lakshmi Kantam welcoming Hon'ble Minister S & T, GOI, Sri Jaipal Reddy, August 2013



Hon'ble Minister S & T, GOI, Sri Jaipal Reddy signing the visitors book of CSIR-IICT, August 2013



Audience during curtain raiser ceremony of CSIR-IICT@70, August 2013



Inauguration of logo for CSIR-IICT@70 by Hon'ble Minister S & T, GOI, Sri Jaipal Reddy, August 2013



Release of a compendium of CSIR-IICT during curtain raiser ceremony of CSIR-IICT@70, August 2013



Release of Souvenir during the International Conference - OLEO-2013, August 2013



Opening Ceremony of International Symposium on Recent Developments in Dye Sensitized, Organic and Hybrid Solar Cells, August 2013.



Honouring Dr Chandrakanta Bandopadhyay on Teachers Day, September 2013



Prof. Shivgoapl Misra with Team Hindi during Hindi Work Shop at CSIR-IICT, September 2013



CSIR-Foundation Day Lecture by Prof. Ramakrishna Ramaswamy, September 2013



Prof. P.Rama Rao releasing the book during Symposium on Adv. in Chemicals & Materials Engineering, October 2013



Group photograph of Chem Careers Participants, October 2013



Interactive Meet of IICT Scientists with Poultry Farmers, October 2013



Prof. SK Braahmachari during CSIR-Mayo Clininc Symposium November 2013



Dr K. Nagarajan receiving memento from Dr. M. Lakshmi Kantam after delivng for CSIR-IICT Founders Day Lecture, November 2013



Dr. AV Rama Rao releasing Souvenir during National Seminar on "Emerging Trends in Analytical Sciences" November 2013



Industrial Meet on Recent Trends in Waterbased Coatings, December 2013



Inauguration of 45th SS Bhatnagar Memorial Tournament by Sri AA Khan, IPS, January 2014



Prof. Ravindra D. Gudi paying floral tribute to Dr. PS Murty before delivering PS Murty memorial Lecture, January 2014



Prof. ED Jemmis inaugurating the International Symposium on Chemistry with Computers, January 2014



Inaugural Ceremony of First International Conference ICCB-2014, February 2014



Shri S. Bhattacharya releasing souvenir on Nat. Sym.on Clean Energy from Coal Resources, February 2014



Dr. M. Lakshmi Kantam Inaugurating the Refresher Course on Processing and Analytical Methodologies of Oils & Fats, February 2014



National Science Day lecture by Dr S.Chnadrasekhar Rao, February 2014



Prof. Sukhdev & Prof. Goverdhan Mehta during International Symposium NIICT-2014, March 2014



Dr M.Lakshmi Kantam welcoming Mrs S. Sainanda for Popular lecture on legal issues , March 2014



Dr. M. Lakshmi Kantam Inaugurating the Business Meet of Centre for Lipid Research, March 2014



SS Bhatnagar Memorial Lecture and Inauguration of Fluoroorganics Building by Prof. C.L.Khetrapal, April 2014



Round Table Meeting by Natural Product Chemistry Division, April 2014





Plantation on the occasion of World Earth-day Celebrations  
April 2014



Souvenir Release during NSPC-2014, April 2014



Inaugural Ceremony of National Seminar on Recent Trends in  
Agrochemicals Research & Manufacture, May 2014



Presentation of memento to Dr Sukumar Devotta  
after delivering Lecture on World Environment Day, June 2014



Presentation of memento to  
Dr MK Bhan after delivering National Technology Day Lecture  
June 2014



Dr BV Rama Rao delivered GS Sidhu Science Day Lecture  
July 2014



# Natural Products Chemistry

The Natural Products Chemistry Division was originally a part of Division of Organic Chemistry in the 1960s which was bifurcated into Organic-I (Medicinal Chemistry) and Organic-II (Pesticides and Crop-protection) in the late 1970s. Under the leadership of Dr A V Rama Rao and Dr J S Yadav in late 1980s, the Division



became multidisciplinary and expanded its research base to isolation, characterization, synthesis and bioactivity studies focusing on natural products, synthesis of drugs and drug intermediates using traditional, catalytic and biocatalytic approaches, and pheromone isolation, characterization and synthesis. The expertise developed in the division during last 10 years has been recognized by Govt of India by setting up National Centre for Semiochemicals, Vaccine Immunology Laboratory, Diversity Oriented Synthesis Laboratory, Genetic Chemistry Laboratory, The National Mol Bank and Indo-French Joint Laboratory for Sustainable Chemistry at CSIR-IICT. Some

of the achievements of this Division are as follows: (i) Process and product standardization of certain classical anti-arthritic ayurvedic drugs; (ii) Designing of herbal formulations 75 K and 76 P for anti-gastric ulcer activity; (iii) Isolation of chemical entities from AP-9a found to be active over cancer cell lines; (iv) Identification for further development of AP-20am 13, AP-20am 14, AP-20am 15 and AP-20am 16 for memory enhancing and anti-depressant activities; (v) Identification of single chemical entities from AP-30b and AP-38a for the study of their biological activity against Leishmania; (vi) Process know-how of APIs in the areas of anti-ulcer, anti-cancer, anti-inflammatory and anti-TB and (vii) Development of new reactions on solid phase such as Merrifield and Wang resins.

## Core Competencies and Activities

- Automation chemistry for High Throughput Synthesis
- Active participation in OSDD programme through "Center for Open Source Drug Discovery" focusing towards tuberculosis therapeutics
- Attracted several national and international clients for collaborative projects such as M/s GSK, Colgate-Palmolive, Evolva, GVK-Bio, Zydus-Cadilla, Zenara, Biocon, Bharath Biotech, Cipla, Loreal-India, Saarum Sciences etc.
- Biocatalysis and Biotransformations
- Deuterium chemistry
- Development of new methodologies in C-C and C-X bond forming processes with Green Chemistry approach
- Development of new adjuvants in vaccine therapy
- Development of non-infringing process for APIs



- Development of new chemical entities for CNS disorders through collaborative programme "Indo-French Joint Laboratory for Sustainable Chemistry at Interfaces"
- Development of new chemical entities for GSK 3 inhibitors, Anti-tobacco therapeutics through collaborative programme "CSIR-Mayo Clinic, US"
- Isolation of bio-actives from natural sources such as terrestrial plants, marine origin, lichens and microbes
- Sample management through National Mol Bank, collaborative high throughput screening and data management for sharing across participating laboratories
- Standardization and formulations of herbal products
- Synthesis of bio-actives and their synthetic analogues with relevance to health sector inspired by nature

### Technologies Developed/Transferred (Selected)

- Carboprost (oxytocic)
- Diltiazem (coronary heart disease)
- Lipoic acid (anti-oxidant)
- Mefloquin (anti malaria)
- Magnolol and its analogues (anti bacterial)
- Misoprostol (Prostaglandins drug)
- Ondasetron (antiemetic)
- Orlistat (anti-obesity)
- Pregabalin (Anti-anxiety)
- Propiomazine (anti histamine)
- *n*-Propylisomagnolol (antibacterial)
- Pyrazinamide (antituberculosis)
- Tamoxifen (breast cancer)
- Taxol (C13 side chain)



### R & D Infrastructure

**Facility Creation:** Genetic Chemistry Laboratory, Diversity Oriented Synthesis Laboratory, Vaccine Immunology Laboratory, Indo-French Joint Laboratory for Sustainable Chemistry at Interface, National Mol Bank

**Instrumentation:** Accelerator synthesizer, Auto plant, Genevac solvent evaporator, High Performance Thin Layer Chromatograph, LC-MSD Trap, LC-Q-TOF, Mass-based Purification system, NMR, Personal SEP Box, Simulated Moving Bed Chromatograph.

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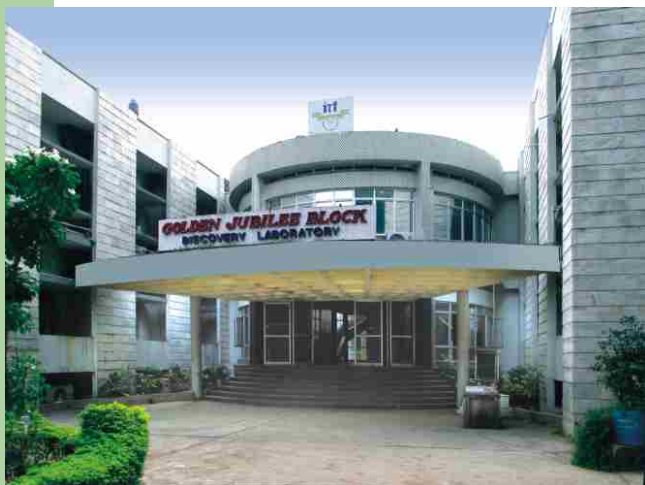
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# Medicinal Chemistry & Pharmacology

Drug discovery at CSIR-IICT is one of the major research programmes of the Institute. The medicinal chemistry research was initiated in the late 1950s in a modest way. This division has a unique distinction of discovering new hypnotic drug



methaqualone [Dr I K Kacker and Dr Syed Hussain Zaheer], however it was lost to Boots Pharmaceuticals. Later in late 1970s Medicinal Chemistry Division developed a new analgesic and anti-inflammatory drug enfenamic acid. This happens to be the first synthetic drug developed in the country. This drug was named as Tromaril and was marked by M/s Unichem Laboratories, Mumbai. Research for new drug continued in this Division and a number of compounds went up to Phase I and Phase II clinical trials like 2-carbamoyloxy ethyl benzoate (4003/2) as a substitute of Aspirin in collaboration with Rallis India Ltd., and a derivative of 3-pentadecyl phenol [cashew

nut shell liquid] as a cholesterol reducing agent in collaboration with Cadila Laboratories.

The Medicinal Chemistry division was strengthened in 1980s by inducting the pharmacology group with necessary facilities to support the new drug development programmes. In the late 1990s research for new anticancer agents was initiated in this Division that lead to several new promising molecules. Some of the US patents relating to these anticancer agents were licensed in the year 2007 and 2008 to IndUS Pharmaceuticals, USA and these are undergoing pre-clinical studies. These patents were licensed with an upfront fees of US \$ 100,000 and the milestone payments of US \$ 400,000 apart from royalties on the sales. This Division has one of the largest patents portfolio in CSIR for the new potential anticancer and anti TB agents.

This Division is actively engaged in developing novel drug delivery systems [NDDS], design and synthesis of NDDS, and their characterization, pharmacokinetic and pharmacodynamic performance in suitable animal models. The drug design aspect is well synchronized by in silico approach which is performed by molecular modelling group. Molecular Modelling group deals with all simulations to provide the most accurate scaffold to be taken for further synthesis.

Several collaborative projects were carried out with both International and National Pharmaceutical Companies and some of these are: Yamanouchi Pharmaceutical Company, Japan; Mitsubishi Chemical Corporation, Japan; Marubeni-Chemix Corporation, Japan; SmithKline Bechem, USA; DuPont, USA; and National Pharmaceutical Companies like Ranbaxy Laboratories; Lupin Laboratories; Rallis India Ltd; Cadila Pharmaceuticals; Unichem Laboratories etc. Various collaborative projects with a number of academic institutes have been undertaken and some of them are: University of Portsmouth, UK; University of Alberta, Canada; University of Capetown, South Africa; Imperial College, London, Kings College, London;

Greifswald University, Germany; University of Wuppertal, Germany; King Saud University, Riyadh, Saudi Arabia; University of Michigan, USA; Advanced Centre for Treatment, Research and Education in Cancer [ACTREC-TIFR], Mumbai; Centre for Cellular & Molecular Biology, Centre for DNA Fingerprinting and Diagnostics and University of Hyderabad.

In an effort to develop greener processes, extensive work was carried out in this Division on the development of bioprocesses and chemoenzymatic processes particularly for the drugs and their intermediates, apart from chiral separations. These activities led to the establishment of Biotechnology Incubation Centre [BTIC] at Biotech Park and Pre-Biotechnology Process Generator [PBPG] at this Institute.

Recently, this Division was awarded a prestigious project on the “Development of Second Generation Biofuels” by the Joint Clean Energy Research and Development Centre [JCERDC] under Indo-US Consortium. This Consortium has eleven partners including two industry partners. CSIR-IICT is the lead institute for implementing this project by achieving the envisaged targets. The successful completion of the project is expected to benefit both the countries by delivering a working model for feedstock production and supply, biochemical conversion approaches and technologies that have been validated on pre-commercial scale systems and the overall economics and sustainability of biofuel production and supply systems.

### Core Competencies

- Discovery and development of effective and affordable new drugs
- Synthesis of complex natural products, new molecules and analogue generation
- Development of newer processes, particularly greener synthesis of drugs and their intermediates
- Application of biotransformations and biocatalysts for the preparation of pharmaceutically important compounds including chiral separations
- Executing various medicinal chemistry and drug discovery programmes
- Development of reaction methodologies for asymmetric synthesis
- In-silico design of novel leads
- Understanding drug mechanisms and their mode of action
- Pharmacokinetic/pharmacodynamic studies
- Preclinical toxicity studies
- Identification of new microorganisms for useful biotransformations

### Technologies Developed and Transferred

- Developed various synthetic methodologies and green chemistry protocols for new synthetic transformations.
- Developed potential anti-cancer and anti-tubercular leads which are currently in preclinical studies.



## R&D Infrastructure

Excellent facilities for design and development of new methodologies for the synthesis of simple to complex molecules and their libraries

Equipped with analytical and related instruments such as UV, FT-IR, polarimeter, GC, HPLC, UPLC, GCMS, LCMS/MS, microwave synthesizer, scale-up lab reactor, parallel synthesizer, fermentors, Blood cell counter and analyzer, multimode microplate readers, RT-PCR, fluorescence microscopes, etc.



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# Organic and Biomolecular Chemistry

The Organic and Biomolecular Chemistry Division (formerly Organic Chemistry Division III) is around 30 years old. Since its inception in 1985 by Dr. AV Rama Rao, the then Director of CSIR-IICT, it has been making immense contributions in the area of Application Oriented Organic Synthesis (AO2S), with a special interest in the Pharmaceutical sector. The areas of research interests of the Division include: Natural Products (isolation and synthesis), Carbohydrates/mimics, Peptides and glycopeptides, Organo Catalysis, Nano-chemistry, Drug Discovery - Natural Product based drug discovery, Glyco-therapeutics and Peptide therapeutics.

The Division, during the last three decades, has been extensively engaged in the fields of: (a) process chemistry by non-infringing routes, (b) contract research for new route identification, development of scaffolds / NCEs and (c) drug discovery, besides frontier research in organic chemistry.

The Division developed process chemistry for the first chiral drug, '(S)-timolol maleate', widely used for the treatment of glaucoma, from D-mannitol. The process development for 'AZT', one of the most expensive drugs for the treatment of AIDS, was developed indigenously for the first time, bringing down the costs in the world market. A new and highly cost-effective route for  $\beta$ -azido thymidine, a crucial intermediate for AZT, was also developed from D-xylose. Likewise, process know-how for the anti-cancer agents etoposide and mitoxantrone;  $\beta$ -blockers, such as metoprolol, nadolol; gemfibrozile (cholesterol reducing drug) and others, using innovative and economical routes, was developed. Bench scale processes were developed for norfloxacin, ciprofloxacin, omeprazole, astemizole, naltrexone (DuPont, USA) and others, for several clients both from In



This Division has the distinction of attracting the overseas client, CytoMed, USA, for Contract Research, for the first time. An innovative new route for a multi KG preparation of CMI-977, their lead molecule, was developed, solving the problems associated with the discovery route. The work paved way for the synthesis of its stereoisomers and related molecules like CMI-983 and others. Likewise, a new route for the process development for SB-213584 was achieved and transferred to SmithKline Beechem, UK. New routes developed for Georgywood / amberketal, two fragrance chemicals, were transferred to Givaudan, Switzerland, wherein, the IICT route resulted Georgywood, in 94:6 ratio, unlike the discovery route with a 45:55 ratio. Translation of chemical reactions in solution into the Solid Phase, produced small libraries for SmithKline Beechem, UK. Similarly, validation studies were carried out for the solution phase reactions for the library generation, for





ArQule, USA, besides generating libraries for DuPont, USA, as potential agro products. A new route was developed for eptifibatide, a cyclic peptide, for Biocon, India.

The Division has been extensively engaged on the synthesis of NCEs for anti-HIV; anti-asthma COX-2, 5-LO, PDE-4, ICAM-1; anti-TB; anti-malaria and anti-cancer. The first product patent was filed on IICT-187919, an anti-HIV (NNRTI agent). Similarly, the efforts in the area of asthma resulted in several hit molecules, while, IICT-TA67, as a lead molecule, completed pre-clinical studies and entered into Phase-I clinical trials, for the first time from IICT. Several PDE-4 / ICAM-1 dual inhibitory molecules identified are under investigation. Several other NCEs evaluated against TB under the OSDD (Open Source Drug Discovery) programme, cancer and malaria, led to few hit molecules, which are evaluated for the lead generation.

The Division has undertaken projects from governmental agencies like DST, DBT and others to support the basic research. The scientists have been successful in synthesizing complex natural products, developing diverse synthetic methods, and design of peptides and glycosubstances. The division has worked with new sugar amino acids (SAAs) and C-linked carbo-amino acids (Caas), undertaken the design and synthesis of peptides, their conformational studies to realized diverse conformations, leading to the establishment of a new frontier area of research on 'FODLAMERS'. These efforts resulted in high quality - publications, patents, and training to the young researchers. The activities of the division attract large number of bright students from all over the country for pursuing their research, which culminated in around 250 Ph. D.s. The training enabled many of them occupying important positions in the industry / institutes both in India and overseas, besides becoming entrepreneurs. The outstanding contributions of the Division have been recognized in the form of honours and awards, such as CSIR / INSA Young Scientist Award, Bhatnagar Award, NASI-Reliance Award, Ranbaxy Award, OPPI Award, besides fellowships of the National Academies.

In the 12th Five Year Plan, the Division has undertaken diverse projects on different aspects, focusing at the core subject of "Human Health Care".

### Core Competencies

- Isolation and synthesis of complex natural products and their derivatives, biomarkers
- Development of synthetic methods for C-C and C-N bond formation
- Organometallic chemistry and its applications for the synthesis of natural products
- Carbohydrate chemistry glycosyl mimics, glycopeptides, carbohydrates for natural products synthesis
- Peptide chemistry synthesis of sugar amino acids, Caas for peptide based foldamers
- Design and preparation of metal alkoxide based Nanomaterials
- Design and synthesis of Novel Scaffolds and NCEs for Drug Discovery
- Development of New Synthetic Routes for Lead molecules for multi-KG synthesis
- Development of non-infringing routes and Proof of Concept Projects
- Carbohydrate and Peptide based Synthetic Vaccines

## Technologies Developed/Transferred/Leads For Drug Discovery

- Timolol maleate (glaucoma)
- AZT (anti-HIV)
- Etoposide / mitoxantrone (anti-cancer)
- Metoprolol / nadolol / (S)-Propranolol ( $\beta$ -blockers)
- Gemfibrozile (cholesterol reducing drug)
- Norfloxacin / ciprofloxacin (antibiotic)
- Naltrexone (opioid receptor agonist)
- Omeprazole (anti-ulcer)
- Astemizole (anti-histamine)
- Vitamin A and E
- New Route for CMI-977 (5-LO inhibitor)
- New Route for Georgywood (Fragrance Chemical)
- IICT-TA67 into Phase I Clinical Trials (anti-asthma PDE4 Inhibitor)

## R&D Infrastructure

- Peptide Synthesizer
- LC-MS
- HPLC (Analytical and preparative)
- CD spectrometer
- IR
- Polarimeters



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# Crop Protection Chemicals

The primary goal of the research endeavours of Crop Protection Chemicals [CPC (Organic Chemistry II)] Division, CSIR-IICT, is to develop green globally competitive, environment friendly and commercially viable technologies for the



market driven agro products and organic intermediates. The research efforts of the Division span a wide area in the realm of organic chemistry. The major research theme of the division is the design and development of novel crop protection strategies, to cater the needs of agrochemical sector specially Indian farmers. Organic process development has been a strong suit of the Division due to the strong leadership of Dr G.S. Sidhu, Dr G. Thyagarajan and Dr U.T. Bhalerao provided to the Division, which has generated viable methods for the industrial scale syntheses of several important agro chemicals which resulted in cash flow to the institute in the

form of royalties and consultancy. The Division is also involved in the development of biopesticides, which along with synthetic pesticides form a vital cog in the integrated pest management program. The Division is also strongly involved in the organic materials research as well as in the drug design and development. In the field of basic research, our efforts are focused on the organic methodology development, heterocyclic chemistry, photochemistry and total synthesis of natural as well as non-natural compounds. The division has been a major participant in the CSIR - Open Source Drug Discovery program for tuberculosis. The Division has been contributing significantly to the national project TAP SUN, a solar energy research initiative aimed at a sustainable future. Keeping in mind the problems faced by the globe in general and the country in particular, CPC division has been working to effectively combine organic chemistry with process technology, crop protection, drug design and sustainable energy.

Organic photochemistry research area was initiated by Dr J. Madhusudan Rao during 1970's at RRL/IICT. The objective was to establish a laboratory with facilities to carry out basic fundamental aspects of light interaction with organic molecules leading to chemical transformations. Later in 1990s it was changed to develop processes involving photochlorination, photooxidation and photochemical cis-trans isomerisation. Further, during 2000 onwards, the orientation changed towards organic materials having optical and optoelectronic applications. Presently, the "Organic Photochemistry" group is involved in synthesizing various organic molecules having applications in (i) Non Linear Optics (NLO); (ii) Photoresists (iii) Organic Photovoltaics (OPV); (iv) Organic Light Emitting Devices (OLEDs); (v) Molecular Switches (vi) Dye Sensitized Solar Cells. Collaborations are initiated to fabricate devices by utilizing organic compounds synthesized.

### Core Competencies

- Agrochemicals & Organic intermediates
- Plant Based Crop Protection Products
- Supramolecular Chemistry
- Photochemistry based specialties
- Organic Materials for Organic Photovoltaics and for OLEDs
- Fluorescence and Applications
- Total Synthesis of Natural Products and Development of Synthetic Methods
- Synthesis of Heterocycles
- Isolation, Structure Elucidation and Synthesis of plant based organics
- Integrated R&D Program for Agrochemical Processes & Technologies for Off-patent/ Generics
- Impurity profiling of insecticides/ drugs

### Technologies Developed/transferred

- Monocrotophos
- Chlorpyrifos
- Diazinon
- Butachlor
- Gammalin (BHC)
- Quinolphos
- s-Fenvalerate
- Trimethylphosphite
- Isoproturon
- Glyphosate
- Acephate
- Thiophanatemethyl
- DDVP
- MBS
- PROFENOFOS
- AVOBENZONE
- Vitamin D Analogues

### R&D Infrastructure

- Fourier Transform Infrared Spectrophotometer (FT-IR)
- Thermogravimetric Analyzer (TGA)
- HPLC (Preparative and analytical)
- Gas Chromatography
- GC-MS
- LC-MS
- UV-VIS-NIR spectrophotometer
- Polarimeter



- Fluorescence Spectrometer
- Cyclic voltammeter
- Photochemical reactor
- Microwave reactor
- Glove box
- Femtosecond laser
- Fabrication Facility for Organic Solar Cells



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# Centre For Semiochemicals

Centre for Semiochemicals (CSC) has been constituted in 2012 at CSIR-IICT with a multi disciplinary inhouse group consisting of expertise in organic chemistry, analytical chemistry, entomology and polymer chemistry. The group has been working on all aspects of semiochemicals / pheromones R&D i.e. from isolation, identification and synthesis of semiochemicals (pheromones & allelochemicals) to their field evaluation and is recognized as the National Center for Semiochemical Research.

