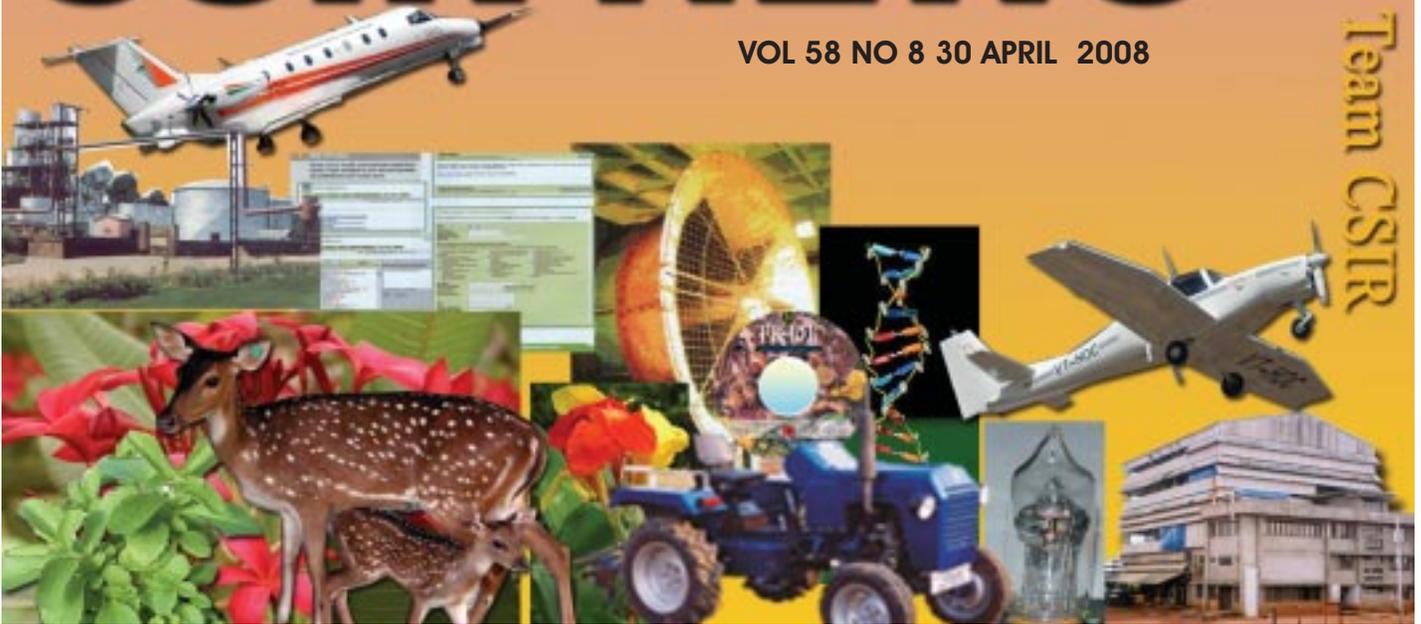


CSIR NEWS

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Team CSIR



Repopulating damaged coral reef areas of Lakshadweep

Coral reefs in India have been under stress for quite some time. Lakshadweep reefs bore the brunt of coral mining, souvenir coral collection, ground water pollution and mechanical damages owing to activities like dredging. While efforts led by scientists could identify these issues and suggest remedies, Dr M.V.M. Wafar, a senior scientist of National Institute of Oceanography (NIO), Goa, involved in the project on coral reefs at Lakshadweep realized that the conservation will not be successful without involvement of local population.

As corals are distributed below water surface down to 50 m depth, assessment of their well-being and management requires competence in scuba diving and observation skills. In order to achieve these twin objectives Dr Wafar created a dive centre in Lakshadweep, acquired diving kits, trained a broad spectrum of stakeholders ranging from officers, wardens, scientific staff to unemployed local youth from all 10 islands of Lakshadweep. Basic training was focused on coral reef monitoring that do not require extraordinary skills but could still produce adequate data for management policies.



Islanders in coral reef monitoring exercise



The output of all these activities is the creation of a community team that is competent to monitor the ecosystem on a regular basis and report damages to the managers. A fall-out from this is a heightened awareness of the importance of coral that feeds into societal commitment to conservation.

A current initiative with the societal target is the transplantation of corals in order to repopulate damaged coral reef areas. During the last two years the technique has been tested and found suitable. It is also simple enough to be used by the local population with limited or no knowledge of corals. Dr Wafar says, "I am in the process of transferring this to a community-involved exercise in all islands so that reef restoration is enhanced and additional income generated for the local population by way of fish catch from near the transplantation site."

The project that began in the year 2000, has made a noticeable impact in the relationship between the local population of Lakshadweep islands and their immediate environment, the coral reefs. NIO hopes that the efforts would bear good fruits in the form of restoration of our damaged environment which is most difficult to recover.