Semiochemicals are naturally occurring volatile organic chemicals released by plants, insects and other organisms for specific communication purpose. They include Pheromones (intra-specific activity) and Allelochemicals (inter-specific activity). Pheromones are chemical substances (usually mixtures of chemicals) that act as messengers of communication between individuals of the same species eliciting behavioural responses in the receiver. In insects, pheromones that are used in different behavioural contexts are referred as sex pheromones, aggregation pheromones, alarm pheromones, epideictic pheromones, trail pheromones etc. Application of insect pheromones in integrated pest management (IPM) practices has been recognized as an important and promising tool in providing ecologically safe and environmentally friendly control strategy. Particularly pheromones are found highly suitable in the management of miner, borer and dweller category of pests as they cannot be controlled by conventional application of insecticides.

Isolation, identification, synthesis of insect pheromones and formulating them for field use to control insects themselves is Pheromone Application Technology (PAT). In India, after certain initial constrains the potential of PAT for quality food production is gradually gaining the attention of farming community.

Considering the versatility and potentiality of pheromones in providing an effective eco-friendly pest management, CSC at Centre for Semiochemicals has taken up the work on PAT for its popularization as an agro practice in Indian farming. The Centre has been working in this unique field of research for the last fifteen years and made extensive efforts during XI FYP to get the feel of farmers about PAT. To reduce our dependence on imported chemicals for the regular supply of pheromone lures at farmers' affordability, CSC has developed and established preparative methodologies for the pheromone components of several economically important crop pests. The pheromone preparative methodologies were transferred to industry.

CSC is ready to extend the collaborations all over the nation in future endeavours and anticipates for wider implementation and popularization for PAT as an agro practice for the benefit of our farming community. Sustainable agricultural methods like PAT



which lead to the production of improved quality and value added agro yields will not only increase the income of rural people but also improve the quality of life in rural areas. This is the overall activity of Centre for Semiochemicals at CSC aiming towards green management methods for the societal development of Rural India.

### Core Competencies

- Isolation, Identification and Exploitation of semiochemicals as Pest Management Tools in Integrated Pest Management (IPM)



- Development of suitable pheromone lures from the market available polymer dispensers
- Development and Popularization of environmentally safe pest control methods based on Pheromone Application Technology (PAT) as one of the best agro practices for sustainable agriculture.
- Synthesis of Insect Pheromones and other semiochemicals with affordable methodologies
- Providing knowledge base and Quality Assurance services to industry and user agencies.

- Providing training at national level on semiochemicals Research & Development
- Popularization of PAT as a Versatile Agro Practice in farming community and society, State Agricultural Departments, NGO and agricultural extension workers and to assist other research scientists of the country who have R&D interest in this fascinating discipline

### Technologies Developed and Transferred

- In India Centre for Semiochemicals (CSC) is the only centre working on the utility of semiochemicals (insect released pheromones/kairomones, and plant derived volatile chemicals) for crop protection. The application not only adds strength to the Integrated Pest Management (IPM) but also works as an alternative eco-friendly and environmentally safe pest control strategy for a given pest.
- Major work of CSC is focused upon, the Isolation and Identification of insect pheromones and related insect behaviour modifying chemicals and Developing feasible synthetic routes and environmentally friendly pest control strategies
- CSC has successfully demonstrated PAT in IPM as monitoring tools for the management of following pest insects belonging to different crops with indigenously developed pheromone lures
  - American Bollworm *Helicoverpa armigera* an obnoxious polyphagous pest (in 100 Ha of cotton/vegetables - Yellow rubber septa/Funnel trap)
  - Diamond Back moth *Plutella xylostella* a serious pest on vegetables (in 100 Ha of cabbage) - White rubber septa / Sticky trap
  - Early Shoot Borer *Chilo infuscatellus*, Pest on sugarcane (in 100 Ha. Sugarcane - Black rubber septa with Water trap)

- Top Borer *Scirpophaga excerptalis*, pest on sugarcane (in 100 Ha of Sugarcane - Black rubber septa / water trap)
- Stalk Borer *Chilo auricillus*, pest on sugarcane (in 50 Ha of Sugarcane - Black rubber septa / Water trap)
- **PAT** as an alternative to pesticides was demonstrated up to mass trapping at village level using indigenously developed synthetic pheromone lures for the control of the following insect pests for the first time in India
  - *Aproaerema modicella* Groundnut leaf miner (GLM) (serious pest on groundnut) (in 6500 Ha. and achieved 70% reduction in pesticide usage)
  - *Leucinodes orbonalis* Brinjal shoot and fruit borer (BSFB) (in 350 Ha. and achieved 60% reduction in pesticide usage)
  - *Chilo sacchariphagus indicus* Sugarcane inter node borer (in 500 Ha. and achieved 60% reduction in pesticide usage)
  - *Scirpophaga incertulas* Rice Yellow Stem Borer (in 1000 Ha. and achieved 50% reduction in pesticide usage)
- CSC developed PAT for GLM control is recognized as agro tool by State Agricultural Department and is introduced for the first time in groundnut IPM
- CSC Developed strong collaborations with different Agricultural institutions/Universities (Institutions - ICAR, DRR, NRCB, NRCS, Indian Cardamom Research Institute SPICES BOARD etc. Universities-ANGRAU, TNAU, MPKV, G.B.Pant University of Agriculture&Technology, Agriculture University Bhubaneswar, Kerala etc.) and Voluntary organizations (SDDPA, KVK, RDT etc.)

### R&D Infrastructure

- Electroantennography (EAG)
- Gas Chromatography Coupled - electroantennographic detection (GC-EAD)
- Gas Chromatography coupled Mass Spectroscopy (GC-MS)
- Air entrainment systems for collection of semiochemicals
- TrackSphere
- Windtunnel and Olfactometers
- Dispenser pre treatment and lure impregnation facilities



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# Inorganic and Physical Chemistry

The Inorganic and Physical Chemistry Division of CSIR-IICT, one of the oldest Divisions of the institute, adopts a multi-disciplinary approach for achieving advancement in both basic and applied industrial research related to catalysis, nanomaterials, and inorganic chemicals. The areas of interest of this division span a diverse range, that include catalysis (heterogeneous and homogeneous for bulk and fine chemicals synthesis employed as drugs and drug intermediates), nano-materials



development (with applications as sensors, bio-based drug delivery systems, and materials for solar energy conversion), sustainable energy (catalytic biomass conversion into chemicals and fuels), computational chemistry as well as organometallic and bio-inorganic chemistry.

This Division is engaged in the development of novel technologies for the conversion of solid waste like used plastics into fuels. The division has the expertise in the state-of-art reforming reactions to generate hydrogen for fuel cell and other applications. Extensive work has also been conducted on development of adsorbents

for carbon dioxide capture, removal of toxic gases from thermal power plant effluents, and fluoride from drinking water. This division has been developing novel materials being employed as photocatalysts, nanocomposites, solid electrolytes, mesoporous materials, and solid acid-base catalysts for various organic transformations.

A highly experienced interdisciplinary group of scientists from this division are working in the area of solar energy conversion. This Division is also known for theoretical computation and modeling studies aimed at the design of function materials such as non-linear optics. Synthetic inorganic and organometallic chemistry being practiced in this division caters to the development of efficient ligands for applications as catalytic materials, sensors, and bioactive substances.

The significant strength of this Division is having adequate number of highly qualified scientific strength on the design and development of materials that can be categorised broadly as nano-structured materials based on inorganic, organic, polymeric and hybrid functional-materials suitable for application in energy devices, sensors, catalysis, etc. Additionally, the major activities deal with tailoring the physical and chemical properties by appropriate surface engineering, characterizing the materials and studying their device properties.

The Division has undertaken several projects from governmental agencies like DST, DBT, DRDO, DAE and others to support the basic and applied research. The scientists have been successful in developing novel catalysts, materials, and process technologies that are in commercial use. The untiring efforts of this division resulted in good number of high quality publications, national and international patents, and

training of young researchers. The research activities and accomplishments of the division have attracted a large number of bright Ph.D. students from all over the country for pursuing their research, which resulted in more than 500 Ph.D.s. The high quality training enabled many of them occupying vital positions in the industry and institutions both in India and abroad, besides becoming very successful entrepreneurs. The outstanding contributions of the division have been recognized in the form of various prestigious honours and awards.

### Core Competencies

- Catalysts for Energy Applications
- Catalysts Fischer Tropsch Synthesis (FTS)
- Solid Catalysts for Conversion of Waste Plastics into Fuel Oil
- Low Temperature CO Oxidation
- Adsorbents for Defluoridation of Fluoride containing Water
- Catalysts for Nitration & Oxidation Reaction
- C-H bond Activation involving Transition and Non-transition Elements as Catalysts
- Application of Micro-flow Reactors for Organic Transformations
- Chiral Catalysis
- Bio-organometallics
- Materials for Application in Photocatalysis
- Magnetically Recoverable Catalysts for Hydrogenation
- Hydrotalcites
- Bioinspired Polyamine-catalyzed Silicification to Fabricate Mesoporous Silica Nanospheres
- Self-assembly of Nanoparticles to make Structured Materials
- Role of Computational Chemistry in Catalysis

### Technologies Developed/Transferred to Industry

- Fuel oil from waste plastics
- H<sub>2</sub> from methanol reforming
- H<sub>2</sub> biomass derived glycerol
- Novel adsorbents for coal gas purification
- Novel silver catalysts for micro-organism control in water
- Adsorbants for defluoridation of ground water
- Superior CO<sub>2</sub> adsorbants
- Catalytic hydrogenation-dehydrogenation coupling reaction
- Catalytic decomposition of methane
- Photo catalysts for energy and environmental applications
- Esterification and trans-esterification for biodiesel production
- Decalin dehydrogenation as H<sub>2</sub> storage medium for onboard fuel cell applications



- CO<sub>2</sub> as soft oxidant in catalytic oxidation reactions
- Heteropolyacids as green catalysts for fine chemicals synthesis
- Glycerol to 2-methylpyrazine
- Nanoceria-based mixed oxides for auto-exhaust purification
- Hydro-dechlorination of chloro-organics
- Functionalized mesoporous materials as catalysts
- Hydrotalcite based catalysts for cross coupling, Heck, and Suzuki coupling reactions
- Ammoxidation of alkyl aromatics
- Process know-how for PMAP, TBBA, Malononitrile, Triphenylphosphine, Furfuryl alcohol, pyrazinamide, and HFC-134A

### R&D Infrastructure

- Micro-Raman Spectrometer
- Low temperature Differential Scanning Calorimetry (DSC)
- Gel Permeation Chromatography (GPC)
- Zeta Potential with Dynamic Light Scattering (DLS)
- Vibrating Sample Magnetometer (VSM)
- Impedance Analyser
- Four Probe Conductivity measurement facility
- DC and AC Conductivity measurement setups
- BET Surface Area
- Chemisorption and Pore Size Distribution
- UV-Vis with Diffuse Reflectance Facility
- X-Ray Diffractometer with Small Angle and Temperature Attachments
- GC-MS
- Ion Chromatograph
- FTIR
- XPS
- DTA/TGA
- DSC
- TEM
- SEM
- AFM
- Pilot Plant Facilities



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# Centre for Lipid Research

The R & D activities in Oils and Fats were formally launched in the institute in 1945 and this division was one of the oldest divisions of CSIR-IICT and Dr K T Achaya provided an outstanding leadership to this group till 1972 and latter the group was headed by Dr G Lakshminarayana, Dr R Subba Rao, Dr TNB Kaimal and Dr Vijay Kale. Initially the division was named as "Oils and Fats" Division and in 1995 this was renamed as Lipid Science and Technology Division. During early fifties the main focus of research of this Division was on development of technologies for processing of non-traditional vegetable oils like cotton seed oil to augment the shortage of edible vegetable oils in India. This was followed by pioneering research in the area of fatty acids, fatty alcohols and their derivatives. Due to the changing scenario in the area of oils and fats, interaction between industry and Lipid Science and Technology Division had grown stronger over the last few years. Castor oil is an indigenous unique raw material and a valuable commodity for export and mostly value addition was done in other countries and Lipids Group developed technologies for several value added products from castor oil like undecenoic acid, hydrogenated castor oil, dehydrated castor oil etc. and transferred to industry on commercial scale.

In later part of eighties, due to acute shortage of edible vegetable oils in India, the focus shifted on development of processes for non-conventional oils like rice bran oil. India being a major producer of rice, research activities were directed towards development of edible grade oil from rice bran. The processing of rice bran oil is associated with many technological challenges. Lipids group actively pursued R & D on this unique nutritious oil and made remarkable achievement by developing technology for enzymatic degumming of rice bran oil with the funding of Technology Mission on Oilseeds, Pulses and Maize (Ministry of Agriculture, Govt. of India) and the technology was transferred to 19 industries and 8 Project Engineering Companies which made a deep impact on the vegetable oil industry in the entire country. CSIR in recognition has honored the efforts of the group by awarding with CSIR TECHNOLOGY AWARD for 2005. In addition the enzymatic degumming team bagged first Industrial Green Chemistry Award (2009) and Technology Development Board Award (2010) for commercialization of this technology.



Increasing price of fossil fuels and growing demands in energy requirement due to rapid industrialization is compelling the attention on alternate fuels from renewable sources. Lipids group actively pursued the development of more efficient and greener technologies for the preparation of biodiesel from non-edible oils like jatropha and karanja. In addition, work was also carried out for the preparation of value added products from the by-products of biodiesel like oilseed cakes and glycerol. Significant R&D work was carried out on the development of value added products (like biofertilizer, biopesticides, biolubricants, additives, surfactants etc.)



from karanja oil, cake and glycerol with the funding of Department of Science & Technology, Govt. of India and several projects are being executed in this direction for commercial exploitation of these products.

India is dependent on advanced countries for its aviation lubricant requirement. Hence IICT has launched a project in a major way for development of technologies for synthetic aviation lubricants from indigenous resources. Very recently Lipids group in collaboration with several other groups of IICT has successfully completed the process development for two such candidates. Analytical facility comprising of



highly sophisticated equipments has been created for lubricant testing and a pilot plant for the preparation of biolubricants has been established. Development of lubricants based on several non edible oils like jatropha, karanja, castor, sal etc. for different applications is also being actively pursued and several patents have been filed in these areas.

Lipids group has also developed a number of processes for utilization of by-products of vegetable oil processing industry. Processes for up-gradation of rice bran wax, hydrogenated wax, triacontanol,

policosanol, oryzanol, lecithin and modified lecithins, tocopherols, phytosterols etc., were developed and transferred to industry. The Division is actively working in the area of enzymatic modifications of lipids for the development of structured lipids like reduced calorie fats, trans-free vanaspati, diacylglycerol etc. Major thrust has also been given for the isolation or preparation of nutraceuticals like GLA, ALA, CLA etc. The Division has initiated many collaborative projects with both industries and other R & D laboratories in the areas like isolation and characterization of PUFA from algal and microbial sources for biodiesel and nutraceutical applications; ALA-rich oils from silk worm pupae; development of specialty fat liquors for the leather industry; enzymatic extraction of vegetable oils etc. Lipids group is also pursuing the processes for the development of high-value specialty oleochemicals based on castor and other non-edible oils using modern approaches like metathesis, enzymatic and microwave-irradiated reactions. Futuristic technologies like membrane separation are being investigated for processing of vegetable oils and for waste water treatment. Very recently 12 lit. capacity supercritical extractor has also been established for the development of green extraction processes.

The Division has established a good rapport with the Indian Industries and CSIR has taken a decision to strengthen this group by recognizing it as "The Centre of Excellence for Lipid Research". Accordingly, three specialized facilities (vegetable oils, biodiesel and lubricants) and one Process Equipment Pilot Plant were established during the 11th five year plan. This state of the art facility caters the needs of the vegetable oil and allied product industry, R&D and academic institutes on par with the International Standards. A dedicated new building was constructed for Lipids Group and the group is presently carrying out its activities from this new building. During last ten years the group has executed more than 100 Grant-in-aid and industry sponsored programmes worth about Rs 50 crores. The Centre has demonstrated 18 technologies to about 50 clients, extended analytical support to more than 250 industries and academic institutions, collaborated with more than 50

organizations, published about 300 research papers in reputed scientific journals and filed 75 patents during last ten years.

During the 12th Five Year Plan Lipids group has initiated a major collaborative project entitled “Development of Sustainable Processes for Edible Oils with Health Benefits from Traditional and New Resources (PEOPLE HOPE)” in collaboration with CSIR-NIIST, CSIR-NEIST, CSIR-IIP, CSIR-CFTRI and CSIR-NCL. CSIR-IICT is the nodal laboratory for this project.

### Core Competencies

**Newer Extraction and Processing Methodologies:** Enzymatic degumming of rice bran oil, Supercritical CO<sub>2</sub> extraction, Membrane processing, Refining process for Emu and Eri-pupal oils, Value added products from processing by-products, Process for refined and hydrogenated rice bran wax, triacontanol

**Biolubricants Based on Vegetable Oils:** Lubricant basestocks with tailor made specifications like pour point and viscosity range etc. (Polyol esters, Dibasic esters, Estolide esters, C36 dimer and C21 diacid esters, Epoxidised oils and fatty acid esters, Acylated oils and fatty acid esters, Bio-based additives with Antioxidants, Anti-wear and Extreme pressure properties

**Surfactants:** Fatty Acid-based Surfactants, Heterocyclic-based Monocationic and Gemini Surfactants, Mannitol-based Surfactants, Alkanolamine-based Surfactants, Estolide-based Surfactants, Amino acid-based Surfactants, Protein-based Surfactants, Lecithin-based Surfactants, Specialized surfactants for specific applications like adjuvants, fat liquors, personal care, etc.

**Castor Oil-based Products:** Hydrogenated castor oil, 12-Hydroxy stearic acid (12-HSA), Polyricinoleic Acid, Dimer Acids, Enriched methyl ricinoleate, Undecenoic acid (UDA) and heptaldehyde, 11-Bromo and 11-Amino, Undecanoic Acid

**Specialty Oleochemicals:** Cetyl myristoleate (CMO), -Undecalactone, Fatty acid-based triazoles, Guerbet alcohols, Designer Wax esters, Sodium stearyl lactylate

**Industrial Products from Processing By-products of Vegetable Oils:** Upgraded Rice Bran Wax, Hydrogenated Rice Bran Wax, Triacontanol, Long Chain Fatty Acids, Lyso Lecithin

**Nutraceuticals and Structured Lipids from Vegetable Oils:** Tocopherols, Phytosterols, Stanol Esters, Octacosanol (Polycosanol), Food grade lecithin, Glycolipid, Gamma Oryzanol, Synthetic Oryzanol, Reduced calorie fat, DAG oil, Trans-free vanaspati

**Bioactive Compounds:** Alkanolamines, Claviminols, Triazoles, Fatty Imidazolines, Fatty Schiffs Bases, Lipophilic Antioxidants, Karanjin

**Biodiesel and its By-products:** Continuous process for multi-feedstock (vegetable oils and algal oils), Glycerol based heterogeneous carbon acid and base catalysts, Fuel additives, Value added products from deoiled cakes and glycerol

**Analytical Support:** Analytical Support and Data Interpretation will be provided to Industry, R&D and Academic Institutes in oils, fats and allied products (lubricants, surfactants etc.), specialty lipids employing Chemical, Chromatographic and Spectral analysis



## R & D Infrastructure

**Vegetable Oil Testing:** Flash Chromatograph (2 to 120 g Capacity), Fourier Transform Infrared Spectrometer (FTIR), Gardner Color Comparator, Gas Chromatograph/Mass Spectrometer (GC-MS and GC-MS-MS). Gas Chromatographs (GC) with multiple Detectors (FID, NPD and ECD), HPLC-Mass Spectrometer (LC-MS-MS), High Performance Liquid Chromatograph (HPLC, analytical and semi-preparative) with multiple Detectors (DAD, RI, FLD & ELSD), High Performance Thin Layer Chromatograph (HPTLC), Lovibond Tintometer, Near Infrared Analyzer (NIR), Pulsed NMR, Rancimat, Refractometer, Thin Layer Chromatograph with FID (Iatroscan), UV-Visible Spectrophotometer



**Biolubricant Testing:** Air Release Value (ASTM D3427), Auto Ignition Apparatus (ASTM E659), Auto Viscometer (ASTM D445), Automatic Flash Point Tester (Cleveland Open Cup) (ASTM D92), Automatic Pour Point Tester (ASTM D97), Brookfield Viscometer, Copper Corrosion and Oxidation Stability Equipment for Light Oils (ASTM FTMS 791C-5308.7), Copper Strip Corrosion Bath (ASTM D3427), Demulsibility Characteristics Analyzer (ASTM D4530), Emulsion Characteristics Apparatus (ASTM D1401), Evaporation Loss Apparatus for grease (ASTM D2595), Evaporation Loss

Apparatus for oils (ASTM D972), High Pressure Differential Scanning Calorimeter, Hydrolytic Stability Apparatus (ASTM D2619), Low Temperature Viscometer Bath (ASTM D445), Noack Volatility Apparatus (ASTM D 5800), Oxidation Stability (IP-48), Oxidation Stability (RPVOT) (ASTM D2272), Rust Prevention Characteristics Analyzer (ASTM D665), Salt Spray Tester (ASTM B117), Twin Foam Test Apparatus (ASTM D892), Viscometer Bath & Tubes (ASTM D445)

**Biodiesel Testing:** Automated Distillation Unit (ASTM D1160), Biodiesel Analyzer, Cold Filter Plug Point Apparatus (EN 116/IP 309), Coulometer, Densitymeter (ASTM 4530), Flash Point Apparatus (Pensky-Martens Close Cup) (ASTM D93), Gas Chromatograph for Biodiesel Analysis (EN 14103), Inductive Coupled Plasma Optical Emission Spectrometer (ICP-OES) for Trace Metal Analysis (EN 14538), Karl Fischer Titrator, Micro Carbon Residue Tester (ASTM D4530), Ramsbottom Carbon Residue Apparatus (ASTM D524)

**Tribology Testing:** 4 Ball EP Tester (IP239), 4 Ball Wear Tester (ASTM D4172), Timkin OK Load (ASTM D 2509)

**Surfactant Testing:** Differential Scanning Calorimeter (DSC), Fluorimeter, Ross Miles Foam Test Apparatus, Particle Size Analyser, Rheometer, Tensiometer

**Pilot Plant and other Laboratory Equipment:** Agitated Thin Film Evaporator (10 lit. / hr), Autoclave (Hastelloy, 1 lit.), Autoclave (SS 316 50 ml, 100 ml, 600 ml, 2 lit., 7.5 lit. & 20 lit.), Automatic Soxhlet Extractor, Ceramic Membrane Separation Systems, Continuous Biodiesel Pilot Plant (10 and 35 kg/hr), Continuous Hydrogenation Reactor, Cross Flow Membrane Filtration, Degumming, Bleaching, Dewaxing and Deodorizer Units (15 kg/batch), Freeze Dryer (4-5 Kg water/day), Glass Jacketed Stirring Reactor (20, 50 lit.), Hydrogenator (Shaker type 150 & 250 ml glass bottles),

Microwave Digestion System, Mini Expeller (60-100 kg seeds/hr), Ozonizer (10 g/hr), Semi-continuous Refrigerated Centrifuge (4 lit.), Short path Distillation Unit (300 ml/hr and 1-3 Kg/hr), Solution Calorimeter, Spinning Band Distillation Unit (30 and 200 Theoretical Plates), Stirred Glass Jacketed Reactor (20 & 50 lit.), Supercritical Carbon dioxide Extractor (12 lit.), Synthetic Aviation Lubricants Pilot Plant (5 and 100 kg/batch), Tubular Continuous Centrifuge

### Technologies Commercialized/Developed

- Enzymatic Degumming of Rice Bran Oil
- Refined Rice Bran Wax
- Hydrogenated Rice Bran Wax
- Triacontanol
- Octacosanol (Polycosanol)
- Food Grade Lecithin
- Tocopherols & Phytosterols
- Docosahexaenoic Acid
- Dehydrated Castor Oil
- Hydrogenated Castor Oil
- 12-Hydroxy Stearic Acid
- Methyl 12-Hydroxy Stearate
- Undecenoic Acid / Heptaldehyde
- 11-Bromo and 11-Amino Undecanoic acid
- PEG Esters
- Sodium Stearoyl Lactylate
- Emu Oil
- Carbon acid/base catalysts for esterification, transesterification and other applications
- Castor, Jatropha, Karanja, Sal and Rubber Seed Oil-based Biolubricants
- Enriched methyl ricinoleate from castor oil methyl esters
- Protein-based surfactants from karanja and jatropha cakes
- Karanjin from karanja oil and cake
- Rice bran oil glycolipids
- Membrane process for waste water treatment
- Structured lipids and nutraceuticals
  - Reduced calorie fats
  - Diacylglycerol
  - Lecithin derivatives
  - Eri pupal oil
  - Synthetic oryzanol
  - Cetylmyristoleate

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## Awards for Enzymatic Degumming



CSIR Technology Prize 2005



Industrial Green Chemistry Award 2009



SEA Golden Jubilee Award 2013



TDB National Award 2009



# Fluoroorganics

The Fluoroorganic Division is established way back in 1992 to pursue R&D on development of technologies for hydrofluorocarbons which are considered as well recommended substitutes for ozone depleting chlorofluorocarbons (CFCs) and Halons. Identifying a dedicated team and establishing a separate division is a unique idea and vision of IICT and such an expertise is not available among the other CSIR labs or academic institutions of India. Further, it is also aimed to develop innovative



and indigenous processes for fluorinated Pharma & Agro intermediates. Thus, Fluoroorganic Division primarily initiated work on a most complex technology for 1,1,1,2-Tetrafluoroethane (HFC-134a) by catalytic vapour phase fluorination reaction using anhydrous hydrogen fluoride as fluorinating agent at elevated temperatures and pressures. The heart of the process is catalyst. A new catalyst was developed without infringing intellectual property of other patents and the innovation made in technology is protected in the form of new patents. The developed technology for HFC-134a from lab scale to semi-commercial scale was transferred to two

Indian industries which were subsequently commercialized the HFC-134a process and product is available to end users.

Similarly, Fluoroorganic Division developed a process for 2H-Heptafluoropropane (HFC-227ea) on lab scale to pilot scale and demonstrated to CFEES, New Delhi and is under commercial implementation by M/s. GFL, Gujarat. In addition to the above major products, the Division also developed process for 3-chloro-4-fluoroaniline, 2,4-dichlorofluorobenzene, 1,1,1-trichlorotrifluoroethane, 2,2,2-trifluoroethanol, trifluoroacetic acid, 1,1-difluoro-2-chloroethane and fluoromonomers such as chlorotrifluoroethylene (CTFE) and vinylidene fluoride (VDF). Further, Fluoroorganic Division has also successfully completed several contract and sponsored projects on important fluorochemicals from internationally reputed companies. The Division has developed expertise on Electrochemical fluorination of carbon nano tubes, layered materials such as graphite, molybdenum disulfide using fluorinating adducts: pyridinium poly(hydrogen fluoride), triethylamine 3HF at room temperature. The Division is also actively involved in organic synthesis by designing and synthesising new potential bioactive molecules and their evaluation as antibacterial, anticancer and antimalarial etc.

The Division has achieved several Institutional Best Performance awards (i) for successful mechanical commissioning of 5 kg/hour pilot plant on HFC-134a (multi-disciplinary project) during 2001-02; (ii) for successful transfer of technology for Heptafluoropropane (HFC-227ea) (2006); (iii) for Process know-how for the synthesis of Acetohydroxamic Acid (2008); (iv) for Process know-how for Siloxane Fluoroalcohol (2009); (v) for Process know-how for the Synthesis of Formohydroxamic Acid (2010) and (vi) for developing process for Fluoroelastomer for plastic bonded explosive applications (2012).

## Core Competencies

- Catalytic vapour phase fluorination reactions using anhydrous hydrogen fluoride
- Fluorination by halox reactions
- Hydro dechlorination reactions
- Denitrochlorination reactions
- Synthesis of fluorinated bio-active molecules by building block method as:
  - Anti-bacterial agents
  - Anti-fungal agents
  - Anti-cancer agents
  - Anti-diabetic agents
  - Anti-malarial agents

## Technologies Developed/Transferred to Industry

- 1,1,1,2-Tetrafluoroethane (HFC-134a)
- 2H-Heptafluoropropane (HFC-227ea)
- 3-Chloro-4-fluoroaniline (3,4-CFA)
- 2,4-Dichlorofluorobenzene (2,4-DCB)
- 1,1,1-Trichlorotrifluoroethane(CFC-113a)
- Acetohydroxamic Acid
- Siloxane Fluoro alcohol (SXFA)
- Formohydroxamic Acid
- 2,2,2-Trifluoroethanol (TFE)
- Trifluoroacetic acid (TFA)
- 1,1-Difluoro-2-chloroethane(HCFC\_142b)
- Chlorotrifluoroethylene (CTFE)
- 1,1-Difluoroethylene (VDF)



## R&D Infrastructure

**Reactions in continuous mode of operation:** Micro reactor assembly, Lab scale reactor system, Modular reactor system, Pyrolyzer, Pressure fractional distillation

**Reactions in batch mode of operation:** Autoclaves, Microwave synthesizer, Cryogenic systems, Electrochemical reactor system

**Analytic equipment:** Gas chromatograph, GC-Mass, High performance liquid chromatograph, Infrared spectrometer, Karl Fischer Titrator

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# Polymers & Functional Materials

Polymers & Functional Materials Division (PFM) Division of CSIR-Indian Institute of Chemical Technology (IICT) is one of the oldest divisions of the institute and has contributed immensely in both basic and applied research on polymers, coatings, adhesives, composites, biomaterials, conducting polymers, and hybrids materials



etc. The division has started its function along with Oils & Fats Division and become a full fledged division in the year 1956. During its journey of more than six decades, the division had contributed immensely for the transfer of various technologies and processes to industry and strategic sectors and the basic research has been published in national and international journals of repute. Coating and allied industry has been always in transition and with the changing environmental and technical requirements, the research focus has been shifted from time to time and CSIR-IICT's Polymers and Functional Materials Division is not an exception to this. This is a unique Division of CSIR-IICT and renamed four times to suit to its expanding activities.

The Division was known as Surface Coatings and/or Paints Division during 1956-81 wherein most of the work has been carried out to exploit the regional and local resources for the development of paints and also building capacity to serve the industry and to help create entrepreneurs. The highlight of the research during this period was the publication in most sought after journal Nature besides many specialized research publications and generation of intellectual property right. On the technology front, various oils and waste materials has been used for paint and ink development and most of the technologies were based on formulary art. A world class infrastructure has been developed for coating processing and evaluation. However during this time the world research was moving towards the more eco-friendly and structurally defined materials for coating development. The name of the Division was changed to Surface Coatings & Polymers (1981-89) and focus was shifted to development to coating using well defined polymers and water based polymers and emulsions, physical organic chemistry, rheological characterization and development of polymers for other sectors than coatings. During this period the Division was able to demonstrate its capability through development of speciality resins for ink, strategic & construction sectors, strengthening its capability in the area of upcoming polyurethanes, emulsions polymers and started its journey in the area of adhesives. The Division was once again renamed as Organic Coatings & Polymers Division (1989-2011) and the emphasis was laid onto utilize the innovative organic, polymeric and materials chemistry to meet the impending globalization and meet the environmental requirements. This period has completely changed the landscape of the Division has entered into many promising and technology yielding areas of research. During this period the Division has transferred many coating and adhesive



technologies to the various industries and strategic sectors. The cyanoacrylate adhesives, eco-friendly polyols for polyurethanes, high solids and water dispersible coatings, irreversible temperature labels, wood substitutes using waste material, guar gum utilization, Fluoropolymers, cyanate ester resins, composite resins for LCA, biopolyols for polyurethane foams, high performance polyurethane ink, moisture curing coating technologies, thermal insulation coatings, polyaniline based technologies, core shell particles, coating for grain, tissue adhesives, biomaterials etc were the highlights of the research. During this period Division has also started new research initiatives such as development of hyperbranched polymers, different nanomaterials, sol gel chemistry, development of hybrid materials, Fluoropolymers, novel polymerization techniques, polymer blends, nanocomposite, supramolecular chemistry, solar energy and battery materials, development of additives, utilization and value addition to waste, utilization of renewable resources etc and also strengthened the basic characterization, processing and evaluation facilities to meet the global benchmark. The expanding research base and the world requirements of materials with added functionality and advancement and applications of nano-technological principles in the process and technologies development has resulted in the latest renaming of the division as Polymers & Functional Materials division (Since 2011). The leadership of this division has been provided by Dr JS Agarwal, Dr MA Sivasamban, Dr MM Shirsalkar, Dr M Yaseen, Dr N Krishnamurti and Dr BS Sitaramam and at present it is lead by Dr KVS N Raju and the division is proud of its all the alumni who are at various positions in both academia and industry and working as entrepreneurs and consultants.

The mission of the division is to be a leading innovative eco-friendly solution provider through creation of relevant scientific knowledge base for understanding and expanding the science and technology of polymers, nano and hybrid materials for coatings, inks, adhesives, healthcare, energy, and construction and other speciality applications.

### Core Competencies

- **Coating & Functional Materials:** Speciality functional, smart and intelligent materials & coatings, decorative and protective coatings, Resin development and modifications such as alkyd, uralkyd, polyurethanes, epoxy, acrylics and hyperbranched polymers and their hybrids for high solids and water based coatings & allied fields, Eco-friendly emulsions & renewable resources based polymers, Adhesives, micro/nano composites, foam & insulation materials, nano-engineered coatings and sol gel based materials, structure & property relationship in coatings etc.
- **Novel Monomers, Polymers & Hybrid Functional Materials:** New monomers & polymers from renewable resources controlled radical polymerization, di & ter block copolymers, Atom transfer Radical Polymerization, Reversible Addition Fragmentation chain Transfer (RAFT), Novel Polymerization Techniques, Supramolecular chemistry & self assembly, Functional organic, polymeric, inorganic, IPN, nano & hybrid materials, core shell, grapheme & carbon nanotubes for different applications including solar energy, Polymer



Blends and Nanocomposites, Fundamental and structure property relationship research on polymers, hybrids, nanomaterials and biomaterials for technological applications

- **Speciality Functional Materials:** Fluoropolymers & Fluoroelastomers, Conducting and liquid crystal polymers, Biopolymers & Biomaterials, Controlled release, thermo reversible gels, solar energy harvesting & energy storage materials, Batteries, Supercapacitors, Solar Inks & Paints, Photopolymers, Opaque Polymer pigments using Core Shell technologies.

Raw material evaluations and new process & product development.

Problem solving and process improvement

### Technologies Developed and Transferred

The Division has transferred more than 140 technologies to various agencies.

- **Organic and Hybrid Coatings**

**Polyols for PU Coatings and Polyurethanes:** Polyester polyols, Castor polyols for coatings and foams, Acrylic polyols, Polyester Urethanes, Acrylic Urethanes, Hybrid Polyols, Hyperbranched Polyols, Polyurethane Wood Lacquer. Moisture Curing Lacquer, PU Filling Compounds, Polyurethane Laminating Adhesive, PU based systems for ink applications, Thermal insulating coatings for GI roof, Eco-friendly high solids resins, Isocyanate free polyurethanes.

**Other Polymers/Resins and Paints:** Alkyd resins and emulsions, Epoxy Paints, Epoxy-phenol Baking, Chlorinated Rubber Paints, Masonry Paints, Abrasion resistant coating for PET fibre, Antimicrobial Coatings, Emulsions for Coatings

**Anti-Corrosive Coatings Based:** Single and two pack PU, Epoxy resins, Moisture cured polyurethane systems, Water based polyurethanes and acrylics, Solvent free polyurethanes.

**Other Technologies:** Nuclear radiation resistant coating for Nuclear Power Plants, Thermal insulating coatings, Polyurethane resins for ink formulations, Anti-static rain erosion resistant coating for LCA, Rebar coating formation, UV resistant coating for outdoor exposure, Anti-static floor coatings for electronic and pharmaceutical industry, Irreversible Temperature Sensitive Labels, Moisture cure polyurethanes, Nitrogen and Sulphur containing hyperbranched polyurethanes, Organic & Inorganic Hybrid coatings, Acrylic urethanes dual cure IPN coatings, Epoxy-urethane-acrylic hybrid coatings, Urethane-siloxane hybrid coatings, Solvent free polyurethanes, Core-shell Styrene Acrylic emulsions, Acrylic and Styrene-acrylic emulsions, Polyurethane Dispersions, Pigments & fillers from waste.

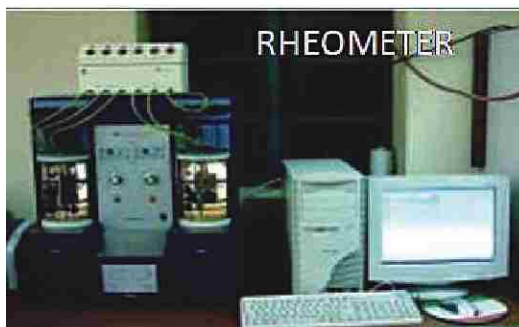
- **Strategic Applications:** Hydrophobic coating for laminates, Silicone high temperature glue, Polyurethane adhesive for honey comb structures, Cyanoacrylate adhesive, Rain erosion resistant coating, Composite resin for LCA radome, Fluoroelastomer, FEP Resin, High temperature resistant glue.
- **Speciality Polymers:** Polymers for Composites, Polymers for Wood Substitute, Monomers for specialty Polymers, Utilization and value addition to waste.
- **Automotive Applications:** Polyurethane adhesive, Rubber-metal bonding PU adhesive.
- **Biomaterials:** Chemically and photochemically cured surgical sealants, Biopolymer based haemostats, Preparation of collagen and gelatin films, foams

etc, Degradable polyurethane binders, Synthesis of specialty monomers and polymers.

- **Conducting Polymers:** Polyaniline materials, Electrostatic discharge film
- **CSNL based Technologies:** Cardanol from CNSL, Anticorrosive paints from cardanol, Polyols from cardanol, cardanyl acrylate and methacrylate, AllylCardanols, Phenalkamines, CSNL oil to CSNL resin preparation
- **Renewable Resource based Materials:** CNSL based polyols, Other Oil based polyols like castor, cotton seed oil etc. reactive surfactants etc.
- **Packaging Adhesives:** Corrugation and pasting gum, Corrugation and pasting gum liquids, Hot melt general purpose adhesive, Acrylic pressure sensitive adhesive for tapes, labels etc. Conversion of starch to white dextrin, Conversion of starch to yellow dextrin, Paper to oil coated tin label (POCT) adhesive, Glue stick, Polyurethane Laminating Adhesive.
- **Stationary Adhesives:** Self sealing envelope adhesive, Pressure sensitive adhesive for envelopes, Synthetic vinyl stationary adhesive, Bottle labelling adhesives for beer, whisky and medical bottles, Adhesive for book binding (hot melt).
- **Shoe Adhesives:** Polychloroprene adhesive for bonding shoe soles (Leather)  
Water based polyurethane adhesive for permanent sole.
- **Adhesives for Construction:** Polyvinyl acetate adhesive, Polyurethane grouting compounds, Water proofing compounds like acrylics, urethanes, epoxies, silicate compounds etc., grouting compounds and add mixtures.
- **Adhesives for Electronic Industry:** Methyl 2-Cyanoacrylate for metal-metal bonding, Acrylic copolymers for Polyurethane coating, Epoxy Urethane Acrylates for printed circuit boards.

## R&D Infrastructure

- **Polymers, Hybrids & Materials Characterization Facilities:** Gel Permeation Chromatography (GPC) couple with HPLC, Rheometer, Dynamic Mechanical Thermal Analysis (DMA), Differential Scanning Calorimetry (DSC), Thermo gravimetric Analysis (TGA), Particle Size Analyzer ( nano range), Video controlled Contact Angle Analyzer & Gonimeter, Electrochemical Impedance Spectroscopy (EIS), Electrochemical Work Station, Four probe Source Meter, Cyclic Voltammeter, Universal Testing Machine (UTM), Karl Fischer Tritimetric Analysis, UV visible Spectroscopy, Infrared Spectroscopy (IR).
- **Centralized Materials & Spectroscopic Characterization Facilities:** X-ray Diffractometer (XRD), MALDI-TOF, Mass spectrometers, Gas Chromatograph (GC), Liquid and solid state NMR, AFM, TEM, FE-SEM, Raman Spectrometer, and ESCA.
- **Coating, Materials and Polymers Processing Facilities:** Sintering & Drying Oven, High Pressure Reactors, High Speed Disperser, Triple and rubber roll mill,



Attritor mill, Red Devil Shaker, Spin Coating Unit, Spray Drier, Hot Press, Dyno mill, Automated Film Applicator, Free Film Casting Facilities, Spray Booth, UV Curing Counter, Low Temperature Drying Unit

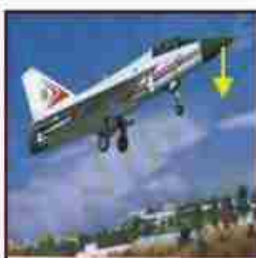
- **Coating and Allied Materials Evaluation Facilities:** Adhesion testing Units, Scratch resistance testing Unit, Impact Tester, Cylindrical Mandrel, Salt Spray Testing Units, Accelerated Weather-o-meter, Different Viscometers, Humidity Cabinets, Taber Abrasion, Dry Abrasion and Washability Tester, Spectrophotometer and all other small equipments for coating testing etc.



Foam sandwich panels  
for roofing



Adhesives



Low Loss Polyester  
Resin-LCA



Bio Adhesive



UV Cure-Adhesives  
& Biomaterials

**Wood substitutes from waste**



Coconut Coir



Rice Husk

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# Coal & Gas Technology

Coal R&D had occupied centre stage in the institute's R&D profile since the inception of this institute. After renaming as 'Regional Research Laboratory, the institute started with focused R&D work on 'Coal Utilization' and recorded voluminous professional expertise in the area of process development for rational utilization of the locally available low-grade coals. Over a period of time, the Coal Division developed technologies for the Low Temperature Carbonization of Coal (LTC), Coal-tar Distillation, Briquetting of Coal-char fines to Domestic coke, Moving Bed Pressure Gasification of Coals for Power Generation, Atmospheric Fluid Bed Gasification for Fuel Gas production, Hydrogenation of Coal-tar hydrogenation to Middle Distillates, Benzene to Cyclohexane, Hydro-cracking of Coal-tar to Paraffins / Naphthalenes, Extraction of Tar-acids and Tar-bases, Extraction of phenols from Ammoniacal liquor, Shaped Industrial Fuel, Formed Coke from Coke Breeze, Biomass Briquettes from Coir-pith, Saw dust etc., Impregnating Pitch from High Temperature Coal-tar, Unsymmetric Di-Methyl Hydrazine (UDMH) for Space Applications, Pine Char Carbonization for Rubber Industries, Activated Carbon from Coconut Shells, 3,5-dimethyl phenol from acetone, 2,3,6-Trimethyl phenol from m-cresol alkylation with methanol, Hot Gas Clean up for dust removal & desulphurization of coal-derived fuel gas for IGCC application, etc. in the past, some of which could even be transferred successfully to the Industry.

Development of Eco-friendly Processes for commercial utilization of abundantly available low-grade Indian non-caking Coals being the primary goal of the division, work on High Pressure Gasification of Low-grade Indian Coals in Dry-bottom Moving Bed Reactors was initiated in as early as 1966. It culminated in the preparation of a Techno-Economic Feasibility Report (TEFR) for a nominal 600MW IGCC power plant that compared four different IGCC processes including the IICT's Moving Bed Gasification based IGCC with NTPC's Conventional Thermal Power Plant of same capacity in 1992. As a follow up, Process development for High/Medium temperature Multi-contaminant Clean up of Coal-derived Fuel Gases with an emphasis on Low Energy-intensive Methods for Gas Separations was taken up.

Specialist groups existed that worked on applied R &D for technology adaptation, Indigenous Process Development as well as Coal S&T Services for Analysis of Coals for Resource Quality Assessment. Our Sponsors & Clientele included UNDP; Ministry of Coal; Ministry of Power; Ministry of Non-conventional Energy Sources; Singareni Collieries Co. Ltd., Kothagudem; Corporate R&D division of Bharat Heavy Electrical Ltd., [BHEL(R&D)], Hyderabad; The Energy & Resources Institute (TERI), New Delhi, etc.