Community effort in maintaining cleanliness of the reef and lagoon



The team of islanders trained by NIO in diving and coral reef monitoring



Materials used for corals transplantation



Fragments of corals translocated in December 2004



Same corals in October 2005



Same corals in April 2006



Same corals in December 2007



Frame-grown corals being introduced in the reef

Patents filed, Technical Services, Sponsored and Consultancy Projects taken up by Central Electrochemical Research Institute, Karaikudi during Jan – Feb 2008

Patents sent for filing in India

- New types of self-supported polymeric hybrid membranes for air humidification in polymer electrolyte fuel cell stacks, A.K. Shukla, S. Pitchumani, P. Sridhar, S.D. Bhat, A. Manoharan
- Development of an efficient anode backfill based on ion conducting paste for cathodic protection of iron and steel strippers and pipelines buried under the soil, R. Bhaskaran, N. Palanisamy, K.K. Sathesh Kumar, M.T. Vijayan, S. Geetha

Technical Services undertaken

- Testing of 12V, 7Ah VRLA batteries, Ammini Solar P. Ltd, Trivandrum (Rs 56180/-)
- Testing of organo-phosphonate samples, NLC Ltd, Neyveli (Rs 56180/-)
- Supplying 40 numbers of mixed metal oxide (MMO) coated titanium anodes for cathodic protection, Protech Anode & Alloy Engineers,

Karaikudi (Rs 80899/-)

- Evaluation of galvalume roofing sheet, Japan Metal Building Systems, Bangalore (Rs 55619/-)
- Evaluation of “Base” tubular battery for capacity test as per ISI3369, Base Corp., Chennai (Rs 58427/-)
- Special training programme on “Electroplating Processes, Hindustan Aeronautics Ltd, Bangalore (Rs 2,13,484/-)

Grant-in-aid/Sponsored Projects taken up

- Development of electro-analytical sensor for pesticides analysis, DST, New Delhi (Rs 16,90,560/-)

Consultancy

- Electro refining of lead from smelted lead/scrap lead acid batteries, Empire Industries, Mumbai (Rs 2,24,720/-)

CFTRI process for chlorogenic acid rich coffee conserve from green coffee beans

Coffee, known for antioxidants and anti-tumour activity, also possesses many therapeutic properties. The phenolic acids present in coffee, such as chlorogenic acid, caffeic acid, paracoumaric acid and eugenol have been shown to exert cancer preventive effects in animal models. Chlorogenic acid, which is the main phenolic acid in coffee, is able to protect the gastric mucosa against irritation and improves the digestibility of foods, beverages and medicaments. The improved digestibility is expressed through a much-reduced systemic acid secretion, which has been found to be directly dependent on an increased level of chlorogenic acid content. Also chlorogenic acid has a chemo-





preventive effect on rat stomach cancer. Chlorogenic acid and caffeic acid are shown to have a potential role in increasing the uptake of glucose in the body and regulating blood glucose levels. The Central Food Technological Research Institute (CFTRI), Mysore, has developed a technology for the chlorogenic acid rich conserve from green coffee beans.

Green coffee beans of various grades and low grade coffee are softened by steam and flaked. The flakes are passed through a suitable dryer to reduce the moisture and to get light cream / light brown coloured crispy flakes, followed by grinding to a coarse powder. The flakes or powder is loaded into columns and extracted with a suitable solvent mixture. The extract is distilled under controlled conditions to maximize the recovery of the solvent to produce coffee conserves, which are mainly chlorogenic acids and diterpenes. Final product is packed in clean containers.

Indian Institute of Chemical Technology, Hyderabad

R & D Highlights

Coal, Gas & Energy and

Following the coverage of the activities/ accomplishments of Indian Institute of Chemical Technology (IICT), Hyderabad, in the field of Synthetic Organic Chemistry & Drug Intermediates, Natural Products, Agrochemicals & Pheromone Chemicals, Fluoro-organics, Inorganic & Physical Chemistry, Lipid Science & Technology, and Organic Coatings & Polymers in *CSIR News*, 58(2008), 86, and Biology and Biotechnology, in *CSIR News*, 58(2008), presented here are the contributions of the institute in the field of (i) Coal, Gas and Energy and (ii) Engineering Sciences:

COAL, GAS AND ENERGY

50 kW Fuel Cell power pack with methanol as primary fuel for technology demonstration (Sponsored by MNRE, New Delhi): IICT has developed a methanol steam reformation system. A 10 kW reformer was designed, fabricated, commissioned and tested for sustainable performance to generate fuel cell grade hydrogen at a net rate equivalent to 10 kW power. A 500 W PEM Fuel cell from SPIC Science Foundation, Chennai, was integrated with the reformer using side stream of the reformat gas and 10 kW methanol reformer has

been operated for 1000 h to establish system endurance and to standardize the scale up methodology. During these studies data have been generated for the design of the 50 kW reformer and all its sub-systems. The feed heating system consisting of preheating, vaporizing & superheating zones and gas clean up section have been designed using the above data. Specifications were prepared for all the necessary instruments. M/s Transtech Projects Pvt. Ltd, Pune, fabricated the unit. After procuring the 50 kW methanol reformer system, all the instruments and blowers were installed along with necessary airlines and control valves. The whole set up was pressure tested after calibrating the various instruments.

The commissioning and testing of the 50 kW methanol reformer, procurement of PEM Fuel Cell and demonstration of the reformer, fuel cell integrated unit are being taken up.



50 kW Methanol reformer

Direct sourcing of coal for value added chemicals (Sponsored by Ministry of Coal): The object of the project is to ascertain precursors for value added chemicals, namely polycyclic aromatics (preferably 2- and 3-ring aromatics) and phenols, which otherwise are not available in any other natural source including petroleum. In the earlier studies on chemical characterization of Singareni Coals, these coals were found to be ~80% aromatic. The coal-based aromatics are highly useful in industry for making engineering plastics such as fibres, aromatic polyamides and liquid crystalline polymers (LCP). The methodology is to catalytically cleave selectively the methylene and ether bridges interspersed between polycyclic aromatic rings. Experiments conducted with molybdenum and tungsten based catalysts impregnated on mesoporous alumina showed that the catalysts were very effective in yielding 2-methyl- and 2-phenyl naphthalenes to the extent of ~20% in the product at low reaction temperatures (~200°C) and ~20 kg/cm². It was also observed that aromatic rings were not hydrogenated under experimental conditions. Experiments are in progress to generate process conditions for improving the selectivity to yield alkyl naphthalenes directly from coal.