LTC process for producing domestic coke was perhaps, one of the first and the largest successful effort in this direction that could be commercialized. A 900 tonnes coal per





day Commercial LTC plant based on the IICT technology went in to operation as early as by 1978 at the Coal Chemicals Complex of the Singareni Collieries Co., Ltd., Ramakrishnapuram, AP, producing the 'SICCO Coke®' and operated uninterrupted for over three decades till it was recently shut down in the late-Nineties due to growing problems in the marketability of the product. Extensive work was carried out on various briquetting aspects including the development of different binders, led to transfer of technology to small, medium and large-scale industry alike that included commercial use of our technology in the Coal chemicals Complex of SCCL.

A 1t/hr pilot plant based on the moving bed gasification was installed and operated



for gasifying low-grade Indian coals during 1983-90. An initiative was taken as early as in the mid-sixties got fulfilment through the UNDP-assisted effort on establishment of the 24 tpd Pilot Plant for pressure gasification of coal and an Elaborate Experimental Programme that included parametric optimization studies and testing of six different low-grade Indian coals and a lignite, Special studies on development of a Mathematical Model and its validation, Elucidation of Gasification Reaction

Kinetics through studies on Coal Reactivity in a Thermo- Gravimetric Analyzer (TGA), Measurement of Axial Temperature Profile in the Fuel Bed, Residence Time Distribution for flow of solids down the reactor, Scale-up studies for application in power generation through Integrated Gasification Combined Cycle (IGCC), etc. The objective was to carry out gasification tests to collect process design data from specific candidate coal samples for different end-uses of the product gas including the development of an indigenous process for making liquid fuels from Indian coals. The tests showed that the dry ash moving bed process is amenable to gasification of high ash Indian coals. The cold gas efficiency of the process is about 88% for oxygen-blown operation and is about 74% on air-blown mode.

IICT's participation in making a comparison of nine different IGCC technologies that were being developed abroad that culminated in the preparation of a Techno-Economic Feasibility Report (TEFR) for a 600MW IGCC plant when using a very high ash Coal from North Karanpura, Jharkhand for comparing four different IGCC processes including the indigenous Moving bed process with NTPC's conventional thermal power plant of same capacity in 1992.

In line with the activity on hand, i.e., Coal gasification for IGCC power generation, it was prudent that, IICT took up work on the Gap areas in IGCC technology and accordingly, a project on Development of a bench- scale process for Hot Clean Up of the Fuel gases from a coal gasifier was taken up with the support of Dept. of coal. The process operating at 850oC and 20 bar is intended to use adsorptive techniques for the removal and recovery of the sulphur components from the fuel gases before being combusted in a Gas Turbine, while ceramic candle filters were tried for particulates control. In order to save on the operating costs of coal gasification plant, Physical Simulation Environment was chosen for the experimental studies, i.e., to prepare a pressurized, hot, dusty coal gas mixture from pure gases and then subject it to Desulphurization and Filtration. Desulphurization is achieved in an adsorber with two separate beds of mixed metal oxides having different affinities towards sulphur. As a result, sulphur trapped in the reactor gets released as elemental Sulphur by-

product, during the regeneration of the metal oxide sorbents. The project was successfully completed in 2006.

As a sequel to the successful Process development on Hot Cleanup of Coal-derived Fuel Gas at 850oC and 20kg/cm<sup>2</sup> for removal of dust by Filtration through Ceramic Candle Filters and Sulphur compounds (H<sub>2</sub>S & COS) by Chemisorption on mixed metal oxide sorbents using simulated gas mixtures (2006), Indigenous development of another process as desired by the user industry, namely BHEL (R&D), could be successfully done (2011) for Cleanup of product gas from a Pressurized Fluidized Bed Gasifier (PFBG), carried out at a medium temperature of 500oC and 20kg/cm<sup>2</sup>, addressing the adsorptive removal of sulphur compounds (Desulphurization) along with removal of trace contaminants such as, Ammonia (Denitrification) and Alkali Metal Vapour (Dealkalization). Some more studies on regeneration of the spent sorbents are currently under progress. Second phase of the project involving design, fabrication, erection, commissioning and operation of a Gas Clean up system in tandem with the PFBG Pilot plant of BHEL R&D at Moulali will be taken up soon.

Fuel cell is an energy conversion device, which transforms chemical energy into electrical energy directly without the Carnot Cycle limitation on efficiency. It is environmentally benign and presently the only technology which can satisfy stipulations of the EPA. Hydrogen forms the basic fuel for the fuel cells. Hydrogen in turn is produced from a variety of conventional feed-stocks viz. methanol, coal gas, natural gas, LPG etc., by steam and/or air reformation. Although, hydrogen production technologies from conventional fuels are well developed, production of fuel cell grade hydrogen involves special techniques and materials. The challenges are development of suitable catalysts for reformation and purification and configuration of a reactor to maximize net energy availability. Sponsored by the Ministry of Non-Conventional Energy Sources, IICT has successfully developed a 10 kW Integrated Methanol Reformer Fuel Cell System including the technology for making all necessary catalysts. The reformer-fuel cell system was fully tested for self-sustainability and continuous operation without supply of any energy from external sources by optimally utilizing energy from the excess hydrogen produced fully accounting for internal energy requirement. Later, a methanol reformer to suit 50 kW PEM Fuel Cell power pack was developed and demonstrated.

Coal & Gas Technology Division has been continuing to serve SMEs and major industrial clientele alike in carrying out various analytical works entrusted to the group in evaluating different solid, liquid and gaseous fuel samples according to ASTM standard procedures, as prescribed by Bureau of Indian Standards, and incorporated in the Departmental operating procedures of ISO: 9001 Quality Standards as the service activity was undertaken according to ISO.

### Core Competencies

- Carbonization of Coal & Biomass materials
- High Pressure Moving Bed Gasification of Coal
- Scale-up & Techno-Economic Assessment of Gasification of Coal for IGCC Power Generation
- Economic Evaluation of Clean Coal Technological Options by Incremental Costing
- Integrated Gasification Combined Cycle for Power Generation
- Hydrogen generation from Oxy-fuels for Fuel Cell Applications



- Clean up and Separation of Gases Coal S&T (analytical) services

#### **R&D Infrastructure**

- 24 tpd Moving Bed Coal gasification pilot plant
- 10 kW reformer with 500 W fuel cell
- Autoclave reactors
- Humidity chamber
- Pressure swing adsorption unit
- Hot gas filter
- Hot gas desulphurisation system
- Dusty gas simulator
- Dealkalizer with in-situ Surface Ionization Detector
- On-line Gas Chromatograph with TCD/FID/FPD to assay Coal gas Composition
- 50 kW Reformer for fuel cell system

#### **Major Technologies Developed/Transferred**

- Low Temperature Carbonization (LTC) of High Ash Coals
- Briquetting of Char Fines to make Shaped Fuel from Coke breeze
- Moving Bed Gasification of High Ash Indian Coals
- Hot Gas Clean Up
- Warm Gas Cleanup
- Methanol Reformer for Fuel Cell Based Energy Systems (10-50 kW range)
- Coal S&T Services

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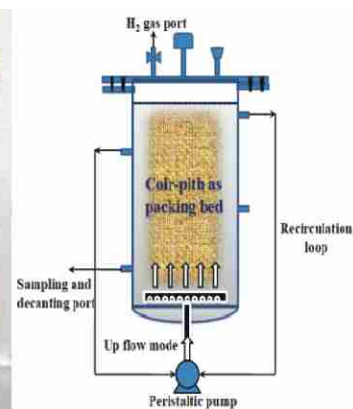
# Bioengineering and Environmental Sciences

The Bioengineering & Environmental Centre at IICT has a multidisciplinary team of experienced Scientists - chemical, microbial, environmental and analytical chemistry. The Division has comprehensive technical competence and project management skills for technology development and basic research work in Bioengineering and Environmental Sciences (BEES). The Centre is equipped with state of art infrastructure in this area. Several Processes are developed in BEES Division for commercial exploitation in the field of Energy and Environment.

Biohydrogen technology being developed in BEES can be easily transferred to the existing effluent treatment plants which reduce the investment by the conversion of negative valued waste in to commercially viable hydrogen which has a positive impact on the growing economics of industrial sector as well as escalating pollution levels. Pilot scale biofilter was developed for the removal of odor containing compounds from industrial emissions and a commercial scale plant of 7.5 m<sup>3</sup> is being installed at M/s SAA Tannery at Erode to remove the odor causing ammonia and hydrogen sulfide from preliminary tanning process of the tannery. An innovative high rate biomethanation digester called Self Mixed Anaerobic Digester (SMAD) was also developed for the treatment of organic solid waste and demonstrated at Live Stock Research Station (LRS) of Sri Venkateswara Veterinary University, Hyderabad. With little modification of technology the multi stage high rate biomethanation plant comprising of feed preparation tank (FPT), hydrolysis tank (HT), AGR, biogas storage balloon was transferred to M/s Ahuja Engineering Services Private Limited (AES), Toofran, Hyderabad for the treatment of approximately 1000 kg of poultry litter (deep litter). A modular digester is designed based on scientific doctrine of environmental biotechnology coupled with advanced engineering principles to accomplish superior process efficiency for safe discharge of garbage and this technology is field tested and currently these digesters are working at two housing colonies having nearly 100 families each. A microbial process for the production of L-asparaginase through solid state fermentation was also developed. Emission control is a major issue with respect to climate change and BEES Division carried out exemplary work in association with TIFR for mapping various pollutants in atmosphere.

## Core Competencies

- Performance evaluation of effluent treatment plants
- Industrial waste water treatment
- Design of effluent treatment facility for industries
- Bioremediation of contaminated soils



- Environmental Impact Assessment (EIA) studies
- Biomass to biofuels
- Production of industrial important compounds and biocatalysts by fermentation process
- Value added products from renewable materials by biotechnological routes
- Self mixed anaerobic digester (SMAD) for high rate biomethanation of solid waste.
- Modular anaerobic digesters for solid waste disposal
- Bio-hydrogen production through treatment of waste
- Bio-electrochemical systems for energy recovery and waste treatment
- Pre-concentration of Non methane hydrocarbons (NMHCs) from atmosphere
- Chemistry of Ozone and its precursor trace gases
- Odor abatement from process industries

### **Technologies Developed and Transferred**

- Generation of biogas from poultry waste
- High rate modular digester for solid waste treatment
- Periodic discontinuous batch process for wastewater treatment

### **R&D Infrastructure**

- Analytical facilities like HPLC, GC, Spectrophotometers for characterization of wastes
- Experimental bioreactors to produce hydrogen from wastewater
- Semi pilot plant MFC (100 liters; 36 chambers) with multiple electrode assemblies
- Pilot scale Self Mixed Anaerobic Digester (SMAD)
- Biofilter- Laboratory setup
- Prefabricated Modular Digester
- Biofilter to remove odor from process industries

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# Centre For Molecular Modeling

With the initiative of Dr. K.V. Raghavan the then Director, a molecular modeling group was established in early 1990's and the group initiated its activities under the guidance of Dr. JARP Sharma. The Division was renamed as the "Centre for Molecular Modeling" during the period of Dr JS Yadav and this Centre made a tremendous impact both at national and international level as a centre of excellence in the field. The group has published about 200 papers in journals of high impact factor during the last 12 years and about 20 Ph.D. students were mentored. The Centre has organized 5 international conferences/workshops. The group's contribution to teaching in bioinformatics course of IICT, AcSIR and NIPER, Hyderabad is significant. About 200 students carried out their dissertation work towards the partial fulfilment of M.Pharm./M.Tech./M.Sc./B.Tech. degrees or Diploma in Bioinformatics.

## Core Competencies and Activities

**Cation-p interaction:** One of the most important and fundamental contribution of the group was to demonstrate that cation-p is the strongest of non-covalent interaction and probe its variation as a function of size, nature of ion, solvent, and environment. These conceptual insights provide important insights in the catalyst design and drug design. Several experimental chemists and biologists have been employing these ideas to optimize their design strategies.

**Theoretical Organic Chemistry:** The group has made outstanding contributions in the area of buckyball chemistry, pericyclic reactions, porphyrins and in addressing the chemistry of hydrocarbon and heterocyclic isomers. These studies have lead to several experimental groups to conduct new experiments to verify our prediction. A number of our computational predictions have thus been verified by the experimentalists.

**Noncovalent Interactions and Cooperativity:** Cooperativity is a concept of outstanding fundamental importance and group has quantified this concept unambiguously. The group has vividly demonstrated how a pair of non-covalent interactions mutually influence each other. The size dependent preferences for the hydrogen bonded clusters were demonstrated through a series of publications. The importance of cooperativity and how it gets manifested in chemistry, materials science and biology has been demonstrated.

**Advance Functional Materials for Energy and Environment:** Centre for Molecular modelling aims to provide a basis for designing novel materials and/or to predict the relationship between material structure and performance in applications. The group has also performed exhaustive studies to assess the performance of carbon nanostructures such as graphene and single walled carbon nanotubes of varying curvatures on the basis of their curvature, chirality on their physisorption and chemisorption abilities. The efficacy of amino acids and clathrate hydrates as CO<sub>2</sub>



Dr. G Narahari Sastry receiving SS Bhatnagar Prize from the Hon'ble Prime Minister Dr. Manmohan Singh



capturing and storage materials has been evaluated by the group. Computational design of new dyes and understanding their intermolecular interactions with semiconductors has been done in collaboration with experimental groups.

**Computer Aided Drug Design:** The group has innovatively designed new lead molecules for several pharmaceutically important drug targets employing a wide range of molecular modeling techniques. The targets chosen are kinases, phosphodiesterase (PDE), P-type ATPase, aromatase, DNA, glycoprotein, 5-lipoxygenase.



### R&D Infrastructure

**Hardware:** Over the years, the group has built up a cluster of clusters, based on different architectures. Currently, the group has the combined capacity of around 600 cores of compute power. Besides the group has been at the forefront of optimizing the available computational power to tackle important problems, which warrants high capacity and capability compute power.



HP-Z800s



Dell work stations



High performing HP computers

**Software:** The available software packages are, Gaussian 09, GAMESS, ADF, Turbomole, Molden, Ampac, AIM, ORCA, MOPAC, GOLD 3.2, SILVER 3.2, Schrödinger Suite, Desmond, Discovery Studio, Chem-Shell, Charmm, Amber 8, Material Studio, Sybyl 6.9, Autodock, Codessa, VASP 5.3, VMD, ChemAxon, Pymol, MOE. Besides we develop our own codes to solve problems of interest.

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# Biology

Biology Division is a centre for excellence to provide high quality of basic and applied research in Bioinformatics, Entomology, Toxicology and Rural Development with state of art facilities. This Division was started basically as a supporting Division in IICT the then Regional Research Laboratory, Hyderabad since beginning to carry out in house investigations on target and non target organisms for the pesticides and allied formulations developed in the laboratory. Initially it was headed by an eminent scientist Dr Naidu with his dynamic team like Dr Mrs Osmani, Dr Qadri etc. The Division was working on various entomological research aspects and catering to the needs of the region and country as it was undergoing "Green Revolution". It carved a name for itself due to the good work carried out by the dedicated band of scientists and grew slowly in stature and structure to be identified as one of the performing laboratories in the Institute both in terms of External Cash Flow (ECF), research publications and patents.

Biology Division is keenly involved in multi disciplinary activities of advanced research areas like Biological control of pests and weeds, Integrated Vector Management (IVM), Bioinformatics, toxicity studies, Marine biotechnology, kairamones for pest management. Disease modelling of vector borne diseases like Filariasis, Malaria, Japanese encephalitis, and Dengue to minimize the outbreak is developed by this division which is pioneering work in the area of Public Health.

This Division is recognized by Central Insecticide Board, Government of India for undertaking, Pesticidal activities on vectors of public health and agricultural pests. Persistent studies of toxicants on different surfaces its bio-efficacy, Anti-bacterial/fungal activity of compounds, Termite testing, Mammalian toxicity studies as per Gaitonde protocol and OECD guidelines are pursued regularly. The department also does toxicological studies on nano materials, drugs, pesticides using in vivo and invitro models with reference to haematological, biochemical, histopathology and geno-toxicity parameters. Antirodents choice and no choice test in laboratories and field conditions are conducted periodically on four species of wild rodents. This department has also contributed significantly in the area of Insect Chemical Ecology, Plant Defense and Nano- Botanical Formulations. For the benefit of the rural populace useful information on the topics of agriculture, health, education, pest disease information system and various other aspects is disseminated through audio and video called as SAMADHAN KENDRA which is transferred many organizations to cater the needs of huge farming community in India. Similarly advanced forecasting system to predict the outbreak of vector borne diseases was developed to the Health ministries of both state and Central Govt to protect the people residing in endemic zones. ENVIS centre on "Bioinformaticsvector control" sponsored by Ministry Environment & Forest, Government of India is being managed by Biology Division ([www.iictenvis.nic.in](http://www.iictenvis.nic.in))







During the years of its long existence the department has served the needs of the common man, the Scientists and staff involved are highly competitive and reputed as evident by patents and high quality publications. In tune with the time the department is always ready for new challenges.

### Core Competence and Activities

- Information Technology for Integrated vector Management
- Environmental management for the integrated vector control & vector born diseases.
- Information technology for rural development
- Rural development through sericulture, plant tissue culture etc.
- Bio-control and Bio-evaluation of new molecules and natural product extracts employing entomological and toxicological and methods
- Standardization of alternate methods for toxicological studies
- Eco toxicological studies
- Medical informatics.
- Biomarkers as biological indicators of xenobiotic exposure
- Development of alternate methods for pest control
- Studies on insect plant interactions for development of better and safer pest control.
- Marine natural product evaluation.
- Offering advanced course in Bioinformatics jointly with CDAC and JNTU

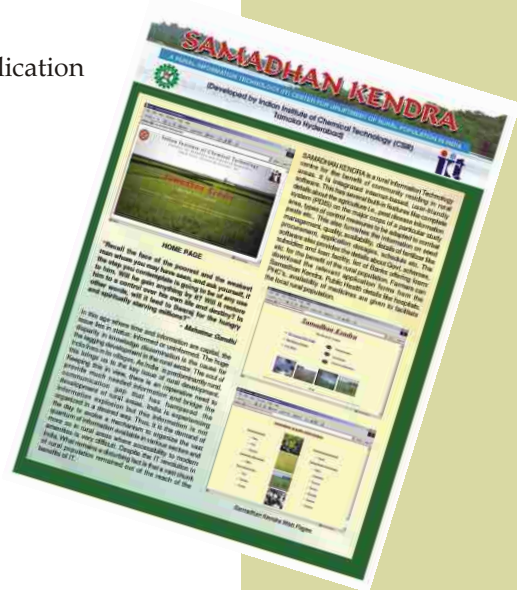
### R & D Infrastructure

- Modern insectry
- Mammalian toxicology lab
- Microbiology lab
- Tissue culture lab
- Glass house
- Animal house as per GLP norms
- Bioinformatics lab with super computer PARAM 10000 access
- UV VIS spectrophotometer
- Video microscope
- Paraffin embedder
- Slide strainer
- Tissue processor
- Microtome
- Liquid scintillation counter
- Climatic chamber
- Autoclave sterilizer
- Laminar flow unit Ultra centrifuge

- High-speed centrifuge
- Inhalation chamber
- Deep freezer(-95 degrees)
- Ethovision
- Co<sub>2</sub> incubator
- Florescent microscope.
- Amino Acid analyzer.
- HPLC

### Technologies Developed/Transferred

- Biological databases on mosquito & mosquito borne diseases (malaria, filariasis & Japanese encephalitis) was developed and transferred to Health department, Govt. of Arunachal Pradesh & Andhra Pradesh.
- Prioritization of disease endemic zones through Self Organizing Maps. This technology was developed and transferred to NVBDCP, Ministry of Health and FW Govt. India.
- Developed an integrated diseases forecasting system for the control of malaria in Mizoram & Sikkim.
- *Anopheles* & *Culex* mosquito identification through expert system application was developed and transferred to DRDO, Tezpur.
- Filaria monitoring visualization and malaria monitoring visualization system-a GIS based application was developed for identifying disease hotspot regions in endemic zones of India. These technologies were transferred to Health department, Govt. of Arunachal Pradesh & Andhra Pradesh.
- SAMADHAN KENDRA technology was developed and transferred to Byrraju foundation, Farmers Federation Association of Andhra Pradesh, NGOS form East and West Godavari districts of Andhra Pradesh.
- Socioeconomic empowerment through sericulture: Implemented sericulture (Mulberry, Muga and Tasar) activities in Andhra Pradesh, Assam, Manipur, Sikkim and Jammu & Kashmir.
- Developed high yielding silkworm breeds/hybrids tolerant to high temperature and BmNPV.



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# Chemical Biology

Chemical biology is an area that employs chemical tools in understanding the biological processes. Moreover, small molecular compounds have proven to be useful tools to understand the function at the molecular, cellular and organism level. CSIR-IICT has established the Chemical Biology facility of 30,000 sft building with basic infrastructure for executing preliminary small molecule screening against cancer, CNS and cardiovascular diseases in the XI FYP with an aim to optimally utilize the synthetic chemistry efforts of the institute by linking biological screening of the molecules and understanding their mode of action in further developing new therapeutic leads.



Chemical biology Division was envisioned in the 10th Five Year Plan (FYP). The Facility for Chemical Biology was accorded the full division status and was renamed as Centre for Chemical biology (CCB) in the year 2012. Since inception, CCB has played instrumental role in the identification of bioactive compounds at IICT and about 150 papers have been published so far in collaborative research. Presently the Division is executing a 12th FYP program, SMiLE (Small Molecule in Lead Exploration) to convert the hits obtained from high-throughput screens into leads. The centre has also established various platforms

for performing both basic and applied biological research and offers capabilities with multiple systems and has access to a collection of small molecule compound libraries. CSIR-IICT has a large resource of chemical expertise and these capabilities are complemented by CCB expertise in assay development, HTS, molecular biology genetics, structural biology, toxicology and molecular modelling studies. In addition, CCB also executes several individual projects funded by DST, DBT and ICMR and are recipient of prestigious fellowship awards such as Wellcome Trust, Ramanujan and Ramalinga Swamy.

## Core Competencies

- Screening of both natural and synthetic entities and understanding the mode of action of the lead molecules.
- Target-based biochemical screens
- Cell-based phenotypic screens
- Gene expression based screening
- RNAi screening combined with small molecules
- Assay development
- Analysis of cellular bioenergetics
- Neurotransmitter analysis
- Stem Cells for regenerative medicines
- Cancer Stem Cells for advance anti-cancer screening



- *In vivo* models of liver fibrosis and cirrhosis
- *In vivo* models of few neuropsychiatric and neurological disorders
- To decipher the pathway-specific disease mechanisms using the lead molecules in the areas of cancer, cardiovascular, metabolic and CNS disorders.
- Protein crystallography
- Recombinant expression and protein engineering for medical and biotechnology applications
- Implementation of bioinformatics, structural biology and molecular modeling strategies to understand the structure-function relationship of the lead molecules.
- Identification of molecular targets / potential biomarkers and their validation.
- Proof-of-concept using appropriate animal models

### **Technologies Developed/Transferred**

- Cloning and development of therapeutic proteins
- Development of biodegradable vehicle for siRNA delivery

### **R&D Infrastructure**

- High throughput Liquid handling system
- Mammalian and bacterial cell culture facility
- Confocal microscopy and live cell imaging
- X-diffraction system with automated robotic dispenser
- Radioactive facility and liquid scintillation counter
- PCR and real-time PCR
- Particle size analyser
- Imaging systems, such as, UV-Vis Gel documentation systems, Chemiluminescence imaging station.
- UV-spectrophotometers, Multimode readers
- Chromatography (UPLC with fluorescence and ECD) FPLC
- Cell metabolism and mitochondrial bioenergetics analyser (Seahorse)
- High-speed refrigerated centrifuge, ultra-centrifuge
- Cryotome
- Lyophilizer and high pressure cell disruptor
- Phosphor Imager



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# Chemical Engineering

Way back in the seventies, the Indian Institute of Chemical Technology, IICT, (then known as Regional Research Laboratory, Hyderabad, RRLH) recognized the urgent need of the country towards self reliance, so far as development and transfer of commercially viable technology to the industry, was concerned. Imported technologies were very expensive, and hence it had become imperative that R&D institutes in the country redirect their attention toward these issues. Thus, a major



CSIR Technology Shield for Glyoxal, 1990

organizational restructuring of RRLH was undertaken in the early seventies, to reorient goals and objectives and sharpen focus towards these issues and help propel the country towards self reliance. Conventional discipline oriented areas were changed and newer areas of work were born and even as early as then, IICT recognized that only a comprehensive multi-disciplinary approach stood better chances of success for the translation of exploratory bench scale scientific experimentation into technologies viable for commercialization. Towards meeting these goals, the Process Development Design and Evaluation group was established in RRLH in 1973, as one of the key thrust

divisions, which over a period of time grew much larger and is now known as the Chemical Engineering division.

Under the able stewardship of Dr.P.S.Murthy, who headed the Chemical Engineering Division in the late seventies, this group grew from strength to strength, developing and successfully commercializing several industrially important technologies, such as, Phosgene, Cynuric-chloride, Glyaxol, Sodium-azide, Benzyl chloride etc., to name a few. Some of these have also won the coveted CSIR Technology award.

The Chemical Engineering division, in collaboration with other groups in the laboratory, contributed immensely to the development of technology for pesticides, which included, process know-how, process design and engineering and commissioning assistance. Several pesticide plants, based on technology developed at IICT, have been set up in different parts of the country; some of them being Monocrotophos, Butachlor, DDVP, Diazinon, Chloropyriphos, as well as pesticide intermediates like, Phosgene and phosgene based chemicals, Chloro-phenol, Allyl-chloride, Diketene and diketene based chemicals, and intermediates for pesticides like, Trimethyl-phosphite etc. These have contributed immensely towards societal needs of the country, wherein, farmers were able to protect their crops, leading to self sufficiency in food production. Currently this group is actively involved in developing technologies for Xylene nitration, Benzaldehyde, Hydrazine hydrate, Avobenzene, Anisole etc. to name a few.

The recent success stories of this active group include technology transfer for Para-tertiary-butyl-benzoic-acid, Para-tertiary-butyl-toluene, and Para-tertiary-methyl-benzoate.

At a very early stage, Dr. Zaheer, the visionary Director, realized the potential of computer aided design and thus the seed for Simulation, Optimization & Control (SOC) was sown, which in due course of time grew to be one of the active groups (as Process Dynamics & Control Group) in the Chemical Engineering Division. The major research activities of this group encompass Process Dynamic Modeling, Real-time optimization, Process Monitoring & Fault Diagnosis, Advanced Process Control, and Model-based Design for Chemical / Biochemical Processes. This group has contributed immensely to basic research through high quality research publications in the above mentioned areas of Process Systems Engineering. The notable projects successfully completed by this group include 'Advanced Real-Time Control Technology for Batch Reactors', 'Automation of Chemical Reactors in Pharmaceutical Industries', 'Artificial Intelligence Based Tools for Process Modeling, Optimization and Control', 'Optimal Operation and Advanced Control of a Reactive Batch Distillation Process', etc. The major on-going projects include On-line Optimization of batch reactors, reactive crystallization, Process monitoring strategies for nonlinear processes, etc.

In keeping with the demand of the times, it was recognized that mathematical modeling was a powerful tool in the design of new process plants as well as in evaluating the performance of existing plants. The process simulation activity catered to the design of plants based on IICT technology and also de-bottlenecking and efficiency improvement of existing plants. Some of the major assignments undertaken were, Development and validation of mathematical models for FCC plant of Hindustan Petroleum Corporation Ltd., Efficiency improvement of Carbon-black plant of Panyam cements, etc.

Dr. Asad Ali Khan, who headed the Division during the nineties, envisioned the need of the times for process safety, and was instrumental in initiating research in this area. The Process safety centre (PROSAC) with the expertise in the areas of Hazard Analysis & Risk Assessment, Safety Audit, HAZOP and Disaster Management Studies offers services to various chemical, petro-chemical and agro-chemical industries. This group has successfully executed more than 100 assignments in the course of time and continues to be an active group of the division.

Membrane separation is one of the active groups of the Chemical Engineering Division. This group has developed several technologies for chemical industries besides contributing immensely to rural welfare through water purification projects as well as academic development through extensive HRD, spreading of technological awareness and laboratory development in several schools and colleges. Major highlights of the group's contributions include, Commissioning of several membrane pilot-plants of varying capacities based on Electro-dialysis, Nano-filtration and Gas-permeation to facilitate solvent recovery, Effluent treatment and gas purification in pharmaceutical, textile and



CSIR Technology Prize for Trimethyl phosphite Plant (1996)



petrochemical industries, and Design and installation of ten model de-fluoridation plants of 600-4000 lph capacity, for purification of ground water for fluorosis affected villages of Andhra Pradesh and Tamil Nadu.

With all its background, the Chemical Engineering Division is presently focusing on research that caters to the present demands of providing clean, green, lean and profitable technologies to chemical industry in the country. The Division's wide spectrum of activities includes research not only in traditional chemical engineering areas, but also in current frontier research areas in this field of engineering. Active basic research is on going in the area of process intensification which is a major step towards meeting the stringent demands of industry's zero waste policy and highly efficient and economical and globally competitive processes.

The chemical engineering division from its inception to the present has made significant contributions both to basic and applied research, besides fulfilling the Institutes commitments to industries for process technologies and has made an indelible mark on its clients. The group has published several papers(>200) both in reputed national and international journals, chapters in books, a number of patents, several technology awards, two young scientist awards and many other recognitions to its credit. It is the unrelenting endeavour of this Division to continue to provide quality, relevant, timely and sustainable support to the country's chemical industry.

### Core Competencies

**PDD (Process development and design):** Experimental evaluation of process routes, Process engineering and scale up of batch/continuous chemical processes, Design data generation, both bench and Pilot scale, Pilot/commercial plant design & operation, Basic engineering for retrofitting/ troubleshooting and commercial plants

**PDOC (Process dynamics optimization and control):** Process dynamic modeling, Soft sensing and state estimation, Advanced process control, Real-time optimization, Process monitoring and fault diagnosis

**PROSAC (Process safety center):** Risk analysis, Hazard and Operability Studies HAZOP study, Failure Frequency Analysis - Fault Tree Analysis/Event Tree Analysis (FTA/ETA), Safety audit, HAZOP and Disaster Mgmt studies, for various chemical, petrochemical & agrochemical industries

**PMS (Process modeling and simulation):** Study of hydrodynamic and transport parameters in bubble column slurry reactor, Modeling studies on liquid liquid extraction & Reactive Extraction, Solvent Selection and Reactive Crystallization Modeling, Modeling and simulation of rate processes in liquid-liquid dispersions

**MS (Membrane separations):** Development and design of membrane processes for water treatment, industrial separations, Development of hollow Fiber membrane technology for water purification & waste water reclamation, Development of novel membranes for gaseous separations, Membrane based intensified operations including membrane distillation, membrane reactors

**Basic Research:** Properties evaluations, Catalytic vapour phase alkylation of aniline, Basic studies using RC & ARC, Hydrodynamics and heat transfer studies in packed beds and multi-phase reactors, Process intensification: (i) Micro processing, (ii) Reactive separations like Reactive distillation, reactive extraction, reactive crystallization, membrane reactors etc.



## Technologies Developed/Transferred to Industry

- Butachlor
- Dichloroovas (DDVP)
- Diazinon
- Mono Chrotophos
- Chloropyriphos
- Quinolphos
- Hydrofloro carbons(HFC 134a)
- Real-time Control Technology for Dipotassium salt (intermediate in Ranitidene prepn)
- Real-time Control Technology for NMSM (intermediate in Ranitidene prepn)
- Phosgene and phosgene based chemicals
- Chloro-phenol
- Allyl-chloride
- Diketene and diketene based chemicals
- Cynuric Chloride
- Tetra bromobis phenol A(TBBA)
- Glyoxal
- Sodium Azide
- Tri Methyl Phosphite
- Para tertiary butyl toluene (PTBT)
- Para tertiary butyl benzoic acid(PTBBA)
- Tertiary butyl methyl benzoate (TBMB)
- Deflouridation Of Ground Water Using Reverse Osmosis
- DMSO Solvent Recovery Using Electrodialysis and Distillation hybrid process
- Membrane Pilot Plant for Natural Gas Sweetening
- Solvent Recovery from Acrylic Fibre Industry using 5stage Nano-filtration
- Risk Analysis of Auto-LPG Dispensing Systems
- Risk Analysis of Auto-LPG Bottling plants
- Risk Analysis of the Proposed and Existing Ammonia Storage
- Risk Analysis of Phosphoric Acid Storage Facility
- Safety Audit of Agro Chemical and Petrochemical Plants
- HAZOP Study for the Aspirin Manufacturing Plant
- On-Site Emergency Plan for Chlor-alkali Plant

## Ongoing Projects

- Avobenzene
- Anisole
- 4MAP





- Nitration
- Benzaldehyde
- UDA
- Hydrazine Hydrate

#### **R&D Infrastructure**

**Process scale up facilities:** Glass distillation unit/ Stirred tank reactor/ Solid liquid extraction unit/ Vacuum Filter/ Spray dryer/ Centrifuge/ Sono crystallization/ Auto claves of varying capacities etc.

**Process development lab & pilot plant:** Jacketed stirred reactors / Tubular reactors of varying sizes / Bubble column reactor/ Packed bed reactor / Densitometer/ Rheometer/ Ebulliometer/ Bio diesel pilot plant etc.

**Reaction engineering lab:** Reaction calorimeter/ Accelerating rate calorimeter / Tubular reactors of varying volume

**Membrane separation lab:** Multipurpose RO/NF/UF/MF Pilot Plants with test cell integrated system/ Bench-scale Gas Separation set-up/ Electro dialysis pilot plant / Laboratory and Pilot-scale/ Peervaporation systems etc.

**Process dynamics and control lab:** Completely automated batch reactors / Tubular reactor/ Distillation column / Packed bed reactive distillation column, fermenter, etc.

**Analytical facilities:** Gas chromatograph/ HPLC / Spectrophotometer etc.

**Process intensification facilities:** Micro channel units / Micro PIV / Falling film micro reactor/ Reactive distillation column, etc

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# Design & Engineering

The Design and Engineering Division (D&E), the only one of its kind in CSIR, was established in 1974 under the leadership of Late Mr. R. N. Parlikar, with an objective of providing a seamless link to technology transfer. The Division had strength of over forty staff members at that time, which included the scientific and technical staff. The Division has a unique opportunity to be associated with the chemistry and chemical engineering groups in all the process plant projects right from the process development, through pilot plant studies/scale-up and basic engineering stages, which are the niche areas of expertise of CSIR-IICT.

The thrust area of work of the Division is to carry out the engineering of pilot and commercial scale process plants by providing the mechanical designs and detailed engineering information required for construction of the plants, leading to seamless technology transfer. Over the years, the activities of the Division have been expanded to include process safety studies as a major partner in CSIR-IICT's PROSAC group, laboratory and biotech facility design and applied research in areas related to process equipment and piping. The Division has vast experience in the use of latest computer-aided methods in the detailed design of process plants.

The D&E Division has been associated with the processes and technologies that have been transferred by CSIR-IICT. The D&E Division has been associated with other CSIR Institutes and various EPC consultants like TNO (Netherlands), DNV Technica (Norway), Dalal Consultants, Tata Projects, Humphreys & Glasgow, Davy Powergas, UHDE, Resource Projects, Toyo Engineering and R J Associates. Members of the Division was awarded the '**CSIR-Technology Prize**' for the Pesticide, Trimethyl Phosphite, Glyoxal and Sodium Azide Technologies which were transferred to the Indian industry.



Design Analysis studies

## Core Competencies

- Process equipment design as per ASME Section VIII, Division 1 and 2 and BIS
- Heat exchanger design as per TEMA
- Detailed equipment specification sheets for fabricated, vendor and utility equipment
- Detailed equipment drawings
- Piping engineering and design as per ANSI standards, including pipe sizing, pressure drop calculations, material selection, stress analysis, support design and specification, insulation and painting specifications, etc.
- Equipment design appraisal
- Equipment arrangement plans and elevations
- Pipe routing drawings, piping GA plans, piping isometrics
- Piping BOQ and material specifications
- 3D plant modelling



- Project planning and monitoring
- Safety audit, hazard analysis fire hydrant design
- Preparation of tender documents

### Technologies and Engineering Assignments

Some of the major technologies transferred or being transferred for which detailed engineering was carried out by D&E Division

- Low temperature Carbonization (LTC)
- Mono chloro acetic acid (MCA)
- Activated Carbon
- Glyoxal (GLY)
- Sodium Azide (SAZ)
- Chlorpyrophos (CPP)
- Hazard and Risk Analysis
- Trimethyl Phosphite (TMP)
- HFC -134a
- Cyanuric Chloride
- Nickel Extraction Proving Pilot Plant
- Undecenoic Acid (UDA)
- Synthetic Aviation Lubricants (SAL)
- Natural Colours Extraction plant
- Ethambutol Hydrochloride
- Hydrazine Hydrate plant
- Para tertiary butyl toluene (PTBT) Ongoing
- Para tertiary butyl Benzoic acid (PTBBA) Ongoing
- Design and development of Rain Erosion Test Rig
- Finite element analysis of pressure vessels
- Fatigue analysis of high pressure vessels
- Detoxification and dismantling of Union Carbide Plant in Bhopal
- Setting-up of the first Biotechnology Incubation Centre (BTIC) with GMP compliant pilot plant facility for development, standardization and scale-up of bio-processes.

### R&D Infrastructure

- Servers, Graphic Work stations and large format printing, copying and scanning
- Process Equipment Design and Piping Analysis Software
- Finite Element Analysis Package
- Plant Modeling and Drafting software

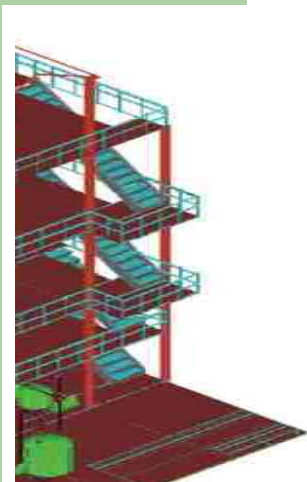
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# Pilot Plant Facilities

Pilot plant facilities of CSIR-IICT covers a whole range of unit operations commonly encountered in chemical process industries, such as distillation, absorption, filtration, evaporation, size reduction, drying, liquid-liquid extraction and solid-liquid extraction (SLE) units. Chemical reactors of various capacities are designed to operate at different temperatures and pressures are also part of pilot plant equipment. Material of construction and design conditions of the individual units are carefully selected with a view to enable to handle a wide variety of chemicals. In most instances, the pilot plant units are custom designed and erected to suit specific process requirements. This facility is a pre requisite for acceptance of the process and the very basic of scale-up, design and retro fitting.

In addition to In-House/Sponsored projects, the pilot plant facilities are also rendered to outside parties, i.e., bulk drug manufacturers, chemical manufactures and R & D units situated around Hyderabad, for custom synthesis of selected drugs, pesticides etc

## Competencies

- Rendering assistance for upscaling of IICT laboratory scale and other agencies processes
- Providing consultancy services to outside agencies to utilize IICT pilot plant facilities

## Infrastructure

- Distillation & Fractionation units, 20 & 50 lit (All glass)
- Stirred Tank Reaction Units 10, 20, 50 lit (All glass)
- Reactor cum distillation unit 100 lit (All glass)
- Rotary Evaporators 10, 100 lit (All glass)
- Distillation & Fractionation unit 20, 100 lit (All glass)
- Solid Liquid Extraction unit 100 lit (All glass)
- Short Column Distillation Units 100 lit (All glass)
- Vacuum Filtration Unit 10 lit (SS)
- Distillation Unit 20 lit (SS)
- Centrifuges 5, 20 lit (SS)
- Centrifuge 20 lit (Ebonite)
- Spray Dryer 10 kg (SS) 1 kg (All glass)
- Ball Mill 4 kg (MS)
- Roller Mill (Rubber)
- Attrition Mill 5 lit (SS)
- Reactor/Distillation Unit 50 lit (SS)
- Distillation Unit 50 lit (SS)
- Reactor/Distillation Unit 50 lit (SS)
- Reactor/Distillation Unit 50, 100 lit (MSGL)





- Open Pan Reactor Unit 100 lit (MSGL)
- Open Reactor Unit 50 lit (MSGL)
- Rota Cone Dryer 100 lit (MS)
- Short Path Distillation Unit 1 lit (Glass)
- Reactor Unit 500 ml, 600 ml, 1, 2, 10, 20, 50 lit (SS)
- Reactor Unit 1, 10 lit (Hastelloy C-4)
- Reactor 1 lit (Nickel)
- Crystallizer 2 lit (SS)
- Reactor Unit 500 lit (SS)
- Shaker Unit 500 and 1 lit (MS)



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# Analytical Chemistry

## (Chromatography & Separation Sciences)

Analytical Chemistry Division (ACD) is a centralized multifaceted division with sophisticated analytical facilities for Instrumental and Chemical analysis with a vision to provide high quality analytical services which foster international standards in basic and applied research output in analytical sciences. The Division provides facilities for qualitative and quantitative analysis to R & D projects of laboratory and also gives analytical services to the chemical industry, universities and other research institutions. The division has produced around 400 research publications, 40 Ph.Ds and several post graduation dissertations in analytical chemistry. The analytical facilities are accredited as per ISO 9000-2011.

The chemical process development activities at IICT need enormous support of analytical services involving micro, semi micro, and macro level of investigations. The Analytical Chemistry Division (ACD) is well equipped with these facilities with an objective to offer a range of knowledge based services not only to R&D projects of the laboratory but also chemical and allied industries which need them to assess quality and performance of industrially important chemicals as well as consumer goods to meet the specifications of national and international markets. The latest trend in the evaluation of fine, performance and specialty chemicals is to employ and a package of analytical tests to assess their full applications potential including their eco compatibility and user safety. The analytical facilities consisting of advanced instruments based on gas, liquid and thin-layer chromatography, IR, UV, electrophoresis have received ISO 9000 accreditation from internationally recognized assessors. Modern developments in data acquisition and processing have made these instruments most efficient and user friendly and provide wealth of information on the structural characteristics of organic and inorganic compounds.

Analytical activities were as old as the institution. When the lab got rechristened as Regional Research Laboratory (RRL-H), analytical activities were directly monitored by then director, Dr. G.S. Sidhu. As the demand for analysis increased, need for a separate division was felt and in 1972, Analytical Chemistry Division (ACD) came into existence under the headship of Dr.MR Subbaram followed by Dr. Y V Subba Rao. During this period chemical analysis of silicates, metals, coal, water and oils & fats was carried out by wet methods. CHNS analysis was in much demand as mass spectrometry facility was not available then. Analytical services were confined to mostly in-house projects. Later the services were extended to Industries around and the facilities were modernized by introducing instrumental techniques. ACD has given extensive service and support to the in-house projects of lab in various capacities. With its expertise lots of consultancy and commercial projects were assigned to IICT for chemical analysis. This also resulted in basic research and started



enrolling Ph.D scholars. ACD is providing services to various state, central and R&D Departments also.

IICT is a nodal lab for preparation and dissemination of pesticide CRMs under the network project coordinated by CSIR-NPL, New Delhi. Around 10 CRIR laboratories participated in round robin testing of the 20 CRMs prepared under this program and ACD is actively participating in this programme.

### Core Competencies

- To render analytical support to R & D projects of the laboratory
- To provide analytical support to the industry, universities and research institutions
- To provide consultancy services in impurity profiling, drug master files (DMF), chemical equivalence, method development and validation, chiral separations, environmental analysis, analytical and preparative isolation of compounds, residual analysis of pesticides and drugs
- To provide facilities for bioanalytical, micro separations and on line 2D LC separations.
- To undertake consultancy services to chemical industry
- To conduct basic and applied research in analytical sciences.
- To develop human resource development by organizing training courses, seminars workshops etc

### Technologies Transferred/Methods Developed

- Development of Analytical Methods for transformer oils
- Estimation of Genopep in serum extracts by HPLC
- Accelerated stability of Genopep, a peptide undergoing the clinical trials for development of new drug for the treatment of burns,
- Analysis coal ash and coal samples
- Asia Pacific Metrology Programme (APMP) TCQM-DEC Proficiency Testing for determination of pesticides in Tea powder
- Development & Validations of Chromatography & Capillary Electrophoresis,
- Analytical & Preparative Separations of Optical and Geometrical Isomers
- Liquid-Liquid & Solid Phase Micro Extractions
- Drug Quality and Safety Evaluations:
- Impurity Profiling & Chromatographic Fingerprinting, Stability Indicating & Forced Degradation studies
- Chromatographic Isolation & Structural Characterization of small molecules by Spectroscopy
- Fate and Distribution of Antibiotics, Pesticides, Aromatic Sulphonates, Fluorescent Whitening Agents and Synthetic Pyrethroids in aqueous media
- Process Control & Monitoring, Computer Assisted Analytical Methods Chemometrics & Design of Experiments

- Detection of adulteration in Food, Beverages and Pesticide Formulations, Detection of Hot Spots in Electrical Transformers and Generators
- Analysis of Minerals, Pesticides, Pharmaceuticals, Water, Fine chemicals, Coal, Petroleum Products etc

#### R&D Infrastructure

- HPLCs with PDA, UV-Visible, ELSD, Fluorescence, Conductivity and RI detectors with LC solutions software
- Gel permeation chromatograph (GPC) system
- Gas Chromatographs
- HPTLC
- Ion Chromatograph
- Capillary Electrophoresis
- UV-Vis-NIR spectrophotometer
- UV-Visible spectrophotometer
- CHNSO analyzer
- FT-IR spectrometer
- Flame photometer
- Atomic Absorption Spectrometer
- ICP-OES Spectrometer
- Density meter



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# Mass Spectrometry

Mass spectrometry is a powerful and versatile analytical technique for the analysis of organic and biomolecules, mainly for determination of their molecular weight and structural characterization. Because of its high sensitivity, selectivity and speed, mass spectrometry finds application in several diverse fields, such as, chemistry, physics medicinal chemistry, biochemistry, pharmaceutical science, biological sciences, geology, cosmo-chemistry, nuclear science, material science, archaeology,



petroleum industry, forensic science, and environmental science. Mass spectrometry has become an integral part of proteomics, metabolomics, lipidomics and the drug development process. Mass spectral analysis of products and various intermediates generated during process development helps in process control very effectively.