Production of clean fuel gas from coal derived gases using reactive regenerable sorbents for sulphur removal and ceramic candle filters for fine particulate control (Sponsored by Ministry of Coal): Objectives of the project is to

develop a high temperature, high pressure process for clean up of the fuel gas generated from a coal gasifier in order to remove its sulphur components and the particulates before it is burnt in a gas turbine for power generation. The project completion report has been submitted to SSRC, Ministry of Coal.

ENGINEERING SCIENCES

CHEMICAL ENGINEERING SCIENCES

Chemical Engineering Sciences is one of the major divisions of IICT involved in development of technology for industrially important products, besides carrying out basic research in frontier areas of chemical engineering. The major activities of Chemical Engineering Division are Process Development, Process Design, Process Safety (PROSAC), Process Modeling and Simulation, Dynamics and Control, Reaction Engineering, Membrane Separations and Properties Measurement and Evaluation.

The division undertakes basic studies in kinetics of industrially important processes, equipment development needed for scaling up and process optimization, process dynamics and control.

Gas liquid packed bed reactor: Some of the important industrial gas liquid reactions carried out in packed beds are hydrogenation, desulphurization and chlorination. Shortly a state of art packed bed column with complete automation will be set up to measure other

hydrodynamic parameters such as RTD, mass transfer coefficient at atmospheric pressure as well as at high pressures.

Bubble column reactor: The focus of the study is primarily on determination of hydrodynamics, residence time distribution, heat and mass transfer parameters, as this information is essential for modeling and design of commercial scale reactors. State of art experimental unit is being set up.

Slurry reactor: The heat transfer and power consumption studies to Non-Newtonian fluids (soap solution, chalk slurries and CMC) in close clearance impeller (anchor) agitated vessel were carried out mainly to determine the heat transfer parameters. Further studies on determining the mixing parameters employing the tracer studies are being carried out.

Vapour phase alkylation of aniline: Alkylation of aniline is very important in chemical process industry. Alkylation of aromatic amines is a very complex one with many side reactions. The vapour phase reactions have gained a lot of importance in the recent times due to their obvious advantages. The research work includes catalyst characterization, kinetic studies, mass transfer and pore diffusion studies. Extensive research has been conducted and six patents have been awarded. A new catalyst has been developed which greatly enhances the selectivity of C-alkylation, in particular towards 2,6-diethylaniline. In continuation to this work zeolites are now being tested for selectivity towards C-alkylation. The research work



includes catalyst characterization, kinetic studies, mass transfer and pore diffusion studies.

Dynamic recurrent radial basis function network model predictive control of unstable nonlinear processes: Model Predictive Control (MPC) is known to be a very powerful control strategy for a variety of chemical and biochemical processes. In this study, a multi step model predictive control strategy based on dynamically recurrent radial basis function networks is employed for single input single output (SISO) control of uncertain nonlinear processes.

Optimal sensor configuration and nonlinear inferential control of multistage dynamic systems: A simplified process model based inferential control schemes has been developed and its performance evaluated through dynamic simulation by applying to multistage multi component processes like batch distillation and reactive batch distillation.

Monitoring and diagnosis of sensor faults using multivariate statistical models: A multivariate statistical control strategy based on correlation coefficient criterion has been employed for monitoring and diagnosis of sensor faults. The performance of the monitoring and diagnosis strategy has been evaluated by applying to a closed loop operated CSTR system. The simulation results demonstrate the ability of the strategy for detection, identification and reconstruction of single as well as multiple sensor faults

Extended Kalman filter

controller: First principles models to neural networks: Extended Kalman Filters (EKF) have been widely employed for state and parameter estimation in chemical engineering systems.

Neural modeling of biochemical systems using CDTA with adaptive learning rate: A combined design and training algorithm (CDTA) has been proposed for training neural networks to simultaneously perform network architecture selection and training of the network weights, and its performance illustrated through application to two fermentation systems.

Optimal control strategies for a batch crystallization process: In the present study, an industrial scale batch cooling crystallizer producing potassium nitrate has been considered for evaluation of optimal control strategies. The closed-loop implementation results are found to be better than the open-loop implementation results, and nonlinear approximation has shown better performance over linear approximation.

Mathematical modeling of fixed-film bioreactors: Mathematical modelling of some of the bio-film processes is not always straightforward. An alternative methodology has been proposed, which makes use of a novel optimization method to evaluate the bio-kinetic parameters, in the course of the solution of an inverse problem with the aid of measured data of fractional conversion of the substrate.

Development of novel optimization methods: Optimization

methods are essential prerequisites in process systems engineering. One such method is the method of Differential Evolution (DE), which belongs to the class of Evolutionary Algorithms. Differential evolution has been modified and applied for problems involving constrained minimization and efforts are now on to develop an improved version of this method for enhancing its efficiency in terms of computational speed and accuracy.

Biofilter modeling: Biofiltration technology presents a very attractive alternative to physico-chemical methods for waste gas clean up. There are some areas of concern, which make this job rather difficult. An improved differential evolution (IDE) method has been proposed and applied for the evaluation of the parameters, in the framework of the solution of an inverse problem. It has been demonstrated that the IDE, which is a variant of the original DE method, is twice as efficient as the DE method in terms of computational speed for the same level of accuracy. A case study involving the biodegradation of phenol in air streams has been investigated to validate the models proposed.