The Mass Spectrometry Centre at CSIR-IICT has been recognized as the National Centre for Mass Spectrometry (NCMS) by the Department of Science and Technology (DST), Government of India in 1999. The Center is well equipped with the state-of-art, equipments which includes GC-MS,

LC-MS/MS, Q-TOF, Ion Trap, GC-TOF, MALDI-TOF/TOF and Orbitrap mass spectrometers to facilitate characterization of various types of analytes ranging from small organic molecules to large molecules such as polymers and biomolecules. The Centre provide knowledge based ISO 9001: 2008 certified services to all IICT projects, industry, academic institutes, governmental agencies etc. We have been working on two major 12th five year plan net work projects (Metabolomics and Augmentation of Analytical facilities). In addition, we also deal with several consultancy projects from chemical industries, academia and other governmental and non-governmental agencies and contribute to the ECF of IICT. The Center also imparts advanced training to post graduate and doctoral students.

The Centre for Analysis of Chemical Toxins, a part of NCMS, is an OPCW (Organization for Prohibition of Chemical Weapons, The Netherlands) designated laboratory for off-site analysis of chemicals related to chemical weapons convention (CWC). To maintain the designated status, which is strategically important to our country, IICT has been successfully participating in the international official OPCW proficiency tests every year. Recently, the OPCW received Nobel Peace Prize (2013) for its extensive efforts to eliminate chemical weapons from the world. On this occasion, the Director General of the OPCW had shared his joy and specially thanked CSIR-IICT for its significant contributions as its partner laboratory towards achieving the common goal for a world free of chemical weapons.

NCMS has been engaged in basic and applied research in mass spectrometry and published more than 400 research papers in reputed international journals.

## Core Competencies and Research Activities

- Low resolution and high resolution EI-MS, ESI-MS and APCI-MS
- Low resolution and high resolution GC-MS and LC-MS
- Matrix Assisted Laser Desorption ionization mass spectrometry
- Structure elucidation of organic and bio-molecules using HRMS and Tandem Mass Spectrometry
- Differentiation of structural and chiral isomers
- Mass Spectral studies of Un-natural amino acid peptides
- Non-covalent interactions involving bio molecules
- Stress stability studies and pharmacokinetics of drugs and pharmaceuticals
- Gas phase rearrangements and isomerisation
- Identification of key reaction intermediates in chemical/biological reactions
- Identification and characterization of chemical weapons convention related molecules
- Pesticide residue analysis
- Metabolite profiling of human body fluids and other biological systems
- Characterization and quantification of natural and biological active compounds in human body
- Protein aggregation and search for new inhibitors
- Study on metal complexes and cationized organic molecules
- Identification and quantification of compounds responsible for aroma in rice varieties



## Technologies Developed/Transferred (selected)

Mass spectrometry division plays a pivotal role in the process/technology development by providing mass spectrometric analytical services for identification and structural characterization of reaction intermediates and products.

## R & D Infrastructure

- Gas Chromatograph Mass Selective Detector (GC-MSD)
- Liquid Chromatograph Triple Quadrupole Mass Spectrometer
- Matrix Assisted Laser Desorption/ Ionization (Maldi)-TOF/TOF
- Liquid Chromatograph-High Resolution Orbitrap Mass Spectrometer
- Gas Chromatograph- Time Of Flight (TOF) Mass Spectrometer

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# Centre For NMR and Structural Chemistry

The Centre for NMR and Structural Chemistry (CNMR&SC) was originally set up as a NMR Group in 1988 as a part of Division of Organic Chemistry-III under the



leadership of Dr. A. V. Rama Rao, the then Director of the institute. In view of NMR spectroscopy being a highly interdisciplinary science with its diverse applications in all branches of chemical sciences as well as the group's independent research programs aimed at developing new NMR methodologies, the NMR group of IICT was separated from the Division of Chemical sciences-III and has been accorded an independent status in 1989 under the headship of Dr. A.C. Kunwar.

The initial activity of the group was in using NMR for detailed structural analysis of novel organic molecules and drugs and designing novel NMR methodologies. In this context, the studies on the structure of anti-HIV drugs (nucleosides and nucleotides)

targeting the reverse-transcriptase were notable. A large variety of broad-band decoupling pulse sequences were designed. Some interesting features of Zeeman NQR spectroscopy were investigated in detail. These techniques have been extensively used to investigate small molecules. Subsequently, in 1999, in support of the independent research activities of NMR group and ascertaining its role in catering the analytical services equally to all the branches of chemical sciences of IICT, Dr. K.V. Raghavan the then director of IICT, had added two NMR spectrometers (300 and 500 MHz) to the existing two (200 and 400 MHz) spectrometers and transformed the NMR group to Centre for Nuclear Magnetic Resonance (CNMR) and the same was inaugurated by Dr. P. Rama Rao on November 7, 1999. From time to time, the CNMR had not only adopted new technological advancements to cater needs of the institute but also significantly contributed to the methodological advances of this area. In recognition of the CNMRs research contributions and uninterrupted analytical service support to the internal users as well as external clients, during 2005-2010, Dr. J.S Yadav, the then director of the institute had further strengthened the CNMR by adding five more state-of-the-art NMR spectrometers (300, 600, 500, 500, and 700 MHz with Cryoprobe and solid-state NMR facilities). With these facilities in its fold, the CNMR has emerged as the largest NMR facility in CSIR as well as a major centre in the country. These facilities were inaugurated by Prof. R.A. Mashelkar (2005) and Prof. Sukdev (2011). By the end of 2010, the CNMR has become as a leading NMR laboratory with international recognition in the field of design-and development of unnatural peptides that mimic biomolecular folding, called "foldamers". The centre

has developed an extensive programme in this area and new class of foldamers were obtained in hybrid peptides. Furthermore, the CNMR had also established itself in the quantum chemical structural computations and design of molecular scaffolds, based on density function theory (DFT). To reflect the character and the nature of work going on in the CNMR, the CNMR was rechristened in 2012 as 'Centre for NMR and Structural Chemistry' (CNMR&SC). The CNMR&SC has now emerged as nerve-centre of IICT that provides NMR services seven days-a-week and 365 days-a-year, without any major break-down for the past 15 years.

In the recent years, the CNMR&SC has made very significant and important contributions to the field of structural/analytical chemistry. For few to mention, (i) development of novel NMR methods for solving structures of complex organic molecules in solution as well as solid-state, including dynamics in ultra-thin polymer/lipid films. The group was the first to demonstrate the importance of RDC-enhanced NMR, for precise determination of secondary structures in organic solvent media. Subsequently, this versatile approach has also enabled unambiguous and simultaneous determination of conformation/configuration in multiple-stereocentre drug/organic molecules, with improved accuracy (ii) development of new NMR-methods that accomplished dramatic enhancement in the spectral-resolution even at low magnetic fields, thereby resulting in the simplification of complex spectra. (iii) DFT-based design and development of small biomolecular mimetics that adopt protein-like folding. These perceptive design strategies by using quantum-mechanical calculations and NMR experimental studies, have resulted in novel molecular scaffolds and provided insight into the preferential folding /unfolding mechanism of natural biomolecules, backbone regulation, including the Amyloid type aggregation/inhibition (Alzheimer type). These designs have formed basis for developing function-oriented scaffolds with drug molecules as side-chains.

Furthermore, CNMR&SC has unique expertise in the area of portable NMR of large objects (inside-out NMR) and NMR-instrumentation, that has enabled the centre to successfully apply these experimental methods to strategic on-site defense applications (DRDO project).

### Core Competencies and Activities

- Methodological developments of both solution and solid-state NMR techniques and homo-decoupling pulse sequences to enhance the spectral resolutions and sensitivity of complex molecules.
- Solution-state NMR (CP/MAS) spectroscopy of organic molecules, natural products, APIs including low-molecular weight anti-coagulants.



- RDC-enhanced NMR methods for precise structural elucidations and solving multiple unknown relative stereocentres.
- Density Functional Theory (DFT) based designs of molecular scaffolds including biomolecular folding/ regulation mimicry and computations of transient state structures.
- Solid-state NMR of polymorphism, cross-linking density and impurity identifications in pharmaceutically relevant molecules.
- NMR based determinations of inter-molecular interactions.
- Portable inside-out low field NMR for studying large objects and process/quality monitoring.
- NMR instrumentation.

### Technologies Developed/Transferred (selected)

- New advanced NMR pulse sequences : Pure-shift COSY, TOCSY , and NOESY, ROESY that are superior to the conventional methods, in terms of resolution and sensitivity .
- Hadamard solid-state NMR for enhanced spectral resolution and determining specific desired spin-spin interactions and inter-nuclear distances.
- <sup>129</sup>Xe NMR of liquid crystals and liquid-crystal films
- Portable NMR devices are developed and handed over to DRDO for on-site on-invasive testing of large objects

### R & D Infrastructure

**Facility Creation:** Four-channel Avance-III 700 MHz NMR spectrometer with cryoprobe and three-channel Avance-II 600 MHz NMR spectrometer with cryoprobe, Avance-III 500 MHz (solids/liquids), Avance-HD 500 MHz, Inova-500 MHz, Inova-400 MHz(solids/liquids) and Avance 300 MHz ( two) with auto-sampler facilities.

**Other Instrumentation:** Liquid nitrogen plant 25 Lts/hour, molecular modeling and DFT computation facilities and NMR repairs/service workstation .

For further technical details contact:

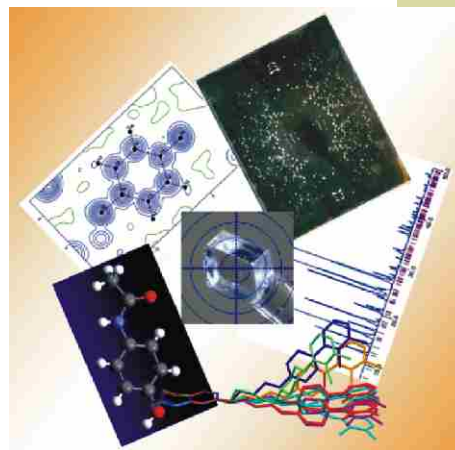
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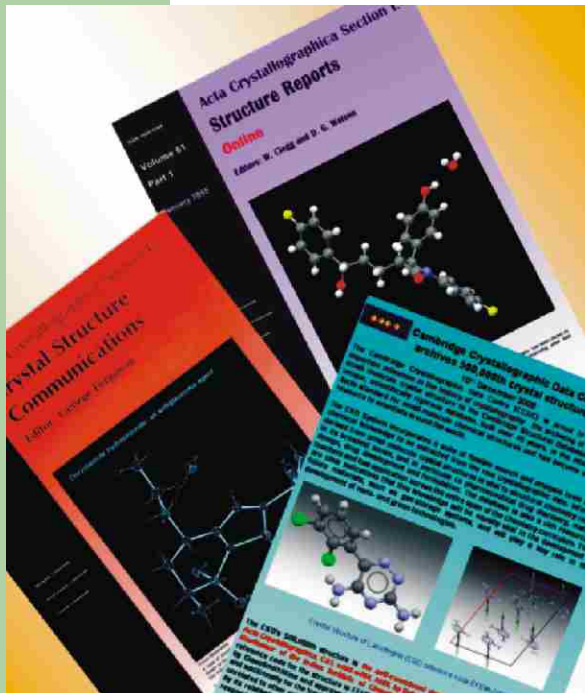
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# Center For X-Ray Crystallography

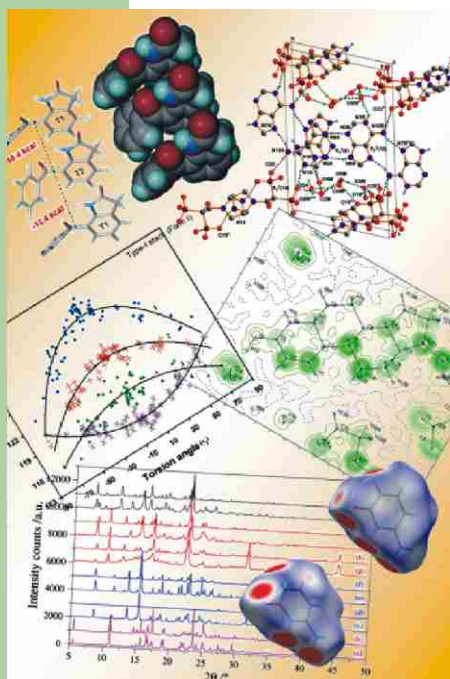
The Center for X-ray Crystallography that exists today was part of the Inorganic and Physical Chemistry Division, as X-ray section, in the early sixties established by Dr. S. Husain Zaheer, then director. The section under director Dr. G. S. Siddhu, used Oscillation, Weissenberg and Laue cameras to capture diffraction photographs of crystal and powder samples of alkoxides, bariumchromate pigments and for indexing. In the early eighties, during director Dr. Thyagarajan's period, the X-ray section started to crawl as the research focus was gradually shifted towards crystallization of materials and grew up when its prime focus was the characterization of inorganic catalysts and materials using X-ray methods, realizing their impact in applied research. In the early nineties, Dr. A. V. Rama Rao, the then director of IICT, desired to set up a full fledged chemical crystallography department to cater the needs of organic chemistry and natural products oriented projects. The first in-house single crystal X-ray diffractometer was procured in 1990, after which it became the foremost technique to characterize three dimensional structures of difficult-to-characterize natural products and synthetic organic compounds. Some of the well known examples are Fredericamycin A, RU 486, FK506, ladderanes etc. The section initiated on its own several crystallographic structures solution studies resulting in publications. In parallel, as the need for powder X-ray diffraction method was required by various pharmaceutical industries, the X-ray section was chosen as a reputed lab to provide expertise studies on API characterization, development of validation methods, and providing support for USFDA approval for drug master file applications. This resulted significant revenues and laurels to the institute. Realizing the growth of the institute and demands from Industries, Dr. K. V. Raghavan, then director, made the X-ray section as CSIR-Diamond Jubilee center for X-ray crystallography, inaugurated by then DG-CSIR, Dr. R. A. Mashelkar in the year 2002. The Center was augmented with the state-of-the-art single crystal and powder X-ray diffractometers. Several industrial projects were completed and the center received the highest customer satisfaction rating (CSIR customer satisfaction evaluation 3.57 on a scale of 4). The Center's XRD facility was duly recognized as one of the key analytical facilities, for which the Institute's analytical services was awarded with ISO-9000 certification. The Center was also highly appreciated by the Institute for being the highest external cash flow (ECF) earner during this decade. The department of AYUSH insisted a focused attention on quality control measures and standardization of herbal drugs, in particular, the concentrations of heavy metals. Realizing the societal needs, Dr. J. S. Yadav, then director, nurtured the center and created a national facility for characterization of herbo-metallic preparations using X-ray fluorescence (funded by DST, India) at the centre for X-ray crystallography, IICT in 2006. Many ayurveda and siddha institutes have greatly benefited. The present director Dr. M. Lakshmi Kantam, valued the center's efforts and encourages undertaking challenging projects in the cutting edge frontier research areas of crystallography. The Center enhances the use of X-ray crystallography in many



research programs of the institute and offers its expertise for collaborative research with other departments within the institute and nation wide universities. This has helped various sectors of people and catalyzed more number of good quality publications with good Journal impact factors.



The Division is known for its R & D activities on drug polymorphism, to name a few, safinamide, setraline HCl, palonosetran, aripiprazole, tamsulosin etc. Over 600 research articles have been published. The division achieved a milestone in the history of crystallography in archiving a half-a-millionth structure at the Cambridge Structural Database (CSD). The polymorph of anticonvulsant lamotrigine elucidated at the X-ray crystallography division, IICT, published in *Acta crystallographica: Structural Chemistry*, C65, 2009, o460-464, was selected by CCDC, Cambridge, UK. Some of the important research works of the division were highlighted on the cover page of the Journals; Ezetimibe monohydrate in *Acta Crystallographica: Sect E* of 2005 and antiglucoma agent Dorzolamide HCl in *Acta Crystallographica: Sect C* of 2007. Conformational analysis of antimigraine triptan-based drugs (sumatriptan, zolmitriptan, rizatriptan, frovatriptan, almotriptan, eletriptan, naratriptan) has helped to develop structure based pharmacophore model.



Currently, the Division is focused on solid-state structural characterization of drug polymorphs, pharmaceutical co-crystals/salts, physicochemical property improvements using crystal engineering, study of drug-nucleobases interactions, and correlation of structural features for biological activity towards pharmacophore modeling and drug design. We present Dutasteride hydrochloride as the first drug molecule that showed amide group protonation in the solid state. Results are highlighted in the "themed issue of Crystal Engineering Communication: Crystal Engineering and crystallography in the pharmaceutical Industry". The primary and most important step in the drug-DNA interaction process is the specific recognition of DNA by the drug, and they are stabilized by non-covalent forces such as hydrogen bonding, van der Waals interactions, etc. In this relevance, the nucleobases drug complex, namely adenine-zoldronic crystal structure was elucidated to shed more information on molecular recognition and hydrogen bonding patterns in the solid state.

The Center activities also includes in developing human resources of the Institute, such as guiding students for PhD program, framing course work on X-ray crystallography, solid state chemistry modules for Academy of CSIR, project works for postgraduate and MTech students of academic universities nearby. The X-ray Crystallography division operates on a 24/7 schedule. We have great minds with diverse experience and expertise. We believe in 'Do what you do the best'. Over the years, the X-ray division has developed into one of the most respected X-ray

Crystallography laboratories in India for providing specialized studies on a strictly confidential basis to industries. The centre sustains a synergistic value addition to IICT's repertoire of analytical facilities. Today, X-ray crystallography is still a young discipline but it has radically transformed many other areas of science, through them, the world we inhabit today.

### Core Competencies

- Chemical crystallography and material characterization using powder X-ray diffraction and X-ray Fluorescence
- Crystal structure analysis on compounds of biological relevance towards structure activity relationship studies
- Polymorphism studies on solids of pharmaceutical importance

### Infrastructure

- X-ray powder diffractometers (Siemens D5000 and Bruker D8 Advance)
- X-ray single crystal diffractometer (Bruker Smart Apex CCD)
- X-ray Fluorescence spectrometer (Bruker S4 Pioneer)

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# Computer Centre

The Computer Centre of IICT started in 1966 and is one of the oldest computer centres in CSIR Labs. A Second Generation Computer IBM 1620 Model II was installed as a the centralized resource facilitator for entire IICT Campus as well as NGRI & CCMB Scientists. In 1981 a new building was constructed with wider space for installation of Sperry Univac Varian 77/900 Computer. During this period several Application



Software of Scientific importance were developed to cater institutional research programs like Conjugate Gradient & Random Search Methods for Optimization, Genetic Algorithms, Polynomial Curve Fitting, Multiple Linear Regression & its accessory models, Factorial Analysis, Solutions of Higher Order Matrix Inverses & Multiplication, Development of Software for Cooler Condenser Design, Vapour Liquid Equilibrium & Distillation column for Tata Consultancy Ltd, Bombay and MECON, Ranchi etc. Some of the major R&D Sponsored Projects successfully completed are Modelling and Simulation assignment of Ammonia Plants for Gujarat State

Fertilizer Corporation Ltd, Baroda, Mangalore Chemicals & Fertilizers, Mangalore and Development of software for Simulation of Rotary Kiln & Acetylene Black Plant for Panyam Cement, The Electronic Data Processing & Statistical Analysis of Survey of India and Nutritional data of NIN. Right from the early 1970s Computerized Monthly Pay Roll processing & MIS applications of IICT & CCMB, Pragatools and Midhani were processed at Computer Centre.

During 1985-98 R&D activities continued to improve as a recognised research centre by the Osmania University for carrying out research leading to Ph D degree in the subjects Mathematics, Statistics, Computer Science. With the Installation of Norsk Data 530 Mini Super Computer for providing application software development in the areas of scientific importance, several institutional research programs were initiated. Details of various R&D activities in which Computer Centre is actively engaged are given below: Computer Assisted Organic Mixture Analysis Studies, Ranking & Decision making application to Coal Field Classification, Lethal Dosages evaluation for biocides and pesticides by Probit & Logit Models, Dynamics of Microfilaria by Statistical Modeling, Assesment of productivity of R&D institutions by the application of multivariate statistical modelling, Probability calculations of accidents of trucks carrying Hazardous chemicals, Soft computing like Artificial Neural Networks, Fuzzy Logic & Cluster Analysis etc, Rule based Expert Systems for Taxonomy Problems usind IDS Algorithm and Electronic Data Processing & Statistical Analysis of All India Survey on Raw Hides & Skins in collaboration with CLRI.

In the year 1997 IICT was modernized by establishing Local Area Network with the Compaq Proliant & Dec Alpha Client Server Architecture Model for launching the Internet & E-mail Services and in-house developed package Project Information System on Oracle Database Visual Basic as Frontend to all IICT Staff across the Campus

Wide Network well connected by means of Optical Fiber and CAT 5 UTP Cables. The Computer Centre is one of the few centres among all the CSIR Labs having VSAT connectivity.

Fault/Event Tree Analysis, Quantitative Assessment & Risk Contouring and Time Series Analysis Techniques etc were initiated during 199-2004 for enhancing the R&D activities of the Centre. During 2001, Sun Sparc E250 servers were installed for Intranet and Internet facilities of the scientific community at a large scale providing high bandwidth of 1 MBPS through leased line to cater Web Enabled Services like Computerized Purchase Procedure System (CPPS), and CCNET etc. Computer Centre has also initiated Video Conference using internet bandwidth & Web Casting.

The internet bandwidth was upgraded to 2 MBPS during 2005-12, which facilitated Web Enabled Services in the IICT Campus like CSIR-ERP, Chem Office, Re-axys, Sci-Finder, and NMR-spectrum services. This would enable collaborative research, and e-management of the laboratory's functions. It is a heterogeneous network system operating under Windows and Linux operating systems. For the sake of convenience and manageability, the entire campus is divided into 12 VLANs. The infrastructure facilities: CISCO Routers, CSM Fire Wall & Core Switch, 15 Nos Distribution Switches, 65 Nos Edge Switches and 50 Nos Wi-Fi Switches connected 8Nos HP DL350 rack servers.