Synthesis of heat exchanger networks: Heat Exchanger Network Synthesis (HENS) has been one of the most-studied problems in process synthesis. An HENS model proposed considers stream splitting, does away with the simplifying assumption of isothermal mixing of the split streams and has the capability to handle compulsory and forbidden matching of streams. The

present work represents thus a step forward in the search for robust and efficient global optimization algorithms for the solution of the HENS problem.

Applied Research

The thrust areas of applied research are: (i) Process development & design (ii) Process dynamics & control (iii) Process safety and (iv) Membrane separation.

Process Development and Design

Process development and design for commercialization of technologies is one of the major activities of IICT. The objective is primarily to develop the eco-friendly process technologies for chemicals belonging to the agrochemicals, speciality chemicals and petrochemicals sectors, chosen on the basis of demand and/or engineering challenges.

Synthetic aviation lubricants: IICT, IOC-R&D, NAL, HAL, GTRE and CEMILAC have formed a consortium to look into the possibility of developing indigenous technology for aviation lubricants. The main objective is to produce the product samples in bulk quantities for further application.

Undecenoic acid: A continuous process (3kg/h) for the preparation of undecenoic acid by pyrolysis of castor oil at high temperature has been developed for the first time in India. This process has been demonstrated to M/s Jayant Oils and Derivatives Ltd (JODL), Mumbai and a design package for

the commercial scale plant of a capacity 1.5 t/d has been prepared and submitted to JODL for the commercialization of the process. In entire process, the reactor is a critical unit and a novel design method has been developed for the reactor.

Continuous production of bio-diesel using multi-feed stock such as Jatropha and Karanja oils: Continuous production of bio-diesel from multifeedstocks is aimed at 10kg/h scale. The project has been sponsored by the AP State Government. A pilot plant for processing 10kg/h is being setup at IICT.

Process Dynamics and Control

IICT has been active in the area of process modeling and simulation of chemical process plants for the last two and half decades. The institute has undertaken several process improvement optimization studies of chemical process plants through modeling and simulation and development of simulation/design software for various unit operations.

Experimental evaluation of energy model based controllers for an exothermic batch chemical reactor: A model based control strategy based on Extended Kalman Filter (EKF) has been employed for real time control of an exothermic batch chemical reactor. The results indicate the better performance of the energy model based controllers over the auto-tuned PI controller for real time temperature control of an esterification batch chemical reactor.

Optimal operation and advanced control of reactive batch distillation: This project has been recently sanctioned by Department of Science and Technology (DST). The aim is to develop optimal operation and advanced control strategies and evaluate their performance in real time. Work in this direction has been initiated.

Biotechnology Incubator Centre: The objective of Biotechnology Incubator Centre (BTIC) is to help new entrepreneurs starting small scale and medium scale biotechnology based industries. BTIC can be used for the development of the process at pilot scale. Products based on biotechnology can be procured in the BTIC for clinical trials also.

Aspirin: The objective is to improve the yield and minimize the raw material consumption of existing process for the manufacture of aspirin at Andhra Sugars. Experimental work has been carried out to optimize the parameters of the process and a multi purpose reactor has been designed based on the data generated at IICT.

Reaction Calorimeter (RC): Reaction Calorimeter is used to study thermokinetic behaviour and assess the potential hazardous nature the reactions/individual steps of the reaction nearer to the conditions prevailing in industry. The clients include M/s Matrix Labs., Hyderabad; M/s HEMRL, Pune; M/s SANDOZ, Thane and M/s Neuland Labs, Hyderabad.

Accelerating Rate Calorimeter (ARC): Accelerating Rate



Calorimeter studies for the reaction mixtures were conducted to assess the potential runaway behaviour and to get a complete understanding of the hazardous nature of the individual process streams for M/s Matrix Labs, Hyderabad and M/s NOCIL India, Mumbai.

Differential Scanning Calorimeter: This instrument is functioning under ISO9001:2000 and the quality service is offered to various commercial firms and research scholars from different universities.

Review of effluent standards and development of emission standards (sponsored by CPCB, New Delhi): The work carried out in this project is as follows: Visits to four industries at different locations in India; Collection of material balance data and water balance data is in the process; Recommendations for the suggestion of process improvements so as to reduce the pollution load; Establishment of other design parameters, i.e., waste water raw material, water consumption per tonne of product, etc.

Processing of byproduct salt mixture from hydrazine hydrate plant: Necessary design data generated on bench scale unit and process flow scheme for the treatment of by-product salt mixture was developed. Basic design reported for 40 tonnes/day commercial plant capacity to obtain about 25% aqueous sodium chloride solution from salt mixture from existing hydrazine hydrate plant. Based on IICT's design report, the plant has been installed and in

operation at Andhra Farm Chemicals Corp Ltd, Kovvur, A.P.

Consequence of release of toxic substance (H_2S) in offshore platforms for M/s IEOT (ONGC), Mumbai: Aim of the project is to develop a customized software for toxic gas (H_2S) dispersion studies for ONGC offshore platforms in order to determine the concentration of H_2S gas at various locations from the source of leak. The main features of the developed software are:

- For a given temperature and pressure of the source like vessel, pipeline, columns, etc., the model would estimate the leak rate from it and the concentration of H_2S at various distances from the source of leak.
- It takes care of both instantaneous and continuous mode of gas release and the effect of obstacle on dense gas dispersions.
- Suitable Graphical User Interface has been incorporated to make the software user friendly.

Process Safety Centre

Process Safety Centre successfully completed approximately 30 Hazard Analysis and Risk Assessment, Safety Audit, HAZOP and Onsite and Offsite Emergency plans, and

Disaster Management assignments during the period. In addition, samples of various chemicals were analyzed for the hazardous properties, such as flammability/explosive limits, auto ignition temperature and overpressure waves generated when explosion takes place.

Process Safety Centre has jointly worked in collaboration with Institute of Engineering and Ocean Technology (IEOT)-ONGC for three assignments related to software and database development. These are:

1. Reliability Study of Critical Control and Safety Systems in Offshore Platforms.
2. Development of Failure Frequency Database.
3. Consequence of Release of Toxic (H_2S) Substances at Offshore Platforms.

Membrane Separation

This activity focuses on the development of novel membranes and membrane-based separation



A view of ONGC off-shore platform

processes for solving difficult industrial separation problems as well as water and wastewater management. Several technologies have been transferred to different industries/institutions:

- Commissioned nanofiltration pilot plant for extraction of 6000 Lit/day of impurity-free solvent for an acrylic fibre manufacturer, Consolidated Fibres & Chemicals Ltd (CFCL), Haldia, West Bengal.
- Commissioned first Gas Separation Pilot Plant in the country for the sweetening of 50-100 NM³/h of natural gas at ONGC, Hazira.
- Commissioned Reverse Osmosis Pilot Plant of 600 litres/h capacity for defluoridation of ground water at Mylaram village, Nalgonda District, Andhra Pradesh.
- Synthesized novel and cost-effective proton conducting polymer membranes from speciality polymers for application in Fuel Cells proposed for transport and stationery applications.
- Oxygen permeability studies on coating materials for Nuclear Power Corporation, Mumbai, as well as composite films for packaging applications.

Current activities involve: Recovery of propylene from refinery off-gas mixtures using metal-incorporated membranes; Dehydration of organic solvents by pervaporation technique; Development of hollow fiber nanofiltration membranes; Multipurpose RO/NF/UF/MF Pilot Plant at IICT Membrane Laboratory.

Process Modelling

In this context, major energy intensive equipment in a steel plant, such as the reheating furnaces, call for special attention because efficient methods of operation of these equipment lead to an optimum utilization of the fuel employed and improved plant economy. A reheating furnace is a key process equipment used to reheat billets of steel from room temperature to "red heat". The objectives of the reheating furnaces are (i) to heat steel to a controlled temperature, (ii) to achieve an acceptable



CFCL Plant at Haldia, West Bengal based on IICT technology



600 kg/h Defluoridation Plant for Drinking Water developed by IICT



Membrane Separation Plant



uniformity of heating, (iii) to minimise fuel consumption and (iv) to minimise oxidation of the steel surface.

MECHANICAL DESIGN AND ENGINEERING

Detailed engineering design of pilot plants — contribution of IICT include:

- Setting up of a pilot and testing facility for preparing and testing of physico-chemical properties of base stock of lubricants for aviation industry, and creation of a Biotech Technological Incubator Centre at SP Biotech Park, jointly with Andhra Pradesh State Government. This is the state-of-the-art facility for incubating biotechnologies and to provide world-class facilities to different clients for scale-up of their processes.
- Setting up of a pilot plant for standardization of bio-diesel process: The work includes mechanical design of equipment, preparation of tender document and project management and engineering activities at the time of erection and commissioning of the plant. The pilot plant is expected to be ready for process trials shortly.

Detailed engineering design of commercial plants to process effluent salts from existing Hydrazine Hydrate plant was prepared. The assignment was to give a Basic Engineering Package to

Andhra Farm Chemicals Ltd, Kovvur.

- E-pack Polymers(p) Ltd, Noida approached IICT for detailed engineering of an expanded polystyrene plant of 36,000 TPA capacity. The process is available with the client and the assignment includes providing P&I (based on PC/PLC systems), layouts, instrument specifications, electrical designs, structural designs, piping designs, etc.
- Designs of Pyrolysis Section for M/s Jayant Oil Mills (P) Limited, Vadodara. for providing the technology package, which includes process know-how for pyrolysis of castor oil methyl esters (CME) for the preparation of crude pyrolysed product containing Methyl UDA and Heptaldehyde as major products and designs for Pyrolysis Section (200 kg/h of CME).
- Deccan Chromates (P) Ltd, Hyderabad, sponsored a project for recovery of metals from leach liquor. Development of process flow diagram based on experimental results and unit operations and layouts and equipment specifications have been completed. IICT also conducted Fatigue Analysis of Pressure Vessels for Dimensions Group, Pune, at their request.

Safety Assignment with Prosac

The contributions pertain to:

- Consequence modeling of release of toxic substances (H_2S) in offshore platforms for IEOTONGC, Mumbai.
- Process safety audits studies for M/s Rallis Pvt. Ltd, Hyderabad, India Pesticides Limited, Lucknow and Rayalseema Alkalies and Allied Chemicals Plant Complex, Kurnool.
- Support for development of damage and risk contours on overall plot plants as part of QRA studies for LPG bottling plants and other industries.
- IICT is setting up a virtual reality facility and develop models that are suitable for process/plant safety applications and that can simulate normal/ emergency and accident scenarios. It develops computer generated manipulation of images with special emphasis on chemical lab safety, fire water safety, gas leak, etc.