Computer Centre implemented successfully the National Knowledge Network (NKN) bandwidth provided by National Informatics Centre (NIC) along with GBIC bandwidth line, which interconnects the leading scientific and technical institutions across India. The Computer Centre established several facilities at IICT under the leadership of former Head of the Departments namely Dr Asghar Husain, Dr P J Reddy, Dr BSN Murty and Dr D Krishna

### Infrastructure Facilities

- Five numbers of IBM two way X6=5670 model servers with 48 GB RAM, 6x300 GB storage, 2x8 GB dual port HBA cords, redundant AC power supply
- Fujitsu ETERNUS DX440make with 20TB usable storage, 8 GB 24 port Brocade Fiber Channel Switch, 2x LT 60 Tape library with 24 tape slots each and COMMVAULT backup software
- Two number Cyberroam Security Appliance
- Operating System : Windows/Linux
- RDBMS : Oracle/MSSQL/MySQL
- System : LDAP/DHCP/DNS/WINS/Samba
- Network Firewall//NFS/NIS/PPP dialin/SSL/SSH
- Web Server : Apache/IIS
- ISPs : NKN/TATA/BSNL
- Fast Ethernet capabilities of 40 VLANs across 1000 desktops



### Activities of Computer Centre

**High Performance Computing (HPC):** The Centre has designed and established HPC for Molecular Modeling Group, Computational Chemistry Group and Organic Group in the IICT campus using Linux open source environment. Most of the resources, like operating system, software for certain applications like mail, squid proxy, MRTG, SARG etc., used in IICT Campus are open source based.

**Software Development:** The Centre is undertaking applications of software development in the areas of scientific importance to institutional research programs.



Additionally, it provides scientific inputs based on computer aided techniques to ongoing R&D Projects. The Centre also undertakes the application software development of various internal departments depending upon their requirement like distribution of monies (Honorarium and Royalty), application for the Visitor's Pass System at main gate of IICT, Application for the Medicine disbursement at IICT Dispensary, Application for the Pathological Department for generating various pathological reports etc..

**Website Design:** The Centre is having a web server for hosting the website, www.iictindia.org, this web site is hosted in the campus itself. In addition, the Centre developed websites for the publicity of various seminars conducted at IICT with the facilities like online registration, upload the abstract etc. The Centre also developed Internal website for the various maintenance modules/software installations/software patches/general instructions etc. like CCNET, CAFAS, ADMINSALCHEMY

**Internet Facility:** Computer Center provides high speed reliable internet facility along with the email to all its staff members and research scholars for research purpose. At present there are about 1000 nodes connected to the LAN. Throughout the campus Fiber cable is laid which gives the reliable connectivity to the remote locations within the campus. In some places Wi-Fi connectivity is also given. There are other two ISPs providing internet connectivity to IICT namely TATA and BSNL. This internet access facility is provided by using the squid proxy server on a Linux environment. The total solution is based on open source code and it is operational for last one decade and is to provide IT enabled facilities in 24/7 mode to research scholars and staff members.

**Email Facility:** Web based email facility is provided to all permanent staff members, which they can access from anywhere in the world. Open Web Mail is used for providing this facility; this facility is hosted on a Linux server. There are around 600 users using this email facility. In addition to this we are using ZIMBRA based mail server for internal use. Most of the software used for installation of these services is open source.

**Network Services:** The Computer centre manage our own Windows DC, LDAP, DNS, WINS, Antinitus, WSUS and DHCP servers. There are around 40 VLANS in the campus which are interconnected with each other using high end core switch, Layer 3 and Layer 2 switches. We have three 20 KVA parallel UPS system for providing uninterruptable power supply. We have high end UTM devices and firewall for internet security. Computer Centre also provides assistance in the Video Conference and online interviews. A computer dedicated to MRTG (The Multi Router Traffic Grapher) will be used for monitoring the traffic load on the network.

**Education & Training:** The Computer Center staff is regularly participating in various education and training activities of the institute in the IT field. Computer Centre Staff has given assistance in conducting Bioinformatics course jointly conducted by IICT, JNTU and CDAC. Computer Centre regularly conducts classes for the administrative staff in MS-Office, to familiarize them with office automation, computer centre has made arrangement for ERP training of the IICT Staff

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# Engineering Services

Engineering Services Division (ESD) is mandated to provide operation, supply and maintenance of utilities namely electricity including standby power supply, air conditioning & refrigeration, clean room & humidity control systems, hot air/ hot oil generation & circulation utilities, high & medium pressure boilers and compressed air / oxygen/ nitrogen & liquefied nitrogen production units. Besides, it manages a large Central Workshop comprising of a machine shop, metal joining & sheet metal fabrication unit, a captive foundry and forge facility, pattern making & carpentry, millwright shop to provide vital engineering support and mechanical & electrical maintenance to R&D activities of the institute.

Historically this Division began its journey along with the then Central Laboratories for Scientific and Industrial Research as Central Workshop Group and transformed into the General Engineering Division in the erstwhile Regional Research Laboratory (RRL). As the services portfolio spread, it resulted in to be called as Engineering Services Division in the present Indian Institute of Chemical Technology (IICT). The division has played a pivotal role in the journey of RRL/ IICT by providing crucial Engineering Support to transform bench scale studies to marketable commercial technologies. Being a manpower intensive core engineering group, the services of the division have become an integral part of development of experimental prototypes for bench scale research, engineering support to scale up and operation of utilities and providing engineering maintenance to technology demonstration pilot Plants. The department saw great leaders like Shri Choudhary, Shri Gopi Reddy, Shri TSR Anjaneyulu, Shri Walter, Shri A Ataullah, Shri. KVRS Murthy to name a few.

The Division's contributions go synonymous with the Coal Gasification in Integrated Gasification Combined Cycle (IGCC) Power Generation project under UNDP. On one hand the General Engineering Team was involved from laying the foundation to the commissioning of the gasification plant and on the other hand, it also participated in the process plant operations for testing of various coals across the country for gasification characteristics. Besides, the engineering teams from the Division also operated major utilities of Coal Gasification namely plant for generation and supply of compressed oxygen/ air, high pressure boiler for supply of super heated steam and coal handling units, tar-oil separation units critically required for the project. Another notable contribution made by the division was for the development of indigenous and internationally competent technologies for ozone benign hydro fluoro carbons by participating in a multi disciplinary team comprising of fluororganic chemists and chemical engineers. The division was involved starting from the erection and commissioning of the pilot plant for the generation of HFC 134A to the operation and supply of utilities and engineering maintenance. In addition, crucial utilities like chilled brine, chilled water and hot oil circulation systems essentially required for the project were exclusively operated by ESD. The Division also played an important role as a part of technical committee for



the implementation of the Lipid Group's enzymatic degumming and dewaxing of rice bran oil project sponsored by TMOP&M and provided vital engineering inspection support vis-à-vis IICT technical specifications to the equipment supplies received from the Project Engineering Companies (PECs') including follow up and removal of non-conformities. Other notable contributions by way of operation & supply of utilities and engineering maintenance were provided for the pilot scale experimentation of Low Temperature Carbonisation of Coals and Fluidized Bed Gasification studies and during pilot scale production of Monochlorophos, Cyanuric Chloride, Co and Co based chemicals, Mono Nitro Toluene (MNT), Biodiesel, Synthetic Aviation Lubricants, Benzaldehyde, Undecenoic acid, Pyrazinamide among many.

In pace with the growth of the Institute, the division made significant contributions to the development of engineering infrastructure in the form of augmentation and modernization of facilities and utilities starting from conceptual planning, design, specifications, procurement, installation and commissioning including project management at cost of over Rs. 200 millions. Some of the important infrastructure projects and associated achievements include (i) The modernization of most of the wet chemical laboratories of the institute conforming to ASHRAE 110-95 and SEFA 1.2-96. This resulted in good turn around in the laboratory air quality and reduced occupational health hazards; (ii) By upgradation of IICT incoming power supply from 11kV to 33kV and. subsequently, steps to systematically coordinate with the power distribution company uninterrupted quality power supply to the institute was ensured. This has resulted in less power interruptions to the ongoing research activities besides savings to an extent of 100laks per annum in the form of savings in Diesel Consumption for standby power generation; (iii) By achieving self sufficiency in Standby power generation capacity of IICT through modernisation & augmentation of DG sets, IICT's R&D activities were given practically uninterrupted power supply; (iv) Augmentation and modernization of OLTC based HT/ LT power transformers and associated vacuum circuit breakers, LT switchgear, XLPE cables at IICT's indoor & outdoor substations and power distribution PCC systems & motor control MCC panels across the institute increased reliability and quality of power supply; (v) Adapting new technologies such as variable refrigeration flow Air conditioning and duct able split systems ensured that the institute's drive for energy efficient utilities is achieved.

ESD has also developed research interests owing to its association with R&D for 70 years in the mechanical engineering domain of Chemical Sciences and Technology and Engineering Prototype Development. Some of the ongoing activities include: (i)



Extraction of vegetable oils using high energy milling either as standalone extraction process or as an extraction aid is being explored as a greener and efficient alternative to solvent extraction and mechanical expelling respectively [as a part of Development of sustainable and greener technologies (PEOPLE HOPE project of 12th FYP) using mechano-chemical processing for vegetable oil extraction and value addition]; (ii) Development of prototype Solar Powered Air Conditioner using DC

power from solar panels directly with an objective to minimize solar panel size and cost; (iii) Computational Fluid Dynamics (CFD) studies for Early Prediction of Thermal Runaways as a part of INSPIRE project in which an attempt is being made to model the temperature distribution in a stirred tank reactor used in the manufacture of esters; (iv) A prototype Dispersant Testing Unit is being fabricated based on the request received from a prospective client; (v) A prototype low cost expeller, 20kg/hr seed processing capacity for rural use was developed by the Division; (vi) A Grant-in-Aid project funded by DST namely "Studies on material flow phenomenon inside the press chamber of horizontal screw expeller" was completed under the leadership of the Division.

### Core Competencies

- Consultancy, conceptual planning, estimation, inviting tenders, selection of contracting agency, overseeing execution of work and services contracts for the augmentation, upgradation, retrofitting and maintenance of electrical & air conditioning installations in a large R&D Institute.
- Conceptual planning, installation, testing and commissioning of standby diesel power plant and grid interactive solar power plant
- Adopting energy efficient technologies in the electrical and air-conditioning and refrigeration
- Conceptual design and associated project management in the development of Modern Wet Chemical Laboratories meeting International Standards
- Application of high energy milling in the domain of chemical and lipid sciences
- Computational Fluid Dynamics based modeling of process phenomena.
- Development of experimental prototypes in the areas of chemical sciences and renewable energy

### Infrastructural Facilities

- CREO Parametric Design Software Version 2.0 and MathCAD 15 for Prototype Design and Development
- CAD Work Station, HPZ800
- Lathe Machines ranging from 12 ½" x12 to 10 ½" x14"
- Universal & Vertical Milling Machines and Cylindrical Grinding Machine
- Slotting Machine (S-L/3-60) and Shaping Machine (24")
- 63tonnes Hydraulic Press and Forging Hammer Capacity 40kg @ 800Storke/min.
- Metal Joining, Metal Cutting and Sheet Metal Fabrication Facilities
- State of the art Glass blowing equipment & facilities

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# Research Management Area

The first Operations Research Cell in India was established at CSIR-IICT (then known as CLSIR) Hyderabad in the year 1950 for the management of scientific and industrial research. The O.R. technique was basically used for internal integration and coordination of research. It uses management tools like PERT, CPM etc. to execute the functions of the Research Management of the lab. The Research Management

Division handles portfolios like Project Management, Human Resource Development & Management, IPR Management, International S&T Affairs, Institutional Events etc.

Research Management Division, IICT

**Project Management:** Planning, Monitoring and Evaluation of R&D projects of various divisions are undertaken through the Research Planning and Budget Committee. The division is involved right from publicity to processing of the R&D project proposals, submission of progress reports, expenditure statements, utilization certificates and follow up for final payment with the funding agencies. The division also handles in obtaining the customer satisfaction evaluation reports of all externally funded completed projects which helps in

improving the deliverables as per the customer's requirements. The staff working in industry sponsored projects are also rewarded with honorarium which is handled by Research Management Division as per the CSIR Technology Transfer guidelines.

**Human Resource Development & Management:** Research Management Division looks after the human resource management of the Institute which facilitates deployment of staff and hired manpower i.e. project assistants and research fellows (Project) in Externally Funded Projects, by coordinating the engagement of project assistants against projects and their further extension of tenure on need basis. The Division processes applications for joining/engaging JRF, SRF (for Ph.D programme), RA, Project Assistants, Student Trainees (for project work) and at the end of the tenure they are given certificates with appropriate citations. Apart from this, RMD had organized Technology Led Entrepreneurship Programme for JRFs/SRFs for a period of 5 years from 2008 to 2012 entrusted by CSIR-HRDG to IICT. The research fellows who attended the program were from various R&D organizations/universities of various parts of the country. The research fellows were given exposure to start-up technology, venture funding schemes etc., in the programme. The skills learned from this programme helped them to enhance expertise in technology commercialization and business development. The programme was conducted by the faculty largely drawn from IIMs.

**Intellectual Property Rights Management:** CSIR-IICT has recognized the importance of IPRs by filing patent applications in India and Overseas. The division interacts with the scientists of the laboratory for filing patent applications by rendering guidance and assistance in drafting, scrutinizing and sending the patent applications to IPU Division of CSIR. Concerted efforts for filing and follow-up have resulted in filing and granting of good number of patents in India and abroad during previous years. The division also handles the licensing agreements/MOUs of patents with Academic and Research Institutes both within India & Overseas.

**Research and Academic Collaborations:** The division looks after the CSIR-IICT-Academic Institutes Overseas Collaborations. RMD facilitates in executing agreements for joint research projects in support of R&D programmes between CSIR-IICT and various international institutes for its research in Chemical Sciences & Technology apart from R&D collaborations.

The Division interfaces with CSIR-IICT scientists and ISTAD at CSIR Headquarters on all matters connected with the International Science & Technology Collaborations of the laboratory like International bilateral exchange programs, Security and sensitivity clearance of international bilateral projects, Bilateral DST projects, MEA, MHA & CSIR clearances for holding international conferences in IICT, Conference funding and Visits of foreign scientists/ research scholars to various countries under various categories.

**Foreign Deputations:** CSIR-IICT scientists are deputed to attend various important international seminars/workshops and also for training on sophisticated analytical instruments and to work with fellow scientists in reputed overseas universities. The division coordinates in obtaining necessary approvals and clearances for these deputations. Subsequently, the division collects visit reports from the deputed scientists, scrutinizes them and forward to CSIR.

**Institutional Events:** The division organizes every year various scientific events like PS Murthi Memorial Lecture, National Science Day, Bhatnagar Memorial Lecture, National Technology Day, Sidhu Science Lecture, CSIR-IICT Foundation Day, CSIR Foundation Day and Founders Day Lectures, World Environment Day, World Earth Day etc. where Eminent Scientists / Academicians/ Nobel laureates are invited to deliver the lectures in the area of science & technology which is of current use to the scientific staff and the research scholars.

**Enterprise Resource Planning (ERP):** CSIR has introduced ERP New Enterprise Transformation Portal in all its laboratories during the year 2012-13. Accordingly CSIR-IICT has been entrusted to implement ERP in their workplaces. ERP consists of several modules like R&D Module, HR Module, F&A Module, PPM Module etc. Research Management Division has been involved in updating R&D Module and HR Module. RMD has provided key inputs like entry of Role Mapping & Project mapping of entire staff of CSIR-IICT, Grant-in-aid Projects entry into ERP numbering around 400 projects. This facilitates the other groups to prepare F&A module and PPM Module etc. It also benefits employees in logging their personal information, leaves, GPF disbursements and other services.

**Softwares Developed:** The division has developed softwares like: Project database, Patent database, Monies distribution from projects etc. These databases facilitates Management for taking information on ECF, Projects, Permanent and Temporary Staff, Awards/Honors, Patents filed / Granted, Customer Satisfaction Reports, Foreign Deputations, etc.





**File Management and Safe Custodial Activity:** The project files pertaining to various externally funded projects is maintained very systematically by Research Management Division apart from the project reports and process know-how and design documents. In addition, Patent Files, Agency Queries, HR/ Awards Files are maintained. Total 1600 files are being maintained, which can be retrieved through computerized data base system. Technology Transfer Documents, Know-how and Design Reports, ISO documented files are kept in safe custody in a systematic manner for quick retrieval for use, as and when required.

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# Business Management Area

Business Management Area is the Institute-Industry Interaction Facilitation wing of CSIR-IICT. It serves as vital link between R&D groups of CSIR-IICT and the Industry. The Division aims to promote the expertise of the Institute toward offering research solutions to industry oriented problems. The key task of the division is to identify potential customers for CSIR-IICT's knowledge base, facilitate techno-commercial negotiations, formulation of projects, preparation of contracts and project monitoring. The Division works in close association with R&D divisions, industries, Government Institutions, overseas and other agencies involved in technology development, transfer and commercialization. The Division facilitates the generation of new R&D projects and entrepreneurship in new and upcoming areas.

## Business Management Area - The Genesis

During its formative years as CLSIR, the research strategies of CSIR-IICT were largely top-driven and the need to have business facilitation cell was never felt. Later, as the lab grew in stature there was a realization of the enormous amount of effort that would be required to liaise with industry, develop relevant technologies and transfer them to back the Industry. It was also realized that scientists need to be fed with information to help them develop processes/ products in gap areas of the innovation chain. To serve these requirements, a new Division named the Operations Research, Technical Information and Liaison (ORTIL) was created in early fifties. ORTIL has traversed through several metamorphoses to keep pace with changing times. The opening up of economy and globalization, has forced several changes in R&D policies. Technology imports were liberal, and to survive, the Institute had to provide low-cost alternatives to technology imports through better planning, coordination of resources and liaison with the industry. ORTIL has transformed itself into Planning, Coordination and Liaison (PCL) Division to tune itself to the changed scenario. However, in the mid-Nineties the PCL Division was divided into three areas/divisions viz. Business Management, Research Management and Information Management, to take care of the growing demands of the Institute. In the current Decade of Innovation, the Business Management Area had shifted its focus towards creating platforms to facilitate technology, innovation and business development in order to fully harness the innovation potential of various research groups of CSIR-IICT and is now referred to as Business Development Division.

## Simple & Innovative Business Solutions

To promote the R&D innovations through industrial collaborations, CSIR-IICT over the years, has established a Business Collaboration culture with the following guiding principles:

- **Simple & Swift, with no bureaucratic hassles:** The Director of the lab is fully empowered to take all decisions on behalf of CSIR, the parent organization
- **Flexible & Transparent, and responsive to the needs of the industry:** The scientists and the industry partner together identify the scope, deliverable and time lines of the collaboration.
- **Participative & Supportive:** The Industry can always bank on support of CSIR-IICT even after the project is executed.
- **Synergistic Collaboration:** The business collaboration aims to synergize the knowledge and expertise of CSIR-IICT and the Industry.



Based on above, CSIR-IICT enters into synergistic business collaboration with the industry through the following models:

- **Sponsored Projects:** The industry partner comes up with a problem which is specific to their organization and CSIR-IICT provides a solution. In select cases, the IP exclusivity terms may be granted up to 5 years.
- **Collaborative Projects:** The industry and CSIR-IICT identify a challenge and together try to find solutions. In this pursuit, the partnership may also obtain funds from funding agencies like DST, DBT, Ministries, State government etc. The IP may be jointly shared if the intellectual contributions of collaborating institute are quite significant.
- **Consultancy Projects:** The expertise of the scientists is utilized by the industry to solve some of their problems. The industry carries out trials, experiments at its own premises through expert consultancy of the scientists at CSIR-IICT.
- **Technical Services Projects:** Analytical & characterization services are offered to the industry.

In addition to above, CSIR-IICT provides technology platform for new and start-up companies through following models:

- **Incubation Support:** CSIR-IICT licenses its lab-space to start-up companies. The start-up companies get the support of CSIR-IICT expertise and world class R&D infrastructure.
- **Public Private Partnership:** CSIR-IICT collaborates with industry in PPP mode in select areas, with an aim to develop expertise in cross-disciplinary areas.

**Examples:** The EVOLVA-IICT partnership has facilitated R&D in chemical genomics. Presently, CSIR-IICT and AISIN COSMOS, Japan, are together working on solar harvesting devices.

**CSIR-IICT collaboration is not just restricted to the above models and is open for newer innovations and models.**

### Activities of the Division

The activities of the Business Development Division are broadly categorized as mentioned below:

- Business Development
- Planning Monitoring & Evaluation (PME) of XII Five Year Plan Projects
- Management of Academy of Scientific and Innovative Research (AcSIR)
- Management of Biotechnology Incubation Centre (BTIC) and other Public Private Partnerships

### A. Business Development

CSIR-IICT has been, at the forefront, catering to the R&D and technology needs of chemical and allied industries. The division plays a prominent role in attracting organizations from diverse sectors by adopting innovative marketing strategies and showcasing the institute's R&D capabilities and expertise to them. The division maintains seamless interaction with prospective clients to identify their specific areas of research interest and then try to match their interest to the R&D expertise available at the institute.

The division organizes regular business counseling sessions to attract clients and solicit their commercial interests and thereby, facilitating industrial research partnerships. Through these sessions the division interacts with industry (Indian and foreign), both private and public to understand the needs and tune the research of CSIR-IICT to match the industry requirement. It also interacts with agencies in the strategic sector like defence, space, atomic energy, with an aim to develop cogent and time targeted & delivery oriented research projects. For projects in new & emerging and translational & transdisciplinary research areas, the Division liaises with the Industry for preparing projects under NMITLI, BIRAC TDB, TIFAC and other such schemes/agencies.

The Business Development division executes various agreements (NDA and MoUs) with the industry through interactions with the management, scientists and clients, by negotiating and finalizing scientific, technical, IP, financial and administrative aspects of collaboration. The division monitors the progress and activities of ongoing industrial research collaborations through regular performance monitoring & evaluation sessions to ensure smooth and timely delivery of project objectives to the industry. It maintains effective and timely communication with clients and scientific teams and ensures proper coordination between them.

The major tasks of the Business Development activity include:

#### **Business Promotion Activity: Projecting CSIR-IICT capabilities and expertise to industrial clients**

- Attracting industry by planning and organizing industry meets for technology promotion, identifying industrial problems and to explore potential areas of collaboration.
- Facilitating prospective clients' visits and projecting CSIR-IICT's R&D capabilities and expertise to them.