BIOENGINEERING AND ENVIRONMENTAL CENTRE

Biohydrogen production from wastewater: Molecular hydrogen (H_2) production with simultaneous wastewater treatment was studied in different configurations (biofilm and suspended) of bioreactors operated in periodic discontinuous/sequencing batch reactor using



Experimental set-up showing biofilm configured reactor with H₂ monitoring system and peristaltic pump producing H₂ from chemical wastewater

chemical and distillery wastewaters as substrate. The experimental data showed the feasibility of molecular biohydrogen generation utilizing wastewater, viz., chemical, dairy and distillery as primary carbon source through metabolic participation. Viability of different pretreatment methods applied on anaerobic mixed inoculum was evaluated.

Bioelectricity generation from wastewater treatment (Funded by Department of Biotechnology): Bioelectricity generation from chemical wastewater treatment was evaluated in microbial fuel cell (MFC). Laboratory experiments were being pursued to evaluate the feasibility of electricity production from distillery, domestic and dairy wastewaters also using dual and single chambered MFCs.



Microbial fuel cell (MFC) [dual chambered; K₃Fe(CN)₆ cathode] treating chemical wastewater during the production of bioelectricity

Microbial production of xylitol (Funded by Department of Biotechnology): Plant wastes constitute the most abundant renewable natural resource, which contains essentially lignocellulose. Since xylan is the major component of plant hemicellulose, most investigations of the enzymic degradation of hemicellulose have focused on xylanolytic enzymes, such as xylanase, produced by numerous microorganisms, among which the fungi are the most potent producers. Considering the industrial application potential of xylanases, work is in progress for xylanase production using different lignocellulosic substrates.

Production of L(+) lactic acid by immobilized Lactobacillus delbrueckii: Optically pure L(+) lactic acid production by immobilized *Lactobacillus delbrueckii* was studied in detail. Modified alginate immobilized *Lactobacillus* cells showed improved metabolic activities in

terms of substrate utilization and effective product yield compared to control.

Isolation of L-asparaginase producing microbial strains: L-asparaginase is a biocatalyst which has

pharmaceutical importance in treating certain types of cancers. A microbial strain was isolated from different exotic soil samples which has potential to produce the L-asparaginase enzyme. The strain was studied for its growth and enzyme production characteristics in the presence of different nutritional compounds and fermentation conditions.

Novel antimicrobial compounds from Actinomycetes: The potent microbes studied by screening were short listed to produce novel substance. Many more isolates (from West Coast and East Coast) have been studied from different habitats and further detailed studies are in progress.

Antimicrobial products from plants: In pursuit to isolate novel antimicrobial compounds IICT has been working on Ayurveda and ethno botanically important plants. The plant products studied are *Premna herbaceae* and *Polyalthia longifolia* seeds.



Production of enzymes and its application to bioremediation:

Transformation of xenobiotic compounds with laccases as a pretreatment option to enhance the biodegradability of wastewater was successfully achieved with free and immobilized enzymes. Laccase and hydrogen peroxidase were used as oxidative enzymes in the degradation studies. Degradation of azo dye and anthracene was studied and very efficient degradation of azo dye and anthracene was observed using the enzymes.

Periodic discontinuous/sequencing batch process development for the treatment of complex chemical wastewater:

Periodic discontinuous process was successfully applied for the complex chemical wastewater treatment. Aerobic metabolic function provided effective substrate yield. Inclusion of anoxic phase in between aerobic metabolic function has shown to have positive influence on the performance. One patent was filed on biofilm configured sequencing batch reactor operated in periodic discontinuous process.

Decontamination of soil by bio-slurry phase reactor: Bio-slurry system operating in periodic discontinuous operation was developed for the treatment of contaminated soil. The ability of the reactor was successfully studied with chlorpyrifos, phthalates, pyrene, anthracene and pendimethalin contaminated soil.

Fluoride monitoring and defluoridation studies: Fluoride concentrations in surface and ground water samples were

determined in eight villages of Prakasham district. Several samples were collected and analyzed for fluoride content along with pH, electrical conductivity, total dissolved solids (TDS), total hardness, total alkalinity, chlorides, sulphates and nitrates.

Anaerobic bioreactor and suitable microbial consortia for the removal of SO₂ from the gaseous streams (funded by Department of Science & Technology): SRB consortia were isolated and enriched from the different sources. Batch reactor studies for optimization of COD/S ratio, Conversion of sulphate and sulphite to sulphide was carried out. Studies on Continuous UASB, AFR and AFBR were completed

Carrying capacity studies of Vishakapatnam region: Surface water samples (including industrial outlets) and soil samples were collected during three seasons [post-monsoon (22 to 26th November, 2005), pre-monsoon (1 May to 3 June, 2006) and monsoon (19th to 21st September, 2006)] in the Vishakapatnam area to evaluate the present environmental status of the study area in order to enumerate the carrying capacity of the area. Analysis of the samples for various physico-chemical parameters is in progress.

Application of biotechnology for eco-friendly management of poultry waste (funded by Department of Biotechnology): Characterization of poultry waste was completed. Self mixing anaerobic digester (SMAD) was developed. Bench scale experiments at IICT were also

completed. Patent was applied in US, PCT and India. Pilot plant erection for the treatment of poultry litter was done at ANGRAU, Rajendra Nagar, Hyderabad. [Applied for U.S and Indian patents, 2006]

Biofilter technology: A Biofilter was developed for H₂S removal. Biofilter with locally available agricultural residue as bedding material was developed for odour control and VOC removal.

Waste minimization in bulk drug industry (APITCO): Waste minimization studies in bulk drug industry (M/S Everest Organics Pvt. Ltd) were carried out for Omeprazole and Ciprofloxacin.

Value added products from agro-industrial waste materials: Acid-stable amylase and alkaline protease production using agro-industrial waste material were evaluated. Isolated microbial strains with potential to produce these enzymes were grown using selected agro-materials as nutrient source under solid state fermentation. Impact of external supplements especially carbon and nitrogen as sources was evaluated. Effective production compared to conventional fermentation was achieved.

Xylitol production studies (funded by Department of Science & Technology): A potential yeast strain has been isolated which has potential to utilize xylose via xylitol-xylulose route. This strain was characterized for its growth under different carbon and nitrogen sources.

Bioreactor studies for enzymes and antibiotics: Many novel

microbes have been isolated, which are capable of producing hydrolases. Optimization studies are in progress. Screening of soil samples for lipase production by enrichment studies. Antibiotics and enzyme production studies have been carried out in different reactor types such as STR, FBR, PBR and ALR with free and immobilized cells.

Biological oxidation and reduction of sulphur compounds: The removal of sulphur compounds from waste streams can be mediated by application of bacteria involved in the natural sulphur cycle. *Thiobacillus sp.* are an obligate autotrophic, acidophilic, sulphur oxidizing bacterium and belongs to *Thiobacilli* genera. Various concentrations and loading rates of sulphide were tested for sulphide oxidation rate in batch and continuous mode in fluidized bed bioreactor.

Sulphur compounds reduction by sulphate reducing bacteria (SRB): The *Desulfovibrio* are the most well known group, which are easy to isolate and purify; they are mesophilic and can be halophilic and do not form spores. Pure cultures of *Desulfovibrio* were isolated from mixed cultures and their ability to reduce the sulphates was tested under different conditions.

International Meet on Mapping the Scientific Consciousness: National and Global Efforts



Shri Gauhar Raza, Scientist, NISTADS, speaking during the international meet. Seated on dais (from left) are: Shri Anuj Sinha, Head, NCSTC, Dr T. Ramasamy, Secretary, DST, Shri Suman K. Bery, Director General, NCAER, Dr Parthasarthy Banerjee, Acting Director, NISTADS and Shri Dinesh Abrol, Scientist, NISTADS

A two-day international meet on Public Understanding of Science was held in Teen Murti House, New Delhi, on 7-8 March 2008. The host was National Institute of Science Technology and Development Studies (NISTADS), New Delhi. Co-sponsored by the National Council of Science Technology and Development Studies, the meet was attended by 14 international scholars, representing 11 countries from across the globe. About 60 scholars from various universities, media institutions, government departments and individual communicators, who are working on various facets of science communication, survey studies,

measurement of public opinion, also participated.

The meet was segmented in eight sessions. The keynote address was delivered by Professor V. S. Ramamurthy, Chairman IIT Board. The session was presided over by Shri Suman K. Bery, Director General, NCAER. After introductory remarks by Gauhar Raza, Scientist, NISTADS, Dr Parthasarthy Banerjee, Acting Director, NISTADS, welcomed the guests. Shri Anuj Sinha, Head, NCSTC, spoke about the importance of the first ever meet, in India, on the subject of Public Understanding of Science. Shri Dinesh Abrol, Scientist, NISTADS, proposed the vote of thanks.



One of the objectives of the meet was to bring together experts from culturally rich countries in large numbers. Majority of the scholars who attended the meet were from developing countries. The meeting presented a balanced mix of perspectives from five developed countries and seven developing countries.

Twenty-one presentations were made in the following six technical sessions:

- Revisiting Indicators
- Models of Analysis
- Methodologies of Data Collection and Database Creation
- Statistical Tools for PUS Research
- Science, Education and Civil Society
- Research in PUS

Each session was divided into two parts, presentation and discussion, equal duration.

Three presentations were made during the session '**Revisiting indicators**'. Hester du Plessis from University of Johannesburg, presented an African perspective on the difficulties faced in mapping of scientific consciousness in culturally diverse countries. Sally Stares from London School of Economics presented exploration of cross-national typologies of public engagement with science and technology using latent class models on Euro-barometer data-set. Dr Ma Theresa Velasco, from

Communication and Development College, Phillipines shared her views on 'Science Communication: Towards Enhancing Public Understanding of Science in the Phillipines'.

Gauhar Raza, NISTADS, presented his paper on the efficacy of Media Channels in raising public understanding of science using Cultural Distance Model of Analysis, during the session on '**Models of analysis**'. Prof Loet Leydesdorff from Netherlands demonstrated a tool developed by his team to represent dynamic time series data through animations. Rivers health by Jennifer Metcalfe was a new and innovative method for PUS investigation coupled with action. The approach attempted to integrate knowledge, values, aspirations and use to produce a better insight into the current public perception.

Febienne Crettaz von Roten in her presentation provided insights into the changing attitude to animal research in Switzerland during the fourth session '**Methodologies of data collection and database creation**'. Valery Todorov from Bulgaria in her paper raised issues of developing universal science indicators. Rohini Wijeratne spoke on conducting of the National PUS survey being proposed in Srilanka. The proposal indicated how specific socio-economic conditions shape the questions that they are interested to moot.

Three presentations were made during the session on '**Statistical**

tools for PUS research'. Dr Rajesh Shukla made a presentation on the fresh approach they have adopted to study the available European databases by 're-normalising' the data to arrive at more meaningful insights. Presentation by Dr Anil Rai and Dr A. R. Rao on hard-core methodological aspects of PUS survey evoked exciting debate among the participants.