#### **CSIR-IICT: Industry R&D Consortium**

A new initiative has been launched to bring industry closer to IICT's research efforts. The CSIR-IICT: Industry R&D Consortium aims to carry out research to develop new processes/products and improve existing industrial processes. The main objective of this consortium is to pursue challenging research projects that benefit industry and society

#### **Business Development through new research collaborations**

- Facilitating interactions between CSIR-IICT management, scientists and industrial clients to define the scientific collaboration framework.
- Negotiating with industries to identify new research collaborations.
- Arranging Non Disclosure Agreements for exchange of information.
- Preparing techno commercial estimates for the industry-institute collaboration

#### **Research agreements and MOUs with clients for new projects**

Executing research collaboration agreements for sponsored, consultancy, and collaborative projects. Obtaining necessary approvals from CSIR-IICT management, Management Council and CSIR HQ, wherever necessary.

#### **Planning Monitoring and Evaluation Activity**

- Regular contact with clients and scientific teams to monitor the progress to ensure timely delivery of project objectives.



- Preparing interim and project completion reports.
- Processing the payments received from clients.

#### **Planning and coordinating publicity to the R&D achievements**

- Publicizing important events in the institute in press and electronic media
- Arranging press meets and press briefs to highlight R&D achievements
- Arranging visits of VIP dignitaries/scientists and other guests

#### **B. PME activity of CSIR-IICT XII Five Year Plan Projects**

A major activity of the Business Development division is the PME activity of CSIR-IICT XII Plan Projects. Under the XII FYP program, CSIR-IICT is the nodal lab for 14 projects and a participating lab for 22 projects. To facilitate effective monitoring of the XII plan projects, the Division has introduced a participative performance review & monitoring system, aimed at ensuring timely delivery of the objectives of the XII plan projects. The division has been carrying out overall coordination of the monitoring activities, which involves continuous assessment of the status of project implementation in relation to the approved work plan and budget.

The tasks carried out by the division in this direction are:

#### **Monitoring of XII Plan Projects**

- Overall coordination of the monitoring activities, involving continuous assessment of the status of project implementation in relation to the approved work plan and budget.
- Conducting Monitoring and Review Meetings for the XII plan projects to facilitate effective monitoring of the XII plan projects.

#### **Planning, Implementation & Coordination of XII Plan Projects**

- Preparation of HR recruitment plan for the XII plan projects.
- Preparation of Equipment Procurement Plan to help in scheduling various activities like placing indents, inviting quotations, placing orders, etc.
- Record keeping and maintenance of all files/ records, documents related to XII Plan projects in physical as well as electronic form.
- Coordinating with other network partners and CSIR HQ
- Compilation of the progress reports of the XII FYP projects

#### **XII Plan Web Portal**

A user friendly intranet portal has been developed to record data pertaining to XII Plan projects.

#### **C. Academy of Scientific and Innovative Research (AcSIR)**

CSIR-IICT has close to about 250 AcSIR PhD students and the division is responsible for maintaining and updating database of JRF Students. It plays a key role in admissions of JRF to CSIR-IICT and AcSIR PhD Program. In this direction, the main tasks carried out by division in close coordination with the AcSIR team are:

- Compiling information about the requirement of Scientists
- Preparing the Advertisement/ Notification for JRF admissions.
- Planning and coordinating interviews

With the help of AcSIR team, the division coordinates the conduct of course work to AcSIR students and assists in conducting the examinations. It maintains Registers/Files of all AcSIR students and accounts of AcSIR. It attends various

queries received regarding AcSIR and compile necessary reports. It coordinates with recruitment Section and accounts Section for handing day to day activities of AcSIR.

The main activities that carried out by the division related to AcSIR are as mentioned below:

- Recruitment of students to CSIR-IICT and AcSIR PhD Program
- Conducting Coursework and examinations
- Maintaining student databases
- Maintaining records and accounts related to AcSIR.

#### D. Other Activities

- **Coordination of Research Council (RC) Meetings:** The Division works closely with the Secretary RC and Director to coordinate RC Meetings, especially the follow-up activities of the action points raised by the RC
- **Institute Publications:** As a business promotion activity, the division publishes institutional reports/ publications/ publicity material in form of annual reports, news bulletins, special promotional brochures, seminar proceedings, etc, The division is instrumental in publicizing institute's R&D achievements and other activities by maintaining excellent relations with media and press. The division publicizes institute's big events, honours/awards received by scientists, National/International seminars organized through press and electronic media.
- **VIP and Student Visits:** The Division coordinates the visits of Ministers and other such dignitaries. The Division also organizes events like CSIR-IICT Open Day for school and college students to infuse scientific temper in them
- **Photography:** The division provides photography services to the institute.

#### Some New Initiatives:

To reorient the CSIR-IICT research towards industrially relevant products & processes, CSIR-IICT has taken up several new initiatives. Some significant initiatives are listed below:

**CSIR-IICT Industry R&D Consortium:** The Consortium aims to carry out research to develop new processes/products, improve existing industrial processes and pursue challenging research projects that benefit industry and society.

**One-to-One Industry Interaction Meets:** To understand the needs of the industry, CSIR-IICT had about 80 one-to-one interactions with prospective industry partners.

**Business Meets:** To showcase the activities of various research groups of CSIR-IICT, several Business Meets were organized.

The division launched a quarterly information bulletin "**NEST (New and Emerging Science and Technologies)**" to disseminate the news related to new emerging science and technologies to CSIR-IICT scientific community to supplement their R&D efforts. The information bulletin is compilation of R&D trends and other related news collected from different sources. The news related to emerging science and technology, industrial R&D, science and innovation policies, scientific achievements of CSIR-IICT scientific staff etc., will be incorporated in this bulletin.

**Tie-ups with Industry Associations:** CSIR-IICT in its bid to reach out to the industry has established strong linkages with industry associations like the Confederation of Indian Industry (CII), Solvent Extractors' Association of India, Oil Technologists' Association of India, Indian Paint & Coating Association, Bulk Drug Manufactures' Association.



**National Facilities:** CSIR-IICT has facilitated visits of several national and international dignitaries to CSIR-IICT with an aim to popularize the National facilities of CSIR-IICT like (a) National Mol-bank facility (b) Chemical Biology (c) Lipid research and (d) Semiochemicals. A proposal is submitted to DSIR to establish Common Research & Technology Development Hub (CRTDH) to help pharma and health sector based industries.

**Showcasing new & emerging technologies:** The research contribution of new & emerging areal like nano-biotechnologies and nano materials, dye sensitized solar cells, renewable energy through biomass & biohydrogen, functional materials were showcased at various national and international forums.

**Business Collaborations:** CSIR-IICT has entered into MoUs with CSIR Tech and IKP, Hyderabad to explore opportunities for marketing CSIR-IICT capabilities.

**Joint proposals to promote entrepreneurship in interface areas:** CSIR-IICT, CSIR-CCMB have submitted a Joint proposal for establishing Entrepreneurial Research & Innovation Centre, Hyderabad (ENRICH Facility).

CSIR-IICT has a rich pool of scientists with a broad range of research interests and expertise enabling multidisciplinary teams to work on various research & industrial products and processes. The Business Development Division strives to create an enabling ambiance for the scientists to focus on research, and to create innovation resource platforms to facilitate the transfer of research outputs to the Industry.



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# Information Management Area

IICT-CCMB Library is a combined facility for two National Laboratories viz CSIR-IICT and CSIR-CCMB and it is known as Information Management Area (IMA). It has precious internationally acclaimed reference collections in frontier areas of Chemical, Engineering and Life Sciences. It plays a vital role in acquisition, organization and dissemination of knowledge. It is consulted not only by the institutional users but also by researchers in and around Hyderabad. It has an impressive collection of both print and electronic resources including books, journals, technical reports, standards, patents, theses and other material. It has adequate infrastructure to meet the user's requirements. Main thrust of the library continues to be the improvement of quality services and facilities, achieving higher degree of user satisfaction and modernization of its activities and operations. Print holdings include Books, Dictionaries, Handbooks, Encyclopaedias, Reference book series and back volumes of journals. Library subscribes to around 150 national and international journals every year.

IMA is acting as a participating agency of CSIR-IICT in the implementation of 12<sup>th</sup> Five Year Plan Project "CSIR Knowledge Gateway & Open Source Private Cloud Infrastructure" (KNOWGATE) under information sciences cluster of National Laboratories scheme of CSIR with a project outlay of Rs.1159.17 lakh. This project will be implemented by CSIR-NISCAIR as a nodal laboratory. The cloud infrastructure is proposed at NISCAIR which will be accessed as a service from any CSIR Labs. This platform will be used by individual Knowledge Resource Centres (KRCs) of CSIR laboratories for their computational needs. Further, a small Open Source Software Technology Solution Cell (OSSTSC) is being proposed to provide the Open Source Software (OSS) solution for library automation, institutional repositories / digital libraries and network security and management. Technical support will be provided to all CSIR KRCs through OSSTSC. The ultimate aim of this project is to supply researchers with all the materials that they need in order to do research, become more educated and empowered.



## Core Competencies

- It is a signature library in Chemical and Life Sciences with Chemical Abstracts available since its inception i.e. from the year 1907.
- Rich document collection which includes more than a lakh of books and journal back volumes.
- Electronic access to about 3000 scientific journals and Electronic databases like Sci-Finder, Reaxys, Indian and ASTM standards, through NKRC Consortium.
- Digital Repository (DRI) of IICT has been commissioned and maintained which is a digital archive of the IICT's research output. Available publications from the year 1947 onwards and bibliographic details of Ph.D theses from the year 1945





onwards are available. 8575 full text articles and bibliographic details of 1115 theses are included in DRI.

- Library Home page <http://libdoc> was designed and maintained which serves as a single point access to all the library resources.
- Scientometric study of research output of the institute which helps the top management of CSIR-IICT in understanding strengths and weaknesses of R & D activity of the Institute.
- **Provides a range of Library and Information services like** Circulation service , Reference service, Inter-Library Loan service, Newspaper Clipping service and Translation service for foreign language research articles.



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# The Journey through Seven Decades



Prime Minister of India Shri Jawaharlal Nehru inaugurating the main building of the Institute



Dr. Hussain Zaheer, Director displaying product samples to Shri Nehru and Ms. Vijaya Lakshmi Pandit



Shri Nehru visiting the Pilot Plants along with other dignitaries



Shri Nehru's visit to Laboratory



Shri Jawaharlal Nehru visiting the Institute along with Dr SS Bhatnagar, DG, CSIR and Dr Hussain Zaheer



Dr. Hussain Zaheer displaying the products to Dr. Rajendra Prasad President of India



Dr. Hussain Zaheer explaining the activities of the laboratory to Dr. Rajendra Prasad



Dr. Rajendra Prasad documenting his message in the Visitor's Book



Dr. Hussain Zaheer showing the Pilot Plant to Dr. S. Radhakrishnan, President of India



Dr. K.T. Achaya explaining the activities of Oils & Fats Group to Dr. S. Radhakrishnan



Dr. Hussain Zaheer displaying a product developed in the laboratory to Dr. S. Radhakrishnan



Dr. Zakir Hussain, President of India visiting the laboratory along with Dr. GS Sidhu, Director

# The Journey through Seven Decades



Dr. Zakir Hussain interacting with Dr. ER Saxena and other Scientists



Dr. R. Vaidyewaran explaining about the activities of Coal Division to Dr. Zakir Hussain



Dr. KT Achaya explaining about the Cottonseed Pilot Plant to Sri Morarji Desai, Dy. Prime Minister of India



Sri Morarji Desai's visit to laboratory along with Sri K. Brahmananda Reddy, Chief Minister of Andhra Pradesh



Dr. GS Sidhu introducing scientists to Dr G Jail Singh  
President of India



Dr PB Sattur explaining about the activities of Pharmaceuticals Group to Dr Jail Singh



Visit of Vice President of India Shri M Hidayatullah and Prof Nurul Hasan, Vice President of CSIR to the Pilot Plant



Prof. Nurul Hasan interacting with Dr GS Sidhu and other Senior Scientists



Dr Zaheer Hussain displaying samples to Shri N Sanjeeva Reddy Chief Minister of Andhra Pradesh



Dr Sidhu demonstrating an equipment to Shri K Brahmananda Reddy, Chief Minister of Andhra Pradesh



Dr Sidhu displaying a product Shri J Vengal Rao, Chief Minister of Andhra Pradesh



Dr Sidhu explaining about the activities of the Institute to Dr M Chenna Reddy, Chief Minister of Andhra Pradesh

# The Journey through Seven Decades



Address by Shri NT Rama Rao, Chief Minister of Andhra Pradesh during Golden Jubilee Celebrations of IICT



Shri PV Narasimha Rao, Prime Minister of India addressing during Golden Jubilee Celebrations of IICT. Shri Krishan Kant, Governor of A.P. and Shri NT Rama Rao are also seen in the picture



Dr Sidhu explaining activities of the Institute to Shri AB Vajpayee Chairman of Parliamentary Committee



Dr. Sidhu displaying the products to Shri AB Vajpayee



Vice President Sri KR Narayanan formally rechristened the laboratory as Indian Institute of Chemical Technology



Address by Shri KR Narayanan during rechristening function



Governor of Andhra Pradesh Ms. Kumud Ben Joshi's visit to the laboratory



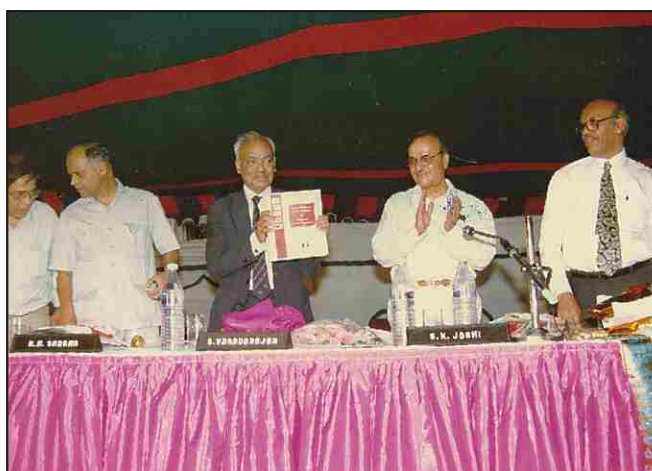
Union Minister Shri KC Panth's visit to the Institute



Shri G Laxma Reddy receiving CSIR Technology Prize from Dr ABJ Abdul Kalam



Dr AP Mitra, DG, CSIR addressing the staff of the Institute



Dr S Varadarajan, former DG CSIR releasing souvenir during a Conference at the Institute. Dr SK Joshi, DG CSIR Prof MM Sharma and Dr AV Rama Rao are also seen in the picture



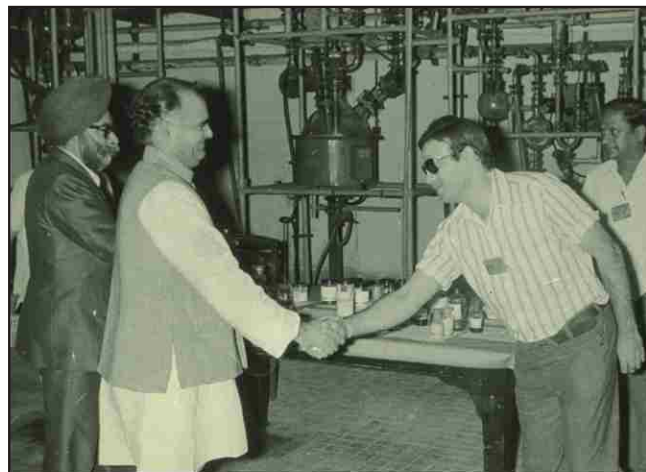
Dr Y Nayudamma, DG, CSIR addressing the staff of the laboratory



# The Journey through Seven Decades



Shri PR Kumaramangalam, Minister of State for Science & Technology visiting the pilot plants of the Institute



Union Minister Shri M Kumar Mangalam's visit to the Pilot Plant of the Institute. Dr GS Sidhu and Dr UT Bhale Rao are also seen in the picture



Dr JS Yadav, Director with Shri Kapil Sibal, Union Minister of Science & Technology and Dr RA Mashelkar, DG, CSIR



Sri Kapil Sibal unveiling the Diamond Jubilee Monument. Dr RA Mashelkar and Dr JS Yadav are also seen in the picture



Sri Kapil Sibal planting a plant on the occasion of Diamond Jubilee Celebrations of the institute



Shri Kapil Sibal and Dr RA Mashelkar visiting the laboratory



Union Minister of Science & Technology Prof Murali Manohar Joshi Participating Directors Conference held at IICT



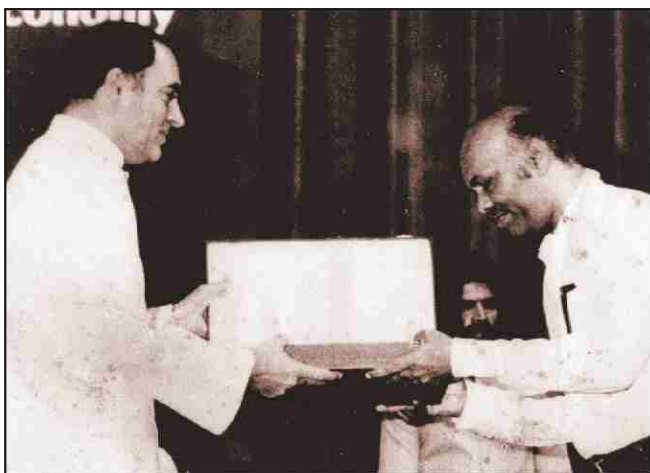
Union Minister Shri B Dattatreya inaugurating a conference at IICT



Dr RA Mashelkar inaugurating the Benzaldehyde Pilot Plant. Dr KV Raghavan, Director Dr Asad Ali Khan and M Lakshmi Kantam are also seen in the picture



Dr Murali Manohar Joshi interacting with the staff of the laboratory



Shri Rajiv Gandhi, Prime Minister of India felicitating Dr AV Rama Rao



Dr C Rangarajan, Governor of Andhra Pradesh inaugurating the CSIR Diamond Jubilee Celebrations of IICT

# The Journey through Seven Decades



Governor of Andhra Pradesh Shri KC Abraham inaugurating a conference at IICT. Dr G Thyagarajan Dr S Vradarajan, DG CSIR are also seen in the picture



Shri PR Kumaramangalam visit pilot plants of the institute along with Dr S Varadarajan and Dr AV Rama Rao



Dr G Thyagarajan explaining about the activities of the Institute to Union Minister Shri P Shiv Shankar



Union Minister Shri Jairam Ramesh visiting the Bio-Diesel Plant at IICT



Dr RBN Prasad explaining about the activities of Lipids group to Shri Prithviraj Chavan at Synthetic Aviation Lubricants Pilot Plant



Dr JS Yadav making a presentation about IICT activities to Shri T Subbarami Reddy, Chairman and other members of Parliamentary Committee on Science & Technology



# The Journey through Seven Decades



Dr RA Mashelkar inaugurating a pilot plant at IICT. Dr BM Chaudhary and Dr M Lakshmi Kantam are also seen in the picture



Shri Prithviraj Chavan releasing a document on "Performance of IICT in the New Millennium"



Dr. JS Yadav Presenting a Memento to Chief Minister of Andhra Pradesh Dr. YS Rajeshkar Reddy in Indian Pharmacological Society's Conference organized at IICT



Dr AV Rama Rao explaining the layout of Golden Jubilee Block to Sri PV Narasimha Rao



Dr KV Raghavan explaining the activities of IICT to Shri N Chandra Babu Naidu, Chief Minister, Andhra Pradesh



Dr KV Raghavan welcoming Governor of Andhra Pradesh Shri Surjit Singh Barnala to IICT

# The Journey through Seven Decades



Dr AV Rama Rao explaining the activities of IICT to the Governor of Andhra Pradesh Sri Krishan Kant and Dr SK Joshi, DG, CSIR



Dr GS Sidhu presenting a Memento to Sri KR Narayanan Union Minister of Science & Technology



Dr AV Rama Rao, Director, IICT receiving Padmashri Honor from Hon'ble President of India Shri R Venkatraman



Dr Ashwini Kumar, Union Minister of Science & Technology with Directors of IICT, CCMB & NGRI in a Press Meet at IICT



Dr AV Rama Rao interacting with Prof CNR Rao and Prof SK Joshi at IICT



Dr JS Yadav showing the MOL Bank Facility to Prof SK Brahmachari, DG, CSIR



Dr JS Yadav explaining the activities of Lipids Group to Prof Goverdhan Mehta, Chairman, Research Council of IICT



Dr Raja Ramanna, Chairman, Atomic Energy Commission interacting with the Scientists of the Institute



Dr APJ Abdul Kalam sharing his views with Dr AV Rama Rao during his Visit to Bio Organic Laboratory of IICT



Sri Nadendla Manohar, Speaker, Andhra Pradesh Legislative Assembly inaugurating IOFATS-2011 at IICT



Dr Samir Bharmachari, DG-CSIR and Dr Rene Gree, CNRS-Director of Research during inauguration of Indo-French Joint Laboratory for Sustainable Chemistry at Interface at IICT.



His Excellency Mr Francois Richier, Ambassador of France to India during the Joint Laboratory visit at IICT.

# CSIR-IICT Research Focus

## Sustainable Chemical Industry



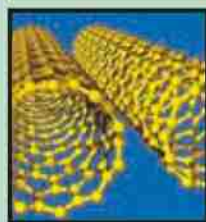
- Catalysis
- Biotransformation
- Fluorine Chemicals
- Process Modelling & Design
- Process Safety
- Process Intensification
- Specialty Chemicals
- Membrane Separations

## Affordable Health Care



- Diagnostics
- Therapeutics
- Vaccines
- Designer Molecules
- Screening
- Delivery Systems

## Advanced Materials



- Micro/Nano Materials for Smart and Intelligent Coatings
- Stimuli Responsive Materials
- Graphene Materials
- Photo Functional Materials



## Environment



- Sustainable Technologies (Pharma, Refineries Tanneries)
- Biohydrogen
- Waste Utilization
- Biodigestors

## Adequate Clean Energy



- Solar & Energy Materials
- Direct Coal Liquefaction
- Coal Gasification
- Carbon Sequestration
- Biomass to Energy
- Photobiological Processes

## Agriculture, Food & Nutrition



- Processes for Edible Oils & Oleochemicals
- Nutraceuticals
- Natural & Synthetic Agrochemicals
- Plant Volatiles for Pest Control
- Pheromone Application



## CSIR-Indian Institute of Chemical Technology

(Council of Scientific and Industrial Research)

### Publication Committee

Dr. R B N Prasad, Dr. N V Satyanarayana, Mrs. C B Lakshmi, Dr. K Yamuna Rani,  
Dr. Shashi Vardhan Kalivendi, Dr. Pradosh P Chakrabarti, Dr. Ramanuj Narayan,  
Dr. Saibal Das, Mrs. V V S Lakshmi, Mr. V G Jacob



# CSIR-IICT



## Towards Global Leadership

Academic and Industrial Collaborations across the Globe



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