The session '**Science, education and civil society**' began with a very interesting presentation by Dr Vijaylaxmi Reddy and Ms Beverly Damonse. They discussed methodological issues related to understating the survey data collected in SA. They pointed out that in developing countries like SA number of respondent reporting 'don't know' is very high. Dinesh Abrol made a presentation on the radical practices of engagement of PSM that diverged from the 'transmitter model' into a new practice that aims to empower the common people. Dr Kinya Shimizu reported their study on the effects of the science curriculum reform on the POUS. Zhang Chao presented a paper on his study on gender difference in scientific literacy in China.

During the last technical session on '**Research in PUS**' five presentations were made. Prof Fujio Niwa from GRIPS, Japan, deliberated on the Technological Literacy in Japan. Ms Preeti Kakkar reported their study on impact of scientific activities on regional socio economic development. The paper

focused on three main indices – economic, welfare and S&T index to arrive at patterns of regional disparities of various states in India. Dr Wague Ahamdou reported on the PUS field activities being conducted in Senegal to improve the science education, especially to improve the experimental basis of science education. Surjit Singh reported their study on the 2001, 2004 and 2007 data-sets to test and validate the ‘cultural distance model’ developed by the PUS group in NISTADS. Dr T. V. Venkateswaran’s paper detailed the bibliometric study of the popular science books and periodicals to map the PUS during the early nineteenth century by ferreting out certain trends.

The valedictory session was chaired by Prof Loet Leydesdorff. After the reporting on the proceedings by Dr Jenni Metcalfe and Dr T. V. Venkateshwaran, Gauhar Raza moved resolution which was adopted by the scholars.

The Resolution

Public Understanding of Science is now an established area of scientific speciality. However, the house recognises that the area is still passing through a phase of growth. New ways of probing the scientific consciousness among the people are being proposed, new relatively robust models of analysis are being constructed to help refine conclusions. The deliberations of this international meet are an effort towards consolidating these gains and explore future directions. The collective wisdom gained during this

stimulating meeting suggests that we take note of the following:

During the past few decades a number of scholars have directed efforts to build and enrich the area in theoretical and methodological rigour.

The number of scholars working in this area has increased exponentially, cross-fertilizing from different disciplinary perspectives.

The number of institutions dedicated to PUS research has not matched the growth in the number of scholars.

The house also notes that the indicators developed in various parts of the world are culture specific and cannot be applied to measure the public understanding of science universally.

The public understanding of science research has matured in developed countries however, it is a serious matter of concern that barring a few, in most culturally rich countries (generally known as developing countries) the research efforts have not even started.

The house also noted that the role of statistical tools is a crucial component in carrying out large-scale empirical studies. There is a need to integrate the quantitative and qualitative methods developed in other disciplines.

The house recommends that a number of strategic and tactic measures need to be taken to fulfil the above-mentioned visions.

- Efforts should be undertaken to inventory and compile the

existing databases.

- Extant literature on PUS should be made available on Open Access on the Web.
- An inclusive network of scholars / researchers working in the area of PUS should be established to facilitate exchange of information and resources.
- Establish research / teaching institutes dedicated to the furtherance of PUS.
- Linkages with other cognate institutes / disciplines be established.
- Efforts should be made to identify common minimum indicators, which would be comparable – in time and space – and surveys be undertaken at various levels.
- In addition to these common minimum indicators, region/ country and culture/the me specific indicators should also be developed and shared with other scholars for their benefit.
- We believe that PUS output would strengthen the democratic spirit among the people to enable them to articulate their entitlements based on rational scientific temper.
- Fund raising to undertake national/regional surveys in the area of PUS be undertaken.

These recommendations should be implemented at global, national and local levels.



PLMSS 08

Product innovation is increasingly becoming the main tool for competitive advantage and a crucial driver for economic growth. In this scenario, organizations strive to quickly realize superior quality and cost effective products by adapting to the state of art technologies in product development. Computer based tools available today have contributed to increased productivity in specific task domains (design and manufacturing in particular) in most organisations. In order to make the transition from being efficient to being innovative, the entire product life cycle has to be managed better to enable collaboration between the various stakeholders in the product. Managing the life cycle activities of the product development is a major challenge because of the lack of integration between the tools used to perform various product development and delivery functions, between the digital world where the product takes shape and the real world where the product is made, used and serviced.

In view of this, an International Conference is being organized on Product Life cycle Modeling, Simulation and Synthesis (PLMSS), as a part of the National Aerospace Laboratories (NAL), Bangalore's Golden Jubilee celebrations, jointly with ADA, DRDO, HAL and IISc. This conference aims at bringing academicians, researchers and practitioners from industry together on a common platform to share their solutions to address the above challenges, best practices and new trends in all disciplines of product development life cycle. A website for this conference was launched on 28 February 2008 by Dr A. R. Upadhyya, Director, NAL. The website can be accessed at <http://www.nal.res.in/nal50/plmss08>.



Obituary Prof. Sibte Hasan Zaidi passes away



Prof. Sibte Hasan Zaidi, Founder Director of Indian Institute of Toxicology Research (formerly Industrial Toxicology Research Centre), Lucknow, passed away on 5 April 2008 in New York, USA. He was 90 years old and was not keeping good health for the past few years.

Prof. Zaidi founded the Industrial Toxicology Research Centre (now IITR) in 1965 and was its Director till 1978. He was an outstanding environmental and industrial toxicologist of the country and was recipient of several national awards including the Shanti Swarup Bhatnagar Prize and the national honour *Padmashri*. He was Fellow of the Royal College of Pathologists, London and the Pathological Society of Great Britain and Ireland. He was a member of the WHO's Expert Advisory Panel on Occupational Health. To acknowledge the contributions of Dr Zaidi, a S.H. Zaidi oration is being organized every year at IITR for the last eleven years.

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